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How companies' investments in energy saving activities affect financial performance

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Abstract

This study investigates the relationship of energy saving activities and financial performance. The research objective of this study is to contribute to the field of CSR investments and its impact on firm performance by providing insight through an empirical cross-sectional study on how the overall effect of investments in energy saving activities on financial performance is composed. This objective has been derived from different and sometimes contradicting findings in extant literature regarding the effect of CSR investments on financial performance. The research objective is studied by formulating an answer to the following research question: *To what extent do companies' investments in energy saving activities affect financial performance directly, and to what extent indirectly by means of reducing energy consumption?* This study aims to understand if and how the rate of energy consumption mediates the relationship between investments in energy saving activities and financial performance.

This research is conducted with a mixed methods approach. Firstly, regression analyses were conducted to test potential direct and indirect effects of this relationship. The data sample that was used for this study is the 2015 Dutch sub sample of the European Manufacturing Survey (EMS). To substantiate findings of the quantitative analyses, a qualitative part is added by conducting semi-structured interviews with CEOs of 4 Dutch manufacturing firms. These respondents have the expertise to provide valuable insights on the tested relationships which aids towards a more in-depth understanding of derived results from the quantitative analyses.

Outcomes of the regression analyses indicate that investing in energy saving activities do not affect the financial performance of a firm directly, when measured in sales and production costs development. This is due to the fact that other factors, like firm characteristics and experience, also play part on the effect of these investments. Subsequently, the indirect influence of investments in energy saving activities through energy consumption on financial performance was assessed, leading to the following conclusion: manufacturing firms that are large consumers are investing more in energy saving activities as they are able to benefit financially from a reduction in energy consumption as this has a relatively big impact on their production costs. These benefits provide a firm the opportunity to lower prices which is likely to result in an increase in sales and further improved competitive advantage. However, manufacturing firms that are not relying too much on their energy consumption do not notice great economic benefits from these investments and are therefore less eager to invest in these activities than large energy consuming firms.

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1. Introduction

Climate change is an ever-increasing problem for our society. Therefore, as part of the European Green Deal, the European Commission set several key targets. One of them being an improvement in energy efficiency of at least 32.5% by 2030 (EC, 2017a). By 2050, the European Union aims to be climate-neutral, indicating an economy with net-zero greenhouse gas emissions (EC, 2017b). Firms can contribute to achieving these key targets by managing their corporate social responsibility accordingly. Castka, Bamber, Bamber, and Sharp (2004, p. 223) define Corporate Social Responsibility (CSR) as "a concept to run organisations profitably yet in a social and environmentally responsible way in order to achieve business sustainability and stakeholder satisfaction". CSR is a widely researched term and has emerged as an inescapable priority for firm managers of many organisations around the globe (Nishitani, Kaneko, Fujii, & Komatsu, 2011; Porter & Kramer, 2006). In addition to this, Dyllick and Hockerts (2002) state that CSR can be a valuable asset in increasing competitiveness and aiding firms to achieve sustainable economic growth. With effective CSR investments, firms can make improvements to the social, environmental and economic performance of their business activities (Cheng, Serafeim, & Ioannou, 2014; El Ghoul, Guedhami, Kwok, & Mishra, 2011; Hart & Ahuja, 1996; Porter & Linde, 1995). Effective investments in CSR also contribute to gain firm legitimacy and firm competitiveness (Bachmann & Ingenhoff, 2016; Castello & Galang, 2014).

A vital aspect of CSR is the reduction of energy consumption. Energy efficiency is considered as one of the most effective ways to reduce environmental impacts that businesses are making (EC, 2016; Fernando & Hor, 2017). Adding to this, energy efficiency is a central theme in the European Union's energy policy (European Commission, 2016), indicating an institutional willingness as well as the importance of the matter. A mean to reduce this energy consumption is the implementation of energy saving activities . These activities can be incorporated in many facets of a business (Schiederig, Tietze, & Herstatt, 2012). Activities such as the implementation of sustainable technologies are considered effective in achieving sustainable development and reducing energy consumption (Babl, Schiereck, & von Flotow, 2014; Kemp & Soete, 1993; Shrivastava, 1995). Especially manufacturing firms can benefit strongly, as they are primary polluters and large scale energy consumers because of their production activities (Dessus & Bussolo, 1998). Nearly a third of the world's energy consumption can be attributed

to manufacturing industries (International Energy Agency, 2007). In addition to this, manufacturing firms are receiving a growing amount of pressure from stakeholders. Therefore, means to minimise environmental impact through enhanced energy efficiency are explored extensively (Porter et al., 2007). However, investing in such means is likely to create more costs without any short-term financial benefits. Hence, the question is how managers can minimise energy consumption without reducing the performance of the firm (Lee & Min, 2014). Recently, management literature emphasizes the 'win-win' idea that investments in environmental strategies have a beneficial impact on both environmental and financial firm performance (Alam, Atif, Chien-Chi, & Soytaş, 2019). In this natural resource-based view, investments in energy saving activities (ESA) play an important role for manufacturing firms in reducing their environmental impacts without compromising financial performance.

The natural resource-based view (NRBV) postulates that sustainable competitive advantage can be achieved through the allocation of resources in environmental-friendly activities (Alam et al., 2019; Hart & Dowell, 2011). Therefore, investments in ESA may minimize environmental impacts and simultaneously stimulate financial performance. Investments in ESA have the potential to reduce environmental impacts without compromising financial performance in multiple aspects. Examples of this are that they improve technological development leading for instance to a faster production with less demand for energy. Adding to this, such technologies or systems could aid the production process by shutting machines down when they are underutilised resulting in less energy waste. Thus, investments in such technologies or practices are assumed to result in less energy consumption.

Despite the assumed advantages of investing in these activities, literature regularly concludes a diverse and sometimes contradicting result when testing the effect of CSR investments on firm performance. A significant body of literature also suggests a negative or not existing relationship between CSR investments and firm performance (Bauer, Koedijk, & Otten, 2005; Klassen & Whybark, 1999; Lee, Faff, & Rekker, 2013; McWilliams & Siegel, 2000; Renneboog, Ter Horst, & Zhang, 2008), this is contradicting with the aforementioned body of literature that suggests that CSR investments provide significant benefits for a firm (e.g. competitiveness, legitimacy, performance), and thus suggest a positive relationship between the two constructs. McWilliams and Siegel (2000) confirm that researchers have found a positive, negative, mixed, or neutral impact on firm performance. Nevertheless, Margolis and Walsh (2003) state that the majority of research found a positive impact on firm performance. The

main reason for the variation of conclusions drawn by different studies is due to the fact that authors formulated different definitions and measurements of performance, implicating a lack of a solid theoretical foundation (Schiederig et al., 2012; Zeng, Meng, Yin, Tam, & Sun, 2010). Regarding any impact found of CSR investments on firm performance, this might be the result of an indirect effect overcompensating a direct effect or vice versa (López-Gamero, Molina-Azorín, & Claver-Cortés, 2009). As they state that the relationship between environmental management and performance is not correlating directly and additionally showed a positive effect when using a firm's resources and competitive advantage as mediating variables. In line with this finding, this thesis aims to increase understanding and clarify a relevant issue in literature, namely that the effect of CSR investments on firm performance might not be direct. This is done by separating the overall effect of the two variables. Firstly, a potential direct effect is measured. More specifically, by analysing investments made by manufacturing firms in ESA to test what effects these investments have had on financial performance. Subsequently, the effect of investments in ESA via energy consumption on financial performance is tested to find out whether there is an indirect effect through energy consumption of investments in EST on a firm's financial performance.

From the aforementioned objectives, the following research question has been formulated:

RQ: To what extent do companies' investments in energy saving activities affect financial performance directly, and to what extent indirectly by means of reducing energy consumption?

To answer this question a mixed methods approach is used. Firstly, direct and indirect effects are tested via a quantitative approach with data on the Dutch manufacturing industry gathered by the European Manufacturing Survey (EMS). The Dutch subsample from the wider EMS sample provides data from Dutch manufacturing firms in 2015. This creates the opportunity to further analyse the direct and indirect relationship between CSR investments and financial performance. To substantiate findings of this quantitative analysis, qualitative methods are applied by conducting several semi-structured interviews. This in an attempt to generate a more in-depth understanding of the results derived from the analyses.

This study attempts to contribute to the field of CSR investments and its impact on a firm's performance by providing insight through an empirical cross-sectional study on how the overall effect of investments in ESA on financial performance is composed. The importance of reducing energy consumption is as aforementioned emphasized by institutions and firms. Accordingly, the United Nations has made reducing energy consumption one of the 17 sustainable development goals (UN, 2016). This combined with the differing outcomes from previous literature expresses the relevance of further research within this field.

Next to the academical relevance, there is also a significant practical relevance regarding this topic. The current environmental problems implicate a huge practical relevance as well as all members of the society need to rethink their practices to reach these goals together. Especially manufacturing firms play a big role in this due to their excessive use of energy. Additionally, managers are receiving more and more pressure from stakeholders regarding the reduction of their energy consumption. Insights on what the overall effect of investing in ESA on financial performance consists off, could therefore be of significant managerial relevance as managers are pushed to make decisions on reducing their impacts on the environment, but also have a firm that needs to keep running. Therefore, this research could provide valuable information on to what extent investments in ESA have an impact on a firm its financial performance.

The study is structured in such a way that it offers a clear overview on how this study is carried out. Therefore it is organised as follows: In chapter 2, the theoretical framework for this study is provided. This chapter will elaborate on CSR, investments in ESA, energy consumption and their relationship with financial performance. From this, expectations are derived and hypotheses are formulated accordingly. Subsequently, in chapter 3, the methodology for this study is provided. This chapter elaborates on the quantitative and qualitative segments of this study. In chapter 4 and 5, the results of the quantitative and qualitative research are presented. In chapter 6 and 7 the conclusion and discussion of the study is provided.

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2. Literature review

In this chapter, the concepts of this research are elaborated on in order to create a better understanding regarding corporate social responsibility, investments in energy saving activities, financial performance and energy consumption. Firstly, corporate social responsibility and investments in energy saving activities are elaborated on. Secondly, financial performance and thirdly energy consumption are described. After describing these variables, their relationship with financial performance is investigated in order to derive expectations and build towards hypotheses and a conceptual model.

2.1 Corporate Social Responsibility and Investments in Energy Saving Activities

Corporate Social Responsibility (CSR) is an extensively researched construct. Early literature on the topic suggested that "the social responsibility of businesses is to increase its profits" (Friedman, 1970, p. 122). CSR however, would decrease profits as these investments were seen as extra unnecessary costs to a firm. Later on, Porter (1991) argued that being profitable and reducing pollution is not mutually exclusive as pollution is seen as a waste of resources, such as energy and materials. Attempts to reduce this resource and energy consumption are suggested to be beneficial for a firm's environmental impact, but also increases a firm's competitiveness (Porter, 1991; Porter & Linde, 1995). Furthermore, Tate and Bals (2018) and Hart (1995) also state that the implementation of sustainable activities can lead to financial benefits for firms, which in turn increases competitiveness. The theoretical framework for this study is based on this line of argumentation.

Even though there are many studies dedicated to researching CSR, there is yet to be appointed one single comprehensive definition for this concept as applications vary (Scherer & Palazzo, 2007; Wood, 2010). This suggests that the definition of CSR is different regarding its manner of application (van Marrewijk, 2003). However, most different definitions on CSR are predominantly congruent, indicating that the lack of a universally comprehensive and accepted definition is less problematic than it might seem at first glance (Dahlsrud, 2008). To provide a clear understanding during this research, CSR is defined in the following manner: *"A concept to run organisations profitably yet in a social and environmentally responsible way in order to achieve business sustainability and stakeholder satisfaction."* (Castka et al., 2004, p. 223).

Energy saving activities, such as the implementation of energy saving technologies are considered as a prominent mean to decrease energy consumption (Babl et al., 2014; Shrivastava, 1995). Therefore, investments in these activities can be considered investments in CSR. An attempt to define sustainable activities is made by Fu, Kok, Dankbaar, Ligthart, and Riel (2018), this definition is derived from the United Nation Environment Programme (UNEP). They describe 'cleaner production' as "the continuous application of an integrated preventative environmental strategy to processes, products and services to increase efficiency and reduce risks to humans and the environment". UNEP categorizes cleaner production into eight aspects, namely 'better process control', 'equipment modification', 'technology change', 'on-site recovery/reuse', 'production of useful by-products', 'product modification', 'change of input material' and 'good housekeeping'. Fu et al. (2018) appointed these categories into three stages for sustainable activities (e.g. preparation stage, production stage, after-production stage). Furthermore, Shan, Qin, Liu, and Liu (2012) state that energy saving and emission reducing manufacturing activities serve three purposes. Namely, resource conservation, energy economizing and environment-friendly. This mainly refers to saving resource consumption, reducing energy consumption and minimizing or eliminating waste that could have a negative impact on the environment during the manufacturing process.

Recently, the fast development of technology in all sectors (e.g. computer, information, control and integration technology) has led to an increase of effectivity of the aforementioned technologies and its potential to improve manufacturing processes (Shan et al., 2012). Sustainability, digitization, precision, flexibility and intellectualization are trending directions within this development. Various manufacturing technologies and practices have been developed and applied to the manufacturing industries, such as certified energy management systems, instruments of product life cycle assessment (e.g. Cradle-to-Cradle, ISO-14020), impact and performance measurements of social and environmental corporate activities, control systems that shut down machines during underutilization (e.g. PROFI-energy), automated management systems for energy efficient production and systems for kinetic and process energy recovery (e.g. waste heat recovery), energy and/or heat generation by means of solar, wind, hydropower, biomass or geothermal energy, switching off components, machinery or equipment measures to reduce energy consumption and upgrading or substituting existing machinery or equipment measures to reduce energy consumption. These activities all propone sustainable development in the manufacturing industry as they attempt to lower energy consumption during the production process (Porter & Linde, 1995). This is also acknowledged

in practice as significant investments have been made in such energy saving activities. In 2019, Dutch companies reported a total investment in energy saving activities of 1.7 billion euros (EIA, 2020). This is a 5% increase compared to what Dutch companies invested in energy saving in 2018. The investments in 2019 resulted in a reduction of 1012 kilotons of CO_2 reduction (EIA, 2020). An example of a Dutch firm investing in energy saving measures is DSM. They reported that their energy efficiency improved with 2.3% in 2019 compared to 2018 (DSM, 2019). This is mainly due to the fact that they invested in energy saving activities at their key sites.

2.2 Financial Performance

Firm performance can be seen as results or achievements that are obtained by management, economics, and marketing in providing competitiveness, efficiency and effectiveness to a firm. Firm performance can be assessed through various perspectives. Taking a financial viewpoint on performance is one of them. The financial performance can identify how a firm is generating its revenues and how it manages its assets, liabilities and financial interests of stakeholders. When assessing financial performance there are various measures that could be used. Often these measures are a firms balance sheet, the income statement and cash flow statements. In the context of CSR, financial performance is often measured in profitability, production costs, sales, asset utilization, liquidity and risk/market measures (McWilliams & Siegel, 2000).

Additionally, financial performance measures such as sales and production costs are often used in order to make an assessment. This is also acknowledged by Klassen and McLaughlin (1996) as they confirm that both sales and production costs influence financial performance. Sales represents the income of a firm that comes from selling products or services (John & Ofek, 1995), and thus measures how efficiently a firm makes profit from sales. Additionally, production costs represent the costs that a firm is making while producing a product or service (Jones & Butler, 1988). Due to the fact that both sales and production are seen as a valid measurement for financial performance, this study will focus on these concepts in order to assess the effect of investments in energy saving activities on financial performance accurately.

2.3 Energy Consumption

Energy consumption has increased its importance in literature in the last decade. This is due to the fact that it is vital to understand how to consume energy in an efficient manner in order to meet environmental goals set by firms and institutions as efficient energy consumption is one of the key drivers for sustainability (Salonitis & Ball, 2013). Energy consumption can be viewed as a very universal term. Hence, the fact that it often has a specific application definition in varying situations (Zhou et al., 2016). A more technical approach to energy consumption is, for example, regarding thermodynamics (Patterson, 1996). Which refers to the ratio of input and output to assess the energy consumption. From a manufacturing approach, energy consumption is often viewed at with a physical thermodynamic perspective. This refers to the ratio of product output and energy input, or input-output efficiency (Quariguasi Frota Neto, Walther, Bloemhof, Nunen, & Spengler, 2009). The International Energy Agency (IEA) sees efficient energy consumption as reducing the demand for energy for manufacturing processes, or to obtain the same quality of manufacturing with less energy consumption (Salonitis & Ball, 2013). To provide a clear understanding during this thesis, energy consumption is referred to as the amount of energy that is used by a manufacturing firm, where it is to be understood that it is desirable to minimize this amount as much as possible, while no quality is lost (Duflou et al., 2012).

2.4 Investments in Energy Saving Activities and Sales

The effect of sustainability efforts, such as investments in ESA, on the financial performance of organisations is still a questionable relation (Schrettle, Hinz, Scherrer-Rathje, & Friedli, 2014), as a group of authors describe the effect as negative or even non-existing whereas others describe the effect as positive (McWilliams & Siegel, 2000; Schrettle et al., 2014). The variety in these conclusions is mostly due to the perspective on firm performance, as firm performance can be measured in different performance indicators (Schiederig et al., 2012; Zeng et al., 2010). In addition to this, results may also be conflicting due to the fact that different research methodologies and definitions were used. In the following paragraphs, empirical findings from studies regarding the relationship between sustainable activities and sales are outlined.

Pons, Bikfalvi, Llach, and Palcic (2013) found in their study that the use of energy saving technologies does not have a clear and significant overall relationship with financial performance. They came to this conclusion after finding that energy saving technologies are

aiding towards being more environmentally friendly rather than improving financial performance on the short-term, due to the investments that were made. Financial performance was in this research measured with return on sales. Furthermore, Chan (2005) found a positive relationship when examining sustainability activities and financial performance amongst 332 valid responses from a sample with 561 organisations. From the results of this research, it was concluded that sustainability activities do in fact lead to cost savings but they do not lead to an increase in sales. A longitudinal study is likely to result in a positive overall relationship between sustainability efforts and higher sales. Additionally, a negative influence on sales-growth was found by Menguc and Ozanne (2005). The authors studied the relationship between natural environmental orientation and business performance. The sample they used existed of 140 manufacturing firms from Australia. The study measured firm performance with several indicators, namely, sales growth, profit after tax and market share. The authors concluded from their study that this orientation has a positive effect on profit after tax and market share. According to the authors, this is due to the fact that sustainability efforts contribute to better financial performance as they are resulting in lower production costs and an increase in reputation. Regarding the variable sales growth, the authors state that their finding was not unexpected given the mixed findings in literature. They explain this is due to the fact that they only measured a short period in time and that it a variable such as sales growth requires a longer measurement period. Thus, a reputational advantage, created by sustainability efforts may yet be reflected in a growth of sales (Menguc & Ozanne, 2005).

Contradictorily, multiple studies found a positive effect when examining the relationship between sustainability efforts and sales. Fombrun and Shanley (1990) concluded from their results of an empirical study of 292 firms that there is a significant positive correlation between a firm's reputation, including environmental reputation, and its profitability. The authors state this is as *"positive reputations are often said to attract investors, lower the cost of capital, and enhance the competitive ability of firms."* (Fombrun & Shanley, 1990, p. 255). Subsequently, this is likely to increase demand from customers, as products that are manufactured in a more environmental friendly manner are becoming more and more appealing (Elkington, 1994). In turn, firms can benefit from premium pricing and increased sales as they can achieve increased legitimacy and greater social approval due to environmental initiatives. However, a firm's reputation is only likely to affect business performance marginally (Fombrun & Shanley, 1990). In conclusion, the aforementioned studies that found no significant overall relationship between the various sustainability efforts and sales give the short-term assessment of the development

of sales as an explanation. The above-mentioned studies that found a positive relationship state that the overall effect of sustainability efforts on sales is likely to increase over time as the development of sales becomes clearer after a longer measurement period. This reasoning gives an explanation for the mixed results in literature. Firms do need time to realise sales growth as a result of sustainability efforts. Still, this is very much dependent on if an organisation is capable to achieve this successfully (Hart & Dowell, 2011). Therefore, it cannot be expected that sustainability efforts, such as investments in energy saving activities, significantly correlate directly with an increase in sales. Given the cross-sectional rather than a longitudinal nature of the current investigation, the following hypothesis is put forward:

H1a: Investments in energy saving activities are not expected to significantly correlate directly with an increase in sales.

Nevertheless, preventing pollution allows for greater environmental efficiencies, which requires firms to reduce energy consumption (Hart, 1997). This in order to strive for increased environmental sustainability and meet goals set by governments and stakeholders (e.g. EC, 2017a). A prominent mean to reduce energy consumption is, as aforementioned, investing in energy saving activities (Babl et al., 2014; Salonitis & Ball, 2013). Additionally, these investment strategies are able to position firms for competitive advantage as recently a significant increase in venture capitalist investments in firms that make use of sustainable strategies was found (Shachmurove & Shachmurove, 2009). According to de Groot, Verhoef, and Nijkamp (2001), energy saving increasingly is becoming more and more a normal matter for firms. The authors explain that the economic potential (e.g. saving costs) is the main reason to invest in energy saving activities. As a reduction of energy consumption results in cost savings, firms are in a position to reduce prices in order to gain competitive advantage. This in turn could lead to an increase in sales as a consequence of less energy consumption. Therefore, the following is hypothesized:

H1b: Investments in energy saving activities result in less energy consumption which results in an increase in sales.

Due to the rapidly increased awareness on environmental issues in the last decade, the society, including firms, is more conscious about where products come from and how a product is manufactured. In addition to this, when considering the potential benefits (e.g. reputation and

cost savings) for firms and the increased pressure that firms are receiving from institutions and stakeholders regarding their environmental behaviour, it is expected that the overall effect of the relationship between investments in ESA and sales is positive, leading to the following concluding hypothesis:

H1: Investments in energy saving activities are expected to have a significant positive overall effect on sales

2.5 Investments in Energy Saving Activities and Production Costs

The relationship between investments in ESA and production costs is explored in various contexts in literature. Authors that found a positive relationship between the two constructs state that decreasing pollution enables a firm to save costs, by for instance decreasing energy consumption (Hart, 1997). This higher efficiency involves manufacturing products, while decreasing the use of resources, such as energy, and environmental damage that is made (Schmidheiny & Beaumont, 1993). Using too much resources can therefore be seen as inefficiency (Porter & Linde, 1995). Molina-Azorín, Claver-Cortés, López-Gamero, and Tarí (2009) state that efficient use of resources should be seen as environmental improvement by firms as resources are saved. Firms that only focus on the implementation costs of energy saving activities should consider the amount of costs that can be saved by handling energy more efficiently. In line with this perspective, the natural resource-based view (NRBV) suggests that sustainable competitiveness can be achieved when a firm uses its resources for long-term environmental-friendly products, processes and technologies rather than short-term profits and benefits (Hart, 1995). In the following paragraphs, empirical findings from studies regarding the relationship between sustainable activities and production costs are outlined.

To start off with, the relationship between environmental management systems and a firms' financial performance was studied by Watson, Klingenberg, Polito, and Geurts (2004). They measured financial performance with multiple indicators. The authors anticipated a positive relationship between environmental management systems and financial performance. However, they found a neutral relationship. This was due to the fact that the investment costs did overcompensate the actual amount saved that was realized with the lower production costs on the short-term. In addition to this, Adebanjo, Teh, and Ahmed (2016) state that there was no relationship found between being environmentally friendly and firm performance. In their study

on of the effects of stakeholder pressure on firm performance, the authors measured firm performance with production costs among others. They state that environmentally friendly activities can have a positive effect on productions costs. However they also find, in line with the study by Watson et al. (2004), that the implementation of these cost saving measures often neutralizes the benefits on the short-term. The dataset that was used existed of 159 manufacturing companies from China, India and Malaysia.

To the contrary, Chan (2005) found, as outlined earlier, a positive relationship when examining sustainability efforts and financial performance. The authors measured financial performance with return on investment, earnings growth, sales growth, and market share change. From the results was concluded that sustainability activities do in fact lead to better financial performance through cost savings. Additionally, Lo, Yeung, and Cheng (2012) find that the adoption of sustainable technologies is improving firms profitability and cost efficiency as they found that the adoption of environmental management systems (e.g. ISO14000) improved manufacturers' profitability. This improvement was mainly due to improvement in energy efficiency. Furthermore, as outlined before, Menguc and Ozanne (2005) concluded from their results that sustainability efforts resulted in a lowering of production costs.

To conclude, within the studies that found no effect or a neutral effect, it is stated that this is due to the fact that savings in production costs are often overcompensated by implementation costs. However, the authors from the studies outlined above also indicate that a longer-term study is most likely to result in more benefit from saved production costs. Another explanation is provided by Hart and Dowell (2011) as they state that firms also need the necessary organisational capabilities and cognition and framing attitude in order to realise financial benefit. This was also acknowledged by Sarkis and Dijkshoorn (2007) as they suggest that companies need experience in order to financially benefit from sustainability efforts. Based on the mixed results of the aforementioned studies, a significantly correlated relationship between sustainability activities, such as investments in energy saving activities, and a reduction in production costs is not expected in the current cross-sectional investigation. Therefore, the following hypothesis has been formulated:

H2a: Investments in energy saving activities are not expected to significantly correlate directly with a reduction in production costs.

The positive relations that were found in the studies outlined above were the result of cost efficiency that has been achieved as a result of investments in ESA (e.g. increased energy efficiency). Therefore, it is hypothesized that more efficient energy consumption reduces production costs as financial assets are saved during the process. Implicating that investments in ESA does reduce production costs, as energy consumption is decreased.

H2b: Investments in energy saving activities result in less energy consumption which results in a reduction of production costs.

In order to not only make statements about the direct (H2a) and the indirect effect (H2b) but also about the overall effect regarding the relationship between investments in ESA and production costs. Based on the studies outlined above and the reasoning in the previous paragraph, it is hypothesized that the indirect effect will overcompensate the direct effect and therefore the overall effect of investments in ESA on production costs is expected to be significant and negative.

H2: Investments in energy saving activities are expected to have a significant negative overall effect on production costs

2.6 Conceptual model and Summary

This chapter elaborated on the relationships that are found and expected between investments in energy saving activities, energy consumption and financial performance. The proposed relationships between the constructs are outlined in Figure 1. The gathered theory in this chapter is based on the relationship between investments in sustainability activities and financial performance. Investments in sustainability activities, such as investments in energy saving activities, are often found to not lead to an increase in sales or a reduction in production costs. Therefore, it is hypothesized that investments in energy saving activities are not expected to significantly correlate directly with these measures of financial performance (H1a, H2a). However, through energy consumption, growth is expected on sales (H1b) and a reduction is expected on production costs (H2b). Thereby, addressing the research gap to gain insight about how the overall effect of investments in energy saving activities and financial performance is composed.

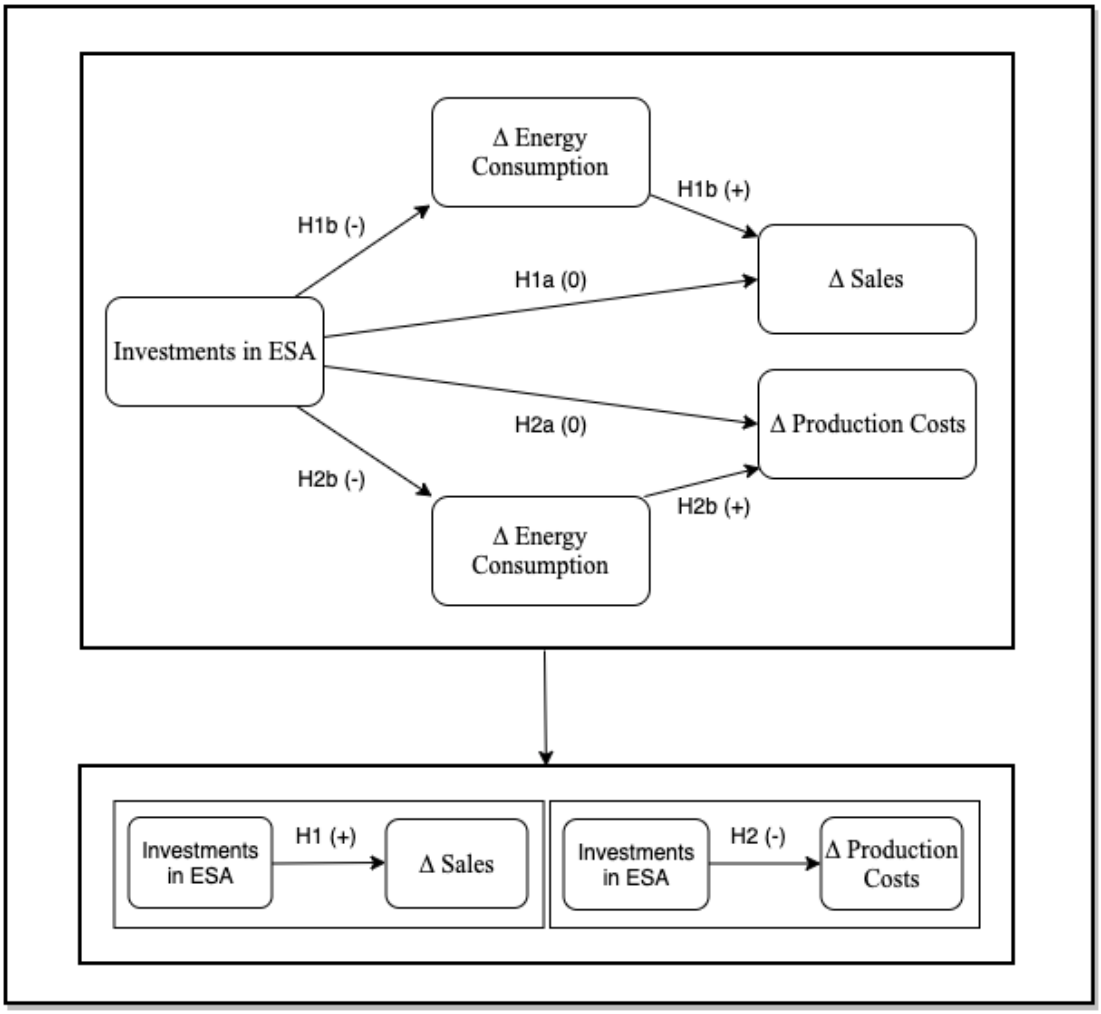

Figure 1: Decomposed and Overall Relationships

3. Methodology

In the third chapter, the methodology of the research is provided. Firstly, the research approach is explained in paragraph 3.1. Secondly, the quantitative and the qualitative aspects of this study are elaborated in paragraph 3.2 and 3.3. Lastly, research ethics that are considered during this study are outlined in paragraph 3.4.

3.1 Research Approach

According to Kothari (2004), there are three approaches to learning. These approaches are the deductive approach, the inductive approach and the abductive approach. The deductive approach starts with knowledge that is already existing, and finding out if it works the same way in other contexts. In other words, a researcher starts with a theory, and subsequently tests this theory. Thereafter, a researcher can conclude whether the theory holds or does not hold. Regarding inductive research, the researcher starts with a new situation as there is little to no existing information. Therefore, new knowledge is created from gathering information empirically during the process. Lastly, with an abductive approach, a researcher has the possibility to explain an empirical phenomenon that is unable to be explained by existing theories. This study has a deductive research approach, as existing theories are used and tested.

Subsequently, a research method is required to be followed. The two most prominent types of research methods are the quantitative and qualitative method. These two can also be combined resulting in a mixed methods approach (Kothari, 2004). With quantitative research, numerical data is collected and analysed. This method is suitable for finding patterns, making predictions, testing causal relationships and the generalizability of results. On the other hand, a researcher can choose for a qualitative approach. Qualitative research involves collecting and analysing non-numerical data. When combining quantitative and qualitative analysis, the mixed methods approach is used. The mixed methods approach is useful to find underlying reasons for certain quantitative results or to confirm them via a qualitative analysis. This can contribute significantly to the substantiation of statements made by researchers. This study attempts to test the relationship between investments in energy saving activities and financial performance of a firm. Subsequently, the results of the quantitative analysis are also tested qualitatively. This in an attempt to generate a more in-depth understanding of the results derived from the analyses.

3.2 Quantitative Research

The Dutch subsample from the wider European Manufacturing Survey (EMS) sample provides data from Dutch manufacturing firms in 2015. This data set is used for the quantitative analyses of this study. This questionnaire focusses on gaining insights into the assessment of manufacturing companies in the Netherlands, in order to modernize their production and business processes. Data is collected in the questionnaire about the use of new technologies, organizational concepts and about indicators such as productivity, flexibility and quality. The research focuses on production companies with a size of at least 10 employees. For companies with several establishments, the questions relate to the establishment addressed and not on the entire company. Managers of these firms that have the knowledge to answer these questions are requested to participate for their establishments.

The variables that are used during this study are operationalized below. The table shows the type of variable (independent, dependent, mediating or control), the name of the variable, a brief elaboration on the items that measure the variable and the boundary of the values for these items. Lastly, the measurement scale and the corresponding question in the survey is displayed.

Table 1: Operationalisation of variables

Variable Type	Variable Name	Item Description	Min	Max	M. Scale	Comments
Dependent	Δ Sales	Development of sales	- ∞	+ ∞	Ratio	EMS 2015, Question 21
	Δ Production Costs	Development of production costs	≤10%	≥10%	Ordinal	EMS 2015, Question 12
Independent	Investments in ESA	Usage of different energy saving technologies and practices	0	9	Ratio	EMS 2015, Question 3, 8.1, 8.3
Mediating	Δ Energy Consumption	Development of power consumption	≤10%	≥10%	Ordinal	EMS 2015, Question, 22.2
		Development of oil & gas consumption	≤10%	≥10%	Ordinal	EMS 2015, Question 22.3
Control	Use of other technologies	Use of 15 other specified technologies	0	15	Ratio	EMS 2015, Question 8.1
	Industry	Type of industry	0	6	Nominal	EMS 2015 Question 1.2
	Firm Size	Number of employees	10	+ ∞	Ratio	EMS 2015, Question 21
	Energy Costs	Total energy costs as % of turnover	0%	100%	Ratio	EMS 2015, Question 21

Within this research, there are two dependent variables. The *development of sales* and the *development of production costs*. This EMS 2015 data sample gives the opportunity to investigate both and interpret potential developments within these variables. The variable Δ Sales has a ratio measurement scale, which makes it metric. The variable Δ Production Costs has an ordinal measurement scale. Normally, this is problematic as a regression analysis needs metric variables. However, as the data is measured with a Likert scale (-10% to 10%) it is possible to treat the variable as an interval scale (Hair, Black, Babin, & Anderson, 2014).

Investments in ESA is the independent variable within this research. The EMS provides 9 main energy saving technologies and practices that are potentially implemented by manufacturing firms. This variable also has a metric measurement scale (ratio). The EMS questions its participants whether certain technologies or practices are implemented or not. Therefore, the usage of one or more ESA indicates that a firm has invested in these activities.

The development of energy consumption is the mediating variable within this study as it is expected that *investments in ESA* positively affect financial performance indirectly via energy consumption. Question 22.2 and 22.3 in the EMS questionnaire asks specifically about the energy consumption a participant has made, making it interpretable for this study. The questionnaire specifically asks for the development of power consumption and for the development of oil and gas consumption. These are both good indicators for the energy consumption rate of a firm. The respondent has to select an answer from a 7-item scale for both these questions. The scale goes from a decrease in consumption of 10% or more to an increase of 10% or more. Furthermore, the aforementioned specific questions within the EMS are chosen as they represent the variables in the most accurate way possible.

In order to statistically analyse the data sample, multiple regression analyses are run. "*A multiple regression analysis is a statistical technique that can be used to analyse the relationship between a single dependent (criterion) variable and several independent (predictor) variables"* (Hair et al., 2014, p. 157). The regression analysis can be used to predict or explain a relationship between (metric) variables. Within this study, there are several control variables; use of other technologies, industry, energy costs and firm size. As there are two dependent variables, two analyses are run (see

Figure 1: Decomposed and Overall Relationships). The control variables *Other technologies, energy costs* and *firm size* are metrically scaled and therefore usable within a regression analysis. However, the control variable *industry* has a categorical nature. This categorical control variable can be transformed into dummy variables (Hair et al., 2014). After the transformation the variable can be included within a regression analysis. Thereafter, all variables in this study can be considered as metrically scaled. Furthermore, the sample size requires to be minimally 50 and preferably above 100 when performing a multiple regression analysis. In case of the 2015 EMS questionnaire, this minimum number of respondents is met as it has 177 respondents. This means that conducting a multiple regression analysis is suitable for this specific study. Furthermore, with a regression analysis, there are several assumptions that need to be considered. Namely, the linearity of the phenomenon measured, the constant variance of the residuals, independence of the residuals and the normality of the residuals' distribution. These assumptions are tested with several graphical plots (e.g. scatterplot, probability plot) and a histogram. Subsequently, when all assumptions are met, the multiple regression analyses are conducted with the PROCESS macro in SPSS by Hayes (2013).

3.2.1 Validity and Reliability

Validity and reliability are important aspects to take into account when assessing the quality of a study. Validity refers to the degree to which a measure accurately represents what it is supposed to. Validity is represented by internal validity and external validity. "*Internal validity is assured when researchers in fact measured what they wanted to measure, whereas a strong external validity indicates that results of a research are generalizable amongst the population"* (Hair et al., 2014, p. 338). Internal validity within this study is ensured as the EMS questionnaire provides detailed questions which are formulated by a team of research experts from different countries, this contributes severely to the quality of the formulated questions within this questionnaire. External validity can be increased with a large enough sample size. Within this study the largest sample size possible is ensured as several measures are taken to increase the sample size for the EMS questionnaire. An example of this is that participants receive a benchmark report which enables them to compare with other participants, giving them more reason to participate. Another example is that the EMS reminds potential participants several times to participate. Furthermore, the questionnaire is spread amongst multiple countries which adds to generalizability as well. *"Reliability refers to the extent to which a variable or set of variables is consistent in what is intended to measure"* (Hair et al., 2014, p. 2). When multiple measurements are taken, reliable measures will be consistent. This differs from validity in that

it does not relate to what is measured, but how something is measured (Hair et al., 2014). The reliability within this study is ensured as the formulated questions are comprehensive and objective, ensuring similar answers from different participants. Furthermore, facts are asked for as much as possible and opinions are avoided.

3.3 Qualitative Research

In order to get a more in-depth understanding and substantiate outcomes from the quantitative analyses, a qualitative research part is added to the study. This research part is conducted via interviews. *"Conducting interviews is a primary manner to gather information"* (Symon & Cassell, 2012, p. 258). More specifically, semi-structured interviews are conducted where an interview guide with questions is formulated beforehand, but the interviewee has the opportunity to deviate from this. This is beneficial for gaining deeper insights in valuable aspects of a study (Bleijenbergh, 2013), in this case a deeper understanding or confirmation of the outcomes of the quantitative analyses as by solely a quantitative analysis, some aspects might remain unclear as they might be unable to be measured statistically.

The interviews are held with the CEO's of 4 Dutch manufacturing firms. The respondent requirements are the same compared to the requirements of the EMS 2015 sample. Respondents are required to be considered a manufacturing firm with at least 10 employees. Additionally, it is important for the respondents to be in different industry types as this is also the case within the data sample. The respondents of the interviews are outlined below.

Table 2: Interview Respondents

Company	Employees	Industry	Position
A	45	Compressed Air	CEO
B	150	Machinery	CEO
C	100	Waste Incineration	CEO
D	60	Packaging	CEO

The results are expected to be in line with what was concluded from the quantitative analyses. The interview guide is provided in appendix 2. The transcripts are not included due to confidentiality reasons. Transcripts can be requested for with the researcher. The duration of the interviews is approximately 45 minutes. The transcripts are coded deductively, as the concepts used for this study derived from existing theory (Symon & Cassell, 2012). This in order to analyse the gathered data optimally. The codes were derived from the theory outlined

in chapter 2 and are the following: investments in energy saving activities, development of sales, development of production costs and energy consumption. Each of the concepts has been assigned to a colour and everything related to these concepts within the transcripts is highlighted. An overview of the concepts and their colours can be found in appendix 3.

3.3.1 Validity and Reliability

Regarding the internal validity, the formulated questions are tested beforehand by multiple individuals to ensure that they are clearly formulated in order to optimize understandability for the participants. Furthermore, unclear concepts are explained to the participant in order to prevent misunderstandings. Regarding external validity, the interviews are held with large consumers of energy or respondents that have expertise on this matter as they are more likely to provide clearer outcomes, therefore adding to this study its external validity. Reliability will be ensured as the interview questions will be formulated with detail and ask for objective data, this will most likely result in similar answers by respondents.

3.4 Research Ethics

This study follows the Netherlands Code of Conduct for Research Integrity (2018). This code covers scientific and scholarly research in the broadest sense. The code addresses several principles, which are the basis of integrity in research. These principles are designed to guide individual researchers towards the right choices and integrity. The widely supported five principles of this code are honesty, scrupulousness, transparency, independence and responsibility. Honesty refers to the reporting of the research process. The reporting should be done accurately, without the fabrication or falsifying of data. In addition to this, results should not be reported more favourably or unfavourably than they actually are. Secondly, scrupulousness. Scrupulousness means that the methods used should be scientific and take the best possible care in reporting and disseminating research. Thirdly, transparency. Transparency means that it is clear to others on what data the research was based on, how it is obtained and how results were achieved. The line of reasoning must be clear and the research process must be verifiable. Fourthly, independence. Independence refers to not allowing the assessments to be guided by non-scientific considerations. Independence is required at all times during the research process. Lastly, responsibility. Responsibility refers to acknowledging that a researcher does not operate in isolation and hence taking into consideration the interests of test subjects. It also refers to conducting scientifically relevant research.

4. Quantitative Results

Within this chapter the results of the quantitative analyses of this study are outlined. Firstly, in section 4.1, the respondents of the EMS survey are elaborated on. Secondly, in section 4.2, an elaboration is given on the construction of the variables used within the analyses. Subsequently, in section 4.3, the univariate analysis is described followed by the bivariate analysis and the multivariate analysis in paragraph 4.4 and 4.5. Lastly, a brief overview of the chapter is given in paragraph 4.6

4.1 Response

For this study, the Dutch subset of the 2015 European Management Survey was used. This questionnaire has a total of 177 respondents. This study focuses on production or manufacturing firms that have more than 10 employees. All respondents are operating in the Dutch manufacturing industry. The EMS divides the respondents in seven categories, indicating the industry type of the respondent. The industry types that were recognized are the metal industry, the food industry, the textile industry, the construction industry, the chemical industry, the machinery industry and the electronic industry. For 175 respondents of the total 177 respondents the industry in which they operate is measured. There are 2 missing values. With these respondents it is unknown in which industry they operate. For this study this is not problematic as the study is not focussing on specific manufacturing industries. Therefore, these 2 respondents do not have to be deleted from the dataset.

Table 3: Respondents per Industry

Type of Industry	Frequency	Valid Percent
Metal	37	21.1%
Food	18	10.3%
Textile	22	12.6%
Construction	13	7.4%
Chemical	22	12.6%
Machinery	31	17.7%
Electronic	32	18.3%
Total	175	100%

Furthermore, the respondents were required to have at least 10 employees that are active within the firm. To find out if all respondents meet these criteria a frequency table is run. This frequency table can be found below (Table 4). The lowest number of employees that are working for one of the respondents is 10. This means all the respondents meet the criteria of

having at least 10 employees. As can be seen in the frequency table below, most firms (62,7%) have less than 49 employees. The biggest segment were the firms with less than 25 employees, 32.2% of the total 100% are among these firms. Specific firm sizes are initially not important for this study as the only requirement is that they should have at least 10 employees. However, differences in outcomes due to differing firm sizes could be an interesting bycatch of the analyses.

Table 4: Number of employees within participating firms

Employees	Frequency	Valid Percent	Cumulative Percent
Less than 25	57	32.2%	32.2%
25 to 49	54	30.5%	62.7%
50 to 99	43	24.3%	87%
100 to 199	16	9%	96%
200 or more	7	4%	100%
Total	177	100%	

4.2 Variable Construction

Within this segment, the variables for the analyses are constructed. This is done in order to make the variables measurable, and therefore suitable, during the analyses. Firstly, the construction of the dependent and independent variables of the conceptual model of this study is elaborated on. Secondly, information on how the mediating variable is constructed is given. Lastly, control variables are elaborated on.

4.2.1 Δ Sales

The 2015 EMS asks its respondents specifically for their sales in 2012 and their sales in 2014 (in millions €). This is done with question 21 of the survey (Appendix 1). The variable Δ Sales is constructed by calculating the sales in 2014 relative to the sales in 2012 in percentages. This has been done by computing a new variable (Δ Sales). As the constructed variable has 24 missing values, the N has decreased from 177 to 153. This has no consequences for the study as N is still high enough to continue. The descriptive table of the variable gives the following outcome:

Table 5: Original descriptive statistics of Δ Sales (%)

Variable	Mean	SD	Skewness	Kurtosis	N	Measure
Δ Sales	111.4862	29.1688	.787	6.802	153	Metric

According to Hair et al. (2014) the skewness and kurtosis of a variable should lie within -3 and +3. This is not the case for the constructed variable as the skewness is .787 and the kurtosis is

6.802 (see Table 5). By transforming variables, the skewness and kurtosis can be brought to the acceptable range of -3 and +3 (Hair et al., 2014). There are several transformations possible, namely, inverse transformation, logarithmic transformation, square root transformation and squared transformation. These transformations are carried out in order to find out if these transformations would make significant improvements to the skewness and kurtosis of the variable. When applying the logarithmic transformation to the variable, a nicely normally distributed variable is presented. The descriptive outcomes are presented in table 6 below.

Table 6: Logarithmic transformation of Δ Sales

Variable	Mean	SD	Skewness	Kurtosis	N	Measure
ln_Δ Sales	4.07	.21184	.548	2.441	151	Metric

When interpreting the skewness and kurtosis of these transformations, it can be concluded that there has been a significant improvement made on the original statistics (Table 5). The skewness and kurtosis now lie within the acceptable range of -3 and +3 (Hair et al., 2014). Therefore, the variable is now more suitable for the analyses. After the transformation, N has decreased by another 2 respondents. This has no consequences for this study. The missing values in this variable have been defined, leading them to be omitted during the analyses.

4.2.2 Δ Production Costs

The variable *Δ Production Costs* is constructed with 7 categories (-10% to 10). The frequency table revealed that the constructed variable has multiple missing values. The amount has decreased from 177 to 144. All missing values have been redefined in order to be omitted during further analyses. Furthermore, the constructed variable is normally distributed as it has a skewness of -.029 and a kurtosis of -.417. In the frequency table below the distribution of the respondents amongst the various categories are presented.

Table 7: Changes in Production Costs

Δ Production Costs	Frequency	Valid Percent	Cumulative Percent
< -10%	6	3.4%	3.4%
-10 to -5%	15	8.5%	11.9%
-5% to 0	54	30.5%	42.4%
Stable	41	23.2%	65.5%
0 to 5%	44	24.9%	90.4%
5% to 10%	15	8.5%	98.9%
> 10%	2	1.1%	100%
Total	177	100%	

4.2.2 Investments in Energy Saving Activities

In the previous chapter, which outlined the methodology for this study, an operationalisation table was presented (Table 1). As mentioned before in the table, the EMS 2015 asks specifically for the implementation of energy saving technologies and practices with questions 3, 8.1 and 8.2. The energy saving activities that were asked for were the following: certified energy management systems according to ISO50001, instruments of product life cycle assessment (e.g. Cradle-to-Cradle, ISO-14020), impact and performance measurements of social and environmental corporate activities, control systems that shut down machines during underutilization (e.g. PROFI-energy), automated management systems for energy efficient production and systems for kinetic and process energy recovery (e.g. waste heat recovery), switching off components, machinery or equipment measures to reduce energy consumption and upgrading or substituting existing machinery or equipment to reduce energy consumption.

In order to create the investments in energy saving activities variable, the items of questions 3, 8.1 and 8.2 are computed into a new variable. Before constructing the new variable, the missing values of each of the different items were checked. There were no missing values so none of the date is being omitted. Normally, when combining multiple variables into one, it is necessary to check if these different variables have a high enough consistency (Hair et al., 2014). Although, in this case, the indicators are not expected to highly correlate with the latent variable that is investments in energy saving activities. This is due to the fact that the variable has a formative nature (Hair et al., 2014). However, when performing a reliability test the outcome is still acceptable as the Cronbach's Alpha indicates a value of .666. Preferably, the Cronbach's Alpha should be around .7 or .8 (Hair et al., 2014). A frequency table of the newly constructed variable is presented below.

Table 8: Number of investments in ESA

Number of ESA	Frequency	Valid Percent	Cumulative Percent
.00	37	20.9%	20.9%
1.00	46	26.0%	46.9%
2.00	28	15.8%	62.7%
3.00	27	15.3%	78%
4.00	18	10.2%	88.1%
5.00	11	6.2%	94.4%
6.00	6	3.4%	97.7%
7.00	1	.6%	98.3%
8.00	1	.6%	98.9%
9.00	2	1.1%	100%
Total	177	100%	

4.2.3 Δ Power Consumption and Δ Oil & Gas Consumption

As mentioned before in chapter 3, *Δ Energy Consumption* is operationalized with two items from the EMS 2015 questionnaire. These items are *Δ Power Consumption* and *Δ Oil & Gas Consumption.* As these variables both represent different aspects of energy consumption, combining these variables into one would not be a good representation. Therefore, two variables are constructed in order to make statements about the development of energy consumption. All missing values have been redefined in order to be omitted during further analyses. The variables are both constructed with 7 categories. The frequencies are presented in table 9 and table 10.

Table 9: Changes in Power Consumption (%)

Δ Power Consumption	Frequency	Valid Percent	Cumulative Percent
< -10%	5	3.4%	3.4%
-10 to -5%	12	8.3%	11.7%
-5% to 0	27	18.6%	30.3%
Stable	68	46.9%	77.2%
0 to 5%	23	15.9%	93.1%
5% to 10%	8	5.5%	98.6%
> 10%	2	1.4%	100%
Total	146	100%	

Table 10: Changes in Oil & Gas Consumption (%)

Δ Oil & Gas Consumption	Frequency	Valid Percent	Cumulative Percent
< -10%	2	1.4%	1.4%
-10 to -5%	13	8.9%	10.3%
-5% to 0	30	20.5%	30.8%
Stable	81	55.5%	86.3%
0 to 5%	14	9.6%	95.9%
5% to 10%	4	2.7%	98.6%
> 10%	2	1.7%	100%
Total	146	100%	

4.2.4 Other Technologies

In order to distinguish from other technologies a control variable is constructed. This control variable *Other Technologies* is constructed by counting the number of times a non-energy-saving technology is measured in the questionnaire. These technologies can be found in question 8.1 in the EMS 2015 survey. Prior to the construction of this variable, the missing values that were found in the dataset are left out in order to prevent them from being included in the variable *Other Technologies*.

4.2.5 Industry

As mentioned before in 4.1, question 1.2 of the questionnaire asks which industry the respondent is active. By adding the control variable *Industry* to the analyses, insight can be found in potential different outcomes from different industries. The variable *Industry* originally had a nominal measurement scale with 7 different industries (Table 3). Therefore, each item in this variable has been dummy coded in order to construct variables that are suitable for a regression analysis. According to Field (2018) the reference category should be the category that is represented most frequently by respondents. Therefore, the metal industry has been used as reference during the analysis as this is the most represented industry among the respondents.

4.2.6 Firm Size

The questionnaire explicitly asks for the number of employees in question 21. By adding the control variable *Firm Size*, insights can be gathered regarding potential differences in the number of employees a firm has and outcomes of the analyses. The descriptive outcomes of the original variable do not meet linearity assumptions as the skewness of the distribution is 12.73 and the kurtosis is 166.07. Therefore, the variable has been recoded into 5 categories (Table 4)

4.2.7 Energy Costs

The control variable *Energy Costs* is constructed with question 21 of the EMS 2015. This variable is a valuable control variable as it provides the opportunity to distinguish firms with low energy costs relative to their total turnover from firms with high energy costs relative to their total turnover. However, the variable appears to have an unacceptable distribution.

Table 11: Original descriptive statistics of Energy Costs (%)

Variable	Mean	SD	Skewness	Kurtosis	N	Measure
Energy Costs	3.7109	4.11097	2.304	7.020	128	Metric

Several transformations have been performed in order to check if the distribution of the variable could be improved compared to the original statistics. A square root transformation provides Significant improvement as indicated in the table presented below.

Table 12: Square root transformation of Energy Costs (%)

Variable	Mean	SD	Skewness	Kurtosis	N	Measure
SQRT_Energy Costs	1.6609	.97976	.633	.718	128	Metric

4.3 Univariate Analysis

In this chapter the univariate analysis is executed. The univariate analysis provides descriptive data regarding the variables that are used within this analysis. The univariate analysis is presented below and gives an overview of the metric variables by providing their mean, standard deviation, minimum value, maximum value, skewness and kurtosis. All variables are provided in this table except for the 'Industry' variable as this is not a metric variable and statistics for this variable are not too meaningful. For the 'Industry' control variable a frequency table is presented in paragraph 4.1.

Table 13: Descriptive statistics of the variables

Variable	Mean	SD.	Min.	Max.	Skewness	Kurtosis
Δ Sales	4.7037	.21184	4.07	5.51	.548	2.441
Δ Production Costs	3.8757	1.27757	1.00	7.00	-.029	-.417
Investment in EST	2.1412	1.91209	.00	9.00	1.039	1.044
Δ Power Consumption	3.8552	1.14855	1.00	7.00	-.158	.653
Δ Oil & Gas Consumption	3.7671	.98290	1.00	7.00	.086	1.596
Other Technologies	3.9096	2.72045	.00	15.00	1.122	1.815
Firm Size	2.2203	1.11398	1.00	5.00	.652	-.300
Energy Costs	1.6609	.9796	.00	5.00	.633	.718

The first two variables of the descriptive table are the dependent variables of this study. *Δ Sales* is the first dependent variable which is described. The first characteristic which is shown is the mean. For this variable the mean is 4.7037, which indicates that on average the respondents their sales have increased with 111% within this period. Furthermore the skewness (.548) and kurtosis (2.441) are within the acceptable range of -3 and +3 (Hair et al., 2014).

Secondly, the variable *Δ Production Costs*. As can be seen in the table above, the mean for this variable is 3.8757. This indicates that most companies had a -5% to 0% decrease of their production costs per unit during 2014. When looking at the skewness (-.029) and kurtosis (-.417) of this variable, they are falling within the range of -3 and +3.

Thirdly, the independent variable *Investments in ESA*. The mean of this variable is 2.1412, indicating that on average the respondents invested in 2 of the 9 outlined ESA. 37 respondents (20.9%) indicated that they are not using ESA at all. Leaving the remaining 79.1% of the respondents that have implemented respectively 1 to 9 of the measured ESA. Only 21 respondents (11.9%) indicated that they have invested in more than 5 of the outlined ESA in the EMS 2015. Regarding the skewness and kurtosis of the variable *Δ Power Consumption*, it can be concluded that the values, respectively 1.039 and 1.044, lie within the acceptable range of -3 and +3 according to Hair et al. (2014).

The descriptive table also presents an overview of the mediating variables *Δ Power Consumption* and *Δ Oil and Gas Consumption*. The means for these variables are respectively 3.84 and 3.77. This indicates that on average companies consumed -5% to 0% less power. The same can be said for the average development of oil and gas consumption. Regarding the skewness and kurtosis of the variable Power Consumption, it can be concluded that the values, respectively -.158 and .653, lie within the acceptable range of -3 and +3 according to Hair et al. (2014). The same can be said for the distribution of the variable *Δ Oil and Gas Consumption* as its skewness (.086) and kurtosis (1.596) also lie within the acceptable range.

Furthermore, the first control variable *Other Technologies* is presented in the table above. The mean for this variable is 3.909, indicating that on average 3 other technologies than energy saving technologies are used by respondents in this sample. Regarding the distribution of the variable, the skewness and kurtosis also lie within the accepted range. The descriptive statistics of the control variable *Firm Size* are also presented. The mean of this variable is 2.2203. This indicates that the average size of the companies that participated in this questionnaire is 25 to 49 employees. Lastly, the control variable *Energy Costs* is presented. According to the descriptive statistics, on average, the respondents of the survey have energy costs that are equal to 3.72% of the total turnover. 14 firms indicated that their energy costs are 10 or more percent of their total turnover.

As aforementioned, Table 13 does not present an overview of the statistics of the variable *Industry*. An overview of the frequencies of this variable can be found in table 3.

4.4 Bivariate Analysis

The following part sheds light on the correlation of the variables that are investigated within this study. In table 14, the correlation matrix is presented. This output presents the outcome of the Pearson correlation test. According to Hair et al. (2014), correlations should not be higher than .85 as this indicates multicollinearity. Within this bivariate analysis, the highest significant correlation is .616, resulting in the conclusion that there is an absence of strong multicollinearity.

The bivariate analysis also provides the opportunity to gain insight on the potential outcomes of the multivariate analysis. In order to assess the strength of the correlations among variables the following indicators, provided by Hair et al. (2014), are used: a small effect size is has a correlation coefficient of .10, a medium effect size has a value of .30 and a high effect is represented by values of .50. When analysing the output of the bivariate analysis, it shows that the correlation of *Investments in ESA* and *Δ Sales* is -.064 and non-significant. Additionally, this effect size is so close to 0 that it can be regarded as neutral (Hair et al., 2014). Therefore, this outcome gives early support to hypothesis 1a. When assessing the correlation between *Investments in ESA* and *Δ Production Costs*, it can be concluded that the effect size is non-significant and has a weak value of -.056. Indicating that *Investments in ESA* does not correlate significantly with *Δ Production Costs.* Therefore, early support of hypothesis 2a is found.

Furthermore, there are several interesting conclusions that can be derived from this bivariate analysis. Firstly, a significant correlation with a medium effect size (.329, $p < .01$) at a 0.01 level was found between *Δ Sales* and *Δ Power Consumption*. Indicating that more sales lead to an increase of power consumption and vice versa. Secondly, a significant correlation with medium effect sizes was found between *Investments in ESA and Firm Size* (.272, $p < .01$) and between *Other Technologies* and *Firm Size* (.336, $p < .01$) indicating that larger firms make more use of ESA and other technologies.

Furthermore, a weak to medium negative effect size (-.179, $p < .05$) correlation was found between *Investments in ESA* and *Δ Power consumption* indicating that an increase in *Investments in ESA* is associated with a decrease in *Δ Power Consumption.* In addition to this, a medium significant effect has been found between *Investments in ESA* and *Δ Oil & Gas Consumption* (-222, $p < .01$). Indicating that an increase in *Investments in ESA* is associated with

a decrease in *Δ Oil & Gas Consumption.* This provides early insight on potential outcomes regarding hypothesis 1b and 2b. *Δ Power Consumption* also correlates strongly with *Δ Oil & Gas Consumption* implicating that more power consumption also leads to more oil & gas consumption and vice versa.

Investments in ESA and *Other Technologies* also correlate strongly with each other (.468, p <.01), implicating that when more investments in ESA are made, there are also more investments made in *Other Technologies.* This provides an explanation for the fact that *Other Technologies* also correlates significantly with *Δ Power Consumption (*-.194, p <.05) and *Δ Oil & Gas Consumption (-.292*, p <.01).

Lastly, the control variable *Energy Costs* correlates significantly and positively with investments in ESA (.186, p < .05). This indicates that an increase in energy costs as percentage of the total turnover leads to an increase in investments in ESA by firms.

The multivariate analysis in the following section can give more insight on the confirmation of early hypothesis support, and give an answer to the other propositions.

Table 14: Overview of correlations between variables

Correlation Matrix	1	2	3	4	5	6	7	8	9	10	11	12	13	14
1. Δ Sales	1	-.064	-.095	.329**	.143	-.035	-.037	-.064	.073	-.095	-.138	.097	-.024	.087
2. Δ Production Costs		1	-.056	-.077	.030	-.042	-.051	-.044	.007	-.067	.048	-.108	.003	.028
3. Investments in ESA			1	.-.179*	-.222**	.468**	.272**	.186*	.142	.107	.002	.071	-.035	-.120
4. Δ Power Consumption				1	.616**	-.194*	-.148	.115	.084	-.047	-.084	.176*	.035	-.098
5. Δ Oil & Gas Consumption					1	-.292**	-.021	.005	.131	.042	-.101	.132	-.041	-.108
6. Other Technologies						1	.336**	-.034	-.148	-.159*	.089	-.102	.190*	.102
7. Firm Size							1	-.038	-.014	-.030	.017	.029	.160*	-.048
8. Energy Costs									.108	.160	-.117	-.046	-.149	-.012
9. Food									1	-.128	-.096	-.128	-.157*	-.160*
10. Textile										1	-.107	-.144	-.176*	-.179*
11. Construction											1	-.107	-.131	-.134
12. Chemical												1	-.176*	-.179*
13. Machinery													1	-.219**
14. Electronic														1
**. Correlation is significant at the 0,01 level. *Correlation is significant at the 0,05 level.														

4.5 Multivariate Analysis

Within this section the multivariate mediation regression analyses of this study are executed and analysed. These analyses are run with the PROCESS macro by Hayes (2013), in order to test the earlier formulated hypotheses. As there are two dependent variables within this study *Δ Sales* and *Δ Production Costs*, two mediation regression analyses are performed. In the first paragraph, the model assumptions are checked. Secondly, in paragraph 4.5.2, the model statistics are presented in order to assess the explanatory power of the model. Subsequently, the hypotheses are repeated and the outcomes are discussed in paragraph 4.5.3. Lastly, a summary of this chapter is provided.

4.5.1 Regression Assumptions

In order to perform a multivariate regression analysis there are several assumptions that need to be met. The assumptions that need to be checked for a mediation regression are the same as a normal linear regression analyses, namely: linearity, independence of error terms, normal distribution of residuals and homo-/heteroscedasticity (Hair et al., 2014). Firstly, these assumptions are assessed for the first dependent variable *Δ Sales* model. In appendix 4, the corresponding output is presented. The probability plot shows that the linearity assumption is met. In addition to this, the scatterplot shows no pattern and no outliers in the residuals, therefore the independence of error terms and the homoscedasticity assumptions are met. Furthermore, the variables are metrically scaled. Regarding the dependent variable *Δ Production Costs*, normal distribution and independence of error terms assumptions are met according to the histogram and the scatterplot. Additionally, from the P-P plot (see appendix 4) the assumption of linearity is also met. Due to the fact that the variable *Δ Production Costs* has a 7 item Likert-scale. An ordinal regression analysis was considered. However, as there are too many items for such an analysis that works with a reference category, this could lead to interpretation issues. Therefore, the linear regression is continued.

4.5.2 Explanatory Power of Models

With a multivariate regression mediation analysis, an evaluation of the overall model is needed in order to assess the explanatory power of the tested model (Hair et al., 2014). There are several measures that assess the explanatory power of a model in this type of analysis. Firstly, there is the ANOVA which provides a F-value and its significance value, which outlines if the model is statistically significant (Hair et al., 2014). Secondly, the R and R^2 , which outlines the amount of variability that is explained by predictor variables regarding the dependent variable (Field,

2018). Furthermore, the number of observations is also of importance as this increases validity (Hair et al., 2014).

Firstly, the explanatory power of the first tested mediation model *Δ Sales* is assessed (N=114). The statistics are presented in table 15. To start off with, the relationship between the mediator *Δ Power Consumption* and the independent variable *Investments in ESA* is tested. The F-value for this model is non-significant (1.6980, $p < .10$). The R value and the R^2 are respectively .3762 and .1415, indicating that 14.15% of the variability is explained by this model. Secondly, the relationship between the second mediator *Δ Oil & Gas Consumption* and *Investments in ESA* is tested. The F-value for this model is significant (1.6722, $p <.10$). The R value and the R^2 are respectively .3737 and .1397, indicating that 13.97% of the variability is explained by this model. Lastly, the relationship between both measurements for *Δ Energy Consumption,* namely, *Δ Power Consumption* and *Δ Oil & Gas Consumption,* with *Δ Sales* is tested. The F-value for this model is significant (1.8828, $p < .05$). This suggests that this model significantly increases the accuracy of its prediction relative to an unfitted model that includes these variables (Hair et al., 2014). The R value and the R^2 are respectively .4276 and .1828, indicating that 18.28% of the variability is explained.

Furthermore, the explanatory power of the other tested mediation model for *Δ Production Costs* is assessed (N=126). Firstly, the relationship between the mediator *Δ Power Consumption* and the independent variable *Investments in ESA* is tested. The F-value for this model is significant (1.8980, $p <.10$). The R value and the R^2 are respectively .3764 and .1417, indicating that 14.17% of the variability is explained by this model. Secondly, the relationship between the second mediator *Δ Oil & Gas Consumption* and *Investments in ESA* is tested. The F-value for this model is significant (2.1543, $p <.05$). The R value and the R^2 are respectively .3972 and .1578, indicating that 15.78% of the variability is explained by this model. Lastly, the relationship between both measurements for *Δ Energy Consumption,* namely, *Δ Power Consumption* and *Δ Oil & Gas Consumption,* with *Δ Production Costs* is tested. The F-value for this model is non-significant (.4871, $p = 9187$). This suggests that this model does not significantly increases the accuracy of its prediction relative to the unfitted models (Hair et al., 2014). The R value and the R^2 are respectively .2218 and .0492, indicating that 4.92% of the variability is explained.

4.5.3 Hypothesis Testing

Within this section the earlier proposed hypotheses are repeated and tested. The outcomes are discussed briefly. For the regression analyses, the PROCESS macro in SPSS by Hayes (2013) is used. An overview of the outcomes of the regression analyses is presented in table 15.

The first hypothesis of this research is the following: *"Investments in energy saving activities are not expected to significantly correlate directly with an increase in sales."* According to correlation matrix, there is no support for a significant relationship between the two variables (P = .438). In addition to this, the outcomes of the regression analysis present a non-significant relationship between *Investments in ESA* and *Δ Sales* (-.0116, (t=-.8388, p = .4035). This outcome suggests that *Investments in ESA* does not significantly correlate directly with an increase in sales. This is in line with findings of Hart and Dowell (2011), as they state that firms can only financially benefit when a firm has the needed organisational capabilities and cognitive and framing attitude. In addition to this, Sarkis and Dijkshoorn (2007) also acknowledge this as they state that experience is needed in order to gain financial benefit from sustainable activities. Therefore, it can be concluded that the first hypothesis is supported.

Secondly, it is hypothesized that "*investments in energy saving activities result in less energy consumption, which results in an increase in sales."* When evaluating the outcomes of the analysis, it can be stated investments in ESA do result in less energy consumption as it has a negative significant effect on *Δ Oil & Gas Consumption (*b= -.1232, (t=-1.9325, p <.05). Furthermore, the analysis shows that *Δ Power Consumption* does have a significant positive effect on *Δ Sales* (b=.0760 (t=3.5759, p < .01). *Δ Oil & Gas Consumption* does not show a significant effect on *Δ Sales* (b=-.0229 (t=-.8988, p = .3709). When both these variables are mediating the relationship between *Investments in ESA* and *Δ Sales* there is no significant indirect effect found (b=.0055 (BCa CI [-.0196, 0126]). This leads to the conclusion that investments in ESA do result in less energy consumption, however this does not autonomously lead to an increase in sales. Therefore, hypothesis 2 cannot be supported and has to be rejected based on these quantitative results. An explanation for this outcome is that these investments are often not communicated with customers of the concerned firm. Despite the advantages it may bring a firm, when these sustainability practices are not communicated effectively with customers it is unlikely for sales to increase. This communication with customers is essential to realise an increase in sales for a firm via sustainability practices (Jayaraman, Singh, &

Anandnarayan, 2012). Another explanation for this outcome is that energy saving measures are increasingly becoming a normal matter for firms and that economic potential is the main reason to invest in ESA, this in turn could lead to a reduction in prices and consequently an increase in sales (de Groot et al., 2001). However, this may take longer than the time period measured in this study. Another explanation is given by Hart and Dowell (2011), as outlined above, they state that firms can only financially benefit when a firm has the needed organisational capabilities and cognitive and framing attitude. In addition to this, Sarkis and Dijkshoorn (2007) suggest that to be able to make profit from sustainable activities, this also relies on a firm's experience. The authors also suggest that firm's short-term productivity might decrease due to implementation efforts of these activities.

The third hypothesis which addresses the overall effect of the relationship is the following: *"investments in energy saving activities are expected to have a significant positive overall effect on sales."* When evaluating the overall effect in table 15, it can be concluded that the overall effect is negative and non-significant (b=-.0170 (t=-1.1862, p = .2383). Therefore, based on these outcomes the third hypothesis of this study cannot be supported. The explanations which are given by Jayaraman et al. (2012), Sarkis and Dijkshoorn (2007) and Hart and Dowell (2011) outlined in the previous paragraph are also applicable to this outcome.

The fourth hypothesis of this study (hypothesis 2a) is the following: "*investments in energy saving activities are not expected to significantly correlate directly with a reduction in production costs."* The outcome of the correlation matrix, provides a correlation between *Investments in EST* and *Δ Production Costs* that is non-significant (-.056, p =.463). In addition to this, the outcomes of the regression analysis present a non-significant relationship between *Investments in ESA* and *Δ Production Costs* (b=.0580 (t=.6849, p = .4948). This outcome suggests that *Investments in ESA* does not significantly correlate directly with a reduction in production costs. This is in line with findings of Hart and Dowell (2011) and Sarkis and Dijkshoorn (2007) which are outlined above are also applicable to this outcome. Therefore, it can be concluded that the fourth hypothesis of this study can be supported.

"Investments in energy saving activities result in less energy consumption which results in a significant reduction of production costs" is the fifth hypothesis of this study. When evaluating the outcomes of the analysis, it can be stated investments in ESA do result in less energy

consumption as it has a negative significant effect on *Δ Power Consumption* (b=-.1167(t=-1.6448, p <.15), and *Δ Oil & Gas Consumption (*b= -.1385, (t=-2.3103, p <.05). Furthermore, it can be stated that *Δ Power Consumption* does have a non-significant effect on *Δ Production Costs* (b=-.1154 (t=-.8773, p = .3822). *Δ Oil & Gas Consumption* does neither show a significant effect on *Δ Production Costs* (b= .1825 (t=1.1721, p = .2436). When both these variables are mediating the relationship between *Investments in ESA* and *Δ Sales* there is no significant indirect effect found (b=.0118 (BCa CI [-.0627, 0420]). This leads to the conclusion that investments in ESA does reduce energy consumption. However, a change in energy consumption does not have a significant mediating effect on the relationship between *Investments in ESA* and *Δ Production Costs*. Therefore, hypothesis 2 cannot be supported and has to be rejected based on these quantitative results. An explanation for this is that production costs do not solely exist out of energy costs. Energy costs only represent a limited proportion of the total production costs of firms.

The final hypothesis within this study is the following: *"investments in energy saving activities are expected to have a significant negative overall effect on production costs".* When evaluating the overall effect in table 15, it can be concluded that the overall effect for this model is non-significant (b=.0462 (t=-.5599, p =.5767). Therefore, this hypothesis cannot be supported based on these quantitative analyses. The explanation regarding the proportion of energy costs in relation to the total production costs outlined above is also applicable to this outcome.

Other than answers on the hypotheses, the analyses can also provide so-called bycatches. Another result of the analyses is that the chemical industry seems to be significantly and positively related with *Δ Power Consumption* compared to the metal industry, which was used as reference category. An explanation for this is that the chemical industry is more dependent on power consumption than other industries. This is in line with findings from Porter and Linde (1995), as they state that within the chemical industry the ecology-economy trade-off is particularly steep.

Table 15: Mediation Regression Analysis of change in Sales and Production Costs

	Δ Sales (Y)			*Δ Production Costs (Y)*		
	A1	A2	B1,B2	A1	A1	B1,B2
	b (SE)	*b (SE)*	*b (SE)*	*b (SE)*	*b (SE*	*b (SE*
	Δ Power Consumption	*Δ Oil & Gas Consumption*	*Δ Sales*	*Δ Power Consumption*	*Δ Oil & Gas Consumption*	*Δ Production Costs*
Control						
Other Technologies	-.0422 (.0553)	-.0267 (.0462)	.0047 (.0099)	-.0337 (.0709)	-.0307 (.0441)	-.0316 (.0610)
Firm Size	-.0592 (.1255)	-.0755 (.1048)	.0191 (.0223)	-.0362 (.1177)	-.0282 (.0995)	.0547 (.1374)
Energy Costs	.1563 (.1158)	.0070 (.0967)	-.0237 (.0208)	.1725 (.1070) (*)	.0177 (.0904)	-.0372 (.1267)
Food	.5843 (.4141)	.5467 (.3459) (*)	.0402 (.0745)	.6633 (.3905)*	.6025 (.3300)*	-.2217 (.4636)
Textile	.0398 (.3785)	.2359 (.3161)	-.0041 (.0675)	.0078 (.3499)	.2041 (.2957)	-.4407 (.4096)
Construction	-.1038 (.4314)	-.2057 (.3603)	-.302 (.0767)	-.0857 (.4147)	-.2276 (.3505)	.1407 (.4849)
Chemical	.8413 (.3876)**	.4974 (.3238) (*)	.0152 (.0704)	.8557 (.3662)**	.5429 (.3095)*	-.6499 (.4380)*
Machinery	.2040 (.3559)	-.0471 (.2973)	-.0244 (.0633)	.2227 (.3391)	-.0325 (.2866)	-.1629 (.3966)
Electronic	.3335 (.3627)	.1389 (.3029)	.0780 (.0646)	-.1057 (.3183)	-.0535 (.2691)	-.0183 (.3721)
Mediators						
Δ Power Consumption (B1)			.0760 (.0212)***			-.1154 (.1315)
Δ Oil & Gas Consumption (B2)			-.0229 (.0254)			.1824 (.1556)
Independent						
Investments in ESA	-.1089 (.0763)	-.1232 (.0638)*	-.0116 (.0138)	-.1167 (.0709) (*)	-.1385 (.0600)**	.0580 (.0848)
Model Statistics						
F Value	1.6980*	1.6722*	1.8828**	1.8980*	2.1543**	.4871
R Value	.3762	.3737	.4276	.3764	.3972	.2218
R^2 Value	.1415	.1397	.1828	.1417	.1578	.0492
N	114	114	114	126	126	126
Total, Direct and Indirect Effects of X on Y						
Overall Effect	b= -.0170; SE=.0144; P = .2383			b=.0462; SE=.0826; P = .5767		
Direct Effect	b= -.0116; SE=.0138; P = .4035			b=.0580; SE=.0848; P = .4948		
Total Indirect Effect	b=-.0055; SE=.0079; 95%; CI (-.0196, .0126)			b=-.0118; SE=.0255; 95%; CI (-.0627, .0420)		

*** Significance at the 0,01 level.
** Significance at the 0,05 level.
* Significance at the 0,10 level.
(*) Significance at the 0,15 level

4.5.4 Summary

Within this chapter, the results of the quantitative part of this study were presented. In chapter 2, various hypotheses were formulated. Within this chapter, they were tested via univariate, bivariate and multivariate regression analyses. 2 of the formulated hypotheses were confirmed and 4 of them were rejected. The outcomes suggest that investing in energy saving activities on its own does not lead to a change in sales or production costs. Furthermore, investing in energy saving activities does not have a significant relationship with an increase in sales when mediated through change in energy consumption. In addition to this, investing in energy saving activities neither has a significant relationship with a reduction in production costs when mediated through change in energy consumption. In the next chapter, more explanations for the found relationships are searched for.

Table 16: Overview of acceptation of the hypotheses based on quantitative analyses

Hypotheses		Supported/ Partly Supported/ Not Supported
1a	*Investments in energy saving technologies are not expected to significantly correlate directly with an increase in sales*	
1b	*Investments in energy saving technologies result in less energy consumption, which results in an increase in sales*	
1	*investments in energy saving activities are expected to have a significant positive overall effect on sales*	
2a	*Investments in energy saving activities are not expected to significantly correlate directly with a reduction in production costs*	
2b	*Investments in energy saving activities result in less energy consumption which results in a significant reduction of production costs*	
2	*Investments in energy saving activities are expected to have a significant negative overall effect on production costs*	

Supported Partly Supported Not Supported

5. Qualitative Results

In order to gain a more in-depth understanding and to substantiate outcomes from the quantitative analyses, a qualitative research part is added to the study. This research part is conducted via semi-structured interviews. As outlined in chapter 3, several CEO's of Dutch manufacturing companies are interviewed in order to shed more light on the outcomes of the earlier proposed hypotheses. The overview of the respondents is repeated below. The interview guideline can be found in appendix 2. In paragraph 5.1, firstly the outcomes of the quantitative research are briefly summarized and subsequently it is explained how the interviews are related to these outcomes. Lastly, a summary of the chapter is provided.

Table 17: Repeated overview of interview respondents

Company	Industry	Position	Employees
A	Compressed Air	CEO	45
B	Machinery	CEO	150
C	Waste Incineration	CEO	100
D	Packaging	CEO	60

5.1 Outcomes

Firstly, the respondents all indicate that they use at least two or more of the technologies and practices which are also outlined by the EMS 2015. The most prominent ones are the energy and/or heat generation by means of solar, wind, hydropower, biomass or geothermal energy that these firms realize, the systems for kinetic and process energy recovery (e.g. waste heat recovery), switching off components, machinery or equipment measures to reduce energy consumption and the upgrading or substituting of existing machinery or equipment measures to reduce energy consumption. When compared to the EMS 2015 data sample, it can be concluded that interview respondents invested more in ESA on average than respondents of the EMS sample. The interview respondents invested on average in 4 of the 7 outlined technologies and the EMS sample respondents invested in 2 ESA on average.

Regarding other technologies and practices, multiple respondents (A, B and D) indicate that they are working on a reduction in transport and improved isolation of their production sites. "*I truly see this as a win-win situation*." (Personal communication, June 2, 2021). This is due to the fact that both the environment and firms benefit from this. Regarding the motivation to

invest in energy saving activities, respondents A, B, C and D indicate that that the decrease of oil and gas consumption is prominent as power can be generated more and more via environment friendly sources (e.g. solar power) and therefore is less harmful for the environment. In addition to this, respondent D indicates that power can be generated by the manufacturing firms themselves which also provides a potential financial benefit. When asked about organisational measures or working methods regarding energy and environmental control, all respondents indicate that they have at least one or more certificate(s) in order to show that they as a firm are thinking about the environment (e.g. consumption of environmentally friendly generated power).

The first hypothesis of the study is: "*investments in energy saving activities are not expected to significantly correlate directly with an increase in sales."* In the quantitative analyses this hypothesis was supported. Interview question 14 is dedicated to gathering more information on the direct relationship between these two variables, relevant information was also derived from explanations of answers from question 10 and 13 up to 18 .

Table 18: Quotes on the direct effect of Investments in ESA on Sales

Company	Quote(s)
A	Investeringen in duurzaamheid zijn vaak langetermijninvesteringen en het is soms onzeker of het zal renderen aangezien dat van veel dingen afhankelijk is. Veel bedrijven zijn ook nog niet bereid te investeren in iets dat hen niet snel geld oplevert.
B	Het is van meerdere factoren afhankelijk of investeringen tot een financieel voordeel leiden. Het gaat om het totaalplaatje en niet alleen om één factor.
C	Voor ons, aangezien ons belangrijkste product energie is, resulteert elke verbetering in energiebesparing in resultaten voor het bedrijf die financieel gunstig zijn. Hoe snel we resultaat zien, hangt natuurlijk af van het type en de omvang van de investering.
D	Wij merken geen grote directe invloed van deze investeringen op onze omzet. Wel is het zo dat bedrijven die zien dat we duurzaam bezig zijn… dan heb je misschien wel eens een streepje voor.

The main explanation on the non-significant correlation between *Investments in ESA* and *Δ Sales* that has emerged from the interviews is regarding the dependency on more factors than just investments. Respondent C, which is a large user of energy, states that when they are investing in energy saving measures, that they can directly see the influence of this as the firm's main product is energy. However, respondent C does also indicate that the extent of financial benefit depends on more than just the investment itself. This is in line with responses from respondents A, B and D as they all indicate that the influence of investments in ESA on *Δ Sales* is dependent on multiple factors and therefore not direct. In addition to this, this is in line with findings from the bivariate analysis as the analysis showed positive and significant correlation between energy costs and investments in energy saving activities. In conclusion, the empirical findings of the interviews agree well with the earlier outlined theory from Hart and Dowell (2011) and Sarkis and Dijkshoorn (2007) and the outcomes of the quantitative analysis regarding this hypothesis.

Secondly, it was hypothesized that "*investments in energy saving activities result in less energy consumption, which results in an increase in sales."* According to the outcomes of the quantitative analysis this hypothesis was not supported. Interview question 13 up to 18 are dedicated to gathering more information on the relationship between these three variables and a potential indirect effect of energy consumption.

Table 19: Quotes regarding the second and third hypotheses

Company	Quote(s)
A	We hebben zelf niet zo veel baat bij minder energieverbruik op economisch vlak, maar onze collega's die wel veel energie verbruiken merken dat wel heel erg.
	Als ik naar klanten ga en laat zien dat ik bezig ben met duurzaamheid in de vorm van bijvoorbeeld energiebesparing, laat dat zien dat ik nadenk over de toekomst van mijn bedrijf en de samenleving, maar als het hen meer geld gaat kosten, zullen ze minder snel doorgaan met de deal, aangezien veel bedrijven nog steeds meer gericht zijn op het besparen op het economische dan op het milieugedeelte.

	Vanuit het oogpunt van de klant is het voor ons niet zo zeer een positief punt om veel aan duurzaamheid te doen, maar het zou wel een groot negatief punt kunnen zijn als we dit niet doen.
B	Ik ga ervan uit dat als wij dit niet zouden doen dat wij dan over 10 jaar niet meer zouden bestaan zoals we dat nu doen.
	Onze industrie is erg traditioneel. Verduurzaming gebeurt dus wel beetje bij beetje alleen dit gaat niet zo snel als in andere industrieën.
C	Deze investeringen leiden zeker tot concurrentie voordeel. Hoe meer wij besparen hoe meer we onze tarieven kunnen verlagen waardoor klanten sneller voor ons kiezen in plaats van onze concurrent.
	Deze investeringen dragen zeker bij aan onze reputatie. Die footprint is heel erg belangrijk voor ons bedrijf dus wij proberen deze zo laag mogelijk te krijgen. Ook kun je binnen onze industrie een zogenoemde R1 status behalen dat laat zien hoeveel energie efficiënt je bent. Dit is ook extra motivatie om steeds met energie bezig te zijn. Met deze status kun je binnen onze branche te koop lopen. Verder is er nog fiscale motivaties zoals heffingen en subsidies.
D	Wij als bedrijf merken geen grote directe invloed van deze investeringen op onze omzet. Wel is het zo dat bedrijven die zien dat we duurzaam bezig zijn… dan heb je misschien wel eens een streepje voor.
	Draagt absoluut bij aan de reputatie van het bedrijf. Steeds meer klanten willen weten waar hun producten vandaan komen en hoe wordt het gemaakt? Zodra je een volledig milieuvriendelijk product produceert heb je toch echt een streepje voor.

After analysing how the interviews relate to the second and third hypothesis of this study, the following outcomes have emerged. When respondents are asked to what extent they agree with the proposition “the size of the energy consumption has a major influence on the size of the total turnover within our company.”, respondent A and B indicate that they completely disagree as energy consumption does not have a major influence on their total turnover. Respondent D slightly disagrees on this proposition. However, respondent C totally agrees on this as they are large energy consumers. This provides an explanation for the non-significant outcome in the

regression analyses, as it is firm specific whether these investments truly are financially noticeable or not. In addition to this, all respondents do completely agree that investments in ESA are contributing to an improved reputation of the firm. "*To not think environmentally friendly is not an option, as 'green thinking' shows that you are thinking about the future of the firm, which is a positive attitude."* (Personal Communication, 2 June, 2021). However, for manufacturing firms that do not rely too much on energy consumption, these activities are more and more getting normal for them and their clients and therefore the competitive advantage is levelling out in this aspect. *"It is not so much a positive point, but more importantly it is not a negative point."* (Personal Communication, 2 June, 2021). In addition to this, according to the respondent A, most firms are not willing to invest extra money in energy saving measures yet if it takes more than a few years to earn those investments back *"The economical aspect is often still greater than that of the environment for many companies."* (Personal Communication, 2 June, 2021). However, respondent C and D indicate that manufacturing firms that rely greatly on energy consumption can financially benefit from an increase in sales as a consequence of less energy consumption. *"When our production costs decrease, we can reduce our prices which makes customers choose for us instead of for our competitor"* (Personal Communication, 7 June, 2021). This is in line with the outcomes of the study from de Groot et al. (2001) and outcomes of the bivariate analysis of this study as *investments in ESA* correlates significantly with *Energy Costs*. In addition to this, respondent C and D stated that the increased reputation through environmental activities also is beneficial for the number of sales. *"Due to our sustainable activities, we do have an advantage over competitors who are not paying attention to this yet."* (Personal Communication, 9 June, 2021). In conclusion, the differences in the responses from the interviewees give an explanation for the non-significant indirect effect outcome from the quantitative analyses. The same can be stated for the third hypothesis, in*vestments in energy saving activities are expected to have a significant positive overall effect on sales.* However, it is likely that there is a difference between low and high energy consuming manufacturing firms regarding the overall effect of investments in ESA and Sales. This difference is also an explanation for the non-significant effect which was found in the previous chapter.

The fourth hypothesis of this study was the following: "*Investments in energy saving activities are not expected to significantly correlate directly with a reduction in production costs."* In the quantitative analyses this hypothesis was supported. Interview question 10 is dedicated to

gathering more information on the direct relationship between these two variables, relevant information was also derived from explanations of answers from question 8, 9, 10, 11 and 12.

Table 20: Quotes on the direct effect of Investments in ESA on Production Costs

Company	Quote(s)
A	Betreft energiebesparing investeringen wij actief in vermindering van stroomkosten. Wij hebben onder andere ledverlichting, automatische verlichting, een goed geïsoleerd pand en we proberen onze transporthoeveelheden zo veel mogelijk te beperken. Betreft de productiekosten hebben deze investeringen geen groot aandeel.
B	Onze investeringen in energie besparing zit vooral in het besparen van energie in onze machines en isolatie van het pand. Maar vergeleken met de totale productiekosten stelt deze besparing niet veel voor. Aangezien het dus maar een klein deel is van onze kosten. Wel zorgt het product dat wij maken voor grote energiebesparing bij fabrieken die onze machines afnemen waar het energie verbruik vaak 20-25% van de totale kosten betreft.
C	Voor ons, aangezien ons belangrijkste product energie is, resulteert elke verbetering in energiebesparing in resultaten voor het bedrijf die financieel gunstig zijn. Hoe snel we resultaat zien, hangt natuurlijk af van het type en de omvang van de investering.
D	Het effect dat deze investeringen op onze productiekosten hebben is echt minimaal.

What has emerged from the interviews regarding this hypothesis is that this the effect of these investments on production costs dependent of the type manufacturing firm. For respondent A,B and D there is no noticeable effect on production costs. However, respondent C does state that this is beneficial for their production costs as they highly rely on energy consumption. This is in line with findings from the correlation matrix as *investments in ESA* correlates significantly with *Energy Costs*. In addition to this, this also provides an explanation for the non-significant correlation as an effect on production costs is dependent on more factors than just the investment (e.g. type of firm).

Furthermore, it was hypothesized that *"Investments in energy saving activities result in less energy consumption which results in a significant reduction of production costs."* According to the outcomes of the quantitative analysis this hypothesis was not supported. Interview question 8 up to 12 are dedicated to gathering more information on the relationship between these three variables and a potential indirect effect of energy consumption.

Table 21: Quotes regarding the fifth and sixth hypotheses

Company	Quote(s)
A	Investeringen in energiebesparingen verminderen zeker merkbaar het energieverbruik binnen ons bedrijf.
	We hebben zelf niet zo veel baat bij minder energieverbruik op economisch vlak, maar onze collega's die wel veel energie verbruiken merken dat wel heel erg.
	Tuurlijk kan het een effect hebben, alleen voor ons is het te klein. In een groot productiebedrijf zal het ongetwijfeld veel meer parten spelen.
B	Voor mijn bedrijf is het energieverbruik slechts een klein percentage van de totale productiekosten, hoewel dit voor sommige van mijn collega's een veel groter percentage is.
	In de eerste 2-3 jaar is dit misschien minder merkbaar vanwege de investeringskosten en eventuele implementatiekosten, maar op de lange termijn zou dit deze bedrijven op consistente basis geld moeten besparen.
C	Energie verbruik is een groot onderdeel van onze totale productiekosten. Als wij hierop besparen dan merken we dat natuurlijk. Gevolgen van dit kunnen dan bijvoorbeeld wijzigingen in tarieven voor onze klanten zijn.
	Wij maken hiermee onze kosten lager, maar ook onze CO2 footprint gunstiger.
D	Het energieverbruik is voor ons maar een klein aandeel van de totale productiekosten. Al zouden deze investeringen leiden tot een besparing van productiekosten, dan is dit zo een klein effect. Dat kan je bijna niet waarnemen.
	Het effect dat deze investeringen op onze productiekosten hebben is echt minimaal.

What emerged from the interviews regarding this hypothesis is that respondent A, B, and D indicate once more that the extent of the effect of less energy consumption on production costs differs amongst manufacturing firms. *"For my firm the energy consumption is only a small percentage of the total production costs, although for some of my colleagues this a much bigger percentage."* (Personal Communication, June 3, 2021). For companies that do benefit from reduction of energy consumption regarding production costs they should notice it according to respondent A, B and C. *"In the first 2-3 years this might be less noticeable due to the investment and implementation costs, but in the long term this should save these firms a significant amount of money on a consistent basis"* (Personal Communication, June 3, 2021). This gives explanations for the found non-significant effect. However, as outlined above, this is in line with outcomes from the correlation matrix. In addition to this, it can be concluded that a longitudinal study could change the outcomes significantly compared to this cross-sectional study. In addition to this, the explanations of the interviewees are also in line with the explanation given in the quantitative analyses as energy costs only make up for a limited part of the total production costs. Regarding the third hypothesis, these explanations also are applicable. However, it is likely that there is a difference between low and high energy consuming manufacturing firms regarding the overall effect of investments in ESA and Production costs. This difference is also an explanation for the non-significant effect which was found in the previous chapter.

5.2 Summary

Within this chapter, the results of the qualitative part of this study were presented. The purpose of this chapter was to shed more light on the outcomes of the quantitative study by looking for explanations on these outcomes via interviews. The interviews were conducted with the CEO's of 4 Dutch manufacturing firms. The outcomes of this qualitative approach are as expected much in line with the outcomes of the quantitative analysis and theory. It can be concluded that Investments in ESA are not likely to directly result in financial benefit as this is dependent on for example the project, time and experience. In addition to this, the extent of how much firms can benefit from these investments and less energy consumption is also firm specific, as one firm in an industry type can be more relying on energy consumption than the other.

6. Conclusion

This chapter formulates the conclusion that answers the central research question: *"to what extent do companies' investments in energy saving activities affect financial performance directly, and to what extent indirectly by means of reducing energy consumption?"* The conclusion is purely an observation and summary of the results that are outlined above. The objective of this study is to contribute to the field of investments in CSR and its impact on a firm's performance by providing insight on how the overall effect of investments in ESA on financial performance is composed. In this study, the indirect, direct and overall effect of investments in ESA and a manufacturing firm's financial performance was investigated by using a mixed methods approach with qualitative and quantitative research methodology. Firstly, a summary of the study is provided. Thereafter, the central research question is answered.

This study focuses on the relationship between CSR activities performed by a firm and the effects of these activities on financial performance. The study builds on the theory provided by Porter and Linde (1995), Hart (1995) and Tate and Bals (2018) which shed light on the relationship between environmental activities and financial performance. The authors argue that environmental activities can influence a firms financial performance positively due to efficient use of resources. This study investigates one specific type of resource, namely, energy. This is due to the fact that energy consumption is one of the most prominent resource types for firms regarding the environment as reducing energy consumption potentially benefits the environment and a firms finances (Salonitis & Ball, 2013). This study focused on generating insight on the direct relationship of energy saving activities and financial performance and the indirect effect of the relationship through energy consumption.

From the theoretical framework six hypotheses were derived. These hypotheses are firstly tested quantitatively. The sample which was used for this study is provided by European Manufacturing Survey of 2015 which included 177 respondents. Additionally, several interviews (4) were conducted with CEO's of manufacturing firms in order to gain a deeper understanding in the outcomes of the quantitative analyses.

During the quantitative analyses, regression analyses were performed. These analyses provided outcomes regarding the formulated hypotheses. To start with, the regression analyses indicate

that an increase in sales is not realized by solely investing in energy saving activities. This was also acknowledged by the most of the respondents of the qualitative research as they indicated that an increase in sales through investments in ESA depends on more factors than just solely investing. Furthermore, the relationship of investments in ESA on Δ Sales through energy consumption was assessed. Several conclusions can be derived from the outcomes. An increase in sales does influence the development of power consumption positively. However, the regression analyses indicate that there is no significant indirect effect found with energy consumption as mediating variable for the relation between investments in ESA and Δ Sales. Extant literature provides explanations for this outcome. Jayaraman et al. (2012), for example, suggest that this could be the result of unawareness amongst clients of these sustainability efforts by the firm. Furthermore, de Groot et al. (2001) indicate that energy saving is likely to lead to less costs, which consequently enables the firm to reduce prices which is likely to result in an increase in sales. However, this may take longer than the time period measured in this cross-sectional study and is also depending on experience, characteristics and capabilities of a firm (Hart & Dowell, 2011; Sarkis & Dijkshoorn, 2007). These explanations were also in line with explanations given during the interviews. What also can be concluded from the results of this study is that the extent of the effects of investments in ESA and sales development depends on the type of manufacturing firm and the extent of their energy consumption as a high energy consuming firm is likely to financially benefit more from these investments than low energy consuming firms.

The second regression analysis provided insight on the relationship between investments in ESA and production costs. The outcomes indicate that a reduction in production costs is not realized by solely investing in energy saving activities. When explanations for this relationship were looked for during the qualitative research, respondents state that investments in ESA that the extent of the effect depends on more factors than investing on its own. Additionally, the relationship of investments in ESA on development of production costs through energy consumption was tested. From the outcomes of the regression analysis, it can be concluded that there is no significant indirect effect in this mediation model. From the interviews it can be concluded that this is mostly due to the fact that energy costs only make up for a small part of total production costs for low energy consuming manufacturing firms. To the contrary, high energy consuming firms are likely to financially benefit from less energy consumption regarding their production costs. Additionally, in a longitudinal study the outcomes are likely

to implicate that these investments are more profitable. This was also acknowledged by the respondents in the qualitative part of this study.

To conclude, an answer is formulated regarding the central research question of this research. The research question is, as outlined above, as follows: *"To what extent do companies' investments in energy saving activities affect financial performance directly, and to what extent indirectly by means of reducing energy consumption?"* From the results of this study, it can be concluded that investments in energy saving activities do not affect the financial performance of a firm directly. This is due to the fact that other factors, like firm characteristics, experience and capabilities of a firm, also play part on the effect of these investments. Indicating that solely investing in these measures does not affect financial performance directly, when measured in sales and production costs development. Regarding the indirect influence of investments in energy saving activities on financial performance by reducing energy consumption, the following can be concluded: manufacturing firms that are large consumers are investing more in energy saving activities as they are able to benefit financially from a reduction in energy consumption as this has a relatively big impact on their production costs. These benefits provided due to less energy consumption makes a firm able to lower prices which is likely to result in an increase in sales and further improved competitive advantage. However, manufacturing firms that are not relying too much on their energy consumption do not notice great economic benefits from these energy saving activities and are therefore less eager to invest in these activities than large energy consuming firms.

7. Discussion

In the following chapter, the discussion section of this study is outlined. Firstly, theoretical implications regarding this study are given. Secondly, recommendations for further research are given. Furthermore, practical implications based on this study are elaborated on and lastly limitations of this study are discussed.

7.1 Theoretical implications

This study attempts to contribute to existing literature on sustainability activities, energy consumption and financial performance. Sustainability activities is a very dynamic term as it concerns many activities with different natures that can be applied to this concept. This leads to the first theoretical implication of this study. The variable *investments in ESA* has not been researched before in the way it was constructed in this research. The combination of these activities/items into one variable *Investments in ESA* is new. As the variable showed multiple significant correlations and effects during this study it can be stated that follow-up studies can also use this combination of items.

Furthermore, another important theoretical implication is that the matter on climate change is increasing in importance year by year. This was already clear from literature but it was also confirmed by respondents during the interviews. Firms are increasing their sustainability efforts more and more. However, the economic aspect is for many companies still more important than the environmental part which could lead to difficulties in achieving the environmental goals by the European Union for 2030 and 2050. Another theoretical implication is that some of the hypotheses that derived from theory in chapter 2 were not supported. However, explanations for the rejection of these hypothesis were found in additional literature, interviews and logical reasoning.

7.2 Further research

From the results of this study, several interesting items that might require further research can be derived. First of all, this study has a cross-sectional nature. The outcomes of this study suggest that more insights in the investigated relationships can be gained via a longitudinal study. Therefore, one of the main suggestions for further research is to replicate this study with a longitudinal nature. The EMS sample also provides the opportunity to do so. Additionally, follow-up studies could also lay more focus on the differences in the various manufacturing

industries that are present. Furthermore, further research could also further investigate the effect of energy consumption on investments in ESA.

Secondly, suggestions for follow-up studies regarding potential mediating and moderating effects in the relationship between investments in energy saving activities and financial performance. For example, mediation effects, other than energy consumption, such as material consumption could be tested for this relationship. In addition to this, moderation effects could also be tested with for example competitive advantage or willingness to invest in ESA.

Another interesting direction for further research would be to focus on other countries than the Netherlands. A replication of this study in another country could add to the generalizability of the outcomes of this study. In addition to this, further research into other industries than manufacturing industries also provides relevant information as it provides insight in differences for manufacturing firms and other firms and could add to generalizability of the outcomes. Further research could also focus on different energy saving activities than the ones used to measure the concept in this study. The outcomes of other items to represent sustainable activities could provide valuable insights and substantiate outcomes of this study. Lastly, further research could be done into the pressure that firms receive from stakeholders regarding environmental issues and what effect this has on the implementation of sustainable activities and the rate of success of these implementations.

7.3 Practical implications

Results of this study can be taken into account by firms in order to improve several procedures regarding environmental management. Firstly, the outcomes of this study can aid managers in the manufacturing field in their decision-making processes regarding environmental management, and more specifically, investing in energy saving activities. The results of this study could influence decision making managers or CEO's that are not investing yet in these energy saving measures, to think again and maybe consider to adopt these activities after all. Furthermore, managers that think about implementing these activities could use these results to indicate to their colleagues that these investments can lead to financial benefits as a positive influence on sales and a negative influence on production costs can be achieved, especially in the long term. In addition to this, the results can be used by a manager to indicate that these investments do lead to an increased reputation of the firm. Furthermore, the results of this study

provide relevant information for low energy consuming firms as they are not likely to benefit greatly in a financial manner from these investments. However, they can benefit in a reputational manner which in combination with pressure from stakeholders could lead to the decision to still invest in these activities.

Lastly, governments can use the insights provided by this study to help low energy consuming companies that do not financially benefit too much from these investments in energy saving activities by making adjustments to their policies in order to motivate these firms more to invest in environmental activities in order to get closer to the environmental goals set by the European union.

7.4 Limitations

Regarding potential limitations, there are several limitations that should be taken into account when interpreting this study. Firstly, a limitation that should be considered is regarding the literature that was used for the theoretical framework of this study. The main concepts for this study are based on findings by Hart (1995), Porter and Linde (1995) and Tate and Bals (2018) regarding the relationship between environmental activities and financial performance. The variable investments in ESA was constructed in order to measure environmental activities by combining several energy saving measures for manufacturing firms. However, potentially different outcomes might be found when other energy saving measures are used.

Secondly, some limitations regarding the sample that was used for the quantitative analysis of this study. The European Manufacturing Survey that was used for this study provides data from 2015. Although, the outcomes are mostly substantiated by the qualitative study, more recent data might provide stronger relationships as the matter regarding climate change has become even more alarming in the recent years. In addition to this, the EMS 2015 sample was not specifically designed for this study. This leads to the fact that the concepts used in this study are not always fully consistent with items from the questionnaire. Furthermore, another limitation regarding this study is concerning the generalizability of the results. This study has been focused on Dutch manufacturing firms. Therefore, outcomes might differ slightly from manufacturing industries in other countries and especially differ from non-manufacturing firms. Lastly, as this study had a deadline, this could have influenced the researcher during the research. Therefore, the time constraint can be seen as a limitation as well.

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Appendix 1: EMS 2015 Questionnaire

Modernisering van de productie
Enquête 2015

Deze vragenlijst heeft als doel inzicht te krijgen in de inspanningen van industriële bedrijven in Nederland om hun productie en bedrijfsprocessen te moderniseren. Het onderzoek richt zich op productiebedrijven met een omvang van tenminste 10 werknemers. Bij ondernemingen met meerdere vestigingen hebben de vragen betrekking op de aangeschreven vestiging en niet op de totale onderneming.

Voor het onderzoek is beantwoording van alle vragen van belang. Ook als niet alle genoemde technologieën of organisatieconcepten van toepassing zijn op uw bedrijfsvestiging, verzoeken wij u vriendelijk de vragenlijst toch volledig in te vullen. Bij het invullen van de vragenlijst kunt u zowel de muis als de tab-toets gebruiken.

Voor vragen kunt u terecht bij: dr. Peter Vaessen E-Mail: P.Vaessen @ fm.ru.nl Tel.: 024 3611266 Fax: 024 3611933

I1 **Is uw bedrijfsvestiging** (kruis slechts één optie aan):

- Het hoofdkantoor van een onderneming/groep met ook buitenlandse vestigingen ☐
- Een dochter/divisie van een buitenlandse onderneming/groep ☐
- Het hoofdkantoor van een onderneming/groep met alleen binnenlandse vestigingen ☐
- Een dochter/divisie van een onderneming/groep met alleen binnenlandse vestigingen ☐
- Een zelfstandige onderneming ☐

I2 Bedrijfstak (bijv. textiel, chemische industrie, machinebouw, enz.) | hoofdproductgroep | aandeel van hoofdproduct (groep) in omzet

		ca. ... %

I3 **Is uw bedrijfsvestiging gelet op uw hoofdproduct(groep) leverancier van eindfabricaten of een toeleverancier van onderdelen/ materialen of bewerkingen?** (Kruis slechts één optie aan)

producent van eindfabricaten		toeleverancier		aanbieder van bewerkingen
☐ voor consumenten	☐ voor bedrijven	☐ van systemen/ installaties	☐ van halffabricaten/ onderdelen	☐ aanbieder van bewerkingen (draaien, coaten, lassen, vermalen, e.a.)

I4 **Als u uw hoofdproduct(groep) levert aan andere bedrijven (als eindfabrikant of toeleverancier), aan welke bedrijfstak levert u dan hoofdzakelijk?** (Kruis slechts één optie aan)

Machinebouw ☐ Chemische industrie ☐ Automotive industrie ☐ Elektro-techniek ☐ andere bedrijfstak, nl.: ☐

I5 **In hoeverre voert uw bedrijfsvestiging voor het hoofdproduct de volgende activiteiten uit van het waardecreatieproces?**
Kruis voor elke activiteit aan in welke mate die in uw eigen bedrijfsvestiging dan wel elders wordt uitgevoerd.
Kruis ook aan of een activiteit in het geheel geen deel uitmaakt van het waardecreatieproces

Waardecreatie-activiteiten

	Onderzoek en Ontwikkeling	Ontwerp/ Vormgeving	Productie/ Verwerking/Recycling	Assemblage	Onderhoud/ Dienstverlening	Verpakken/ Distributie
grotendeels intern > 85%	☐	☐	☐	☐	☐	☐
relevant deel intern (25%-85%)	☐	☐	☐	☐	☐	☐
klein deel intern (<25%)	☐	☐	☐	☐	☐	☐
niet nodig voor vervaardiging van het hoofdproduct	☐	☐	☐	☐	☐	☐

I7 **Hoe belangrijk zijn de volgende factoren voor de concurrentiepositie van uw bedrijfsvestiging?** (geef de volgorde van belangrijkheid aan met een score van 1 tot 6; 1 is het belangrijkst, gebruik elke score slechts één keer)

productprijs	productkwaliteit	innovatieve producten	aanpassing producten aan klantenwensen	tijdige levering/ korte levertijden	dienstverlening en service
☐	☐	☐	☐	☐	☐

Welke van de volgende organisatieconcepten en werkwijzen worden momenteel in uw bedrijfsvestiging toegepast?

Toepassing gepland voor 2018	Nee	Organisatieconcepten	Ja	Voor het eerst toegepast[1]	Omvang van het toegepaste potentieel [2]
		Organisatie van het werk			
		Gedetailleerde voorschriften voor de werkplekinrichting, van apparatuur en opslag van tussenproducten (bijv. 5-S methode)		19/20	
		Gestandaardiseerde en gedetailleerde werkinstructies		19/20	
		Taakverrijking productiemedewerker (integratie van planning, uitvoering of controle)		19/20	
		Organisatie van de productie			
		Maatregelen ter verbetering van de interne logistiek (Value Stream Mapping/Design, ruimtelijke inrichting van productiestappen)		19/20	
		Klant- of productgeoriënteerde inrichting van productie-eenheden (i.t.t. functionele indeling)		19/20	
		Vraaggestuurde productie (bijv. KANBAN, afschaffen van tussenvoorraden)		19/20	
		Voorgeschreven methoden voor het verkorten van omstel- en aanlooptijden bij productwisseling (bijv. Single Minute Exchange of Die; Quick Change Over)		19/20	
		Productiemanagement/ -beheersing			
		Grafische weergave werkprocessen en -status (Visual Management; dashboard)		19/20	
		Kwaliteitsmanagement (bijv. preventieve onderhoud, total quality management/TQM, total productie-onderhoud/TPM)		19/20	
		Methoden voor operation management o.b.v. wiskundige analyse van productie (bijv. Six Sigma methode)		19/20	
		Methoden van continu verbeteren (Kaizen, kwaliteitscirkels e.d.)		19/20	
		Energie- en milieubeheersing			
		Gecertificeerd energie-management systeem volgens ISO 50001, voorheen: EN 16001		19/20	
		Instrumenten voor productievenscyclus-analyse (bijv. EU.Ecolabel, Cradle-to-Cradle certificaat, ISO-14020)		19/20	
		Het opnemen van sociale en duurzaamheidseffecten in het vaststellen van bedrijfsprestaties		19/20	
		Human resource management			
		Maatregelen voor het behoud van oudere werknemers of hun kennis voor uw bedrijfsvestiging (bijv. teams met verschillende leeftijdsgroepen, begeleidingsprogramma's, senior-junior tandems)		19/20	
		Instrumenten ter bevordering van werknemersbetrokkenheid (bijv. gratis kantine, ondersteuning kinderopvang, gezinsvriendelijke werktijden)		19/20	
		Gestandaardiseerde methoden van functie-ontwerp ter verbetering van gezondheids- en veiligheidsomstandigheden op het werk (bijv. Methods-time-measurement (MTM))		19/20	
		Financiële participatie toegankelijk voor alle werknemersgroepen (bijv. winstdelingsregelingen, aandelen(optie)plannen, enz.)		19/20	

Toelichting:

1 Het jaar waarin deze technologie voor het eerst werd toegepast in uw bedrijfsvestiging (maak een schatting indien u onzeker bent over het exacte jaar)

2 Daadwerkelijke toepassing ten opzichte van maximaal zinvolle toepassingsmogelijkheden: omvang van het gebruikte potentieel is "gering" bij eerste aanzetten, "midden" bij gedeeltelijke toepassing en "hoog" bij omvangrijke toepassing

Welke van de volgende activiteiten worden uitgevoerd voor uw productiepersoneel in uw bedrijfsvestiging?

Aanwezige competenties van productiewerknemers worden systematisch vastgelegd?	nee	ja
Functiebeschrijvingen zijn ontwikkeld voor specifieke functiegebieden in de productie?	nee	ja
Er bestaan specifieke competentieprogramma's voor bepaalde functies	nee	ja

Bij welke personeelsgroepen worden deze instrumenten gebruikt?

LBO of ongeschoold personeel | MBO geschoold personeel | Hooggeschoold personeel (HBO+WO)

Bestaat er afzonderlijk beleid voor competentie-ontwikkeling en training van productiepersoneel?

nee | ja → Is er in uw bedrijf voor dit beleid een vast jaarlijks budget beschikbaar? nee | ja

Is er een vastgesteld aantal dagen per jaar voor verdere kwalificatie, training en ontwikkeling van het productiepersoneel?

nee ja → **Hoeveel dagen per jaar is er per persoon vastgesteld?** ca. dagen per jaar

Zijn de volgende activiteiten voor verdere kwalificatie, training en ontwikkeling toegepast voor het productiepersoneel in uw bedrijfsvestiging?

	nee	ja	In aanmerking komen de volgende groepen van productiepersoneel: LBO of ongeschoold	MBO-technisch geschoold	Hooggeschoold (WO+HBO)
Training voor specifieke vaardigheden (bijv. machine-onderhoud)		→			
Training met interdisciplinair oogmerk (bijv. taalcursussen, leiderschapstraining)		→			
Digitale zelfscholingprogramma's (e-learning)		→			
On-the-job training (bijv. taakrotatie, werkplekinstructie, georganiseerde ervaringsuitwisseling met collega's)		→			
Informatie-aanbod (bijv. bedrijfstak specifieke beurzen, externe databases)		→			
Deelname aan activiteiten voor continue kwaliteitsverbetering (bijv. kwaliteitscirkels, Kaizen)		→			

Werkt uw bedrijfsvestiging samen met andere bedrijven op de volgende terreinen?
(samenwerking = vrijwillige samenwerking die verder gaat dan eenmalige transacties tussen bedrijven)

	nee	ja	Locatie van de partners: regionaal (< 50km)	nationaal (> 50km)	buiten-land
Samenwerking in inkoop		→			
Samenwerking in de productie (voor gezamenlijke systeemleveringen of capaciteitsuitbreiding)		→			
Samenwerking in distributie/verkoop		→			
Samenwerking in service		→			
Samenwerking in onderzoek en ontwikkeling met afnemers of leveranciers		→			
Samenwerking in onderzoek & ontwikkeling (O&O) met onderzoeksinstituten (bijv. universiteiten, TNO)		→			

Indien uw bedrijfsvestiging voor onderzoek en ontwikkeling samenwerkt met andere bedrijven, zijn daarbij bedrijven actief op het gebied van nanotechnologie, micro-elektronica, photonen, nieuwe materialen, of biotechnologie?

nee ja → nanotechnologie micro-elektronica photonen nieuwe materialen biotechnologie

Welke van de volgende maatregelen zijn genomen om het risico van industriële spionage te vermijden in uw bedrijfsvestiging? Sinds wanneer zijn deze ingevoerd?

	nee	ja	sinds wanneer?
Speciale IT-veiligheidsmaatregelen (bijv. geen gebruik cloud computing, versleutelen van documenten, algemeen verbod op gebruik van draagbare data media)		→	19/20
Werknemerstrainingen en verhoging van waakzaamheid voor het gevaar van industriële spionage		→	19/20
Veiligheidsmaatregelen voor toegang tot terrein, gebouwen of kamers		→	19/20
Veiligheidsinstructies over illegale verspreiding van informatie (bijv. regelingen voor omgaan met gevoelige gegevens in relatie tot derde partijen)		→	19/20

Heeft uw bedrijfsvestiging te maken gehad met spionage door andere bedrijven, buitenlandse overheidsorganisaties of met verdachte gevallen in de laatste vijf jaar?

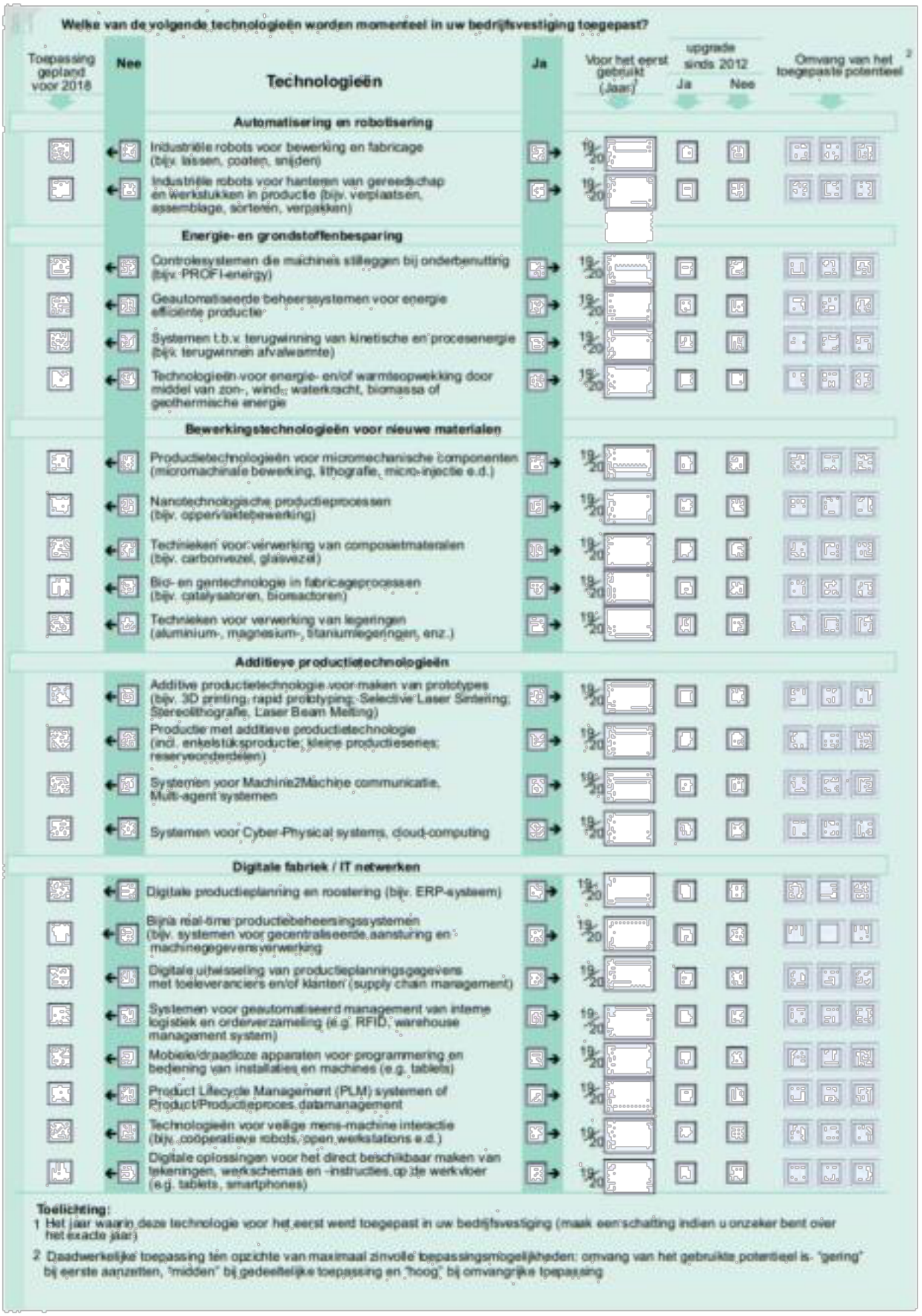
concrete(e)(n) geval(len) nee ja → ander bedrijf buitenlandse overheidsorganisatie onbekend

verdachte(n) geval(len) nee ja → ander bedrijf buitenlandse overheidsorganisatie onbekend

Indien er sprake was van een verdacht of concreet geval, welke informatie was het doelwit van industriële spionage?

Informatie over...

Producten (bijv. ideeën, studies, ontwikkeling, ontwerp) Productie- of fabricageprocessen Klanten/toeleveranciers (bijv. contracten, prijzen) Bedrijfsstrategie (bijv. investeringsplannen)


Welke van de volgende technologieën worden momenteel in uw bedrijfsvestiging toegepast?
Toepassing gepland voor 2018
Nee
Technologieën
Ja
Voor het eerst gebruikt (Jaar)[1]
upgrade sinds 2012
Ja
Nee
Omvang van het toegepaste potentieel[2]
Automatisering en robotisering
Industriële robots voor bewerking en fabricage (bijv. lassen, coaten, snijden)
Industriële robots voor hanteren van gereedschap en werkstukken in productie (bijv. verplaatsen, assemblage, sorteren, verpakken)
Energie- en grondstoffenbesparing
Controlesystemen die machines stilleggen bij onderbenutting (bijv. PROFI-energy)
Geautomatiseerde beheerssystemen voor energie efficiënte productie
Systemen t.b.v. terugwinning van kinetische en procesenergie (bijv. terugwinnen afvalwarmte)
Technologieën voor energie- en/of warmteopwekking door middel van zon-, wind-, waterkracht, biomassa of geothermische energie
Bewerkingstechnologieën voor nieuwe materialen
Productietechnologieën voor micromechanische componenten (micromachinale bewerking, lithografie, micro-injectie e.d.)
Nanotechnologische productieprocessen (bijv. oppervlaktebewerking)
Technieken voor verwerking van composietmaterialen (bijv. carbonvezel, glasvezel)
Bio- en gentechnologie in fabricageprocessen (bijv. catalysatoren, biosactoren)
Technieken voor verwerking van legeringen (aluminium-, magnesium-, titaniumlegeringen, enz.)
Additieve productietechnologieën
Additive productietechnologie voor maken van prototypes (bijv. 3D printing, rapid prototyping, Selective Laser Sintering, Stereolithografie, Laser Beam Melting)
Productie met additieve productietechnologie (incl. enkelstuksproductie, kleine productieseries, reserveonderdelen)
Systemen voor Machine2Machine communicatie, Multi-agent systemen
Systemen voor Cyber-Physical systems, cloud-computing
Digitale fabriek / IT netwerken
Digitale productieplanning en roostering (bijv. ERP-systeem)
Bijna real-time productiebeheersingssystemen (bijv. systemen voor gecentraliseerde aansturing en machinegegevensverwerking
Digitale uitwisseling van productieplanningsgegevens met toeleveranciers en/of klanten (supply chain management)
Systemen voor geautomatiseerd management van interne logistiek en orderverzameling (e.g. RFID, warehouse management system)
Mobiele/draadloze apparaten voor programmering en bediening van installaties en machines (e.g. tablets)
Product Lifecycle Management (PLM) systemen of Product/Productieproces datamanagement
Technologieën voor veilige mens-machine interactie (bijv. coöperatieve robots, open werkstations e.d.)
Digitale oplossingen voor het direct beschikbaar maken van tekeningen, werkschemas en -instructies op de werkvloer (e.g. tablets, smartphones)
Toelichting:
1 Het jaar waarin deze technologie voor het eerst werd toegepast in uw bedrijfsvestiging (maak een schatting indien u onzeker bent over het exacte jaar)
2 Daadwerkelijke toepassing ten opzichte van maximaal zinvolle toepassingsmogelijkheden: omvang van het gebruikte potentieel is: "gering" bij eerste aanzetten, "midden" bij gedeeltelijke toepassing en "hoog" bij omvangrijke toepassing

Welke van de volgende maatregelen nam uw bedrijfsvestiging om energieverbruik te verminderen?

	Toepassing gepland voor 2018	nee	ja
Afschakelsystemen voor onderdelen, machines of installaties indien niet in gebruik (bijv. afschakeling luchttoevoer, aangepaste verlichtingssensoren)			
Verbeteren van bestaande machines of installaties (bijv. hoogefficiënte motoren (IE3), aanbrengen isolatie, warmtewisselaar)			
Voortijdige vervanging van bestaande machines of installaties door nieuwe machines of installaties			

Welke van de volgende redenen en welke van de genoemde barrières zijn van doorslaggevende betekenis voor het wel of niet invoeren van energie en warmte opwekkende technologieën op basis van hernieuwbare energie in uw vestiging?

Redenen voor invoering	Energie	Warmte	Belangrijke barrières	Energie	Warmte
Verwachte ontwikkeling van de energieprijzen			Te grote investeringen of voordelen ontbreken		
Strategische redenen (bijv. "groen imago")			Administratieve last (bijv. goedkeuringsprocedures)		
Terugdringen broeikasgassen			Niet van toepassing in deze bedrijfsvestiging		
Eigen energie-opwekking ter vergroting aantal energiebronnen			Vooralsnog geen relevant onderwerp in deze vestiging		
Politieke of wettelijke bepalingen			Andere barrières		

Heeft uw bedrijf sinds 2012 producten geïntroduceerd die nieuw waren voor uw bedrijf of die technisch ingrijpend zijn vernieuwd?
(Bijv. door nieuwe grondstoffen of materialen te gebruiken, veranderingen in productiefuncties of werking e.d.)

nee ja → Hoe groot was het aandeel van deze producten in de omzet van het jaar 2014? ca. ... %

→ Hoe lang duurde gemiddeld genomen de ontwikkeling van zo'n product? (van productidee tot en met lancering) ca. ... maanden

Hebben deze productvernieuwingen ook geleid tot betere milieu-effecten bij gebruik of verwijderen van deze nieuwe producten?

nee ja → Welke verbeteringen in de milieu-effecten zijn met deze producten bereikt? (Kruis aan wat van toepassing is)

- Vermindering van gezondheidsrisico's bij gebruik
- Vermindering van energieverbruik bij gebruik
- Vereenvoudiging van onderhoud of herstel
- Verlenging productlevensduur
- Vermindering van milieuvervuiling bij gebruik (van grond, water, lucht, of geluid)
- Verbeterde recycling, terugwinning of verwijderingseigenschappen

Bevonden zich bij deze nieuwe producten (nieuw sinds 2012) ook producten, die nieuw-voor-de-markt waren en die uw bedrijfsvestiging als eerste op de markt introduceerde?

nee ja → Wat was hun aandeel in de omzet van 2014? ca. ... %

→ Zijn deze producten speciaal ontwikkeld vooral voor (kruis slechts één optie aan):

- bestaande klanten binnen uw huidige markt
- aantrekken van nieuwe klanten binnen uw huidige markt
- toetreding tot markten nieuw voor uw bedrijfsvestiging
- het ontwikkelen van geheel nieuwe markten

Heeft uw bedrijfsvestiging producten in het programma die u al langer dan 10 jaar aanbiedt?

nee ja → Welk percentage van de omzet hadden deze producten in 2014? ca. ... %

Welke van de volgende productgerelateerde diensten biedt u uw klanten aan?
Als uw bedrijfsvestiging dergelijke diensten aanbiedt, worden zij dan ook aangeboden voor producten van andere bedrijven?

	nee	ja	Voor producten van andere bedrijven		nee	ja	Voor producten van andere bedrijven
Installatie, inbedrijfstelling		→		Software-ontwikkeling (bijv. software-aanpassing)		→	
Onderhoud en reparatie		→		Klantondersteuning op afstand (helpdesk, service hotline, website)		→	
Training		→		Reviseren, vernieuwen (incl. functie opwaardering of software-uitbreidingen)		→	
Ontwerp, technisch advies (incl. testen, simulaties, O&O voor klanten)		→		End-of-life dienstverlening (bijv. recycling, opheffen, terugname)		→	

10.2 **Indien u productgerelateerde diensten aanbiedt, hoe hoog schat u het aandeel daarvan in de totale omzet van 2014?**
► In geval van geen omzet, vul in „0".

Aandeel in totale omzet van diensten die u in 2014 direct, d.w.z. apart, in rekening heeft gebracht ca. ☐☐☐ %

Aandeel van diensten die u in 2014 indirect in rekening heeft gebracht (via de productprijs) ca. ☐☐☐ %

10.3 **Heeft uw bedrijfsvestiging vanaf 2012 nieuwe productgerelateerde diensten aangeboden, die geheel nieuw zijn voor uw bedrijfsvestiging of belangrijke verbeteringen bevatten?**

☐ nee ☐ ja → Hoe groot was het aandeel in de omzet van 2014 van deze sinds 2012 nieuw aangeboden productgerelateerde diensten, die uw bedrijfsvestiging direct of indirect in rekening heeft gebracht? ca. ☐☐☐ %

11 **Hoe vaak heeft uw organisatie vanaf 2012 de volgende activiteiten verricht?**

		(0=niet; 1=1 keer; 2=vaker)
Spin-offs	Opstarten van nieuwe organisaties of activiteiten buiten de onderneming	☐ ☐ ☐
Uitgaand intellectueel eigendom	Verkopen, of aanbieden van licenties/patenten aan andere organisaties	☐ ☐ ☐
Werknemer-betrokkenheid	Benutten van kennis en initiatieven van niet-O&O medewerkers bij het realiseren van innovaties	☐ ☐ ☐
Klantbetrokkenheid	Direct betrekken van klanten in uw innovatieprocessen	☐ ☐ ☐
Extern netwerken	Het samenwerken met andere organisaties (niet klanten) voor innovatie	☐ ☐ ☐
Externe participatie	Deelnemen (met bijv. vermogen, kennis) in ondernemingen om toegang te krijgen tot hun kennis of om andere synergieën te creëren?	☐ ☐ ☐
Uitbesteden van O&O	Uitbesteden van O&O (diensten) aan andere organisaties, zoals universiteiten, publieke onderzoeksinstellingen, commerciële ingenieurs of leveranciers?	☐ ☐ ☐
Inkomend intellectueel eigendom	Kopen of in licentie nemen van intellectueel eigendom van andere organisaties	☐ ☐ ☐

12 **Hoe hebben zich in uw bedrijfsvestiging de productiekosten per eenheid product (eenheidskosten) ontwikkeld in 2014?**

Gedaald met 10% of meer	Gedaald 5 - < 10%	Gedaald 0 - < 5%	Gelijk gebleven	Gestegen 0 - < 5%	Gestegen 5 - < 10%	Gestegen met 10% of meer
☐	☐	☐	☐	☐	☐	☐

13 **In de voorafgaande vragen heeft u informatie gegeven over verschillende velden van innovatie. Rangorden deze innovatievelden naar mate van belangrijkheid voor uw bedrijfsvestiging.**
Geef met een score van 1 tot 4 de volgorde van belangrijkheid aan met 1 als het belangrijkst; gebruik elke score slechts één keer.

Toevoegen van diensten aan uw producten	Organisatie-vernieuwing	Technische vernieuwing in het productieproces	Ontwikkeling van nieuwe producten
☐	☐	☐	☐

14 **Welke van de onderstaande informatiebronnen zijn het meest relevant voor belangrijke innovatie-impulsen/ideeën in uw bedrijfsvestiging op de volgende gebieden?** (Kruis maximaal drie informatiebronnen aan voor elk gebied van innovatie)

	intern				extern			
	O&O, engineering	productie-afdeling	Klanten-service	Leiding bedrijfsvestiging	Klant of gebruiker	Leverancier	Onderzoeks-instellingen, universiteiten	Conferenties, beurzen
Nieuwe producten	☐	☐	☐	☐	☐	☐	☐	☐
Nieuwe proces-technologieën	☐	☐	☐	☐	☐	☐	☐	☐
Nieuwe diensten	☐	☐	☐	☐	☐	☐	☐	☐
Nieuwe organisatie-concepten	☐	☐	☐	☐	☐	☐	☐	☐

15.1 **Wat is het opleidingsniveau van het personeel van uw bedrijfsvestiging?**

Hoger onderwijs (HBO+WO)	ca. ☐☐☐ %	
MBO technische opleiding	ca. ☐☐☐ %	
MBO administratieve en commerciële opleiding	ca. ☐☐☐ %	= 100%
LBO of ongeschoold	ca. ☐☐☐ %	
Personeel in opleiding (leerlingen, stagiaires)	ca. ☐☐☐ %	

15.2 **Hoe is het personeel in uw bedrijfsvestiging verdeeld over de volgende werkterreinen:**

Onderzoek en ontwikkeling	ca. ☐☐☐ %	
Ideevorming, ontwerp en vormgeving	ca. ☐☐☐ %	
Fabricage en montage	ca. ☐☐☐ %	= 100%
Klantenservice	ca. ☐☐☐ %	
Overige (administratie, inkoop, logistiek/distributie, onderhoud, productieplanning enz.)	ca. ☐☐☐ %	

Heeft uw bedrijfsvestiging in de afgelopen twee jaar delen van de productie of delen van onderzoek en ontwikkeling (O&O) overgeheveld naar andere bedrijven (uitbesteding) of eigen vestigingen in het buitenland (verplaatsing) danwel vestigingen vanuit het buitenland teruggeplaatst?

Overheveling:

nee | **Ja:** (meerdere opties mogelijk)

- Naar andere bedrijven in Nederland
- Naar andere bedrijven in het buitenland
- Naar eigen vestigingen in het buitenland

Naar welk land (landen)?

Redenen: (meerdere opties mogelijk)

- Arbeidskosten
- Ontsluiting nieuwe markten
- Nabijheid belangrijke klanten
- Toegang tot nieuwe kennis technologieënclusters
- Belasting, heffingen, subsidies
- Gebrek aan gekwalificeerd personeel in eigen land
- Importbeperkingen
- Nabijheid van O&O of productie die reeds is overgeheveld
- Toegang tot natuurlijke hulpbronnen leveranciers
- Aanwezigheid van concurrenten

Overheveling van **productie-activiteiten** sinds 2013

Verplaatsing **onderzoeks- en ontwikkelingsactiviteiten** sinds 2013

Terugplaatsing (repatriëring) vanuit het buitenland naar het thuisland

Nee | **Ja**

- Vanuit andere bedrijven in het buitenland
- Vanuit eigen vestigingen in het buitenland

Uit welk land/landen

Redenen:

- Kwaliteit
- Flexibiliteit, leversnelheid
- Capaciteitsbenutting
- Beschikbaarheid gekwalificeerd personeel
- Arbeidskosten
- Transportkosten/ logistieke kosten
- Kosten van coördinatie en toezicht
- Nabijheid van binnenlandse O&O
- Verlies van kennis/ kopieerexploratie
- Infrastructuur

Terugplaatsing van (delen van) de **productie** sinds 2013

Geef a.u.b. de herkomst van uw toeleveringen (inputs) en de bestemming van uw producten in 2014.
► Toeleveringen zijn gekochte onderdelen, (ruwe) materialen, productiemiddelen en diensten. Geef alleen het aandeel aan van producten gemaakt in uw bedrijfsvestiging.

Toeleveringen afkomstig uit:

binnenland ca. ... % }
buitenland ca. ... % } =100% van de inkoopwaarde

Producten verkocht in:

binnenland ca. ... % }
buitenland ca. ... % } =100% van de omzet

Heeft uw bedrijfsvestiging onderzoek en ontwikkelingsactiviteiten (O&O) uitgevoerd of laten uitvoeren door externe partners in 2014?

nee | ja → O&O-uitgaven in procenten van de omzet in 2014 ca. ... %

Heeft uw bedrijfsvestiging sinds 2012 continu O&O uitgevoerd of laten uitvoeren door externe partners?

nee | ja

Welk van de volgende kenmerken zijn het meest van toepassing op uw hoofdproduct(groep)?

Productontwikkeling (kruis slechts één optie aan)

- Op specificatie van klant
- Voor een standaardprogramma waarbinnen klantspecifieke wensen gerealiseerd kunnen worden
- Voor een standaardprogramma, waaruit de klant kan kiezen
- Niet aanwezig in deze bedrijfsvestiging

Fabricage/montage (kruis slechts één optie aan)

- Na binnenkomst klantorder. (make-to-order)
- Eindmontage van het product wordt uitgevoerd na binnenkomst klantorder (assemble-to-order)
- Op voorraad (make-to-stock)
- Niet aanwezig in deze bedrijfsvestiging

Seriegrootte (kruis slechts één optie aan)

- Enkelstuksproductie
- Kleine of middelgrote series (20-1.000 stuks per maand)
- Grote series (meer dan 1.000 stuks per maand)
- Geen discrete productie (procesindustrie)

Productcomplexiteit (kruis slechts één optie aan)

- Eenvoudige producten
- Producten van middelgrote complexiteit
- Complexe producten

Beantwoordt u de volgende vragen over uw hoofdproduct(groep).

Wat is de gemiddelde productietijd van uw hoofdproduct(groep)? (doorlooptijd vanaf moment dat opdracht binnenkomt bij productie tot product klaar is voor levering) ca. ☐ werk-dagen of ☐ uren

Hoeveel procent van de orders wordt op tijd afgeleverd? ca. ☐ %

Hoeveel procent van uw productie moet na kwaliteitscontrole nabewerking ondergaan of geheel worden afgekeurd? ca. ☐ %

Welk percentage van de geleverde bestellingen heeft klachten van klanten opgeleverd vanwege kwaliteitsproblemen? ca. ☐ %

Hier worden enkele gegevens over uw bedrijfsvestiging gevraagd:

Jaaromzet 2014 ☐ miljoen € 2012 ☐ miljoen €

Aantal werknemers (excl. uitzendkrachten) 2014 ☐ aantal

Aantal werknemers dat is afgevloeid in 2014 2014 ☐ aantal

Had uw bedrijfsvestiging uitzendkrachten in dienst in 2014? ☐ nee ☐ ja → Hoeveel uitzendkrachten waren in 2014 gemiddeld in dienst bij uw bedrijfsvestiging? ca. ☐ aantal

Inkoop 2014 (ingekochte onderdelen, materialen en diensten) ☐ miljoen €

Afschrijvingen op machines en installaties 2014 (zonder grond en gebouwen) ☐ miljoen €

Investeringen in machines en installaties 2014 ☐ miljoen €

Personeelskosten als percentage van de omzet in 2014 (incl. loonnevenkosten) ☐ %

Graad van capaciteitsbenutting (gemiddeld in 2014) ☐ %

Totale energiekosten als percentage omzet 2014 ☐ %

Rendement op de omzet (vóór belasting in 2014) ☐ negatief ☐ 0 tot 2% ☐ > 2 tot 5% ☐ > 5 tot 10% ☐ > 10%

Jaar van oprichting, c.q. inschrijving bij de Kamer van Koophandel jaar: ☐

Heeft uw bedrijfsvestiging een ondernemingsraad? ☐ nee ☐ ja

Geef uw energieverbruik aan als volgt:

Wat was het aandeel groene stroom in het totale stroomverbruik van uw bedrijfsvestiging in 2014? ca. ☐ %

Hoe groot is de te verwarmen oppervlakte van uw bedrijfsvestiging? ca. ☐ m²

Hoe heeft het stroomverbruik van uw bedrijfsvestiging zich ontwikkeld in 2014?

☐ Gedaald met 10% of meer ☐ Gedaald 5 - < 10% ☐ Gedaald 0 - < 5% ☐ Gelijk gebleven ☐ Gestegen 0 - < 5% ☐ Gestegen 5 - < 10% ☐ Gestegen met 10% of meer

Hoe heeft het olie- en gasverbruik van uw bedrijfsvestiging zich ontwikkeld in 2014?

☐ Gedaald met 10% of meer ☐ Gedaald 5 - < 10% ☐ Gedaald 0 - < 5% ☐ Gelijk gebleven ☐ Gestegen 0 - < 5% ☐ Gestegen 5 - < 10% ☐ Gestegen met 10% of meer

Wie is in meerderheid of exclusief eigenaar van het bedrijf waartoe uw bedrijfsvestiging behoort?

☐ Private eigenaar/ familie ☐ Financiële investeerder (bijv durfkapitaal) ☐ Ander bedrijf (bijv. niet-financiële investeerder) ☐ stichting ☐ overige eigenaren ☐ Geen meerderheidseigenaar

→ Is de familie actief in het management? ☐ Nee ☐ Ja

Hartelijk dank voor uw bijdrage aan dit onderzoek.

Wij verzoeken u de ingevulde vragenlijst terug te sturen per e-mail naar: P.Vaessen@fm.ru.nl

of per post naar:

Radboud Universiteit Nijmegen, t.a.v Dr P.Vaessen, Antwoordnummer 1908, 6500 VC Nijmegen

Appendix 2: Interview Guideline

Respondent:

Datum:

Tijd:

Plaats:

Allereerst even kort voorstellen. Mijn naam is Justin Looman, ik ben 24 jaar en woon in Nijmegen. Momenteel ben ik in de afrondende fase van mijn master I&E aan de Radboud Universiteit. Hiervoor ben ik ben bezig met mijn afstudeeronderzoek, met als onderwerp investeringen in energiebesparende activiteiten en de invloed hiervan op de financiële prestaties van bedrijven in de maakindustrie. Dit interview heeft tot doel meer nauwkeurige of gedetailleerde informatie bij ondernemers te verzamelen over het bedrijfseconomisch effect van dergelijke investeringen. Ten eerste het verzoek om dit interview op te nemen om de verzamelde informatie optimaal te kunnen verwerken. Dit zal mij helpen om rekening te houden met alle relevante informatie die tijdens dit interview wordt gegeven en niets te missen tijdens het verwerkingsproces. Het interview zal worden geanonimiseerd en de informatie wordt vertrouwelijk behandeld. Het interview start met vier inleidende vragen over u en het bedrijf.

Algemeen
1. Kunt u een korte beschrijving geven van de kernactiviteit van uw bedrijf?
2. Wat is precies uw functie binnen het bedrijf?
3. Hoelang werkt u al binnen dit bedrijf?
4. Hoeveel medewerkers werken er op dit moment bij het bedrijf?

Nu volgen enkele vragen betreft energiebesparende technologieën/praktijken die bij uw bedrijf worden toegepast.

5. Welke van de volgende energiebesparende technologieën/praktijken worden momenteel in uw bedrijfsvestiging toegepast?	
❑	Controlesystemen die machines stilleggen bij onderbenutting (bijv. PROFI-energy)
❑	Geautomatiseerde beheerssystemen voor energie-efficiënte productie
❑	Systemen t.b.v. terugwinning van kinetische en procesenergie (bijv. terugwinnen afvalwarmte)
❑	Technologieën voor energie- en/of warmteopwekking door middel van zon-, wind-, waterkracht, biomassa of geothermische energie
❑	Verbeteren van bestaande machines of installaties (bijv. Hoog efficiënte motoren (IE3), aanbrengen isolatie, warmtewisselaar
❑	Afschakelsystemen voor onderdelen, machines of installaties indien niet in gebruik (bijv. afschakeling luchttoevoer, aangepaste verlichtingssensoren)
❑	Voortijdige vervanging van bestaande machines of installaties door nieuwe machines of installaties
❑	Andere technologieën

Aanvullende vraag:
6. Is de invoering van deze technologieën en praktijken primair ter vermindering van het olie of gasverbruik of primair voor vermindering van het stroomverbruik?

7. Kruis a.u.b. aan of en zo ja welke van de volgende meer organisatorische maatregelen of werkwijzen in uw bedrijf worden toegepast op het gebied van energie- en milieubeheersing	
❑	Gecertificeerd energie-management systeem volgens ISO 50001, voorheen: EN 16001
❑	Instrumenten voor productlevenscyclus-analyse (bijv. EU Ecolabel, Cradle-to-Cradle certificaat, ISO-14020)
❑	Het opnemen van sociale en duurzaamheidseffecten in het vaststellen van bedrijfsprestaties
❑	Andere praktijken

Nu volgen een aantal stellingen betreft de evt. invloed van deze investeringen op het energieverbruik en de productiekosten van het bedrijf.

8. Kruis aan in hoeverre u het eens of oneens bent met de volgende stelling				
Investeringen in energiebesparende technologieën en praktijken verminderen merkbaar het energieverbruik in ons bedrijf.				
❑	❑	❑	❑	❑
Volledig mee oneens	Enigszins oneens	neutraal	Enigszins mee eens	Volledig mee eens

Kunt u uw antwoord toelichten:

9. Kruis aan in hoeverre u het eens of oneens bent met de volgende stelling				
De omvang van het energieverbruik is van grote invloed op de omvang van de totale productiekosten in ons bedrijf				
❑	❑	❑	❑	❑
Volledig mee oneens	Enigszins oneens	neutraal	Enigszins mee eens	Volledig mee eens

Kunt u uw antwoord toelichten:

10. Kruis aan in hoeverre u het eens of oneens bent met de volgende stelling				
Investeringen in energiebesparende technologieën en praktijken hebben geen merkbaar effect op de hoogte van de totale productiekosten in ons bedrijf				
❑	❑	❑	❑	❑
Volledig mee oneens	Enigszins oneens	neutraal	Enigszins mee eens	Volledig mee eens

Kunt u uw antwoord toelichten:

11. Kruis aan in hoeverre u het eens of oneens bent met de volgende stelling				
Het effect van investeringen in energiebesparende technologieën en praktijken op de totale productiekosten in ons bedrijf zijn meer zichtbaar op de lange termijn dan op de korte termijn (na 2 jaar)				
❑	❑	❑	❑	❑
Volledig mee oneens	Enigszins oneens	neutraal	Enigszins mee eens	Volledig mee eens

Kunt u uw antwoord toelichten:

12. Kruis aan in hoeverre u het eens of oneens bent met de volgende stelling				
Het effect van investeringen in energiebesparende technologieën en praktijken op de totale productiekosten in ons bedrijf zijn niet zichtbaar op de korte termijn (0-2 jaar)				
❑	❑	❑	❑	❑
Volledig mee oneens	Enigszins oneens	neutraal	Enigszins mee eens	Volledig mee eens

Kunt u uw antwoord toelichten:

De volgende stellingen en vragen zullen gaan over de evt. invloed van investeringen in energie besparende activiteiten en de ontwikkeling van de omzet van een bedrijf.

13. Kruis aan in hoeverre u het eens of oneens bent met de volgende stelling				
De omvang van het energieverbruik is van grote invloed op de omvang van de totale omzet in ons bedrijf				
❑	❑	❑	❑	❑
Volledig mee oneens	Enigszins oneens	neutraal	Enigszins mee eens	Volledig mee eens

Kunt u uw antwoord toelichten:

14. Kruis aan in hoeverre u het eens of oneens bent met de volgende stelling				
Investeringen in energiebesparende technologieën en praktijken hebben geen merkbaar effect op de hoogte van de verkoop door ons bedrijf.				
❑	❑	❑	❑	❑
Volledig mee oneens	Enigszins oneens	neutraal	Enigszins mee eens	Volledig mee eens

Kunt u uw antwoord toelichten:

15. Kruis aan in hoeverre u het eens of oneens bent met de volgende stelling				
Het effect van investeringen in energiebesparende technologieën en praktijken op de totale omzet in ons bedrijf zijn meer zichtbaar op de lange termijn dan op de korte termijn (na 2 jaar)				
❑	❑	❑	❑	❑
Volledig mee oneens	Enigszins oneens	neutraal	Enigszins mee eens	Volledig mee eens

Kunt u uw antwoord toelichten:

16. Kruis aan in hoeverre u het eens of oneens bent met de volgende stelling				
Het effect van investeringen in energiebesparende technologieën en praktijken op de totale omzet in ons bedrijf zijn niet zichtbaar op de korte termijn (0-2 jaar)				
❑	❑	❑	❑	❑
Volledig mee oneens	Enigszins oneens	neutraal	Enigszins mee eens	Volledig mee eens

Kunt u uw antwoord toelichten:

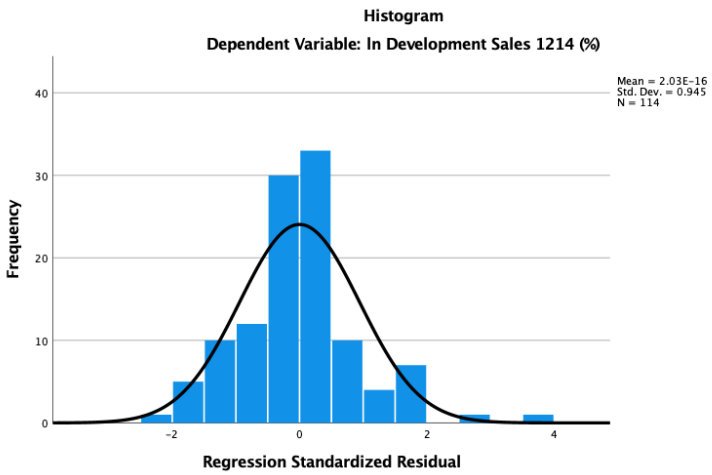
Aanvullende vragen:
17. Dragen deze investeringen bij aan een verbeterde reputatie van het bedrijf? Zo ja, op welke manier?
18. Leiden deze investeringen tot een concurrentievoordeel? Zo ja, op welke manier?
19. Zijn er nog andere manieren waarop deze technologieën de verkoop van het bedrijf kunnen beïnvloeden?

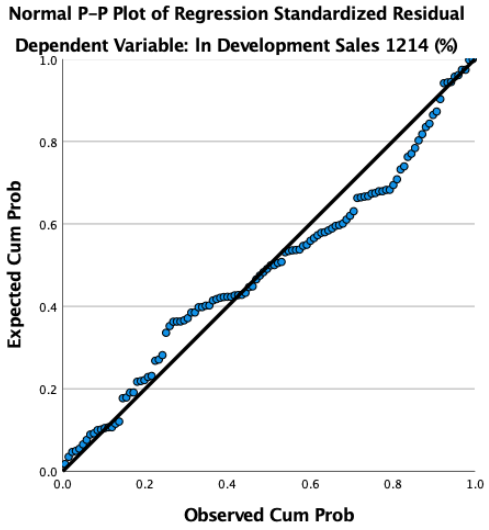
Appendix 3: Interview Codes

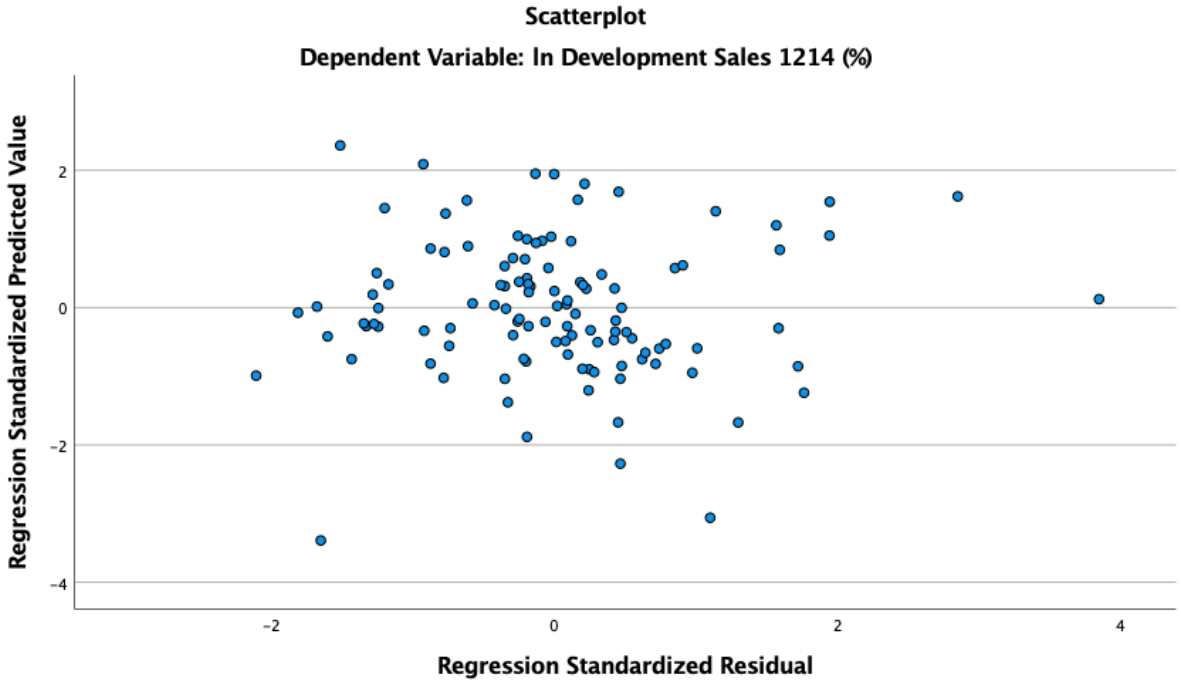
Code	Kleur
Investeringen in energie besparende activiteiten	
Productie kosten	
Omzet	
Energie verbruik	

Appendix 4: Assumptions Regression Analysis

Assumptions: Δ Sales







Assumptions: Δ Production Costs