Management control for sustainability

Activities and procedures for energy
management in industrial companies

Josefine Rasmussen

Management control for sustainability

Activities and procedures for energy management in industrial companies

Josefine Rasmussen

Linköping Studies in Arts and Sciences No. 778

Faculty of Arts and Sciences

Linköping 2020

Linköping Studies in Arts and Sciences • No. 778

At the Faculty of Arts and Sciences at Linköping University, research and doctoral studies are carried out within broad problem areas. Research is organized in interdisciplinary research environments and doctoral studies mainly in graduate schools. Jointly, they publish the series Linköping Studies in Arts and Sciences. This thesis comes from the division of Business Administration at the Department of Management and Engineering.

Distributed by:
Department of Management and Engineering
Linköping University
581 83 Linköping

Josefine Rasmussen
Management control for energy management
Activities and procedures for a sustainable industrial sector

Edition 1:1
ISBN 978-91-7929-925-5
ISSN 0282-9800

Cover: Gerd Altmann (Pixabay)

©Josefine Rasmussen
Department of Management and Engineering 2020

Printed by: LiU-tryck

Abstract

The thesis takes its point of departure in the important role of the industrial sector in mitigating climate change through a reduced energy use. There is a lack of understanding for how energy management should be organised and implemented in industrial companies. The aim of this thesis is therefore to analyse the management control activities and procedures used by energy-intensive industrial companies for energy management and one of its key elements—energy efficiency investments. The thesis also examines how so-called non-energy benefits are considered for energy efficiency investments and their role in driving these investments. The thesis consists of a cover essay and four appended papers, one of which is based on a systematic literature review of benefit concepts applied in the context of energy efficiency investments. The remaining papers build on three empirical studies in Swedish manufacturing and process industries with a particular focus on the pulp and paper industry.

Energy management is an important aspect of sustainability for the industrial sector. This thesis advances the understanding of management control for energy management by bridging the theoretical domains of energy management and sustainability management control. The thesis acknowledges both the strategic and operational dimensions of energy management, going beyond the predominating operational perspective, and illuminates the way in which both dimensions are reflected in management control practices. The role of established organisational arrangements spanning different functions and levels is identified. A framework for categorising non-energy benefits is also developed, which may facilitate their inclusion in the investment process. However, the configuration of management control activities and procedures applied for the investment process is essential for the extent to which non-energy benefits can be acknowledged during investment decision-making. Through its emphasis on management control activities and procedures for energy management, this thesis contributes to the managerial path of sustainability management control, providing both theoretical and managerial contributions. Altogether, the four studies constituting this thesis illuminate the need for adequate tools and methods in the transition to a sustainable industrial sector and the role of management control configurations in this endeavour.

Keywords: Sustainability management control, energy management, energy efficiency investments, decision-making, activities and procedures, non-energy benefits, energy-intensive industries.

Sammanfattning

I ljuset av de pågående klimatförändringarna spelar en minskad energianvändning i industrin en allt viktigare roll. Med avstamp i detta behandlar denna avhandling energiledning inom främst energiintensiv industri. Det saknas idag en djupare förståelse för hur energiintensiva industriföretag arbetar med energiledning och investeringar i energieffektivisering från ett styrnings- och beslutsfattandeperspektiv. Avhandlingen syftar därför till att särskilt belysa de styrningsaktiviteter och procedurer som används för energiledning. I avhandlingen analyseras också mervärden av energieffektivisering, s.k. non-energy benefits, hur dessa beaktas inför investeringsbeslut samt hur de kan verka som drivkrafter för energieffektivisering. Avhandlingen består av en kappa och fyra artiklar varav en är en systematisk litteraturoversikt över de mervärdeskoncept som använts i tidigare studier. Övriga tre artiklar redovisar empiriska studier genomförda vid företag i svensk tillverknings- och processindustri med ett särskilt fokus på massa- och pappersindustrin.

Energiledning positioneras i avhandlingen som ett viktigt medel för hållbarhet i industrin och avhandlingen bidrar med en ökad förståelse gällande styrning för energiledning genom att kombinera energilednings- och hållbarhetsstyrningslitteratur. Avhandlingen tar sin utgångspunkt i styrningsrelaterade aktiviteter och procedurer i företag inom energiintensiv industri. Analysen bidrar med praktiska och teoretiska implikationer för styrning för energiledning mer specifikt och hållbarhet mer generellt. Avhandlingen utgår från ett flernivåperspektiv på energiledning och går bortom det annars dominerande operativa perspektivet och belyser hur både den operativa och strategiska dimensionen av energiledning återspeglas i styrning och beslutsfattande. Vikten av att ha organisatoriska stödfunktioner som spänner över olika nivåer identifieras. Ett ramverk för att kategorisera mervärden tas också fram, vilket kan underlätta för att mervärden beaktas inför investeringsbeslut. Dock är utformningen av styrningsaktiviteter och procedurer för investeringar avgörande för om, och i vilken utsträckning, mervärden beaktas. Sammanfattningsvis belyser de fyra artiklarna behovet av lämpliga verktyg och metoder för industrins omställning mot hållbarhet och vikten av styrningsaktiviteter och procedurer för detta.

Nyckelord: Energiledning, investeringar i energieffektivisering, styrning, beslutsfattande, aktiviteter, procedurer, mervärden, energiintensiv industri.

Acknowledgements

Doing a PhD is quite a journey and I could not have made it on my own. Now, I finally have the opportunity to say thank you and show my gratitude to all of you who have supported me throughout these years.

First, this thesis would not have been possible without my supervisors who gave me this opportunity in the first place. I am grateful for your support, knowledge, academic guidance and inspiration along the way. Our supervision meetings have always been constructive and insightful (even though they did not always completely stick to the agenda). You have pushed and guided me while also giving me the freedom to make my own choices. To my main supervisor, Mikael Ottosson, thank you for your great support throughout these years and for your encouragement and always being straightforward. To my co-supervisor Henrik Nehler, thank you for always being so supportive and for your constructive feedback. Thank you also for motivating me in my teaching and encouraging me to, at an early stage, take on more responsibility and develop as a teacher as well. To my second co-supervisor Fredrik Tell, I have truly valued your experience and expertise. Thank you for your positive spirit, and for asking those tricky questions that have challenged me and helped me develop.

I am indebted to Martin Carlsson-Wall for the constructive feedback at my final seminar that really helped to develop this thesis – thank you. To Andrea Fried, thank you for reading and providing valuable feedback on the thesis at a later stage, pushing it those extra steps. I also wish to thank Anders Sandoff for your discussion and comments on the licentiate version of this thesis.

This thesis would not have been possible without the companies that opened up and shared their experiences on energy management and energy efficiency investments. To all of you who participated: thank you for giving so freely of your time, participating in interviews, meetings, sharing documents, and answering all my questions. I also wish to express my gratitude to the Swedish Energy Agency and the Department of Management and Engineering at Linköping University for funding this research.

I also wish to thank Therese Nehler and Elias Andersson for the good collaboration in our research projects, especially in data collection. I have really appreciated our work together! Thank you also Therese for the nice collaboration in writing Paper II.

For the first part of my PhD studies, I belonged to the IEI Research School. It gave me the opportunity to meet PhD students from many different disciplines. Thank you for the fruitful discussions during workshops, seminars, courses, and the (too few) AWs.

I am thankful for my great colleagues at the division of Business Administration – thank you for all your support. A special thanks to my former and present PhD colleagues, Svjetlana, Hugo, Linus, Johanna, Aliaksei, Alexander, Birgitta, Christopher, Jenny, Elisabeth, David, Vivi, Susan, Anja. To Linus, Hugo, Johanna, Aliaksei, we have shared our struggles, particularly during this last year. I am thankful for our discussions on and off work, and for the company during weekends and late-night dinners at work. To Svjetlana, you are a dear colleague and you have also become a close friend. I am so thankful for all your support and encouragement, and to have someone who (almost) can keep up with my liquorice indulgence!

Finally, I want to thank my family. *La familia*, thank you. To my parents, Gunilla and Johan, thank you for your love and support and for raising me to believe I could be anything – even a PhD. To my sisters Julia, Sofie and Malin, thank you for everything, you are the best sisters one could wish for – sister power! To Petter, I do not know how to express how grateful I am for your support throughout these years and for the efforts you have made to make this possible. Thank you for your love, your patience, and for always being there. And Ruben, thank you for being my sweet little *busunge* and for reminding me of what really matters in life.

Linköping, December 2019

Josefine Rasmussen

Appended papers

Paper I

Rasmussen, J. (2017), The additional benefits of energy efficiency investments – a systematic literature review and a framework for categorisation. *Energy Efficiency*, 10: 1401-1418. Single authored.

Reprinted with permission from Springer according to the Creative Common License (<https://creativecommons.org/licenses/by/4.0/legalcode>).

Paper I was preceded by a conference paper: Rasmussen J. (2014). Energy-efficiency investments and the concepts of non-energy benefits and investment behaviour. *Proceedings ECEEE Industrial Summer Study – Retool for a Competitive and Sustainable Industry*, 733-744.

Paper II

Nehler, T., Rasmussen, J. (2016), How do firms consider non-energy benefits? Empirical findings on energy-efficiency investments. *Journal of Cleaner Production*, 113: 472-482. Co-authored with Therese Nehler, main author.

Reprinted with permission from Elsevier.

Paper III

Rasmussen J. Investment activities and procedures for sustainability in industry – a case study. Working paper, single authored.

Previous version presented at ECEEE Industrial Summer Study, Berlin, 2016.

Paper IV

Rasmussen, J. Sustainability management control systems: Configurations, use and orientation. Working paper, single authored.

Previous versions presented at Nordisk Workshop i Ekonomistyrning, Linköping, 2019 and EAA Annual congress, Paphos, 2019.

My contribution to each paper is elaborated further in chapter 3.7.

Statement regarding the preceding licentiate thesis

The thesis is a compilation of my PhD work since October 2013. In 2016, I defended my licentiate thesis (Rasmussen, 2016), which included Paper I, Paper II, and a previous version of Paper III. Paper I was, at the time, under review for journal publication and has been revised to some extent. Paper II was already published and has therefore not been subject to any changes. Paper III was, at the time, an early-stage working paper. It has since then been presented at a conference and has been heavily revised, both in terms of theoretical framing and analysis. As for the content of the cover essay, it should be acknowledged that there are parts of the text that are partly, or wholly, present in the cover essay of the licentiate thesis, particularly in the method chapter.

Abbreviations

EKL	Law stipulating that large companies are obligated to undertake quality-assured energy audits at least every fourth year. Entered into force in 2014. (In Swedish: <i>Lagen om energikartläggning i stora företag</i>)
EU ETS	EU Emission Trading System
GHG	Greenhouse gas
ISO 50001	International standard for a certified energy management system
LoC	Levers of control
MCS	Management control systems
NRBV	Natural resource-based view
PFE	Long-term agreement running between 2005 and 2017. Energy-intensive companies could benefit from an electricity tax exemption for electricity used in the production process. (In Swedish: <i>Programmet för energieffektivisering i energiintensiv industri</i>)
PPI	Pulp and paper industry
RBV	Resource-based view
SMCS	Sustainability management control systems

Table of Contents

Chapter 1 Introduction	1
1.1 Energy management – a ‘win-win’ strategy for sustainability	2
1.2 Energy management and energy efficiency investments	4
1.2.1 Previous research on energy management and energy efficiency investments	4
1.3 Energy management beyond the operational dimension	6
1.4 Sustainability management control	8
1.4.1 Management control activities and procedures	10
1.4.2 Organisational levels of sustainability management control	10
1.5 Non-energy benefits as a driver for energy efficiency investments	11
1.6 Research problem and positioning of the thesis	12
1.7 Aim and research questions	15
1.8 Research design and appended papers	15
1.8.1 Appended papers’ connection to aim and research questions	16
1.9 Thesis outline	18
Chapter 2 Theoretical background	19
2.1 Sustainability and sustainability management control	19
2.1.1 Sustainability management control configurations	21
2.2 Activities and procedures, use and patterns	22
2.2.1 Enablers and barriers for sustainability management control	25
2.2.2 The LoC framework in the context of sustainability management control	26
2.2.3 Directions from the sustainability management control literature	28
2.3 Investment decision-making as a management control activity	28
2.4 Energy management	30
2.5 Energy efficiency investments and non-energy benefits	33
2.6 Two theoretical domains: Sustainability management control and energy management	35
2.7 Reflections on theoretical standpoints	38
Chapter 3 Methodology	41
3.1 Research design and process	41
3.1.1 A pragmatic view	43
3.2 Initial literature review of benefit terms	45
3.2.1 Influence on the subsequent empirical studies	46
3.3 Three empirical studies with three research designs	47
3.3.1 Phase 1. Interviews and questionnaire: Exploring energy efficiency investments and non-energy benefits	47
3.3.2 Phase 2. Single case study	48
3.3.3 Phase 3. Multiple case study	49
3.4 Sampling and the industrial context	50
3.5 Data collection: A (mainly) qualitative approach through semi-structured interviews	51
3.5.1 Additional data sources	55
3.5.2 The questionnaire	56

3.6	Data analysis.....	56
3.7	My contribution to the studies and papers.....	58
3.7.1	Predefined projects	59
3.8	Ethical considerations	60
3.8.1	The role of external funding.....	60
3.8.2	Anonymity	60
3.9	Validity.....	61
Chapter 4	Summary of papers.....	65
4.1	Paper I: The additional benefits of energy efficiency investments—a systematic literature review and a framework for categorisation.....	65
4.2	Paper II: How do firms consider non-energy benefits? Empirical findings on energy-efficiency investments in Swedish industry	66
4.3	Paper III: Investment activities and procedures for industrial sustainability—a case study	68
4.4	Paper IV: SMCs: Configurations, use, and orientation	69
4.5	Contributions of appended papers	71
Chapter 5	Discussion	73
5.1	Management control for energy management.....	73
5.1.1	Activities and procedures: configuration and use.....	73
5.1.2	The importance of orientation	75
5.1.3	Configuration of investment activities and procedures	77
5.2	Organisational levels of management control for energy management	79
5.2.1	The role of addressing the organisational levels of management control.....	80
5.2.2	The energy manager.....	82
5.3	The role of non-energy benefits.....	83
5.3.1	The instrumental role vs. the strategic role of non-energy benefits	83
5.3.2	Non-energy benefits driving energy efficiency investments?	85
5.4	Cross-paper comparison.....	87
5.5	Supporting strategies and decision-making in a sustainability direction.....	88
Chapter 6	Conclusions and implications	93
6.1	Conclusions.....	93
6.2	Managerial implications	95
6.3	Theoretical implications	96
6.4	Implications for sustainable development.....	98
6.5	Avenues for future research.....	99
6.5.1	A matter of integration.....	99
6.5.2	The ‘win-win’ thinking	100
6.5.3	The industrial setting.....	100
6.5.4	Methodological avenues	101
References		103

List of Tables

Table 1. Paper overview and connection to research questions. 17

Table 2. Research process. 43

Table 3. Summary of the search and selection process. 46

Table 4. Description of interview guides and respondents. 53

Table 5. Overview of conducted interviews. 54

Table 6. Additional data sources for the case studies. 55

Table 7. The questionnaire. 56

Table 8. Main contributions of appended papers. 71

Table 9. Applied controls for energy management. 74

Table 10. Management control for a proactive energy management. 91

List of Figures

Figure 1. Positioning management control for energy management as a case of sustainability management control. 17

Figure 2. Illustrating the role of method and domain theories in this thesis, adapted from Lukka and Vinnari (2014, Figure 1, p. 1314). 37

Figure 3. The role of sustainability orientation and organisational arrangements for SMCS. Adapted from Tessier and Otley (2012, figure 1, p. 173). 90

Chapter 1

Introduction

"The ultimate limits to global development are perhaps determined by the availability of energy resources and by the biosphere's capacity to absorb the by-products of energy use. These energy limits may be approached far sooner than the limits imposed by other material resources. [...] Hence sustainability requires a clear focus on conserving and efficiently using energy." (Brundtland, 1987, pp. 52-53)

In light of the persistent and urgent challenge of climate change (e.g. Intergovernmental Panel on Climate Change (IPCC), 2018, 2014; Rockström et al., 2009), questions related to sustainable development¹ have, over the past decades, gained in priority and have become a strategic consideration for organisations and society as a whole. One strategy in the strive for mitigating climate change is improving energy efficiency, which also is found among the goals of the United Nations (UN) and Agenda 2030 (Goal 7, Target 7.3) for sustainable development (UN, 2018), the European Commission's (EC) Energy Efficiency Directive (2012/27/EU), and the energy goals formulated by the Swedish government (Swedish Energy Policy Agreement, 2016). The industrial sector is the largest end-use sector regarding both energy use and greenhouse gas (GHG) emissions and measures on the demand side have been deemed as key elements in the 1.5°C

¹ Defined as "In essence, sustainable development is a process of change in which the exploitation of resources, the direction of investments, the orientation of technological development; and institutional change are all in harmony and enhance both current and future potential to meet human needs and aspirations" (Brundtland, 1987, p. 43). Another often-cited definition from the same report is: "Sustainable development is development that meets the needs of the present without compromising the ability of future generations to meet their own needs" (p. 41).

pathway proposed by the IPCC in their special report on global warming (Rogelj et al., 2018). The capital and energy-intensive processing industries (e.g. iron and steel, pulp and paper (PPI), chemicals, aluminium, and cement) are crucial in this regard (Wesseling et al., 2017) as they are responsible for over 70 per cent of the energy and process-related CO₂-emissions globally² (Fischedick et al., 2014). For these industries, even a small decrease in energy use can have a significant economic impact (Boyd and Curtis, 2014). Hence, reducing energy use and improving energy efficiency in these industries constitute essential and cost-efficient actions for climate change mitigation and sustainable development (e.g. International Energy Agency (IEA), 2015; UN Environment Programme (UNEP), 2014; Worrell et al., 2009); this is also the underlying motive for this thesis.

1.1 Energy management – a ‘win-win’ strategy for sustainability

Improving energy management and energy efficiency corresponds to the paradigm of so-called pollution-prevention strategies, which are embedded within sustainable development (Hart, 1995). Improving energy efficiency, and thus eco-efficiency, is a ‘win-win’ strategy (e.g. Porter and van der Linde, 1995a), a “no-brainer” (Epstein and Yuthas, 2012), and a means for industrial sustainability (Cagno et al., 2018). The ‘being green and competitive’ argument emerged in the 1990s³ (e.g. Porter and van der Linde, 1995a; Shrivastava, 1995) for which supporting empirical evidence has been indicated; efforts to reduce pollution is often “partly or completely offset by gains elsewhere” (Ambec and Lanoie, 2008, p. 57). According to the ‘green and competitive’ reasoning, pollution is considered an inefficiency stemming from a waste of resources, which should be managed through pollution prevention rather than costly end-of-pipe pollution control (Porter and van der Linde, 1995a) and regulations and policies should also be implemented to support such pollution-prevention innovations (Porter and van der Linde, 1995b).

² In the industrial sector, energy is used for various reasons, for example to create heat, drive chemical reactions, or during the production process (Fischedick et al., 2014).

³ The win-win argument developed in parallel with the natural-resource-based view (NRBV), a development of the resource-based view (RBV) (e.g. Barney, 1991; Barney et al., 2011; Wernerfelt, 1984), that takes the constraints imposed by the natural environment into account (Hart, 1995). The framework suggested by Hart (1995) builds on three interconnected strategies through which the NRBV proposes that sustained competitive advantage can be enabled (p. 992): (i) Pollution prevention, which minimises emissions and waste, resulting in lower costs; (ii) Product stewardship, i.e. minimise life cycle costs of product systems to pre-empt competitors; (iii) Sustainable development, i.e. to minimise environmental burden and have a sustainable production also in economic and social terms. The RBV has, despite its potential, not been acknowledged to a large extent in sustainability management control research (Crutzen and Herzig, 2013). Although this thesis does not directly apply it, it draws upon the thoughts from the NRBV and the way in which sustainability may be a source for competitive advantage; the ‘win-win argument’.

Several policy initiatives have been made to support a sustainable transition in the industrial sector in terms of reducing energy use and emissions, both at the EU level, e.g. the EU Emissions Trading System (EU ETS)⁴, and through national initiatives, e.g. the US Energy Star Program for industries (Åhman et al., 2017, Table 1). Swedish examples include the Programme for Improving Energy Efficiency in Energy-Intensive Industries⁵ (PFE) and The Act on Energy Audits in Large Enterprises⁶ (EKL). Voluntary agreements, such as the PFE, have been successful in pushing energy-efficiency improvements in energy-intensive industries (Stenqvist, 2014) and are identified as a driver for energy management (Lawrence et al., 2019).

The EU ETS may in turn provide incentives to reduce CO₂ emissions (Posch et al., 2015), but it has also been indicated not to drive further investments in low carbon technologies (Brohé and Burniaux, 2015), and the ‘carbon price tag’ it infers is only one minor factor for industrial investment decisions (Stenqvist, 2014). Moreover, even though energy-intensive industries are often subject to regulations and compliance regarding, for example, emissions and pollution, they are, at the same time, often exempted (fully or partially) from certain regulations (such as energy or carbon taxes) to ensure the economic competitiveness of these industries (Wesseling et al., 2017). Sullivan and Gouldson (2017) further discuss the ways external governance actions (e.g. regulations, standards, certifications, or voluntary codes) interact with internal processes and how having well-developed internal management systems and processes are crucial for how such external pressures work. Hence, external policy efforts may not be sufficient in the strive towards climate change mitigation, which calls for other approaches to tackle this challenge.

⁴ The EU ETS (2018/410) is an international carbon trading system that was implemented in 2005 and is a trading system based on the “cap and trade” principle in which companies are obligated to surrender emission allowances on a yearly basis to cover all their emissions (EC, 2019). The EU ETS has been revised several times and the fourth phase, covering 2021-2030, is currently under development (EC, 2019).

⁵ PFE was a long-term agreement running between 2005 and 2017 in response to the new law for improving energy efficiency in the industrial sector (2004:1196). Through the programme, energy-intensive companies benefited from an electricity tax exemption for electricity used in the production process, given that they undertook certain requirements stipulated through the programme (Swedish Energy Agency (SEA), 2016). This included the employment of a structured approach to improving energy efficiency through a certified energy management system (such as ISO 50001), undergoing an energy audit, and being obligated to undertake identified energy efficiency measures with a payback period of three years or less (SEA, 2016, 2015a). PFE was cancelled in 2012 and the final companies ended their programme in 2017.

⁶ EKL (2014:266) entered into force in 2014 in response to the EU Energy Efficiency Directive (2012/27/EU; SEA, 2018c). The law stipulates that large companies are obligated to undertake quality assured energy audits at least every fourth year (SEA, 2018c). Energy audits aim to delineate the energy used in the company’s operations and to identify cost efficient measures to reduce energy use and improve energy efficiency (SEA, 2018d).

1.2 Energy management and energy efficiency investments

For energy-intensive industries, Wesseling et al. (2017) note the importance of having established energy management systems; otherwise, companies lack the organisational structures for effectively engaging in low carbon innovation, i.e. innovations that purposefully (directly or indirectly) reduce GHG emissions: for example, by improving energy efficiency, emission capture, or lowering electricity demand. Having an energy management system thus facilitates the implementation and support of energy-efficient activities. The literature provides several definitions of industrial energy management (Schulze et al., 2016). Bunse et al. (2011, p. 668), for instance, define energy management in production as the “control, monitoring, and improvement activities for energy efficiency”, while Schulze et al. (2016, p. 3704) define industrial energy management as “the systematic activities, procedures and routines within an industrial company including the elements strategy/planning, implementation/operation, controlling, organisation, and culture and involving both production and support processes, which aim to continuously reduce the company’s energy consumption and its related energy costs”.

Energy management is therefore an example of demand-side management of energy involving different elements (Thollander and Ottosson, 2010), including implementing investments for improving energy efficiency (e.g. Trianni et al., 2014; Ådahl and Harvey, 2007), i.e. investments leading to improved energy efficiency in which the return of the investment partially or solely stems from energy cost savings (Fleiter et al., 2012). These investments are heterogenous and may be related to either production or support processes (Fleiter et al., 2012; Thollander and Ottosson, 2010). Energy management is thus important for (from the inside rather than outside) supporting industrial companies in managing their energy use as well as to improve energy efficiency. Hence, motivated by the importance for sustainable development, this thesis’s main concern is to add a management-oriented perspective on industrial energy management and energy efficiency investments.

1.2.1 Previous research on energy management and energy efficiency investments

The literature on industrial energy management and improving energy efficiency with an internal perspective identifies minimum requirements for the energy management system, (such as implementing an energy policy, establishing energy goals, implementing energy-saving projects, and having an energy manager) with additional suggestions (e.g. Ates and Durakbasa, 2012; Christoffersen et al., 2006). These include task and responsibility-oriented organising of energy management activities, establishing purchasing procedures with energy efficiency as one

selection criterion, and efforts to increase awareness among employees through, for instance, information and training. However, as indicated in two previous literature reviews, this literature is dominated by studies within the engineering sciences with an operational focus on the implementation of energy efficiency measures (May et al., 2017; Schulze et al., 2016). For example, recent frameworks for characterising energy-efficient measures emphasise, in addition to energy, aspects related to implementation and production (Trianni et al., 2014). While this operational focus is relevant for integration of energy management in production, management-related factors should be acknowledged (Bunse et al., 2011). Empirical findings have indicated that, even in energy-intensive industries, there are issues related to the lack of strategic priority of energy: for instance, a lack of organisational integration of energy issues, energy not considered part of the core business, and obstacles to undertaking energy efficiency investments (Rudberg et al., 2013).

This is also evident in the literature on the implementation of energy efficiency investments, which, in addition to economic barriers⁷, i.e. lack of budget funding, other priorities for capital investments, high initial investments, and slow return (e.g. Brunke et al., 2014; Cagno et al., 2013; De Groot et al., 2001; Del Río González, 2005; Sorrell et al., 2000; Thollander and Ottosson, 2008; Trianni et al., 2013; Venmans, 2014), also identifies non-economic barriers, i.e. barriers related to awareness and information or behavioural and organisational barriers (Cagno et al., 2013; Cagno and Trianni, 2014; Chiaroni et al., 2017; Rohdin et al., 2007; Venmans, 2014). These barriers include lack of information on costs and benefits, energy-related information not being integrated in procedures (e.g. operating, maintenance, or purchasing), lack of interest, lack of awareness, lack of internal control, and complex decision chains. The lack of connection to the core business has also been addressed in this regard (Cooremans, 2012; Rudberg et al., 2013).

In response to the identified issues above (particularly the economic barriers), there has been a growing research interest during the past two decades on the additional benefits of improving energy efficiency—so-called non-energy benefits—and for the way in which these can improve the business case for energy efficiency investments, for instance by reducing the payback time (e.g. Pye and McKane, 2000; Worrell et al., 2003; Nehler, 2018). However, these benefits range from improved image and work environment to reduced maintenance costs to reductions in emissions (Worrell et al., 2003) and are thus varying in nature and can be of qualitative or quantitative character. This raises concerns for how these additional benefits can be accounted

⁷ See, for example, Brunke et al. (2014) for an overview of previous studies with the barriers/drivers' approach.

for during the investment process. The additional benefits should be acknowledged *ex-ante* in order to improve the business case for energy efficiency investments (Pye and McKane, 2000) and have been added to recent frameworks for characterising energy-efficient improvements (Fleiter et al., 2012; Trianni et al., 2014). However, the majority of previous studies have been carried out from an *ex-post* perspective (Nehler, 2018), i.e. by analysing experienced non-energy benefits after implementation, thus neglecting their role in the investment decision-making process. As these benefits could be important for strengthening the business case for improving energy efficiency, thus overcoming known barriers, they warrant further attention. In addition, due to the potential strategic character of some of these benefits (such as improved image) non-energy benefits may also provide a link to the strategic dimension of energy efficiency investments (Cooremans, 2011).

From the other end (i.e. the drivers for improving energy efficiency and working with energy management), the potential of going beyond the operational level is highlighted further. While reducing energy costs are ranked highest (e.g. Brunke et al., 2014; Thollander and Ottosson, 2008), organisational drivers related to both management (e.g. awareness, image, management system, energy strategy, energy audits and KPIs, management ambition and support) and structure (e.g. organisational structure, cooperation between units), have, in a recent literature review, been identified as playing a vital role for improving energy efficiency (Solnørdal and Foss, 2018) along with knowledge-related drivers and the importance of having well-functioning relations within the organisation and a committed top management (Lawrence et al., 2019).

1.3 Energy management beyond the operational dimension

The role of having energy management systems in place was explained above (e.g. Wesseling et al., 2017). Previous literature has been successful in identifying the factors to consider in relation to energy management and the implementation of energy-efficient measures, including barriers and drivers as well as the required components of the energy management system. However, the same literature has also failed to thoroughly address how these activities are and should be organised and implemented to positively influence energy management practices in industrial companies; i.e. the organisational and strategic dimensions of energy management have not been devoted enough attention. A strategic management perspective is lacking (Rudberg et al., 2013) even though the need for strategic support, e.g. top management engagement or energy strategy, is frequently addressed as a driving factor for improving energy efficiency and energy management (Brunke et al., 2014). This illuminates the need to go beyond the operational

dimension. Research which focuses on “the specific mechanisms dealing with the process of strategy implementation by utilising resources and influencing individual and/or collective action towards energy-related objectives” has been called for (Schulze et al., 2016, p. 3705). Taking a management control approach to industrial energy management is one possible avenue for approaching this problem, which, in this thesis, is done by examining energy management and energy efficiency investments from a management control perspective and the additional benefits of improving energy efficiency.

At its core, management control is concerned with influencing organisational members and actors in a strategic direction (Merchant and Van der Stede, 2017), i.e. it is a means to translate strategic priorities into organisational activities (Simons, 1995). Management control for energy management has so far only been scarcely studied in the literature, despite the potential associated with implementing management control systems⁸ (MCS) for energy management (Schulze et al., 2018). Recent work by Virtanen et al. (2013) on energy efficiency indicators and performance management highlights the need for energy management research from a management control perspective as well as from cross-disciplinary perspectives. Examining management control in relation to energy management can thus add to the body of knowledge of internal processes for energy management and how to increase the strategic priority of energy issues. In turn, this would enable a more proactive approach to industrial energy management. This knowledge should be an important building block in the strive for climate change mitigation in the industrial sector.

Due to this limited previous research on energy management and management control—the studies by Virtanen et al. (2013) and Schulze et al. (2018) provide rare exceptions—this thesis approaches management control for energy management by bridging energy management literature with another theoretical domain: sustainability management control. Management control could possibly push sustainability in organisations (Arjaliés and Mundy, 2013) and is important for integrating sustainability in organisations and their strategies (Gond et al., 2012) and ensuring that sustainability efforts are long-lasting (Sullivan and Gouldson, 2017). In light of this, sustainability management control is an emerging field (Crutzen and Herzig, 2013; Guenther et al., 2016; Lueg and Radlach, 2016).

⁸ Which can be defined as “the formal, information-based routines and procedures managers use to maintain or alter patterns in organizational activities” (Simons, 1995, p. 5).

In their literature review, Lueg and Radlach (2016) describe this development as characterised by a tension between different goals; on the one hand, the economic goals of traditional management control (i.e. 'hard values', such as growth and profitability) and, on the other hand, goals concerning the natural environment as well as social values. These tensions are also evident in energy management. Energy management and sustainable development also share the characteristic that while they may be regarded as important within companies, they are not core business, which infers management challenges. One consequence this may have is, for example, a lack of organisational integration, as addressed both in the 'energy' stream (e.g. Rudberg et al., 2013) and the sustainability management control literature (e.g. Gond et al., 2012). Hence, there should be potential synergies between these two domains and, by drawing upon the theoretical domain of sustainability management control, this thesis could provide new insights—both empirical and theoretical—for management control for energy management and energy efficiency investments. In particular, the thesis provides an internal management-oriented perspective on energy management that has been, so far, scant in the literature.

1.4 Sustainability management control

Sustainability is a key aspect for contemporary organisations, and the way in which sustainability is operationalised and communicated is becoming increasingly prioritised (Schaltegger and Burritt, 2010). Burritt and Schaltegger (2010) discuss two paths currently within the sustainability accounting stream of literature: the critical path and the managerial path. According to the critical path, the problems of corporate sustainability actually stem from sustainability accounting, and sustainability mainly being a fad or buzzword in the corporate setting. They note how the critical path should be considered valid in the sense that it raises awareness of issues related to corporate sustainability; however, it "does not lead to problem solving in the pragmatic way espoused by a managerial path" (Burritt and Schaltegger, 2010, p. 843), which instead considers sustainability accounting as a problem-solving entity, providing tools and supporting decision-making.

Positioned within management control, this thesis follows the managerial path and the inside-out approach located within it, which aims to provide the required sustainability information and support internal decision-making for sustainability issues, in contrast to the stakeholder-driven outside-in⁹ approach (Burritt and Schaltegger, 2010; Schaltegger and Wagner, 2006). Compared

⁹ i.e. including for example stakeholder dialogues and a reporting driven development process of sustainability accounting (Burritt and Schaltegger, 2010).

to external reporting issues, i.e. an outside-in perspective, internal management control for sustainability has been given limited attention in the literature (Ditillo and Lisi, 2016) but is starting to receive increasing interest (see for example Arjaliés and Mundy, 2013; Crutzen et al., 2017; Ditillo and Lisi, 2016; Gond et al., 2012; Herremans and Nazari, 2016; Hosoda and Suzuki, 2015; Journeault, 2016). As discussed by Maas et al. (2016), sustainability management control has the same rationales as the inside-out perspective and takes its point of departure from an analysis of aspects that are necessary for a successful implementation of the sustainability objectives. Identified management controls for sustainability include, for example, environmental management systems, benchmarking, performance measurement, communication tools, reporting, cultural controls (e.g. shared values and beliefs), investment appraisal, policies and procedures, guidelines (e.g. ethical, approved activities, practices, investments, and so forth), and budgets (Albelda, 2011; Arjaliés and Mundy, 2013; Bui and de Villiers, 2017; Crutzen et al., 2017; Hosoda and Suzuki, 2015; Virtanen et al., 2013).

Sustainability management control is thus an emerging field (Lueg and Radlach, 2016), yet still requires empirical studies (Crutzen and Herzig, 2013). In particular, several reviews of the literature have identified how few empirical studies take holistic perspectives on sustainability management control systems (SMCS) (Crutzen and Herzig, 2013; Guenther et al., 2016; Lueg and Radlach, 2016), despite the notion that management control elements do not operate in isolation (e.g. Chenhall, 2003; Malmi and Brown, 2008; Otley, 2016). Focusing on single controls will fail to give the full picture and may lead to ambiguous and spurious findings (Chenhall, 2003; Ferreira and Otley, 2009). Hence, there is a need for empirical studies with holistic approaches to management control for sustainability.

Studies have also indicated how the views, motivations for, and orientation on sustainability issues may differ between organisations as well as within organisations, i.e. between managers within the same organisation (Ditillo and Lisi, 2016; Pérez et al., 2007; Schaltegger and Burritt, 2010). Internal practices could therefore also differ from what is communicated externally, yet this is rarely accounted for in empirical studies (Lueg and Radlach, 2016). The inside-out approach thus provides the possibility to focus on what companies do, to illuminate the configurations of management control to support sustainability strategies (Maas et al., 2016). In this thesis, the management control activities and procedures are therefore examined in the context of energy management.

1.4.1 Management control activities and procedures

*“We argue that integrating sustainability into management control and strategy should also be approached as something people **do**, in line with recent calls for a practice perspective” (Gond et al., 2012, p. 209, emphasis in original)*

This thesis thus embraces the *do* in the above quote and focuses on the internal practices of management control for energy management by taking an inside-out (Burritt and Schaltegger, 2010) perspective on sustainability management control by examining the management control activities and procedures associated with energy management. Whereas management control is concerned with the direction of an organisation, the *controls* represent the means to the end, i.e. the rules, systems, practices, values, and activities used by management to direct the members of the organisation (Malmi and Brown, 2008). Management control practices can then be described in terms of recognising these elements “as part of larger arrays of activities” (Ahrens and Chapman, 2007, p. 10¹⁰) and how they are used. In this thesis, management control activities refer to activities such as planning, coordinating, evaluating, and communicating information and decision-making (e.g. Anthony and Govindarajan, 2007). In a sustainability context, activities may, for example, include communication of environmental policy, review processes regarding sustainability aspects, benchmarking, goal setting, implementing life cycle analysis (LCA), or having, for instance, an environmental management system (Pondeville et al., 2013). The procedures then stipulate the way in which these activities should be carried out, i.e. formal procedures such as plans and budgets (Simons, 1995) that “aim to ensure that specific outcomes will be achieved and involve monitoring, measuring and taking corrective actions” (Langfield-Smith, 1997, p. 208). Or, in the case of investments, for which Simons (2000, p.141) stipulate how “procedures should specify a process by which proposals are evaluated and approved”.

1.4.2 Organisational levels of sustainability management control

Recent developments in the SMCS literature have explored the integration of SMCS and MCS (e.g. Ditillo and Lisi, 2016; Gond et al., 2012). Integration has, for example, been defined in terms of cognitive, organisational, and technical integration in which (i) cognitive integration concerns shared cognitions and common understanding of those engaged in MCSs and SMCSs; (ii) organisational integration concerns aspects such as organisational structure, groups, and practices; and (iii) technical integration concerns infrastructure and methodological links

¹⁰ See also Jørgensen and Messner (2010) and Schatzki (2001).

between MCS and SMCS (Gond et al., 2012). This also implies that sustainability and sustainability management control (should) span the organisation and its different functions and systems; i.e. control spans from strategic to operational levels within organisations (Guenther et al., 2016; Tessier and Otley, 2012). Empirical findings on management control practices for corporate social responsibility (CSR) activities (Arjaliés and Mundy, 2013) and energy management (Virtanen et al., 2013) have indicated incongruencies between organisational levels in how these activities are managed. Both strategic integration (i.e. senior management engagement with sustainability management control) and operational integration (i.e. sustainability integration in operational practices) have been advocated for in a recent empirical study on carbon MCS (Bui and de Villiers, 2017). This, together with the indicated barriers and tensions regarding strategic issues related to energy management, implies a need for acknowledging the different organisational levels of sustainability management control, such as the case of energy management.

1.5 Non-energy benefits as a driver for energy efficiency investments

Information assessment plays an important role for management control. For instance, Simons (1995) defined MCS as “the formal, *information-based* routines and procedures managers use to maintain or alter patterns in organisational activities” (p. 5, emphasis added). In a sustainability context, this connects both to matters of transparency and disclosure and to support decision-making (Maas et al., 2016). Given the inside-out perspective taken in this thesis, emphasis is on the latter. In this vein, Maas et al. (2016) further argue on the role of sustainability information in supporting decision-makers and managers with relevant data for investment appraisals and operational management activities. Others have also advocated the need for research to address questions concerning both the arguments for internal sustainability management, as well as the tools and processes used and the use of qualitative and quantitative information to build these arguments (Salzmann et al., 2005).

For energy management, and energy efficiency investments in particular, similar concerns have been raised. For instance, Sandberg and Söderström (2003), in their study on the need for improved support tools for investment decision-making, establish how tools and working methods are needed which enable for comprehensive and transparent information assessment for energy efficiency investments. The role of information is also evident through the controlling element of the energy management system (Schulze et al., 2016), involving energy accounting, performance measurement, monitoring, and information and decision support systems. Here, the additional benefits, i.e. non-energy benefits, are highly relevant as these can contribute to a more

well-informed case for energy efficiency investments. There is an established need for insights regarding (i) the extent to which and the way in which these benefits are acknowledged before making energy efficiency investments (Nehler, 2018) and (ii) the role of these benefits in, supposedly, supporting decision-making.

Acknowledging the additional benefits, in addition to energy savings, is thus in line with the previously addressed inside-out approach (Burritt and Schaltegger, 2010)—these aspects should be considered in order to improve and support the decision-making process for energy efficiency investments. This includes quantifiable, tangible benefits as well as less tangible benefits, such as improved image or worker morale (e.g. Aras and Crowther, 2008; Worrell et al., 2003). Aras and Crowther (2008) also acknowledge the fact that certain environmental effects might require a longer time horizon to enable their recognition. Hence, acknowledging the additional benefits could possibly help drive industrial energy efficiency investments, but an increased understanding is needed to determine if and how this is the case. The heterogeneity of these benefits (being both quantitative and monetisable as well as intangible) along with the lack of knowledge on the role of non-energy benefits in the investment process (Nehler, 2018), necessitates further investigations into how different non-energy benefits are acknowledged in relation to investment decisions for energy efficiency investments and how they may, from a (sustainability) management control perspective, support the investment decision-making process.

1.6 Research problem and positioning of the thesis

From the preceding discussion, it is implied how adequate management systems and processes are necessary both for the implementation of external pressures (Sullivan and Gouldson, 2017), i.e. policies, and internal actions, i.e. energy management activities and investments (e.g. Bunse et al., 2011). Energy management and improving energy efficiency in the industrial sector are identified as important means for mitigating climate change, particularly for energy-intensive industries, and the sector has been subject to several policy efforts to stimulate this. However, there is a lack of knowledge concerning the internal management practices for dealing with energy issues. This thesis responds to this by taking a management control perspective on energy management, focusing on the management control activities and procedures for energy management and energy efficiency investments. Related to the energy efficiency investments is also the thesis's exploration of the role of non-energy benefits, within the 'win-win' line of reasoning. The strategic, operational, and organisational dimensions of energy management are

acknowledged to illuminate the “control mechanisms that are necessary to implement energy-specific organisational goals/targets and to influence collective and/or individual actions towards enhanced energy efficiency” (Schulze et al., 2018, p. 814), and account for the different levels of management control (Tessier and Otley, 2012).

By bridging energy management and sustainability management control, this thesis seeks to respond to gaps identified in both domains, providing a management control perspective on energy management and an inside-out perspective on sustainability management control. It also contributes insights on how management control activities and procedures should be configured to improve and support decision-making in a sustainability direction. As argued in this chapter, energy management research has been predominated by operational, implementation-of-technologies perspectives, with recent studies advocating the need for management control approaches to energy management (Schulze et al., 2018; 2016). The configurations of sustainability management control and its support for sustainability strategies, enabling for a more well-informed decision-making, is a critical task for the management control field (Arjaliés and Mundy, 2013; Maas et al., 2016) in line with the managerial path of the inside-out approach on management control for sustainability (Burritt and Schaltegger, 2010). Still, internal perspectives are scarce in previous research (Crutzen et al., 2017; Ditillo and Lisi, 2016; Lueg and Radlach, 2016).

This thesis provides a holistic perspective on management control for sustainability (Lueg and Radlach, 2016) through the case of energy management and acknowledges both the operational and strategic levels of control (Tessier and Otley, 2012); thus, it advances the understanding of sustainability management control configurations (Gond et al., 2012). Specifically, the thesis contributes to the literature with constructive knowledge on the configurations of management control for energy management and identifies key activities and procedures, both strategic and operational, for proactive energy management. This thesis also addresses the role of sustainability orientation, in line with previous research (e.g. Ditillo and Lisi, 2016), and the organisational arrangements as important aspects to consider in relation to sustainability management control.

In bridging two theoretical domains (discussed further in chapter two), this thesis draws on different streams of literature. Although some recent special issues linking sustainable development and management literature indicate a growing awareness and interest of integrating these fields (e.g. Bebbington and Thomson, 2013), Guenther et al. (2016) note that this stream of literature and the management accounting and control fields “take little note of each other” (p.

157). Cross-disciplinary approaches have been advocated both in the 'energy' literature stream and for sustainability management control (e.g. Albelda, 2011; Rotzek et al., 2018; Thollander and Ottosson, 2008; Virtanen et al., 2013). By taking different approaches in research design and theoretical framing, this thesis acknowledges these calls and enables for the research problem to be addressed from different perspectives and levels of analysis (described further in 1.8 and chapter three).

Energy management is thus, in this thesis, positioned as critical for the industrial sector's sustainability work. The environmental dimension of sustainable development is to which most empirical studies on sustainability management control have been focused (Crutzen and Herzig, 2013; Lueg and Radlach, 2016), and this thesis will also add to this body of literature. However, in addition to the environmental dimension, energy management and improving energy efficiency have the potential to contribute to the economic and social sustainability dimensions. The additional benefits are essential in this regard as they can be found amongst all sustainability dimensions (see for example Worrell et al., 2003). They can be contrasted against the economic dimension through cost reductions (e.g. energy costs, maintenance costs) and the environmental dimension through a reduction in CO₂ emissions and other pollutants. Last, benefits such as improved health and work environment correspond to the social dimension. Hence, acknowledging these additional benefits may improve the business case for energy efficiency investments as well as contribute to industrial sustainability (Cagno et al., 2018). Moreover, energy efficiency is an output-input ratio (e.g. IEA, 2012; Patterson, 1996) and a pollution prevention strategy (Porter and van der Linde, 1995a), and improving this ratio is one way to improve eco-efficiency (Gimenez et al., 2012). Eco-efficiency has been described as a possible solution for companies to unify a reduction in ecological impact with economic objectives, as well as a necessary constituent for corporate sustainability (Henri and Journeault, 2009). This further emphasises energy management as a valid context for a research inquiry on management control for sustainability.

1.7 Aim and research questions

The overarching aim of this thesis is to analyse the management control activities and procedures used by energy-intensive industrial companies for energy management and energy efficiency investments. This aim is accomplished through four studies, which are guided by three research questions. The first discusses the nature and use of management control activities and procedures for energy management and energy efficiency investments:

RQ 1: What management control activities and procedures are applied for energy management and how are they used?

(a) For energy management in general?

(b) For energy efficiency investments in particular?

The second research question aims to explore the role of acknowledging the organisational levels of management control for energy management and how this can help to overcome known barriers and tensions to enable for a more proactive energy management work:

RQ2a: How are the operational and strategic dimensions of energy management and energy efficiency investments reflected in management control activities and procedures?

RQ2b: How can addressing the organisational levels of management control help to overcome barriers to energy management and energy efficiency investments?

The third research question seeks to explore the role of non-energy benefits as driving factors for energy efficiency investments. This includes their characteristics, i.e. quantifiability and so forth, and how and the extent to which they are considered in investment activities and procedures.

RQ 3: How can the configuration of investment activities and procedures enable for non-energy benefits in acting as a driver for energy efficiency investments?

1.8 Research design and appended papers

The aim of this thesis has been accomplished through four studies. These studies share the underlying purpose of contributing knowledge that, in different ways, can improve industrial energy management and energy efficiency. However, there are multifaceted problems associated with improving industrial energy efficiency, going beyond implementation of technologies (Palm and Thollander, 2010), and the four studies are therefore different in terms of design and theoretical approach. A detailed description of the four studies (henceforth referred to as Papers

I-IV) is provided in chapter three, but a brief presentation of them now follows to illuminate the different perspectives that are addressed in this thesis.

Paper I and Paper II are both concerned with energy efficiency investments and how to increase the implementation of these investments in industrial companies. Specifically, the studies are concerned with information assessment in relation to the investment decision, particularly the way in which non-energy benefits of making energy efficiency investments are considered. Paper I is a systematic literature review of additional benefit terms and develops a framework for categorising these benefits according to level of quantifiability and time frame, which aims to facilitate the inclusion of additional benefits during the investment process. Paper II is an interview study conducted at firms within the Swedish manufacturing industries analysing how companies consider non-energy benefits and also exploring their arguments for adopting energy efficiency investments.

In Paper III and Paper IV, the emphasis is more specifically on management control activities and procedures. In Paper III, the focus remains on energy efficiency investments. It is a single case study on the use of management control activities and procedures during the investment process. It takes a multilevel perspective on the investment process and the role of energy and non-energy benefits. It was conducted at a company group within the energy-intensive PPI. Paper IV is a multiple case study on the configuration and use of MCSs for energy management. Thus, it takes a holistic management control perspective *and* a holistic perspective on energy management by considering energy management in its broader sense, beyond the implementation of energy efficiency investments. This includes elements related to, for example, strategy, organisation, and communication (Schulze et al., 2016). The multiple case study was conducted at three company groups within the Swedish PPI. Hence, the thesis takes both a micro perspective on energy efficiency investments as well as a holistic perspective on energy management.

1.8.1 Appended papers' connection to aim and research questions

The first two research questions are addressed through Paper III and Paper IV. In these papers, energy management is positioned as a means for sustainability for the industrial sector. These papers bridge the theoretical domains of energy management and sustainability management control. The third research question, which specifically concerns non-energy benefits and energy efficiency investments, is thus addressed through Papers I, II, and III.

Table 1. Paper overview and connection to research questions.

Research question	Addressed in paper(s)
RQ 1: What management control activities and procedures are applied for energy management and energy efficiency investments and how are they used?	Paper III-IV
RQ2a: How are the operational and strategic dimensions of energy management and energy efficiency investments reflected in management control activities and procedures? RQ2b: How can illuminating the organisational levels of management control help to overcome barriers to energy management and energy efficiency investments?	Paper III-IV
RQ 3: How can the configuration of investment activities and procedures enable for non-energy benefits in acting as a driver for energy efficiency investments?	Paper I-III

The papers are numbered according to the order in which they were written, reflecting the research process. As evident in Table 1, the research questions are placed in reverse chronological order of the papers. This is to reflect the framing of the thesis, with energy management positioned as a means for (industrial) sustainability and energy efficiency investments being an element within energy management. The thesis therefore starts with sustainability management control and the case of energy management, proceeding with energy efficiency investments, then becoming more ‘micro’ by exploring the non-energy benefits of energy efficiency investments. This is visualised in Figure 1.

Figure 1. Positioning management control for energy management as a case of sustainability management control.

1.9 Thesis outline

This thesis consists of four appended papers and a cover essay. The cover essay aims to both summarise the appended papers but also to go beyond the summative description and further elaborate their combined contribution, theoretically and empirically. The remainder of the cover essay is organised as follows. Chapter two provides the theoretical foundations and previous research relevant for the thesis. In chapter three, the methodology and applied research methods are discussed. Chapter four presents summaries of the appended papers. The results are then discussed further in chapter five. Last, the thesis' conclusions, implications, and avenues for further research are provided in chapter six.

Chapter 2

Theoretical background

This chapter will lay out the theoretical background for the thesis. As this thesis is a combination of theoretical perspectives, this chapter is a compilation of the literature addressed through the four appended papers. The thesis draws upon two main theoretical domains: management control for sustainability and energy management. This chapter starts with a discussion on the concepts of sustainability and sustainability management control and an elaboration on the concept of configurations of sustainability management control. It then centres around the first theoretical domain, sustainability management control, including a subsection on Simons (1995) Levers of Control (LoC) and a revised version of this framework (Tessier and Otley, 2012), as the latter is applied in this thesis through Paper IV. This is followed by investment decision-making, drawing upon capital budgeting literature and literature from sustainability management control. The chapter then proceeds with the second main theoretical domain, energy management, and also addresses energy efficiency investments and non-energy benefits. A section then follows in which the theoretical contributions by bridging these two domains are discussed, in terms of domain and method theory (Lukka and Vinnari, 2014). Last, the chapter ends with a reflection upon the theoretical choices made in the thesis.

2.1 Sustainability and sustainability management control

In order to contribute constructive knowledge for the way in which management control activities and procedures can support decision-making in a sustainability direction, this thesis takes an

inside-out approach and follows the managerial path for sustainability management control (Burritt and Schaltegger, 2010). However, before discussing the use and patterns of sustainability management control activities and procedures in the literature, this section will discuss the way in which sustainability and sustainability management control are considered in the thesis.

Sustainable development, sustainability, and CSR are examples of overlapping concepts in the literature (Carroll and Shabana, 2010; Lueg and Radlach, 2016). In this thesis, the term 'sustainability' will be used. Sustainability can be defined according to the three dimensions of economic, environmental, and social sustainability, i.e. the triple bottom line (Elkington, 1999). On a corporate level, this implies that firms should undertake efforts to reduce their ecological footprint, acknowledge others than only financial stakeholders and pursuing societal interests (e.g. legal, ethical, environmental, economic), and aim for economic prosperity (Bansal, 2005). It has been acknowledged, however, that 'sustainability' in management control literature is often used interchangeably and inappropriately with environmental sustainability, although it is only one dimension (Bebbington and Thomson, 2013; Schaltegger and Burritt, 2010). This thesis is limited to energy management as a means for sustainability in the industrial sector. Although its main contribution is to the environmental dimension, it is also argued that the thesis may contribute to both the economic and social dimensions through its impact on energy costs and the additional benefits associated with improving energy efficiency.

Maas et al. (2016) note how sustainability management control as a concept or term so far has not been elaborated in detail. They also notice how sustainability management control, accounting, and reporting are used both as synonyms and as separate concepts in the literature. For example, in their literature review on sustainable development and MCS, Lueg and Radlach (2016) note sustainability accounting as an approach within the dimension of cybernetic control of MCS, while Joshi and Li (2016, p. 4) depict sustainability accounting as "an interlocking, mutually reinforcing sustainability-related information system encompassing external reporting, internal decision-making support, and MCS that are consistent with the overall business strategy". Schaltegger and Burritt (2010) describe sustainability accounting as a subset of accounting concerned with the activities, methods, and systems used for assessment, analysis, and reporting of economic, social, and environmental impacts and the linkages between these three dimensions of sustainability. Hence, sustainability accounting and control are defined differently with both being addressed as subsets to one another. This pattern has also been identified in the general management control and accounting literature; management accounting as a topic has become broader in scope, blurring the lines between management accounting and MCS (Otley, 2016). Chenhall (2003) also

noted how MCS, management control, and management accounting, alongside additional related concepts, have been used interchangeably in the literature. This may be an explanation for the somewhat confused state of the art in the sustainability stream of literature.

Maas et al. (2016) propose an integrative framework in which the interlinkages between sustainability management accounting, control, and reporting are acknowledged. From an inside-out perspective, they identify several questions regarding what the key sustainability aspects strategically relevant for the organisation are (i.e. sustainability assessment and formulation of strategy and objectives); how to develop accounting-based systems for data collection to manage these aspects (i.e. sustainability accounting and management); how to develop formal and informal controls (sustainability management control); and how to communicate to internal and external stakeholders (Maas et al., 2016, p. 244). While this thesis acknowledges the interlinkages between sustainability management control, accounting, and reporting (Maas et al., 2016; Guenther et al., 2016), its focus and contribution to this literature are on sustainability management control. Reporting, for example, is indirectly addressed, particularly through Paper IV, but then in terms of a communication activity relating to the control system.

The thesis considers sustainability management control in the same vein as Guenther et al. (2016) and their assessment of environmental management control as going “beyond information delivery and decision support by influencing routines and behaviours and by aligning those routines and strategies with the environmental strategies and objectives of the firm” (p. 152). Sustainability management control is thus herein considered as the management control practices, in terms of activities and procedures, used for managing and evaluating sustainability (Lueg and Radlach, 2016); in other words, “sustainability management controls can be said to include all devices and systems that managers use to formally and informally ensure that the behaviours and decisions of their employees are consistent with the organisation’s sustainability objectives and strategies” (Crutzen et al., 2017, p. 1293). SMCS are thus in line with the definition of MCS by Simons (1995) provided in the introduction, defined as the MCS used for achieving sustainability objectives; in this thesis illuminated through the case of industrial energy management.

2.1.1 Sustainability management control configurations

As argued in the introduction, sustainability management control should be viewed in its entirety and not only focus on individual controls (Crutzen et al., 2017), i.e. from a configurational

approach (Bedford and Malmi, 2015). Configurational thinking is a means to go beyond individual attributes and look at organisational issues (such as management control) as “clusters of organisational attributes ‘in their entirety’” (Kruis et al., 2016, p. 29). In other words, “*configuration* refers to a specific arrangement of multiple parts, components, elements, mechanisms, attributes, or the like” (Bedford and Malmi, 2015, p.3, emphasis in original). The configurational thinking then provides a means to consider management control in practice (Bedford and Malmi, 2015). More specifically, considering management control in terms of practices can be described as regarding management control as “a bundle of practices and material arrangement. [...] Organisational members negotiate strategies, budgets, and performance targets, they discuss ways of realising them, [...] give and receive advice, find excuses, take corrective action, etc. Those activities occur in chains of actions and within management control practices” (Ahrens and Chapman, 2007, p. 9).

In this thesis, this configurational approach is operationalised by examining the management control activities and procedures for energy management and the way in which they are used, aiming to also contribute to sustainability management control theory. For SMCS, a configurational approach can “indicate different modes of managing, monitoring and controlling sustainability” (Battaglia et al., 2016, p. 215) and clarify the roles and uses of management control for sustainability (Gond et al., 2012). Gond et al. (2012) also provide an important contribution to configurations of SMCS. In their conceptual paper on the integration between SMCS and MCS, eight so-called ideal types of configurations are delineated according to the dimensions of technical, organisational, and cognitive integration (i.e. infrastructure, organisational and social practices, and shared cognitions or practices). These dimensions have been returned to in other studies, which are described in 2.2.1.

2.2 Activities and procedures, use and patterns

Research on management control for sustainability is growing (Lueg and Radlach, 2016). Previous research has addressed issues such as the way firms use controls to implement CSR strategy (Arjaliés and Mundy, 2013), technical and managerial complexities of energy efficiency management (Virtanen et al. 2013), integration of sustainability control systems with traditional MCSs (George et al., 2016; Gond et al., 2012), the role of sustainability orientation (Ditillo and Lisi, 2016), sustainability reporting (Herremans and Nazari 2016), eco-control (e.g. Henri et al., 2017), and control patterns for sustainability (Crutzen et al. 2017). Arjaliés and Mundy (2013) studied the role of MCSs for managing CSR activities by applying the LoC framework (Simons, 1995).

Based on a survey of 36 large French companies, the results indicate how various MCSs (including, for example, internal and external communication processes, environmental management systems, and CSR reporting systems) are used to manage CSR strategy. The levers of control are mobilised through activities and procedures such as environmental management systems, formal meetings, codes of conduct, and exchanging of best practices (Arjaliés and Mundy, 2013).

Crutzen et al. (2017) studied large companies and, based on the Malmi and Brown (2008) package, depict four management control patterns: (i) basic management control, i.e. limited formal and informal control; (ii) behaviour-based management control, i.e. predominantly informal; (iii) advanced formal management control, i.e. developed sustainability MCSs with respect to organisational structure and clear responsibilities, resources, budget, and planning; and (iv) full management control package, i.e. both developed formal and informal controls. Of the 17 surveyed companies, ten have behaviour-based management control, three have advanced management control packages, and four have basic management control packages (Crutzen et al., 2017). None of the companies had a full management control package. The conclusion is therefore that there is a lack of developed complete packages, despite the surveyed companies being subject to sustainability legislation and international standards, and the companies appear to focus on either formal or informal control, especially the latter (Crutzen et al., 2017). The use of formal and informal MCSs has been addressed in additional studies (e.g. Hosoda and Suzuki, 2015; Pondeville et al., 2013) and Hosoda and Suzuki (2015) indicate, in their study of Japanese companies, how informal management control dictates the climate and mindset for sustainability issues in the organisation, which, together with a formal MCS, can support the fulfilment of sustainability strategies. However, Crutzen et al. (2017) explain the absence of complete packages of both formal and informal control indicated in their study as possibly stemming from the fact that sustainability management control is still a novel and under-developed phenomenon.

While the studies addressed above are concerned with sustainability in terms of both environmental and social aspects (e.g. Crutzen et al., 2017) or CSR practices (e.g. Arjaliés and Mundy, 2013; Hosoda and Suzuki, 2015), there are also studies which focus solely on the environmental dimension of sustainability (Lueg and Radlach, 2016), sometimes referred to as eco-control¹¹ (Gray et al., 2014; Henri and Journeault, 2010). For example, Pondeville et al. (2013) examine the role of contextual and strategic factors, including perceived stakeholder pressures,

¹¹ Defined as “the application of financial and strategic control methods to environmental management” (Schaltegger and Burritt, 2000, in Henri and Journeault, 2010, p. 63).

environmental¹² uncertainty, and corporate environmental proactivity, for the development of an environmental, formal and informal, MCS. Formal MCS include, for example, the integration of environmental objectives in planning systems, environmental criteria in investment decisions, and having elaborated environmental procedures, while the informal MCS include, for example, having teams on production level as well as cross-functional teams managing environmental issues and employees that are encouraged to make suggestions for environmental improvements in products and processes (Pondeville et al., 2013). The findings indicate that the strategic factor corporate environmental proactivity was positively linked to the development of an environmental MCS, which is in line with Ditillo and Lisi (2016) who argue for the role of sustainability orientation for the level of integration of SMCS and MCS. Regarding contextual factors, perceived environmental uncertainty negatively influenced the development of environmental MCS as well as corporate environmental proactivity, indicating a more passive stance under uncertain circumstances (Pondeville et al., 2013). The second contextual factor—perceived stakeholder pressures—is indicated to positively influence corporate environmental proactivity and the development of an environmental MCS, formal and informal. Organisational stakeholders are indicated as particularly important and are the only type of stakeholder influencing an informal environmental MCS, which highlights the importance of ensuring employee (both management and non-management) involvement in sustainability issues (Pondeville et al., 2013). This further strengthens the role of organisational structures and arrangements indicated in the literature (Ditillo and Lisi, 2016; Engert and Baumgartner, 2016; Gond et al., 2012; George et al., 2016), such as the role of cross-functional coordination and communication for integrating internal organisational stakeholders' interests (Pérez et al., 2007) and the role of interactive processes (Arjaliés and Mundy, 2013; Gond et al., 2012).

The link between eco-control, environmental, and economic performance has also been addressed in previous works (Henri et al., 2017; Henri and Journeault, 2010; Journeault, 2016). Positive links, both direct and indirect, between eco-control and environmental performance have been indicated (Henri et al., 2017; Henri and Journeault, 2010; Journeault, 2016). Henri et al. (2017) also find support for changes in practices which lead to a higher importance of eco-control have a positive influence on environmental performance. Eco-control has also been indicated to indirectly affect economic performance through environmental performance (by its impact on competitive advantage through, for example, cost reduction) (Journeault, 2016). This link between environmental and economic performance is in line with the 'win-win' argument (Henri

¹² i.e. ecological environment (Pondeville et al., 2013).

and Journeault, 2010; Porter and van der Linde, 1995a) advocated in this thesis. However, Henri and Journeault (2010) only find support for this indirect link in certain contexts, namely those companies subject to higher environmental exposure, higher public visibility, higher environmental concerns, and larger companies.

2.2.1 Enablers and barriers for sustainability management control

Battaglia et al. (2016) provide a longitudinal analysis on SMCS and identify several enablers and barriers, following the Gond et al. (2012) dimensions addressed above (i.e. technical, organisational, and cognitive). Development of managerial best practices regarding resource efficiency is mentioned as an enabler for technical integration, while lack of information systems for activities such as data collection and monitoring of sustainability issues are addressed as technical barriers. Weak collaboration across work roles and difficulties in communication between organisational levels are noted as organisational barriers. Enablers for organisational integration instead include top management engagement, establishing a sustainability manager, and establishing procedures such as codes of conduct and sustainability plans and reports (Battaglia et al., 2016), in line with Ditillo and Lisi (2016). Cognitive enablers include, for instance, top-level vision for a managerial approach, and cognitive integration is identified as particularly important to achieve a lasting integration of sustainability issues into organisational strategies (Battaglia et al., 2016) and is concluded to be “especially important in facilitating a supportive culture in organisations” (George et al., 2016, p. 210).

George et al. (2016) identify both barriers and enablers for integration related to all three dimensions and similar to enablers indicated in other studies (see for example Ditillo and Lisi, 2016). For example, establishing adequate organisational structures and arrangements, such as sustainability working groups, were identified by George et al. (2016) as important enablers along with activities and procedures such as: changing the mindset of top management; increasing employee understanding; policies and procedures; linking KPIs to sustainability performance; and including sustainability in, for instance, budgeting and reporting. Identified barriers, on the other hand, include lack of understanding, unclear roles and responsibilities, separated planning processes, and difficulties related to measurement. Hence, establishing adequate management control activities and procedures may work as enablers for advancing sustainability in organisations.

Although some of the studies reviewed above base their analysis on theoretical frameworks (see, for example, Arjaliés and Mundy, 2013; Crutzen et al., 2017; Journeault, 2016), a recent literature review indicated that few empirical studies on sustainability management control build on established management control frameworks (Guenther et al., 2016). Of those that do, the LoC is very common (Guenther et al., 2016), but studies that draw upon, for example, the Malmi and Brown (2008) framework of management control as a package are also present in SMCS research (see for example Crutzen et al., 2017; Journeault, 2016). There is also a stream of research concerned with sustainability balanced scorecards (see, for example, Figge et al., 2002). Paper IV of this thesis joins the body of studies that apply the LoC framework, which therefore is given attention in the next subsection.

2.2.2 The LoC framework in the context of sustainability management control

The LoC framework (Simons, 1995) is frequently applied in empirical MCS research (Guenther et al., 2016; Martyn et al., 2016), and it has also been applied in a sustainability context (e.g. Arjaliés and Mundy, 2013; Gond et al., 2012; Journeault et al., 2016). The LoC framework consists of four levers: (i) beliefs systems, through which the organisations' values and purpose are provided; (ii) boundary systems, which provide delimitations through business conduct boundaries as well as strategic boundaries; (iii) diagnostic control systems, which are "the formal information systems that managers use to monitor organisational outcomes and correct deviations from pre-set standards of performance" (1995, p. 59); and (iv) interactive control systems, which expand and guide opportunity-seeking by focusing attention and encouraging discussion and debate. Thus, beliefs and boundary systems set the strategic domain, while interactive and diagnostic control systems serve to formulate and implement strategies (i.e. emergent and intended strategies, respectively) (Simons 1995).

The framework belongs to the configurational line of thought that management control is not limited to a single type of control but rather a system of controls that should be considered together (e.g. Bedford and Malmi, 2015; Henri et al., 2017; Kruis et al., 2016; Martyn et al., 2016): "The power of the control levers does not lie in how each is used alone but rather in how they complement each other when used together" (Simons, 1995, p. 153). Still, many studies only focus on one or two levers (Martyn et al., 2016), even though control systems have been indicated to be inter-related and complementary¹³ (Henri et al., 2017; Widener, 2007).

¹³ For example, the belief system influences all other three systems and the interactive system influences both the boundary system and the diagnostic system (Widener, 2007).

Research has argued for an enhanced understanding of the role of MCSs for sustainability by exploring their use rather than existence or structure (Arjaliés and Mundy, 2013; Crutzen and Herzig, 2013), which speaks in favour of the LoC framework (Gond et al., 2012). Arjaliés and Mundy (2013, Table 2, p. 296) provide several examples on how the levers are mobilised in a sustainability context, including, for example:

- Diagnostic processes: leveraged by managers through reports used to manage activities of operational departments. Examples of MCS: Environmental management systems, standardised CSR reporting processes, competitive benchmarking.
- Interactive processes: leveraged through formal and regular discussions. Examples of MCS: regular meetings, intranet systems, exchange of best practices to share innovations.
- Beliefs systems: leveraged through formal and explicit statements of intentions. Examples of MCS: CSR strategic plans, organisational-wide conferences, values chart, mission statements, communication tools (e.g. intranet).
- Boundary processes: leveraged through formal and explicit statements of appropriate and inappropriate areas for consideration, as well acceptable and unacceptable behaviour. Examples of MCS: documentation on legal and voluntary regulations, guidelines, job descriptions, communities of best practice.

The LoC framework takes the perspective of top management (Martyn et al., 2016; Simons, 1995), focusing on strategic issues (Ferreira and Otley, 2009). However, while the role of top management is “developing arrays of activity and understandings that organised the activities of other organisational members—the manifesting of structures of intentionality” (Ahrens and Chapman, 2007, p. 19), Tessier and Otley (2012) acknowledge how management control should not only be considered from a top management perspective. Rather, it should be incorporated in both the operational and strategic levels of the organisation, which is taken into account in their revised LoC framework. It is a framework which, in addition to the organisational levels of control, considers: (i) the types of controls, i.e. technical or social; (ii) the objective of controls, i.e. performance or compliance; and (iii) the use of controls, i.e. diagnostic or interactive (Tessier and Otley, 2012). Hence, the framework includes four control systems: operational boundaries, operational performance control systems, strategic boundaries, and strategic performance control systems. Also, controls may be used with different intentions, i.e. based on different aims and choices—i.e. managers can, depending on their intentions, make decisions on which controls will be used for interactive or diagnostic purposes and in enabling or constraining ways (Tessier and Otley, 2012, p. 181). However, controls may also be used for more than one objective (Tessier

and Otley, 2012) and Widener (2007), for example, finds how the performance measurement system is used both diagnostically and interactively for managing operational risk. The revised LoC framework was recently applied in a carbon management setting, where the importance of both strategic and operational integration of carbon MCS for improving performance was indicated (Bui and de Villiers, 2017). As discussed in the introduction, management control complexities related to differences and tensions between operational and strategic levels have been indicated in previous studies (Arjaliés and Mundy, 2013). Virtanen et al. (2013) also identified how the strategic attributes of energy management and improving energy efficiency were lost in communication to operational levels, indicating limitations in organisation and management control for energy management. To acknowledge the above, the revised LoC framework (Tessier and Otley, 2012) was applied as an analytical framework in Paper IV.

2.2.3 Directions from the sustainability management control literature

To summarise this section, sustainability management control is an emerging and relatively young field. As such, it is still characterised by dispersed definitions and uses of concepts (see, for example, Lueg and Radlach, 2016). Several studies have pointed to a lack of holistic and configurational approaches to sustainability management control (e.g. Crutzen and Herzig, 2013). Studies have also indicated how (i) (sustainability) management control spans organisational levels (e.g. Arjaliés and Mundy, 2013; Bui and de Villiers, 2017; Tessier and Otley, 2012) and (ii) organisational arrangements and structures play an enabling role (Ditillo and Lisi, 2016; George et al., 2016). These aspects have been acknowledged in this thesis, particularly in Paper IV in which a holistic approach to SMCS is taken through its examination of management control configurations for energy management. The organisational levels of management control (Tessier and Otley, 2012) were acknowledged in Paper III as well, in which a multilevel perspective was taken on the investment process. This leads to the next section, in which investment decision-making is discussed as a management control activity.

2.3 Investment decision-making as a management control activity

As discussed in the introduction, energy efficiency investments constitute a key element of energy management, belonging to the implementation dimension (Schulze et al., 2016); i.e. it is an action for implementing sustainability. Therefore, it has an important role in the MCS, involving several management control activities and procedures. The investment process can be defined as “the process by which a firm makes discrete decisions to invest resources in order to achieve strategic objectives” (Bower, 1970, p. 19) or “the means by which firms create value for their owners”

(Haka, 2007, p. 698). Since investments may affect operations and cash flows—both in the short- and long-term, investment decisions are of strategic importance for companies (Haka, 2007; Lumijärvi, 1991). Management control thus, through the activities and procedures of the MCS and how these are used, plays a crucial role in aligning investment decisions with strategy (Slagmulder, 1997; Simons, 2000).

By taking a management control approach on investment decision-making, this thesis examines the activities and procedures associated with the investment process in the context of energy efficiency investments. This includes formal management control activities such as planning, evaluation (e.g. NPV, Payback requirements etc.), and coordination (Anthony and Govindarajan, 2007) and procedures such as investment manuals and guidelines (Segelod, 1997), and the role of information during investment decision-making, as this may be both instrumental and strategic (Hirst and Baxter, 1993). In line with the preceding discussion on the need to acknowledge the organisational levels of management control (e.g. Tessier and Otley, 2012), recent studies have made similar claims for the investment process, requiring a multilevel perspective (Strauch et al., 2019). Through its approach which focuses on the management control activities and procedures, this thesis goes beyond the otherwise common emphasis on capital budgeting practises and instead addresses the internal controls and organisational context in which investment decisions take place (Haka, 2007; Harris and El-Massri, 2011).

Formal guidelines have a decisive role for the investment decision-making process (Segelod, 1996). Organisational arrangements are also in the ‘investment context’ indicated to play a significant role; Cheng and Mahama (2011) emphasise the role of reviewers for establishing the extent to which investment proposals follow such guidelines. Investment boards and committees have elsewhere been identified as important means of control and coordination and for sharing information on investment opportunities (Segelod, 1996). This is especially the case in large organisations in which investment decision-making is delegated to managers on different organisational levels (Bower, 1970; Haka, 2007) due to the need for more local information input (Graham et al., 2015). Activities, procedures, guidelines, and so forth, thus function as communication tools as well as instruments for legitimising investment proposals (Cheng and Mahama, 2011; Van Cauwenbergh et al., 1996).

For the sustainability context, a crucial issue is then the role of sustainability-related information and the way in which it is accounted for through the activities and procedures during the investment process, and whether the investment process enables for sustainability-related

investments. Accounting for environmental features during the investment process facilitates an integration of environmental considerations in management and decision-making (Albelda, 2011), in line with the rationales for integration of sustainability (e.g. Gond et al., 2012). Hales et al. (2016) note the need for more research to answer questions regarding the rationale for sustainability investments; for example: What are companies' perspectives on these investments? How can the costs and benefits be measured? The conflicting time frame of short-term financial goals and long-term sustainability benefits is also discussed (Hales et al., 2016).

2.4 Energy management

Improving eco-efficiency through saving energy is one example of a 'win-win' scenario within the environmental dimension of sustainability (Gray et al., 2014). Cost-related factors are highly ranked and have been indicated as a driving force behind energy management (Posch et al. 2015) and implementing an energy management system is a means to simultaneously improve both carbon and economic performance (Böttcher and Müller, 2016). However, as argued in this thesis, improving energy efficiency may provide benefits outside the environmental dimension.

Energy management is receiving increasing research interest (May et al., 2017) and previous studies include aspects such as energy planning (Paunescu and Blid, 2016), implementation of ISO 50001 (e.g. Ates and Durakbasa 2012; Mkhaimer et al. 2017), energy performance measurement (Andersson et al., 2018; Sivill et al. 2012; Virtanen et al. 2013), and energy saving investments and measures (e.g. Liu et al. 2012; Suk et al. 2013; Trianni et al. 2014). Here, a clarification may be necessary: within the energy literature, energy efficiency investments and energy efficiency measures are used to denote actions undertaken to improve energy efficiency, i.e. elements within energy management (May et al., 2017; Schulze et al., 2016). These concepts often overlap but potential differences should be acknowledged. In their classification scheme for energy efficiency measures, Fleiter et al. (2012) distinguish between different technology-related measures and organisational measures. Organisational measures include, for example, changes in routines, instructions, and so forth (i.e. energy efficiency measures not requiring any investment). Energy efficiency investments are instead energy efficiency measures that require an investment, i.e. technology-related energy efficiency measures that can range from being related to support processes (e.g. lighting) to being closely related to core processes. Although such measures clearly range in scope, both in terms of size and impact, they require an investment expenditure (Fleiter et al., 2012).

Two recent reviews of the growing energy management literature provide a holistic perspective and conceptual frameworks for industrial energy management (May et al. 2017; Schulze et al. 2016). First, Schulze et al. (2016) reviewed the literature on energy management in the industrial sector on an organisational level and provide a framework for an integrative energy management. The framework consists of five key elements and associated actions in which the elements are: (i) strategy/planning; (ii) implementation/operation; (iii) controlling; (iv) organisation; and (v) culture, where organisation and culture surround the other three elements. The elements of the framework range from the strategic dimension to operational aspects, such as implementing measures (technical or managerial), taking actions, and making investments. The controlling element is consequently focused on aspects such as data collection and monitoring, evaluation (e.g. KPIs), reporting, and benchmarking. It is stipulated that all five key elements should be equally considered for successful energy management (Schulze et al. 2016).

Second, May et al. (2017) carried out a literature review of energy management in manufacturing. Six streams of research were identified: drivers and barriers; information and communication technologies; strategic paradigms¹⁴; supporting tools and methods; manufacturing process paradigms; and manufacturing in the trade-off. A framework for energy management in manufacturing is suggested in which measurement, KPIs, monitoring, and evaluation and control of energy efficiency are explained as key components. Information and communication technologies, strategic paradigms, supporting tools and methods, and manufacturing process paradigms work as enablers (i.e. input factors) for energy management. Manufacturing performances in the trade-off concerns the results and output of implemented energy efficiency practices (i.e. energy efficiency indicators and measurement, optimisation, and trade-off analysis) and drivers and barriers are considered as controls, together with so called mechanisms/resources (i.e. people, machines, and tools) (May et al. 2017).

The two suggested frameworks differ in the sense that May et al. (2017) consider certain activities, routines, and procedures not as part of energy management, but rather as enablers; whereas Schulze et al. (2016) present an integrative framework in which all activities, routines, and procedures are included. Bunse et al. (2011) also differ between measurement, control and improvement, and enablers (ICT and standardisation). The two reviews also differ in scope and level of perspective: Schulze et al. (2016) takes a broader industry perspective but delimits the

¹⁴ Including articles focusing "on the development of policies and strategies concerned with the advancement of industrial energy efficiency" (May et al., 2017, p. 1469).

review to the organisational level; May et al. (2017) focus on energy management in manufacturing but is broader in scope since it includes literature on various levels of perspective, such as organisational, sectoral, and international.

Despite the differences in scope and outcome, the two reviews provide common ground for further research within energy management. Both reviews describe energy management as consisting of various activities, routines, and procedures, and that it takes place on several levels in the organisation, from the strategic management decision to the operational level and production: “Energy management covers different operational hierarchical levels in a manufacturing plant (i.e. tool, equipment, group, area, factory etc.)” (May et al. 2017, p. 1475). May et al. (2017) do not provide an explicit definition¹⁵ of energy management but do, however, state that its key components are measurement, monitoring, evaluation, and control.

Yet, a majority of the previous literature on energy management has been conducted within the engineering discourse focused on measures, i.e. on an operational level. Rare contributions to energy management from a management control perspective include Virtanen et al. (2013) and Schulze et al. (2018). Schulze et al. (2018) present three main findings. First, having an energy MCS is positively significant for firms’ energy performance; second, the effect is emphasised if the firm has a full-time energy manager; and third, the effect is also emphasised if the firm uses external consulting support, such as energy consultants. For an energy MCS, performance management controls and operational controls are identified as the most influential (Schulze et al. 2018). Johansson and Thollander (2018) also identifies having an energy manager, although not necessarily a full-time position, as a success factor for in-house energy management.

Another success factor identified by Johansson and Thollander (2018) is having clear energy KPIs, which is addressed further by Virtanen et al. (2013) and Christensen and Himme (2017). They combine environmental management accounting and performance management research with technical energy efficiency research and examine the complexities related to measurement and management of environmental performance through the lens of energy management. Difficulties related to the construction of an energy efficiency performance indicator (i.e. technical complexities) as well as unsatisfactory integration of the strategic importance of energy efficiency

¹⁵ As stated in the introduction, Schulze et al. (2016, p. 3704) define energy management as: “the systematic activities, procedures and routines within an industrial company including the elements strategy/planning, implementation/operation, controlling, organisation, and culture and involving both production and support processes, which aim to continuously reduce the company’s energy consumption and its related energy costs”.

were identified; the strategic importance of energy efficiency had not spread to all employee groups and employees' perception of energy efficiency varied between the strategic level and operational, floor-level employees, where the latter group perceived quality and safety to be of higher importance (Virtanen et al., 2013). The authors therefore suggested that "putting more pressures on energy efficiency issues at the management level would be advisable in order to encourage improvement efforts within the organisation" (Virtanen et al., 2013, p. 412). Christensen and Himme (2017) focus on the role of statistics and performance measurement for improving environmental accounting. Improving energy performance measurement is concluded to be a first step in increasing awareness for energy management and energy efficiency.

Hence, there is a need for going beyond the technology perspective of energy management and address the elements of energy management related to *management*. One such avenue is to take a management control perspective to illuminate the activities and procedures used by management, both on strategic and operational levels. Communication, information (production, measurement, and dissemination), and knowledge on energy-related issues should be prioritised based on the findings in previous literature. Additionally, and in line with the position of this thesis, Virtanen et al. (2013) acknowledge the potential of improving energy efficiency and contribute to all sustainability dimensions but also state that in order to result in reduced energy costs, i.e. contribute to the economic dimension, "this may require capital investments" (p. 413). Hence, energy efficiency investments will be addressed in the next section.

2.5 Energy efficiency investments and non-energy benefits

"To effectively seek competitive advantage, decision makers, and those who influence them, must consider a broad array of potential organisational benefits when planning environmental improvement activities." (Finster and Hernke, 2014, p. 652)

Non-energy benefits¹⁶ can be described as the additional benefits of energy efficiency investments, in addition to energy cost savings. This may include, for example, reduced waste, improved productivity, reduced emissions, reduced maintenance, a 'green' public image, or an improved work environment (Pye and McKane, 2000; Worrell et al., 2003), and these may often

¹⁶ In the literature on the additional benefits of improving energy efficiency, various terms are applied, including non-energy benefits, co-benefits, multiple benefits, indirect benefits, and so forth. One of the aims with Paper I was to gain clarity on this. Based on the results of Paper I, the term non-energy benefits will be used to denote the additional benefits of energy efficiency.

exceed the energy cost savings (Hall and Roth 2003; Lung et al. 2005; Pye and McKane 2000; Worrell et al. 2003).

Knowledge of non-energy benefits is a driver for improving energy efficiency, and accounting for them in profitability evaluations can increase the adoption of energy efficiency investments (Trianni et al., 2017b). Although recent frameworks for energy efficiency investments acknowledge additional benefits as attributes that should be accounted for (Fleiter et al. 2012; Trianni et al. 2014), research of industrial non-energy benefits tend to take an *ex-post* perspective (Nehler, 2018), i.e. focused on reported benefits while how, or the extent to which, additional benefits are acknowledged before the investment project is undertaken is not considered in the literature. As addressed in the introduction, previous research on energy efficiency investments have devoted much attention to the drivers and barriers for their adoption (see for example Cagno et al., 2013; De Groot et al., 2001; Del Río González, 2005; Johansson and Thollander, 2018; Sorrell et al., 2000). Barriers can be defined as “a postulated mechanism that inhibits investments in technologies that are both energy efficient and (apparently) economically efficient, without the necessity that one or more other barriers occur¹⁷” (Cagno et al., 2013, p. 295). Hence, they are mechanisms counteracting win-win investment opportunities. Non-energy benefits could therefore play an instrumental role in the investment decision-making process (Hirst and Baxter, 1993) and improve the business case for the investment.

Compared to barriers, drivers are instead those “factors promoted by one or more stakeholders, stimulating the sustainable adoption of energy-efficient technologies, practices and services, influencing a portion of the organisation and a part of the decision-making process in order to tackle existing barriers” (Trianni et al., 2017b, p. 204). Drivers identified in the literature include, for example, cost savings, people with real ambition, top management commitment, and improved ‘green’ image (e.g. Brunke et al., 2014; Del Río González, 2005; Thollander and Ottosson, 2008; Venmans, 2014). Some of these drivers, such as image or cost savings, correspond to previously identified non-energy benefits (e.g. Worrell et al., 2003). Trianni et al. (2017b) also address how drivers can affect the investment decision-making process by influencing barriers. For example, people with real ambition are important for corporate culture, which has been identified as a factor that should be recognised in the context of energy management (May et al., 2016; Rotzek et al., 2018), and to overcome barriers early in the decision-making process, i.e. to generate

¹⁷ This definition is a slight modification from the definition of barriers provided by Sorrell et al. (2000, p. 11) (Cagno et al., 2013).

awareness and identify opportunities (Trianni et al., 2017b). This is in line with the SMCS literature on the need to integrate sustainability for a common understanding (Gond et al., 2012).

Cooremans and Schönenberger (2019) provide an integrative approach to energy management and energy efficiency investments and find that if energy efficiency is considered as strategically important, companies tend to have a more developed energy management. Energy management also provides decision-makers with data and information, which in turn can enhance the possibilities for a positive investment decision (Cooremans and Schönenberger, 2019). Hence, there are potential synergies between the implementation of energy efficiency investments and advancing energy management. Calls have been made for research on how to enhance investment opportunities for low carbon innovation, including energy efficiency, in energy-intensive industries (Wesseling et al., 2017). Examining the ways in which non-energy benefits are integrated in investment activities and procedures and their role for energy efficiency investments is therefore one possible avenue to gain insights that could (i) advance the understanding for the assessment of sustainability-related information and (ii) enable for an increased adoption of energy efficiency investments.

2.6 Two theoretical domains: Sustainability management control and energy management

This chapter has sought to outline the theoretical background for the thesis. The thesis draws upon two theoretical domains: (i) management control for sustainability and (ii) energy management. First, the literature on management control for sustainability indicates how MCS can elevate sustainable development in organisations (Arjaliés and Mundy, 2013). Empirical research indicates various controls in use (e.g. Crutzen et al., 2017; Lueg and Radlach, 2016). The general conclusion is that integrating sustainability aspects (e.g. environmental, social or energy related) into management activities and procedures, supports decision-making and control for sustainability (e.g. Ditillo and Lisi, 2016; Pondeville et al., 2013). However, the need to address sustainability management control from the perspectives of different functions and organisational levels is acknowledged (Lueg and Radlach, 2016), of which the latter is strengthened by recent theoretical developments in the management control literature (Tessier and Otley, 2012) and empirical applications (Bui and de Villiers, 2017). Also, enablers and barriers for successful SMCS that supports this call have been identified in previous research, including enablers such as adequate organisational arrangements, top management engagement, and

infrastructure, and barriers such as short-term vision and poor collaboration and communication between organisational levels and work roles (Battaglia et al., 2016; Ditillo and Lisi, 2016).

Second, from the literature on energy management, energy efficiency investments, and non-energy benefits, several conclusions can be made. Energy management appears as multifaceted, being both operational and strategic and is comprised of activities, routines, and procedures ranging from technology-related to cultural (May et al., 2017; Schulze et al., 2016). What becomes evident is that energy management constitutes more than investments and technologies. This calls for acknowledging organisational aspects, which also shows in the identified drivers for improving energy efficiency (Brunke et al., 2014; Del Río González, 2005; Thollander and Ottosson, 2008). 'Win-win' opportunities remain unexploited (e.g. Backlund et al., 2012; Hirst and Brown, 1990; Paramonova et al., 2015) and new perspectives are necessary. Barriers related to lack of information and awareness, lack of integration in internal processes, and lack of budget funding have been identified in previous studies on energy management (see for example Brunke et al., 2014; Cagno et al., 2013; Venmans, 2014). The importance of emphasising organisational drivers has also been identified (Solnørdal and Foss, 2018). Hence, there is common ground between these two theoretical domains, indicating the potential for bridging the SMCS and energy management literature.

However, a distinction should be made here to clarify the roles of the different theories applied in this thesis, as well as how and where the thesis seeks to contribute to the extant literature. This thesis follows Lukka and Vinnari (2014) and distinguishes between domain and method theory: "A domain theory refers to a particular set of knowledge on a substantive topic area in a field or domain such as management accounting, while a method theory can be defined as a meta-level conceptual system for studying the substantive issue(s) of the domain theory at hand" (p. 1309). Sustainability management control and energy management thus constitutes the domain, i.e. field, theories of this thesis. Lukka and Vinnari (2014) specifically acknowledge that the terms *domain* and *field* in this regard are used interchangeably (see note 2, p. 1331). The method theories in turn represent the theoretical or analytical lens or framing applied that come with, for example, a vocabulary, propositions, and the like, that can enable for alternative perspectives for the domain theory it is applied to¹⁸ (Lukka and Vinnari, 2014). Baxter and Chua's (2009) discussion on the use of practice theory as analytical framing theory for management accounting research may

¹⁸ However, it is not the same as a methodology or method (Lukka and Vinnari, 2014). Lukka and Vinnari (2014) specifically address how actor-network theory is an example of a common method theory in management accounting research but that it also can be theories from, for instance, organisation studies.

provide further clarification on the role of method theory¹⁹: “theories that are able to couple accounts of management accounting practices to concepts enabling their analytical framing” (p. 75).

Two method theories can be delineated in this thesis: the revised LoC framework by Tessier and Otley (2012) and capital investment decision-making theory. To clarify this further, the domain theories represent the theoretical domains to which this thesis seeks to contribute. The method theories represent the analytical lenses applied within the domain theory. A domain theory in one area may also work as a method theory for another, and vice versa (Lukka and Vinnari, 2014). Capital investment decision-making theory is one such example. It could, in another thesis, be a domain theory but it is applied here as a theoretical lens to assist in the study of investment decision-making as a management control activity. Domain and method theories can be connected in different ways, depending on the way in which the method theory is applied (Lukka and Vinnari, 2014). Figure 2 aims to illustrate the connections for this thesis.

Figure 2. Illustrating the role of method and domain theories in this thesis, adapted from Lukka and Vinnari (2014, Figure 1, p. 1314).

Hence, this thesis bridges the two theoretical domains of management control for sustainability and energy management. It takes an inside-out and managerial approach to management control for sustainability focused on supporting decision-making for sustainability issues (Burritt and Schaltegger, 2010; Schaltegger and Wagner, 2006). The revised LoC framework by Tessier and Otley (2012) was applied as a method theory in Paper IV. Based on Lukka and Vinnari (2014), it is connected in two respects. First, by being one of the first applications in a SMCS setting (Bui and

¹⁹ However, it should be noted that Baxter and Chua (2009) do not use the term “method theory”.

de Villiers (2017) is, to the author's best knowledge, the only preceding empirical application in a sustainability context), it can illustrate the usefulness of this method theory for the domain theory problem: in this case, the configuration and use of management control for energy management. Applying the revised LoC framework (Tessier and Otley, 2012) is also motivated by Lueg and Radlach (2016) who argue for a stronger link between conceptual SMCS literature and empirical studies, such as through the application of theoretical concepts in empirical case studies. The second relates to refinement of the method theory to be more well-adapted for the domain theory problem: in this case by adding the dimension of sustainability orientation (Ditillo and Lisi, 2016).

The second method theory is capital investment decision-making theory, which is applied as a theoretical lens on management control aspects related to energy efficiency investments. Hence, it is applied as a method theory in Papers III, II, and I. For energy efficiency investments, this line of theory has been previously applied but mainly restricted to the application of evaluation methods and capital budgeting techniques (e.g. Harris et al., 2000), with Cooremans (2012, 2011) as an exception. However, as a method theory, it should be considered as rather established for this domain (Lukka and Vinnari, 2014).

2.7 Reflections on theoretical standpoints

This thesis takes three positions that should be reflected upon. The first concerns the positioning of energy management within the sustainability management control literature. Others have positioned energy management and energy efficiency within environmental management accounting and eco-efficiency²⁰ (Christensen and Himme, 2017; Virtanen et al., 2013; Schulze et al., 2018). Improving energy efficiency is a means for eco-efficiency, i.e. improving the ratio of resource input (e.g. energy, materials) to output (Glavič and Lukman, 2007) and it is a cornerstone of the 'win-win' argument (Gray et al., 2014; Porter and van der Linde, 1995a) that underlies this thesis. Thus, positioning this thesis to the eco-efficiency stream of literature would also be close at hand. However, energy management encompasses more than the energy efficiency ratio and its adjacent indicators, including energy management practices related to organisation, strategy, and so forth. This thesis also considers energy management as going beyond the production process and operational dimension (May et al., 2017; Schulze et al., 2016), which is where eco-efficiency has its main focus²¹ (Glavič and Lukman, 2007). The non-energy benefits of working with energy

²⁰ Which "involve(s) the delivery of competitively priced goods and services that satisfy human needs and bring quality of life, while progressively reducing ecological impacts and resource intensity throughout the life cycle, to a level at least in line with the Earth's estimated carrying capacity" (Elkington, 1999, p. 395).

²¹ The literature review by Caiado et al. (2017) also imply an operational, indicator focused stream of literature.

management also imply that energy management potentially can contribute to sustainability in a broader sense, particularly for industrial sustainability (Cagno et al., 2018; Trianni et al., 2017a), and go beyond solely the environmental dimension of sustainability. Hence, while this thesis acknowledges the role of energy efficiency for eco-efficiency, it views energy efficiency and energy management as a means for sustainability in an industrial context. It thus follows that management control for energy management is positioned within sustainability management control rather than eco-efficiency. As also discussed in Paper IV, the thesis follows Crutzen et al. (2017, p. 1293) in the argument that “as the literature on sustainability management control is still limited, research on the environmental and/or social pillar(s) of sustainable development is considered as belonging to the (broad) sustainability management control literature”. This also enabled a more holistic management control perspective on energy management than would have been possible otherwise.

Second, this thesis follows the managerial path and inside-out approach to sustainability management control (Burritt and Schaltegger, 2010). However, Burritt and Schaltegger (2010) propose three approaches for the managerial path where the other two are the outside-in and the twin track approach. The outside-in approach is stakeholder and external reporting driven: “Its logic is that companies are social organisations embedded in society, and that corporate responsibility will be judged by stakeholders, on which the company depends. To act responsibly can thus only be ensured if managers know what expectations, goals and views stakeholders have” (Burritt and Schaltegger, 2010, p. 836). Hence, while external reporting and communication is the endpoint in the inside-out approach, it is the starting point for the outside-in approach with the key issue being how to communicate sustainability performance to the relevant stakeholders (Schaltegger and Wagner, 2006). However, solely focusing on the outside-in perspective may have its drawbacks as stakeholders are also subject to their own intentions and agendas, and the twin-track approach brings these two approaches together to acknowledge both the internal and external dimension of the managerial path (Burritt and Schaltegger, 2010; Schaltegger and Wagner, 2006). Hence, only focusing on the inside-out approach and the internal dimension may be considered a theoretical limitation of this thesis. However, taking an inside-out perspective is in line with the aim of this thesis, which focuses on the management control activities and procedures and responds to calls in the management control literature (e.g. Berry et al., 2009; Lueg and Radlach, 2016). This can provide a nuanced understanding for sustainability-related decision-making in organisations (Bebbington and Thomson, 2013).

Finally, a limitation of how the LoC framework (Simons, 1995) is used in this thesis should be addressed. Although the framework, in the revised form by Tessier and Otley (2012), is used in its entirety, i.e. with respect to all levers (Martyn et al., 2016), this thesis is only concerned with one part of the MCS: energy management. While this focus enables for an in-depth understanding of the management control practises for energy management, both in terms of configurations and use, it also delimits the analysis to one system. Even though some interlinkages with other MCSs in the organisation were implicitly addressed through analysis, these are neglected by definition. This limitation of not explicitly considering the integration with other MCSs is acknowledged and discussed further in chapter six where it is identified as an avenue for further research.

Chapter 3

Methodology

This chapter will discuss the research design and research process of the thesis and describe the applied methods for data collection and analysis. The research has been conducted with a qualitative approach with interviews as the main data source. This thesis can be divided into three phases, an initial explorative phase, including a literature review and an interview and questionnaire study (Phase 1), followed by two in-depth case studies: one single case study (Phase 2) and one multiple case study (Phase 3). This chapter starts with a discussion of the overall research design and the choices made during the research process. The design of the literature review and the three empirical studies is then discussed, followed by data collection and analysis. Finally, the ethical considerations of this thesis and how quality has been sought are addressed.

3.1 Research design and process

The research within this thesis has been conducted with a qualitative approach. The broad aim of the thesis has been to examine management control activities and procedures for energy management. The research problem is positioned within both the literature on energy management and sustainability management control. As argued earlier, the latter stream of literature is emerging, still characterised by scattered empirical findings and different concepts (e.g. Lueg and Radlach, 2016). Energy management, as a means to improve industrial sustainability (Cagno et al., 2018), has been researched more extensively, although mainly within

the engineering discourse. Recent calls for research from organisational and strategic perspectives have been raised (Schulze et al., 2016), to which this thesis seeks to respond.

Hence, this research is not concerned with outcomes. Rather, it seeks to understand how management control for energy management is executed, operationalised through its activities and procedures, which motivates a qualitative research design (Maxwell, 2009). A qualitative research design also enables for in-depth studies (Yin, 2011), which can contribute to an increased understanding of energy management. In addition, both theoretical domains of the thesis (management control for sustainability and energy management) are young and emerging, which is why a qualitative design is useful due to the strength of qualitative methods for exploratory purposes (Maxwell, 2009).

The research process can be described in three phases. The first phase was concerned with understanding the additional benefits of energy efficiency investments, i.e. what are the benefits and the applied terminology, how are these benefits acknowledged, what characterises energy efficiency investments, what is the relation between benefits and energy efficiency investments, and so forth. This phase was thus exploratory in nature and emphasised the additional benefits of energy efficiency investments. Research was conducted through a literature review and a combined interview and questionnaire-study. In the second phase, I remained focused on energy efficiency investments, examining the investment process and the applied management control activities and procedures. While the purpose still has an overarching how-question, I took a more in-depth approach both method-wise (through a single case study) and theory-wise, (by bridging energy management literature with sustainability management control and taking in investment decision-making theory). In the third phase of the research process, the perspective was broadened to encompass energy management as a whole, i.e. not only limited to energy efficiency investments. A multiple case study was conducted in the PPI. The study analytically draws upon the thoughts of Simons (1995) and his LoC framework by analysing the data through the revised version by Tessier and Otley (2012). The research process is summarised in Table 2 below.

Table 2. Research process.

	Method	Theoretical domain		Empirical setting	Connection to RQs	Paper
Phase 1.	Literature review, interview study, questionnaire.	Energy management	Benefits of energy efficiency investments. Investment process.	Manufacturing and process industry	RQ 3	Paper I Paper II
Phase 2.	Single case study.	Energy management Sustainability management control	Benefits of energy efficiency investments. Management control activities and procedures for investments. Multi-level perspective on investment process.	Pulp and paper industry	RQ 1-RQ 3	Paper III
Phase 3.	Multiple case study.	Energy management Sustainability management control	Management control activities and procedures for energy management. Organisational levels of management control.	Pulp and paper industry	RQ 1, RQ 2	Paper IV

3.1.1 A pragmatic view

This thesis takes a pragmatic view. Pragmatism “emphasises that all aspects of research inherently involve decisions about which goals are most meaningful and which methods are most appropriate” (Morgan, 2014, p. 1050). Pragmatism states that there is an objective reality but that this can only be encountered through human experience and inquiry (Kaushik and Walsh, 2019; Morgan 2014) and on the scale or continuum of mode of inquiry, with deductivism and postpositivism on one end, and inductivism and constructivism on the other, pragmatism is located in the middle (Kaushik and Walsh, 2019). Instead of being “trapped” in either of these dichotomous corners, pragmatism accepts that there are multiple realities and research should

apply the methodological approach best suited for the particular research problem at hand (Feilzer, 2010; Kaushik and Walsh, 2019). For this reason, pragmatism is often connected to mixed-methods research, but it is not limited to any particular method (or mix of methods), nor does it exclude any other (Feilzer, 2010).

The research within this thesis has been conducted, for the most part, through a qualitative approach. A common research orientation in qualitative research is the interpretive, rooted in constructivism (Kaushik and Walsh, 2019), in which the research aims to develop an understanding based on the subjective meanings of the studied actors or persons (Schwandt and Gates, 2018). Or, as put by Kakkuri-Knuuttila et al. (2008, p. 268): “the act of interpretation, referring to describing the meaning of something, lies at the heart of this approach [the interpretative]” and it is through interpretation that these socially created meanings become understandable. However, the interpretive orientation has its limitations. As argued by Kakkuri-Knuuttila et al. (2008, p. 285), “interpretations *per se* are of limited interest unless they have some bearing on the way people actually make choices and interact with each other”. Concerns have been raised for management accounting research, as well as in the sustainability context, that theories should be useful for practice, advocating for a more pragmatic view (Malmi and Granlund, 2009; Gibassier and Schaltegger, 2015). Malmi and Granlund (2009) further argue that “it should not be in anybody’s interest to generate research articles the results of which, if any, could not be of less interest to practitioners” (p. 599). Pragmatism is thus concerned with creating constructive knowledge that is useful for action and change, i.e. being prescriptive (giving guidelines), normative (exhibiting values), or prospective (suggesting possibilities) (Goldkuhl, 2012, p. 140), or as expressed by Van de Ven (2007, p. 40): “knowledge is ‘truthful’ to the extent that it is successful in guiding action”. I agree with this view—although I see reality and knowledge as constructed and somehow based on interpretation, the knowledge we as researchers contribute to build should be relevant and useful.

The thesis therefore takes a pragmatic view but with instances of interpretivism through its engagement in understanding and qualitative, explorative studies, i.e. the thesis has interpretive elements that are seen as instrumental for the pragmatic study (Goldkuhl, 2012). The thesis aims to contribute to the literature on the configuration of SMCS with constructive knowledge focusing on activities and procedures, i.e. an example of referential pragmatism (Goldkuhl, 2012). Reconnecting to the pragmatic stance on the choice of methods, to choose the approach best suited for your research problem, has the implication that the research process could take other paths than initially planned, i.e. the initial research design may not fit the research problem as

planned, requiring “reflection and abductive reasoning, and the research methods or the underlying theory need sharpening or rethinking” (Feilzer, 2010, p. 14). This also happened during the research process of this thesis, particularly during phase one and while collecting and analysing the questionnaire, which steered the thesis in a more qualitative direction. This will be described in more detail in the following sections where the research methods are addressed.

3.2 Initial literature review of benefit terms

During the first phase of the research process, I was particularly concerned with the additional benefits and their role on energy efficiency investments. The research process therefore began with a literature review of the benefit terms used in the literature on energy efficiency investments²². It aimed to map the existing literature (Tranfield et al., 2003) and, if possible, define the adequate benefit term to be used in the industrial context of this research. The point of departure for the literature review was the report by the International Energy Agency (IEA), *Spreading the Net: The Multiple Benefits of Energy Efficiency Improvements* (2012). In the report, and reports that followed (see for example IEA, 2014), the IEA applies the term ‘multiple benefits’, (encompassing both energy savings and additional benefits), which range from climate change mitigation to productivity benefits. Through this terminology, the IEA (2012) argues for covering the terms used in the literature to denote additional benefits: ancillary benefits, co-benefits, and non-energy benefits. The three benefit terms were therefore reviewed systematically to assess their potential differences and similarities and establish which should be used in an industrial context and the subsequent research for this thesis. The method applied during the review is briefly described below.

To ensure replicability and transparency of the review process, the recommended method for systematic reviews with predefined keywords and search strings was followed (Needleman, 2002; Tranfield et al., 2003). The search included both articles and conference papers, since published conference papers are rather common in the energy field and excluding them could risk leading to incomplete results. The first step was to read the abstracts and decide whether to include or exclude the paper. A paper was included if it considered additional benefits in line with this research. Thereafter, a full-text review was made. The applied search string and results are summarised in Table 3 below.

²² The literature review resulted in Paper I of this thesis.

Table 3. Summary of the search and selection process.

Search string	TITLE-ABS-KEY ("BENEFIT TERM") AND (LIMIT-TO (SUBJAREA , "ENER")) AND (LIMIT-TO (DOCTYPE , "ar") OR LIMIT-TO (DOCTYPE , "cp"))		
Benefit term	Ancillary benefits	Co-benefits	Non-energy benefits
Number of hits	299	701	44
Subject area restriction	37	166	30
Document type restriction	34	156	26
After full-text review	12	17	15
Overlap	10		
Total	34		
Papers from additional searches	3		
Final sample	37		

When the literature search was complete, the final papers were read and analysed further. Based on this analysis, the term “non-energy benefits” was identified as the most relevant for an industrial context. The industrial sector was one of the main research areas, alongside buildings and the residential sector, and the benefits discussed in this literature occurred, in most cases, on an individual (household or firm) or sectoral (e.g. industrial) level. The analysis then continued to a second phase in which non-energy benefits were explored further, including an analysis of included benefits (type, characteristics, and frequency) and categorisations. A conceptual framework for defining and categorising non-energy benefits according to time frame and level of quantifiability was then developed (Paper I).

3.2.1 Influence on the subsequent empirical studies

The literature review provided guidance for the empirical studies conducted within this thesis. First, ‘non-energy benefits’ was defined as the most relevant benefit term to be used in relation to energy efficiency investments in an industrial context, and this was also the benefit term applied in the following studies. Second, the developed framework was applied empirically in Paper II. Third, the discussions on the difficulties of assessing additional benefits in investment appraisals continued into the second empirical study and Paper III.

Initially, the literature review also included a traditional review (Dijkers, 2009) on investment decision-making with the goal of a combined review²³. During the review process of Paper I, this part was excluded from the paper. However, this analysis still influenced the research process that

²³ Please refer to my licentiate thesis (Rasmussen, 2016) and the conference paper preceding Paper I (Rasmussen, 2014).

followed and laid the basis for using capital investment decision-making as a method theory, as discussed in chapter two.

3.3 Three empirical studies with three research designs

As described earlier, three empirical studies with different designs took place during the research process. The motivations for these designs will now be discussed. Each study is presented in detail in the appended papers.

3.3.1 Phase 1. Interviews and questionnaire: Exploring energy efficiency investments and non-energy benefits

This study has a mixed design of semi-structured interviews and a questionnaire. The study started with qualitative interviews²⁴. Interviews for collecting data and producing knowledge is one of the most common methods within the social sciences (Brinkmann, 2018; Czarniawska, 2014). As described by Brinkmann (2018, p. 580), interviews are suitable when a researcher is “seeking descriptions of *how* interviewees experience their world, its episodes and events, rather than *why* they have certain experiences” (emphasis in original). It was thus an appropriate method for data collection during the explorative first phase of the research process.

Initially, the idea was to conduct a larger questionnaire on non-energy benefits and their role for energy efficiency investments in the Swedish manufacturing industry. Questionnaires facilitate the collection of larger data sets, which, in turn, may lead to generalisable results (Rowley, 2012). Also, to our knowledge, industrial non-energy benefits had, at the time, only been researched through case studies or interviews. We therefore constructed a less extensive questionnaire to perform a pilot study (described further in 3.5.2). However, the results were ambiguous and revealed uncertainties both for how the concept of non-energy benefits was understood by practitioners and for the way in which non-energy benefits had been experienced. It was thus interpreted that at this stage, a questionnaire was not the appropriate method for collecting the desired type of information on non-energy benefits. We therefore proceeded with the interview method and conducted additional interviews.

This empirical study emphasises energy efficiency investments and non-energy benefits and is particularly interested in the motives behind these investments and the extent to which non-

²⁴ Also described in Nehler et al. (2014), a conference paper preceding Paper II.

energy benefits are acknowledged and monetised in the investment process. The companies participating in the first empirical study belonged to the Swedish manufacturing and process industries. The companies were high energy users and eight of them also participated in the PFE programme. The companies participating in PFE can be assumed to have previously worked with energy efficiency issues. For the remaining companies (five), a similar assumption can be made on the basis of their energy use; therefore, these issues are presumably a priority. All companies except for one are considered large with more than 250 employees. The last company is a large medium-sized firm with approximately 200 employees. The respondents were energy managers or similar (described further in 3.5), which inferred some limitations to the study. Although they had knowledge on energy issues and the companies' energy work, they often had only limited insights concerning the investment process in general and strategic priorities. They could, for example, have knowledge on which payback criterion (or other applied evaluation tool) was required, but not the underlying reasons for these requirements.

3.3.2 Phase 2. Single case study

After the interview study, the qualitative research process continued with a single case study, resulting in Paper III. Case studies are fruitful both for explorative purposes and for theory building (Eisenhardt and Graebner, 2007; Eisenhardt, 1989; Voss et al., 2002) and suitable when asking *how* and *why* questions (Yin, 2009). Case study research allows the research question to alter and develop during the research process (Eisenhardt, 1989; Voss et al., 2002), which can be a strength for emerging topics as in this thesis (Benbasat et al., 1987). Case studies are also, in line with the aim of the thesis, a means to provide an inside-out view and an increased understanding of the complexities related to management control for sustainability (Bebbington and Thomson, 2013).

As described in section 2.6, capital investment decision-making theory was used as a theoretical lens, as a method theory, to provide insights both on a specific as well as on a general level (Lukka and Vinnari, 2014). I sought to take a comprehensive perspective on the investment process and its activities and procedures and not limit the study to, for instance, the financial evaluation. The case firm, Alpha, was selected based on it having an interest in energy issues, belonging to an energy-intensive industry (the PPI), and having made a major investment that was examined in close. The investment, a new evaporation plant and upgraded recovery boiler, had at the time been implemented for one year and was necessary for keeping the production permit due to environmental compliance. It was thus considered a strategic investment. In addition to its main

aim of reducing dust emissions, it resulted in a major energy efficiency improvement, increased production, reduced maintenance costs, and other non-energy benefits. As discussed in Paper III, this case study sought to examine both the intervention (i.e. the investment) and the setting in which it took place (i.e. the investment process) and provide insights for energy efficiency investments in particular. But it also provided insights on complex investments in general and the role of management control activities and procedures in the decision-making process.

3.3.3 Phase 3. Multiple case study

For the third and final phase of the research process, the perspective was broadened from energy efficiency investments to energy management and the applied management controls, i.e. management control for energy management. Energy management was positioned as a means for sustainability and hence management control for energy management as an example of sustainability management control. For this phase, a multiple case study design was adopted in which three companies within the Swedish PPI were studied, including the company from the single case study, Alpha. Compared to single case studies, multiple case studies are based on more than one setting (Meredith, 1998) and offer higher analytical power and are more robust (Eisenhardt, 1989; Voss et al., 2002; Tellis, 1997; Yin, 2009). Moreover, having multiple cases enables comparison and cross-case analysis (Darke et al., 1998).

Companies within the PPI are subject to extensive external pressures on sustainability through regulations and legislation on, for example, emissions, certification standards (such as the ISO 50001²⁵), and the Act (2014:266) on Energy Audits in Large Enterprises. These companies were therefore expected to be engaged in energy management and sustainability work. Within the Swedish PPI, production is dominated by a few large groups. For this study, the four largest were contacted, of which three (Alpha, Beta, Gamma) agreed to participate, i.e. replication logic is present in the design of this multiple case study (Eisenhardt, 1989; Voss et al., 2002; Yin, 2009). The main source of data was semi-structured interviews, which were conducted on both group

²⁵ ISO 50001 is a standard for a certified energy management system, providing a framework of routines and guidelines for energy management (International Organisation for Standardisation, ISO, 2018), with the latest edition being ISO 50001:2018, replacing ISO 50001:2011. It aims to systematically integrate energy efficiency in the organisation (Böttcher and Müller, 2016). In line with other ISO standards, ISO 50001 is designed according to the plan-do-check-act framework. Böttcher and Müller (2016, pp. 1450-1451) summarise its requirements and guidelines according to six key components: management responsibility and the appointment of an energy manager; establishment of an energy policy; energy planning; implementation of actions; implementation of an energy controlling system; and management review, i.e. regular revisions by top management.

and unit²⁶ (two for each group) levels. This means that an embedded multiple case study design was adopted with analysis taking place on more than one level (Yin, 2009).

3.4 Sampling and the industrial context

The empirical studies were conducted at large companies within Swedish energy-intensive manufacturing and process industries²⁷, particularly the PPI. In Sweden, the PPI alone accounts for over 50 percent of the industrial sector's energy use (SEA, 2019), while iron and steel accounts for 15 percent, the chemical industry 9 percent, mechanical engineering 6 percent, and other industries the remaining 18 percent (SEA, 2017). Energy-intensive industries are large contributors of energy-related GHG emissions (Fischedick et al., 2014; Wesseling et al., 2017), which is why insights that contribute to an improved energy management of these industries are relevant to climate change mitigation and sustainable development (e.g. IEA, 2015; Rogelj et al., 2018).

This thesis aims to develop knowledge on the internal management of energy management, energy efficiency investments, and non-energy benefits, and this guided the selection of companies, i.e. a theoretical sampling logic aiming to develop, rather than test, theory (Eisenhardt and Graebner, 2007). Due to the external pressures in this sector (e.g. PFE, EKL, standards such as ISO 50001, etc.), these companies are expected to engage in activities related to energy management and energy efficiency investments. The structure of the pulp and paper companies under study in the two case studies (Paper III, Paper IV) enabled an embedded case study design in which energy management could be studied on both strategic (company group and unit) and operational levels. This sampling logic, however, infers limitations in terms of generalisability, which instead is discussed in terms of analytical generalisability and transferability (e.g. Guba, 1981); this is elaborated further in 3.9.

Despite the amount of research that has been carried out within the contingency stream, the industry context remains rather unexplored as a factor potentially influencing management

²⁶ Units or facilities of companies within the PPI are in the engineering literature often addressed to as mills. However, the mills included in the studies of these thesis operate as individual units.

²⁷ Energy-intensity refers to "the amount of energy input to deliver the unit of service, product or output" (Pérez-Lombard et al., 2013, p. 241) and industries usually regarded as energy-intensive include the iron and steel industry, the PPI, chemical, metallurgical, and mining industries (see for example SEA, 2015b and Unander, 2005). It should be noted that in Paper II, five of the companies belong to other manufacturing industries (engineering) that are usually not classified as energy-intensive. However, due to its significant share in terms of production, this industry is responsible for six per cent of the Swedish industrial sector's energy use (SEA, 2015c, p.14). Two of these companies also participated in PFE, which was targeted for energy-intensive (specifically electricity-intensive) companies.

control practices (Bromwich and Scapens, 2016; Messner, 2016). Messner (2016) conceptualises industry context in two different ways, based on core organisational practices or according to influential factors, such as regulations, legislation, or praxis. The latter is of relevance here, i.e. factors that are not core organisational practices but still may influence management control practices in that industry: “we would expect to find some homogeneity in management accounting within an industry, not because of how this industry operates in principle, but because of some (more or less tangible) context factors that shape organizational practice and, in turn, management accounting practice in that industry” (Messner, 2016, p. 106). This thesis can thus contribute insights on sustainability management control practices for the energy-intensive industrial sector. However, this expected homogeneity can also provide a limitation as there may be difficulties in discerning what activities originate from the company rather than external pressures. Therefore, it was also examined how, and to what extent, management control activities and procedures are used for energy management. The dimension of sustainability orientation was added (Paper IV) to provide a more detailed picture of the management control activities and procedures for energy management in this compliance-driven industrial sector.

3.5 Data collection: A (mainly) qualitative approach through semi-structured interviews

Interviews are a common source of data collection in qualitative research. Within the social sciences, semi-structured interviews are possibly the type of interview most often performed (Brinkmann, 2018; Rowley, 2012), and that was also the case in this thesis. Interviews are a valuable source of data for gaining insights into, for example, experiences, processes, or understanding of opinions (Rowley, 2012). Semi-structured interviews were therefore conducted in all three empirical studies, with the advantage of being more focused than unstructured interviews while at the same time providing more freedom for the interviewer compared to structured interviews, enabling for knowledge-producing dialogues (Brinkmann, 2018).

Brinkmann (2018, pp. 580-583) defines the interview with four keywords: purpose, descriptions, lifeworld, and interpretation of meaning. Purpose illustrates the fact that “interviews are conversations conducted for a purpose” (Brinkmann, 2018, p. 580), and they are performed in a way consistent with the motive and goal of the researcher. The second keyword, description, explains what is usually sought in interviews, i.e. a description of the research matter, often in terms of what and how. In qualitative research, lifeworld phenomena or lived experience are the focus for our research inquiries (Brinkmann, 2018), and the subject of the qualitative, semi-

structured interview can be described as the lifeworld of the interviewee and his/her relation to it (Kvale, 1997), i.e. the third keyword. Finally, interpretation of meaning concerns interpreting the descriptions provided by the interviewee on their lifeworld, such as what is said and how it is said (Brinkmann, 2018; Kvale 1997). It is a process taking place throughout an interview project (Brinkmann, 2018); hence, the reliance upon qualitative interviews is an interpretive element of this thesis, as discussed earlier.

However, interviews are subject to some shortcomings, such as the asymmetrical power relation during the interview and monopoly power of the interviewer in interpretation (Brinkmann, 2018). Therefore, it is recommended to strive for a reflexive position (Alvesson, 2003; Kvale, 1997), and, as a researcher, one should thus strive for continuous reflection and analysis during the interview project (Yin, 2011). During the research process, I sought to acknowledge this. Interview guides were applied during the interviews (Yin, 2011). Being semi-structured, they suggested themes and questions in line with the purpose of the interview, but these were not necessarily addressed in the predefined order (Kvale, 1997) and depended on the direction of the dialogue during the interview. Additional follow-up questions were also posed.

The general themes of the interview guides used for the three empirical studies are summarised in Table 4 alongside a short description of the respondents. The questions asked during the interview can vary (Kvale, 1997; Leech, 2002), and in this thesis the interview questions have ranged from so-called grand tour questions (Spradley, 1979, in Leech, 2002), i.e. where the interviewee is asked to provide a tour on the research topic, for instance; *How do you work with energy management?* (Multiple case study, Paper IV), to more direct questions in which the topic is more specified (Kvale, 1997). This includes, for example: *Is this type of non-energy benefit possible to monetise?* (Interview study, Paper II); *What motivates energy efficiency investments at your company?* (Interview study, Paper II, and single case study, Paper III); *How do you communicate information on energy management work at the mill?* (Multiple case study, Paper IV).

Table 4. Description of interview guides and respondents.

Themes of interview guides	Respondents
Interview study	
1. Background information, e.g. energy use.	Energy managers or similar. Responsible for the companies' energy issues and interacted with management and/or belonged to energy steering committees.
2. Investments, e.g. motives, implemented energy efficiency investments, investment process, evaluation tools, and so forth.	
3. Non-energy benefits, e.g. experienced benefits, quantification.	
Single case study	
1. Background information, both on the company and the respondent.	Representatives on group and unit level. Interviewees in varying ways involved in the investment process and with energy efficiency and sustainability issues.
2. Investment process in general, e.g. actors involved, financial evaluation, guidelines, information etc.	
3. Investment process for energy efficiency investments in particular, including questions on strategic support and motive for energy efficiency.	
4. Additional benefits, e.g. experienced benefits, how they're accounted for in the investment process, etc.	
5. 1-4 for the case investment.	
Multiple case study	
1. Background information, e.g. history of energy management work, motive.	Representatives on group and unit level. Interviewees in varying ways involved in energy management, sustainability, and management control aspects.
2. Organisation and structure.	
3. Activities and procedures of energy management: Top management, Control, Employees, Communication, Measures, Investments, Information & Analysis, Evaluation & Follow-up.	

In Table 5, an overview of the interviews which this thesis draws upon is provided. This includes 36 interviews of which I have been part of conducting 25²⁸. The number of interviews can be considered a limitation. At the same time, only relying on the quantity of interviews is not enough to ensure validity if they, for instance, only reflect one perspective (Alvesson, 2003). This is often a limitation for empirical sustainability management control studies (Crutzen and Herzig, 2013). However, the interviewees in this thesis have had different roles and management functions on different organisational levels. The most common role was the energy manager (Paper II, Paper IV) but controllers, department and division managers (i.e. head of), investment managers, environmental manager, sustainability director, production engineers, and senior energy managers (Paper III, Paper IV) were also interviewed. This has enabled various perspectives on energy management and energy efficiency investments to be acknowledged. It also responds to previous calls (Pérez et al., 2007) and enabled for insights regarding the role and connections of different management functions in energy management work.

²⁸ Nine of the interviews in the interview study were conducted by Therese Nehler alone. My contribution to this study is elaborated further 3.7.

Table 5. Overview of conducted interviews.

Interviewee(s)	Duration	On site/phone	Interviewer(s)
Phase 1. Interview study, Paper II. Energy Managers or similar.			
Company A (Pulp and paper)	1 hour	Phone	TN
Company B (Iron and steel)	1 hour	Phone	TN
Company C (Pulp and paper)	1:10 hours	Phone	TN
Company D (Engineering)	1:20 hours	Phone	TN
Company E (Engineering)	1 hour	Phone	TN
Company F (Engineering)	50 minutes	Phone	TN
Company G (Engineering)	1 hour	Phone	TN
Company H (Engineering)	40 minutes	Phone	TN
Company I (Chemical)	2 hours	On site	TN, JR
Company J (Chemical)	1:20 hours	On site	TN, JR
Company K (Other)	1:05 hours	On site	TN, JR
Company L (Iron and steel)	1:45 hours	On site	TN, JR
Company M (Pulp and paper)	1 hour	Phone	TN
Phase 2. Single case study, Paper III. Company Alpha			
Group Sustainability Director	40 minutes	On site	JR
Department Manager Sulphate Pulp Unit	40 minutes	On site	JR, TN
Investment Manager	1:15 hours	Phone	JR
Environmental Manager	1 hour	Phone	JR, TN
Division Manager	1:15 hours	On site	JR, TN
Investment Manager Strategic Projects	1:45 hours	On site	JR, TN
Financial Manager	1 hour	On site	JR
Maintenance Manager	45 minutes	On site	JR, TN
Technical Controller	45 minutes	On site	JR, TN
Manager Work Environment & Safety	1:15 hours	On site	JR, TN
Phase 3. Multiple case study, Paper IV. Companies Alpha, Beta, Gamma.			
Company Alpha			
Senior Energy Manager (Group level)	1:15 hours	Phone	JR
Division Manager (Unit 1)/Senior	1:30 hours	On site	JR/EA
Technology Manager (Unit 1)			
Energy Manager (Unit 2)	1:50 hours	Phone	JR/EA
Company Beta			
Head of Unit (Unit 1)	1 hour	Phone	JR/EA
Department Manager (Unit 1)	1:15 hours	On site	JR/EA
Energy Manager ^a (Unit 1)	1:55 hours	On site	JR/EA
Production-Energy Engineer (Unit 1)	1:20 hours	On site	JR/EA
Two Production-Energy Engineers (Unit 2)	1:55 hours	On site	JR/EA
Controller (Unit 2)	45 minutes	Phone	JR
Company Gamma			
Senior Energy Manager (Group level)	2 hours	On site	JR/EA
Division Manager (Unit 1)	1:20 hours	On site	JR/EA
Energy Manager, acting (Unit 1)	1:15 hours	On site	JR/EA
Energy Manager (Unit 2)	1:40 hours	Phone	JR/EA

JR: Josefine Rasmussen; TN: Therese Nehler, EA: Elias Andersson, research colleagues in joint research project.

As evident from the table, the interviews were, to a large extent, performed by two researchers, which should be considered a strength due to the additional perspectives and support for the findings that multiple investigators can provide (Eisenhardt, 1989). As much as possible the interviews were conducted on site, face-to-face, which enables acknowledging expressions and

other non-linguistic information (Kvale, 1997). For analysis, all interviews were recorded and transcribed. Notes were also taken as well as reflections after the interview, as recommended in the literature (Kvale, 1997).

3.5.1 Additional data sources

Case studies have the advantage of possibly drawing upon multiple data sources (Eisenhardt, 1989; Meredith, 1998). Document reviews were the most common additional data source for the case studies. In the single case study, the interviews were supplemented with internal and external documents, including, for example, forms for investment application, sustainability reports, and press releases. (Table 6). An introductory meeting and tour of the unit also took place during the single case study.

Table 6. Additional data sources for the case studies.

Data Source	Description
Single Case Study	
Introductory meeting.	Initiated data collection. Meeting between research project group and the Division manager. Presentation of the unit (mill) and its operations. Notes.
Unit tour.	By Division manager in connection to the informational meeting.
Financial and sustainability reports.	External documents, publicly available.
Press releases.	For case investment and other sustainability-related investments. External document, publicly available.
Investment application form.	Internal document. Received copy.
Environmental analysis form.	Internal document. Received copy.
Risk analysis.	Internal program and document. Observed on site and took notes.
Presentation on case investment.	Internal document. Received copy.
Multiple Case Study	
Financial and sustainability reports.	External documents (all companies), publicly available.
Notes from internal meeting.	Internal, received copy (Alpha 2).
Balanced Scorecard.	Internal, received copy (Beta 2).
Observation at energy group meeting.	Internal. Notes and received presentation (Beta 2).
Policy documents (e.g. energy, environment, sustainability).	Internal, received copy (Beta, Gamma).
Presentation of unit.	Internal document. Received copy (Beta 1).
Document about unit.	External document, publicly available (Gamma 2).
Manual for assessment of energy aspects.	Internal document. Received copy (Beta 1).
Manual for energy management work.	Internal document. Received copy (Gamma 2).

For the multiple case study, the additional data sources likewise included financial and sustainability reports but also policy documents, manuals, other internal documents, and an observation of an energy group meeting. In addition to the data sources described above, notes

taken during interviews and telephone and email conversations also serve as supporting data for the case studies.

3.5.2 The questionnaire

As described in the research process, the initial idea was to collect data through a questionnaire, and a pilot study was therefore conducted in 2014. A three-item questionnaire was distributed and recollected during a networking event arranged by the Swedish Energy Agency for firms participating in PFE. Forty-three firms participated, all from energy-intensive industries, and the respondents regularly worked with energy issues. The three questions of the questionnaire are presented in Table 7, along with the response rates (63 percent responded to all questions).

Table 7. The questionnaire.

Question	Response alternatives	Response rate
1. What capital budgeting tools are normally applied at your firm before making an investment decision? For example: PB, NPV, or IRR.	Open-ended.	72%
2. Have you experienced the listed non-energy benefits when making energy-efficiency investments at your firm?	Yes/No Rank importance for energy efficiency investments, 1-5.	70%
3. State whether or not the listed non-energy benefits are included in investment calculations when making energy-efficiency investments at your firm.	'Yes' 'No, but included as a comment in application.' 'No, it is not included.' Possibility to elaborate on why/why not a benefit was included.	63%

When the results of the questionnaire were analysed, ambiguity and uncertainty were revealed in the answers. The results of the questionnaire were therefore mainly used to draw methodological conclusions on the research inquiry on non-energy benefits.

3.6 Data analysis

Since the thesis is based on three separate empirical studies, the methods for data analysis have varied depending on the nature of these studies. However, since all three are based on qualitative data (with the exception for the questionnaire during Phase 1), the analysis can be described according to the five phases of data analysis depicted by Yin (2011, p. 180): (i) compilation of data; (ii) dissembling; (iii) re-assembling; (iv) interpreting; and (v) concluding. This process should be iterative with the researcher going back and forth between the phases (Yin, 2011) to enable reflection and rethinking on both methods and theory (Feilzer, 2010). The first phase, compilation, followed the same pattern for all three studies in compiling recordings, transcripts,

notes, and additional data sources. The remaining steps varied between the studies and ranged from structural coding (Saldaña, 2009) to within- and cross-case analysis (e.g. Eisenhardt, 1989) of the case studies. This will therefore be described for each empirical study separately.

During the data analysis of the first empirical study's interviews, we applied structural coding. It is a content-based method deemed appropriate for qualitative research, including multiple participants and semi-structured means of data collection (Saldaña, 2009). This approach means that the coding is based on content and related research questions (Saldaña, 2009); it also has been referred to as a question-based method (Namey et al., 2008). In this study, it concerned motives and factors of adopting energy efficiency investments and the extent to which non-energy benefits had been experienced in relation to such investments (Paper II).

The data analysis for the single case study had a more in-depth approach through a within-case analysis. Its aim is that the researcher should "become intimately familiar with each case" (Eisenhardt, 1989, p. 540). Ayres et al. (2003) discuss the identification of significant statements and analysing the data both on the level of each participant (in this case, each interviewee) and on an aggregated level. Patton (2015) describes the use of sensitising concepts as "categories that the analyst brings to the data" (p. 545) to be used as guidance for both inquiry and analysis. Both the single case study and Paper II were analysed through the lens of capital investment decision-making theory which also guided the data analysis.

The third empirical study, the multiple case study, took one additional step in data analysis and also included a cross-case analysis. However, it started with a within-case analysis. The study used the revised LoC framework by Tessier and Otley (2012) as its analytical framework, which steered the analysis of the data. First, the individual controls were identified (i.e. social or technical), followed by an analysis with respect to objective and use. After this initial within-case analysis, data analysis proceeded with a cross-case comparison searching for patterns (Eisenhardt, 1989; Patton, 2015) both within and between the company groups, i.e. both inter- and intra-organisational patterns in the configuration of the MCS for energy management. Analysis took place both on the unit and group level, seeking to avoid an analysis only on the subunit level, a common pitfall of embedded case studies (Yin, 2009).

Qualitative studies are often characterised by an analysis in which patterns, themes, and categories are inductively discovered (Patton, 2015, p. 542) and this was, to a large extent, also the case during the analysis for the three empirical studies of this thesis. However, as evident from

the above discussion, there were also instances of a more deductive content analysis through the identification of predefined activities, procedures, and controls (Paper III and Paper IV). This process is similar to the methodology used by Guenther et al. (2016, p. 152) who combine both deductive and inductive content analysis by identifying known definitions as well as discovering patterns on environmental MCSs.

3.7 My contribution to the studies and papers

Paper I is a single-authored literature review. During the research process I was involved in two collaborative and interdisciplinary research projects with researchers from business administration and energy systems. Collaboration took part through joint data collection for all three studies and the writing of Paper II. Paper II was co-authored with Therese Nehler, who also was the main author. As evident from Table 5, the majority of the interviews were conducted by Therese alone, whereas I only participated in four of them. For these four interviews, I took notes and posed follow-up questions while Therese was the lead interviewer. Therese was also main responsible for the interview guide and questionnaire, but I did, however, provide feedback on them before data collection. Regarding data analysis, we both read and analysed the transcripts from all interviews and the responses from the questionnaire. I also transcribed two of the interviews. When writing the paper, I was main responsible for the two chapters on previous research, while Therese Nehler was main responsible for the method chapter. For the remainder of the paper, we contributed equally in writing. How to frame the paper and how to analyse and present the results were continuously discussed between us during the writing of the paper. We also shared the work during the revision process.

Paper III and Paper IV are single authored. However, as described above, collaboration within the interdisciplinary research project took place during data collection for these empirical studies, which should be acknowledged. Out of the ten interviews of the single case study resulting in Paper III, seven were conducted together with Therese Nehler and two by me alone. Therese also transcribed one of the interviews. In contrast to the interview study, we reversed roles and I was the lead interviewer. The interview guides were constructed by me, with feedback from Therese and other members of our research group. It should also be noted that the interview guide for the interview with the health, safety and environment (HSE) manager was mainly prepared by Therese.

The interviews conducted within the multiple case study resulting in Paper IV were partly conducted with Elias Andersson (Table 5). Here, the setup was quite different. Within our research project, we had different objectives but with some shared interests. While my research interests were energy management activities, procedures, controls, and related aspects, Elias' interests were on benchmarking and energy KPIs. These are in turn aspects of energy management and we therefore conducted joint interviews. The interviews had two parts. First, the interviews centred around the companies' energy management and its associated activities, procedures, and controls; I was the lead interviewer for this part. For the second part, Elias was the lead interviewer and posed more elaborated questions regarding benchmarking and energy KPIs. We prepared our own parts of the interview guides and provided feedback to each other. For data analysis, I transcribed nine interviews and Elias transcribed the remaining four. Although the interviews had two distinct parts, we had some overlaps and could benefit from this interdisciplinary collaboration in data collection and from each other's different perspectives.

3.7.1 Predefined projects

The research carried out within this thesis was conducted within two collaborative and interdisciplinary research groups. These groups have included both doctoral students and senior researchers, which has enabled for valuable discussions and opportunities for feedback during the research process. However, this also implies that I have been influenced in my research by the overall aims of the projects in terms of empirical setting and frame of the thesis. The aim of the first research project (under which the studies of Paper I-III were conducted) was to analyse how energy can become a strategic issue for Swedish industry by analysing the capital budgeting and decision models used to guide companies' strategies, including non-energy benefits. The aim of the second research project, under which the multiple case study was conducted, was to analyse how energy management is conducted in the Swedish PPI and the way in which energy management work can be developed to contribute to the industry's shift towards sustainable energy systems and long-term competitiveness. However, as is also discussed below in relation to the role of being externally funded, I have sought to be as independent as possible as a researcher in formulating the research problem and in choice of theory, method, and analysis. Since my studies have constituted only one part of these research projects, there has been room for individual freedom in terms of design and focus.

3.8 Ethical considerations

3.8.1 The role of external funding

The research constituting this thesis was conducted within research projects funded by the Swedish Energy Agency. This implies an issue of being “stuck in-between” the funded research project and the thesis or balancing between market orientation and academic orientation, as discussed by Ylijoki (2003). The overall aim of the research projects has of course had an impact on the thesis and its research subject. However, I have sought to protect my academic freedom as a researcher. For instance, the theoretical framing of energy management within sustainability management control and the use of the LoC framework are examples of independent choices.

Eisenberg (1988) identifies two possible threats to academic values and academic freedom when the research is externally funded: distortions of viewpoints and claims of academic researchers and distortion of the research agenda²⁹. The threat of distortion of viewpoints and claims involves the risk of adapting viewpoints and scientific claims in order to please the funder’s agenda. The second threat, distortion of the research agenda, involves the risk of the research being led by the goals of the sponsor (Eisenberg 1988). These threats may lead to the researcher being constrained by the aims of the sponsor; falsified or exaggerated results to please the sponsor; or, on the contrary, not publishing results that are not in favour of the sponsor. As already noted, the research presented in this thesis has been influenced by the research project within which it has been conducted. Still, choices regarding the research focus as well as methods, for instance to do case studies, have been made without being implied by the goals of the research project. The form of funding has not affected what results that have been published.

3.8.2 Anonymity

The empirical data of this thesis have been anonymised, which implies a lack of transparency and replicability. Anonymity may reduce the “political” risks of interviewing, but it is no guarantee—the interviewees may still experience uncertainty and doubt, for instance on how the interview material will be used in the future (Alvesson, 2003). However, if participants, such as organisations or individuals, are not anonymised, the presentation of the research may be censored in order to protect the participants (Guenther, 2009).

²⁹ Eisenberg (1988) also states the possible threat of secrecy of results, but this has not been an issue in this research project since no such claims have been stated.

3.9 Validity

Establishing quality and rigour of qualitative research has long been considered a difficult task (e.g. Creswell and Miller, 2000; Gioia et al., 2012; Whitemore et al., 2001), which implies the need for taking various actions and strategies (Morse, 2018). One important aspect in this regard is validity, of which Cho and Trent (2006) discuss two perspectives, transactional and transformational. Transactional validity is concerned with applying different techniques to ascertain credibility (Cho and Trent, 2006). This includes common techniques such as triangulation (Creswell and Miller, 2000; Lincoln and Guba, 1986; Yin, 2011, 2009). On the other hand, transformational validity is described as a process in which the researcher is self-reflective and strives for a deeper understanding of the research problem, rather than applying different techniques (Cho and Trent 2006). Through the interdisciplinary approach taken in this thesis, I have been forced to step out of my comfort zone and address new theoretical avenues and streams of literature. Reflection has taken place regarding methods and theory, and, in line with the pragmatic stance, resulting in changes in direction during the course of the research process.

Transactional processes to ascertain validity are described as taking place on a continuum between the positivist and the constructivist view, while the transformational approach is more rooted in the social constructivist view³⁰ (Cho and Trent, 2006). Cho and Trent (2006) advocate a holistic approach in which both perspectives are combined, depending on the research problem: "Our distinction is that is not an either/or choice. One need not choose between practical and emancipatory purposes any more than one must select transactional validity criteria over transformational validity aims" (p. 333). The holistic approach is applied here with a mix of "traditional" quality criteria (Yin, 2009), i.e. transactional validity techniques, and transformational elements, which was discussed in the previous paragraph. This follows from the research design of this thesis which has a research problem engaged with developing a deeper understanding as well as providing constructive knowledge and practical implications for improving sustainability in the industrial sector. It also analyses data involving deductive as well as inductive, interpretive elements.

Construct validity is concerned with whether the researcher measures what he or she claims to measure, for which one tactic is the use of multiple sources of evidence and triangulation (Yin,

³⁰ "It makes sense that meanings are social constructions and multiple perspectives on a topic yield multiple meanings. Therefore, the question of validity in itself is convergent with the way the researcher self-reflects, both explicitly and implicitly, upon the multiple dimensions in which the inquiry is conducted. In this respect, validity is not so much something that can be achieved solely by way of certain techniques" (Cho and Trent, 2006, p. 324).

2009). This thesis rests upon multiple sources of empirical data and methods: interviews, internal documents, a questionnaire, external and publicly available documents and information, meetings, one observation, and additional communications (phone, email). Triangulation aims for convergence among multiple sources of information in different ways (Creswell and Miller, 2000). Triangulation has occurred in terms of research designs, methods for data collection, data sources, and investigators. Methodological triangulation is often discussed in terms of mixing quantitative and qualitative methods but might as well be a combination of qualitative methods (Pritchard, 2012), as it is in this thesis. The thesis includes four studies with separate research designs and methods (i.e. a systematic literature review, an explorative interview study, a single case study, and a multiple case study) which, from different perspectives, address the research problem in line with the pragmatic view of this thesis. Methodological triangulation may help to counteract bias in research findings due to method-specific errors (Jack and Raturi, 2006). For data collection and sources, this thesis is based on interviews made with respondents on different positions and with different viewpoints, on both operational and strategic organisational levels, which has enabled different perspectives. The interdisciplinary research projects have also enabled investigator triangulation, which has provided complementary perspectives and interpretations during data collection and increased confidence in the findings (Eisenhardt, 1989).

For the case studies, it has been carefully documented what type of data (interviews, documents, observation, etc.) was collected for each study, how it was gathered (e.g. recorded, transcribed, notes), and the way in which it has been stored (e.g. paper or digital copy). Building this database is also a means to increase reliability (Yin, 2009). For case studies, Yin (2009) also discusses internal validity, which is only applicable for explanatory case studies and hence only the multiple case study for this thesis. Establishing internal validity was sought by relying on theoretical propositions in analysis (Yin, 2009) by applying Tessier and Otley (2012) as a method theory and adding the dimension of sustainability orientation (Ditillo and Lisi, 2016). This analytical lens was the basis during the analysis of within- and cross-case patterns (Eisenhardt, 1989).

External validity concerns generalisability, which, for qualitative research, is discussed in terms of analytical generalisability (Yin, 2009) and transferability (Guba, 1981). This implies that the conclusions are applied and transferable to similar contexts in which the studied phenomenon is of interest (Yin, 2011). Baxter and Chua (1998) also argued for the possibility to theorise beyond the empirical case, since the empirical case serves to exemplify the research problem; it is a matter of “moving from the general to the local to the general” (p. 80). In this thesis, the general research problem was studied in the local context of the included firms. The findings presented in this

thesis should thus be transferable from the studied firms to a more general context. Considering the characteristics of the included firms, the findings would be transferable to other large firms within manufacturing and process industries and possibly also to additional industries with similar characteristics, such as those with high energy intensity and/or those subject to environmental regulations.

For multiple case studies, external validity is established through the replication logic (Eisenhardt, 1989; Yin, 2009). For the single case study and the interview study, it is instead suggested to be established by the use of thick, descriptive data (Lincoln and Guba, 1985; Creswell and Miller, 2000). These thick descriptions aim to provide a “*data base* that makes transferability judgements possible on the part of potential appliers” (Lincoln and Guba, 1985, p. 316, emphasis in original). Maxwell (2009, p.244) further stresses that “[i]n interview studies, such data generally requires verbatim transcripts of the interviews, not just notes on what you felt was significant”. All interviews in this thesis were recorded and verbally transcribed and the role of each interviewee is described. The aim has been to describe the methods with as much detail as possible for the studies that constitute this thesis. These descriptions, together with document procedures for the case study data described above, are also a means for establishing the reliability of the study (Yin, 2009).

Chapter 4

Summary of papers

This chapter provides an extended summary of the appended papers. The chapter ends by stating their respective contribution.

4.1 Paper I: The additional benefits of energy efficiency investments—a systematic literature review and a framework for categorisation

Paper I is a systematic literature review of three benefit concepts applied in the literature—co-benefits, non-energy benefits, and ancillary benefits—which aims to assess the potential differences and similarities between these terms and establish which one should be used in an industrial context as well as the subsequent research for this thesis. An underlying motive for this paper is that acknowledging these additional benefits, for example, reduced maintenance costs, reduced emissions, or improved public image (Worrell et al., 2003), can improve the business case for energy efficiency investments (Pye and McKane, 2000) and may also plausibly contribute to increase competitive advantage (Cooremans, 2011), i.e. it is in line with the ‘win-win’ argument (Porter and van der Linde, 1995a) for improving energy efficiency discussed earlier.

One important means to reduce energy use is through investments in energy efficiency. However, energy savings alone are not always enough to motivate such investments and acknowledging the additional benefits of energy efficiency investments has therefore gained an increased interest in the literature (e.g. Pye and McKane, 2000; Worrell et al., 2003; Fleiter et al., 2012). However,

different benefit terms are used in the literature with a lack of clear definitions and distinctions between them. Paper I sought to gain clarity on this matter. An additional aim with the paper was to develop a categorisation framework to facilitate an *ex-ante* analysis of the additional benefits, which in turn could contribute to improving the business case for energy efficiency investments. For an industrial context, the term identified as the most adequate was *non-energy benefits*, based on main research area, societal level, and addressed benefits within the concept. Non-energy benefits are then defined as: "...the benefits related to industrial energy efficiency investments, beside energy savings, that are quantifiable at a varying level and arise in a short- and/or long-term perspective" (Paper I, p. 1411).

Non-energy benefits range from being quantifiable (for example, reduced maintenance costs or a reduction in raw materials) to less quantifiable (for example, improved work environment). According to the literature, the time in which the benefit occurs also appear to vary with both short-term benefits related to, for example, production and long-term benefits, such as improved image or reduced emissions. Hence, it is argued that both the level of quantifiability, and thus the possibility to translate additional benefits into monetary values, should be acknowledged alongside its time frame. A framework in which non-energy benefits can be categorised according to these two dimensions is therefore developed.

The framework is suggested to facilitate for decision-makers to account for non-energy benefits during the investment process. It provides a shared language in how to express non-energy benefits to improve the business case arguments for energy efficiency investments. This could both act as an offset to barriers, such as short payback requirements, as well as reinforce drivers (e.g. green image) and increase the adoption of energy efficiency investments thus contributing to improving energy efficiency for the industrial sector.

4.2 Paper II: How do firms consider non-energy benefits? Empirical findings on energy-efficiency investments in Swedish industry

Paper II continues in the same vein as Paper I and focuses on the non-energy benefits of energy efficiency investments, specifically on how industrial companies have experienced non-energy benefits, i.e. it aims to explore companies' perspectives on and experience of energy efficiency investments and non-energy benefits. The paper aims to explore the way in which industrial companies consider energy efficiency investments and the extent to which non-energy benefits were acknowledged in the investment process. Three research questions guide the paper: (i)

What are the firms' motives with energy efficiency investments?; (ii) What are the critical factors for approving an energy efficiency investment?; and (iii) To what extent are non-energy benefits acknowledged in the investment process (i.e. what non-energy benefits have been observed? which non-energy benefits are monetised? and which non-energy benefits could be monetised?).

The results are based on thirteen interviews with energy managers, or alike, at companies within the Swedish manufacturing industry. A smaller questionnaire was also distributed at a networking event for companies who participated in the PFE programme. The interviews included questions on investment motives, the investment process (e.g. phases, capital budgeting tools etc.), implemented energy efficiency investments, experienced non-energy benefits, quantification and monetisation of non-energy benefits, and so forth. Three questions were posed through the questionnaire regarding (i) usually applied capital budgeting tools; (ii) experienced non-energy benefits; (iii) the way in which non-energy benefits are included in investment assessment.

The main motive for energy efficiency investments indicated from the interviews was the potential cost savings; however, there could often be several motives. Despite energy efficiency being regarded as a priority, profitability and payback time were indicated as dominating for the outcome of investment decisions. In light of these findings, and building on Paper I, this paper first stresses that the level of quantifiability should be acknowledged when accounting for non-energy benefits. Second, the paper proposes that non-energy benefits be denoted in terms of costs and revenues, when applicable. The paper also provides suggestions on measurement of certain benefits. It also sheds light on the possibility of indirect non-energy benefits, in the paper discussed as when non-energy benefits are measured through other benefits.

The empirical data indicated that the studied companies had experienced various non-energy benefits, particularly related to reduced maintenance costs and improved work environment. Non-energy benefits were, however, rarely monetised or included beforehand in investment calculations, with one explanation being a lack of knowledge on how to measure these benefits. Hence, the paper contributes insights that could facilitate the inclusion of non-energy benefits in the assessment of energy efficiency investments, which is important for improving the business case. These contributions would be valuable from a managerial perspective when put together with the paper's findings on investment motive and the rigid requirements on profitability and payback period. Energy cost-savings alone were rarely enough to motivate an energy efficiency investment. Thus, these findings could contribute to improving the business case for energy

efficiency investments and a framing that meets the profitability requirements, which, in turn, may increase the possibility for a positive investment decision.

4.3 Paper III: Investment activities and procedures for industrial sustainability—a case study

Whereas the first two papers were focused on the non-energy benefits of energy efficiency investments, this third paper took a comprehensive perspective on the investment process. More specifically, the paper takes a management control perspective on energy efficiency investments and aims to examine the activities, procedures, and roles of information in the investment process. Through a case study of a major, complex, and sustainability-related capital investment, the study is concerned with how the structural context of the investment process enables for (or limits) complex investments that may not fit its predefined rules and controls, with an emphasis on sustainability-related investments. By addressing the activities and procedures of the investment process and the integration of sustainability (here energy and non-energy) benefits in management control practices, the study frames investment decision-making as a management control activity (Bower, 1970; Harris and El-Massri, 2011). The paper seeks to contribute to the emerging field of management control for sustainability (e.g. Gond et al., 2012; Guenther et al., 2016; Hosoda and Suzuki, 2015) and, by applying investment decision-making theory as a method theory (Lukka and Vinnari, 2014), to a developed understanding of investment decision-making (e.g. Clancy and Collins, 2014; Graham et al., 2015; Haka, 2007).

The paper is based on a single case study of a company operating in the Swedish PPI. Empirical data was collected through interviews at the group and unit levels, along with secondary data sources, such as the investment manual and other internal and external documents. The stages of the investment process at the company and for the case investment was identified. This was followed by an analysis of what took place during and between the stages, the involved actors, and the nature of their involvement. This was accompanied by an identification of the activities and procedures and the way in which energy efficiency and non-energy benefits were accounted for.

The paper revolves around three main concepts: activities, procedures, and information. The findings indicate an investment process which involves various functions and decision-makers in different investment activities. The investment process is, to a large extent, delegated to the units (i.e. mills) and therefore also formalised with pre-defined activities and procedures (such as the authorisation route and investment manual) to guide and direct unit-level (mill) managers.

Information is also identified as having both an instrumental and a strategic role. This makes the configuration of the activities and procedures crucial for how sustainability-related information can be acknowledged in investment processes. The findings indicate incidences of integration that can enable sustainability-related investments to pass the process as well as influence the execution of an investment, for example the inclusion of energy efficiency as an investment criterion and the requirement of an environmental analysis for all investment appraisals. However, they also indicate ambiguities and opposing practices that could cause tensions in the investment process, stemming from a dual role of information and ambiguous signals from the configurations of the activities and procedures, which are simultaneously broad in scope and contain explicit requirements regarding simplicity and clarity.

There are three main implications from these findings. First, the instrumental role of information (Hirst and Baxter, 1993) argues for acknowledging energy efficiency and non-energy benefits to improve the business case for these investments. Second, the strategic role of information and the ambiguous use of investment activities and procedures during the investment process implies a need to explicate the sustainability goals and strategies throughout the company to increase the priority of sustainability-related investments and to enable for sustainability aspects to be accounted for during all stages of the investment process. Last, these ambiguities and the tensions they may cause imply that non-energy benefits as driving factors not only depend on methods for assessment and evaluation to improve the business case, but they are also dependent on the investment activities and procedures allowing for such information to be considered.

4.4 Paper IV: SMCSs: Configurations, use, and orientation

This paper broadens the empirical phenomenon from energy efficiency investments to energy management and examines the management controls applied in this regard. The revised LoC framework by Tessier and Otley (2012) is applied as an analytical framework to account for objective, use, and organisational levels of control. The study was guided by three research questions: (i) What management controls are applied in the context of energy management?; (ii) How are these management controls used on a strategic and operational level, respectively?; and (iii) How does sustainability orientation impact the configuration of the SMCS?

The study was designed as a multiple case study involving three company groups within the Swedish PPI. Data was collected through interviews on group and unit level, one meeting observation, and internal and external documents. Based on Tessier and Otley (2012), the controls

were analysed with respect to type (i.e. technical or social), objective, and use, with the additional perspective of sustainability orientation (Ditillo and Lisi, 2016). The analysis included both within- and cross-case analysis.

The empirical findings indicate how various controls are applied in the context of energy management, where technical controls related to operational performance predominate. Both a diagnostic and interactive use is indicated. The findings indicate how the configuration of SMCS may vary both within companies and between companies operating in the same industrial context. The way in which controls are used appears to vary in two respects. First, energy management controls are used on different organisational levels, i.e. strategic and operational levels. The empirical setting within which the study was conducted also has two strategic levels: the group level and the strategic level of the units. Second, sustainability orientation is indicated as a possible influence on the configuration of SMCS, for which a proactive orientation appears to be associated with a more interactive use and a higher level of integration (compared to a reactive orientation). An additional finding is the importance of adequate organisational structures and arrangements for enabling an interactive use and an orientation beyond compliance.

The paper seeks to make several contributions to the literature. First, it seeks to contribute to the emerging field of SMCS (e.g. Arjaliés and Mundy, 2013; Crutzen et al., 2017; Gond et al., 2012; Lueg and Radlach, 2016) by providing insights on SMCS configurations. Second, through its application of the Tessier and Otley (2012) framework, the paper provides empirical insights and confirms it as a relevant framework for SMCS. Last, the paper responds to the recent calls in the literature for research on energy management from a management control perspective (Schulze et al., 2016).

4.5 Contributions of appended papers

The main contributions of the four appended papers are summarised in Table 8 below.

Table 8. Main contributions of appended papers.

Paper I	Clarifies terminology on the additional benefits of energy efficiency and provides a definition of non-energy benefits. A framework for categorising non-energy benefits is developed, which aims to facilitate the assessment of non-energy benefits to improve the business case for energy efficiency investments.
Paper II	Contributes empirical insights on how companies perceive non-energy benefits and the extent to which these are considered in the investment process. Provides further insights on the assessment of non-energy benefits to improve the business case for energy efficiency.
Paper III	Contributes insights on the role of integrating energy efficiency and non-energy benefits in management control activities and procedures for investments. The role of the structural context within which investment decisions are taken is explored, emphasising its implications for sustainability-related investments, such as energy efficiency investments.
Paper IV	Contributes insights on the configurations of MCS for energy management, as a means for sustainability. Provides an empirical application of the recently revised LoC framework by Tessier and Otley (2012), illuminating the need to acknowledge the organisational levels of management control. Also highlights sustainability orientation as an important dimension for the configurations of SMCS.

Chapter 5

Discussion

The thesis examines management control for energy management in industrial companies by bridging energy management literature with that of sustainability management control. Through its emphasis on internal management control activities and procedures for energy management, the thesis has aimed to take an inside-out approach (Burritt and Schaltegger, 2010). The thesis has also examined the management control activities and procedures of the investment process for energy efficiency investments—a key element within energy management—including an exploration of the role of non-energy benefits within the ‘win-win’ line of reasoning. This chapter seeks to (i) discuss the findings relating to the research questions (5.1-5.3); (ii) make a cross-paper comparison to elaborate on the similarities and differences resulting from the four studies (5.4); and (iii) provide a synthesised discussion on how management control for energy management in energy-intensive industries may support and improve decision-making and strategies in the direction of sustainability (5.5).

5.1 Management control for energy management

5.1.1 Activities and procedures: configuration and use

The first research question of this thesis concerns the configurations of MCS for energy management, i.e. *what management control activities and procedures are applied for energy management and how are they used?* This analysis is initially based on the revised LoC framework by Tessier and Otley (2012). Both performance and boundary controls have been identified.

These are used both diagnostically and interactively and on a strategic and operational level in the studied companies. The findings indicate, compared to previous studies on SMCS (Crutzen et al., 2017), an extensive use of formal controls. As visible in Table 9, a majority of the indicated controls belong to the dimension of operational performance, i.e. they are focused “on critical performance variables at an operational level” (Tessier and Otley, 2012, p.180). Performance management controls, as well as operational controls, have also recently been identified as influential for MCS for energy management (Schulze et al., 2018). This could possibly stem from the fact that energy is a large production-related cost in the studied context and many of the actions taken within energy management therefore take place on an operational level, close to production. This includes making energy efficiency investments, which constitutes an important action for improving energy efficiency (Thollander and Ottosson, 2008; Trianni et al., 2014). The majority of controls are also internal with little interplay with external-oriented activities. For example, external energy communication was, in most cases, limited to a few lines in the sustainability report.

Table 9. Applied controls for energy management.

Strategic boundary controls	Strategic performance controls
ISO 50001	Energy strategy documents
Energy policy	Top management engagement
Energy criteria applied in investment assessment	Senior energy manager
Energy as a strategic priority	Budget funding for energy efficiency projects
Belief system	External energy communication
	External collaboration and networking
	External benchmarking
	Energy in vision statement
	Reward system
Operational boundary controls	Operational performance controls
Routines & guidelines for	Target setting
– Energy management activities	Energy audit
– Investment procedures	Training
Segregation of duties	Energy management and measurement system
Action plan	Energy cost accounting
Energy included in investment guidelines	Energy performance measurement (e-KPIs)
– Manual and appendices	Energy performance review process
	Performance evaluation of energy efficiency projects
	Internal energy reporting
	Internal communication and discussion
	Intra-organisational collaborations
	Internal benchmarking

According to the four MCSs of the Tessier and Otley (2012) revised LoC framework, based on the findings in Paper III and Paper IV, summarised on an aggregated level, analogue to Bui and de Villiers (2017, p. 1287, Table 1).

This thesis has aimed to examine the configurations and use of management control for energy management and seeks to contribute both to literature on energy management and to the growing SMCS literature. This implies studying the way in which different controls are used and combined, i.e. taking the whole MCS into account (Ditillo and Lisi, 2014; Kruis et al., 2016), which, in the thesis, was carried out by applying the revised version of Simons' (1995) LoC framework (Tessier and Otley, 2012). Use of the MCS for energy management is addressed in terms of diagnostic (i.e. focused on the achievement of predetermined goals and targets) and interactive use (i.e. focused on dialogue throughout the organisation to stimulate search and learning to deal with strategic uncertainties), and the enabling or constraining use of controls. Paper IV concluded that there appears to be a need for activities and arrangements to enable a more interactive use and to improve integration (Ditillo and Lisi, 2016; Gond et al., 2012). This is due to issues with systems at work in parallel, such as the formal energy management system stemming from ISO 50001 and the actual energy management system operating in practice. On a strategic level, both an interactive and diagnostic use were indicated, while the use on operational level appeared as mainly diagnostic. The operational level use was mainly characterised by a constraining and diagnostic use (Tessier and Otley, 2012) where emphasis was on measurement, monitoring, and reporting of energy data, plausibly due to energy being such a large cost (Paper IV). The enabling use, however, was indicated by for example encouraging search for continuous improvements, i.e. promoting creativity (Tessier and Otley, 2012).

5.1.2 The importance of orientation

Improving energy efficiency and engaging in energy management work may be motivated by both potential cost savings and sustainability-related motives, such as reducing environmental impact (Paper I-IV). Managerial intention and orientation influence the objective and the way in which controls are used (Ditillo and Lisi, 2016; Tessier and Otley, 2012). As discussed above, Tessier and Otley (2012) discuss managerial intention with respect to an interactive/diagnostic and enabling/constraining use of control. In Paper IV, sustainability orientation was added to the initial analysis as an additional dimension of intention to acknowledge recent indications that sustainability orientation is a plausible determinant for the configuration and implementation of SMCS (Ditillo and Lisi, 2016; Johnstone, 2018). The thesis also notes industry as an empirical context and the way in which it may influence management control practices (Messner, 2016). The archetypes *strategy emergence through sustainability* (interactive use of SMCS and a lack of integration with MCS) and *compliance-driven sustainability strategy* (diagnostic use of SMCS and a lack of integration with MCS) (Gond et al., 2012) would seem plausible due to the characteristics

of the studied companies and the PPI to which they belong. Gond et al. (2012) hypothesise that the archetype *strategy emergence through sustainability* may plausibly occur in “mature and stable industrial sectors that become subject to profound transformations due to new and emerging sustainability agendas such as global warming” (p. 212) and *compliance driven sustainability strategy* as when the SMCS is motivated by external pressures and aims to signal that a situation is under control. All three groups also agreed that their energy management work had benefited from and had been intensified by the PFE programme (and to some extent from EKL) and its requirement of implementing an energy management system, i.e. external pressures may be important, especially for a move towards a compliance-driven sustainability strategy (George et al., 2016). The companies also indicated similarities, particularly regarding their reliance on operational performance measurement and monitoring of energy use.

However, despite the initial conformance, the companies’ MCSs for energy management have taken different paths (Paper IV). The differences in configuration and use appeared to plausibly have been influenced by the companies’ sustainability orientation, which emphasises it as an important dimension to consider in SMCS studies (Ditillo and Lisi, 2016; Pondeville et al., 2013). These differences occurred mainly between the groups but to some degree also within the groups, i.e. between the units. A more proactive orientation appears to be associated with a more interactive and enabling use when compared to a reactive orientation. A proactive orientation is also reflected in the measures taken on the strategic level to enable energy management work on the operational level, such as establishing budget funding and a more proactive execution of energy audits. On the other hand, a reactive orientation appears to be associated with a lack of top management engagement and compliance-oriented activities, such as the limited energy audit.

This is also reflected in the way the belief system was categorised. Belief systems are, on an aggregated level, categorised as a strategic boundary control (Table 9). Belief systems concern the core values of the company (Simons, 1995), and it is, in the Tessier and Otley (2012) framework, regarded as a social control (and not a control system in itself as in Simons’ original framework). Therefore, as indicated in Paper IV (please refer to Table 4 and Table A1 in Paper IV), the way belief systems are categorised varies, to some extent, between the companies and on unit levels, depending on their objectives and orientation (i.e. it can be regarded in relation to both performance and boundary control systems, with instances of a performance-oriented belief system in particular for Alpha). Bui and de Villiers (2017) discuss this further, noting how the way in which carbon is integrated, i.e. enabling or restricted to compliance, in the belief system can have different implications on performance: an enabling integration encourages a continuous

improvement in environmental performance and outperforming targets. Hence, sustainability orientation should be considered in relation to SMCS configurations. However, this does not reject industry as an important (empirical context) factor to acknowledge (Messner, 2016) for sustainability management control, but it does emphasise the role of the inside-out perspective (Burritt and Schaltegger, 2010) on *how* organisations actually do sustainability (Gond et al., 2012). It also calls for longitudinal approaches on how configurations may develop over time (Gond et al., 2012) with respect to internal characteristics such as sustainability orientation, since “the focus on either performance or compliance is not absolute, but transitional” (Bui and de Villiers, 2017, p. 1290).

One of the case companies, Alpha, provides an example of how orientation and configuration may develop over time. At the time of the single case study (Paper III), their energy management work was mainly cost-motivated, and they lacked budget funding appointed for energy efficiency investments. At the time of the multiple case study (Paper IV), Alpha instead emerged as the company with the most proactive energy management work and SMCS in place. The motivation for energy management from a sustainability perspective was more profound and communicated to the units, and measures had been undertaken to support this strategic direction. This included, for example, an introduced investment budget specifically for energy efficiency investments. Also, although reducing costs still was an important motive for working with energy management, it was also integrated in their sustainability strategy. Compared to Beta and Gamma, Alpha had several committees and regular meetings which enabled an interactive use. Specifically, these committees also had a connection to the executive level, which signalled a strong top management engagement. Hence, although the companies were subject to the same external pressures, such as EKL and PFE, they responded in their MCSs in varying ways with differences in degrees of development (Pérez et al., 2007). The influence of sustainability orientation on configuration and use indicated here and by previous studies (e.g. Dittillo and Lisi, 2016) thus would suggest a need for insights on enablers and tools that can contribute to a proactive sustainability orientation and the enactment of proactive sustainability strategies.

5.1.3 Configuration of investment activities and procedures

As investments for improving energy efficiency are given explicit attention in this thesis (in different ways through Papers I-III), this section aims to discuss the configuration of investment activities and procedures specifically. When looking at energy management from a broader perspective, performance controls predominate MCSs (Paper IV, Tables 2, 3A & 3B), but when the

perspective is narrowed to only include energy efficiency investments (Paper III), a more detailed picture of applied boundary controls arises. While energy efficiency investments constitute an important means in achieving both operational (i.e. reducing energy use) and strategic performance, the controls associated with these investments are, to a large extent, found along the boundary dimension. These controls include, for example, guidelines, such as investment manuals, and routines for prioritisation and authorisation of investment proposals (Paper III), and are controls which set the boundaries to direct opportunity seeking (Simons, 1995), i.e. investment potentials, and to delimit organisational actions on an operational level (Tessier and Otley, 2012).

The thesis is concerned with management control for energy management, as a means for sustainability in the industrial sector. The take on SMCS in this thesis is on the configuration and use of management control for energy management (as for example Arjaliés and Mundy, 2013) and strategic and operational integration (Bui and de Villiers, 2017) rather than how sustainability issues are related to, and integrated with, overall MCS (e.g. Gond et al., 2012). However, incidences of integration are indicated from the empirical studies and, in particular, for investments. As the investment process is generic for any investment category, the question of integration has a more profound role in the management control activities and procedures for investments, such as the way in which energy aspects are considered in investment guidelines.

The case study findings in Paper III indicated integration of energy and non-energy benefits in the investment activities and procedures through, for example, an appendix for environmental analyses and guidelines. These stipulate that energy influence should be addressed, whereas a lack of integration was indicated for control elements such as investment budget, classification, and the long-term investment plan. This contrasts with the findings of Paper IV, in which available financial resources such as budget funding was identified as a strategic performance control, in accordance with previous empirical research (Bui and de Villiers, 2017). It has also been defined as an enabler for integration (Ditillo and Lisi, 2016). The absence of budget funding and lack of access to capital are also known barriers to the adoption of energy efficiency investments (e.g. Brunke et al., 2014; Trianni et al., 2013). Since budget funding, planning, and so forth constitute prerequisites for the company's investment process by stipulating what they can and should do, establishing such controls that enables for the consideration of energy efficiency should be prioritised. The non-energy benefits also contribute to improving the business case for energy efficiency investments (Paper I, Paper II). Hence, the thesis's findings on the configuration of investment activities and procedures advocate the need for an integrative approach (e.g. Ditillo

and Lisi, 2016; Gond et al., 2012; Guenther et al., 2016) as it should be important for overcoming identified barriers (discussed further in 5.3.2 below). Since standard documents and processes, such as the investment manual, provide the basis for the way in which investments are evaluated and authorised throughout the organisation, as well as influence the execution of the investment, an integrative approach can also encourage more sustainable solutions (Paper III). The role of the configuration of investment activities and procedures is discussed further in 5.3.

5.2 Organisational levels of management control for energy management

Research has identified complexities of SMCS relating to the different organisational levels on and between which management control activities take place (Arjaliés and Mundy, 2013; Bui and de Villiers, 2017; Virtanen et al., 2013). At the same time, energy management studies are predominated by operational perspectives (e.g. Schulze et al., 2016). Through its second research question, *(a) how are the operational and strategic dimensions of energy management and energy efficiency investments reflected in management control activities and procedures?* and *(b) how can addressing the organisational levels of management control help to overcome barriers to energy management and energy efficiency investments?*, this thesis seeks to explore the organisational levels of management control for energy management and SMCS, providing new insights to both of these fields. Therefore, the Tessier and Otley (2012) revised LoC framework served as the analytical framework for Paper IV. Management controls for energy management were used both on strategic and operational levels, both on group and unit levels. Paper IV also indicated how single controls could be used on both operational and strategic levels, especially performance controls, while others were limited to one organisational level. Hence, acknowledging the organisational levels of control enabled for a more detailed understanding of SMCS and management control for energy management.

The importance of acknowledging both the operational and strategic levels of management control was also indicated in Paper III. Although energy efficiency investments in the literature are considered to belong to the operational dimension of energy management (Schulze et al., 2016) and are actions to reduce energy use in production or support processes (Fleiter et al., 2012), investment decisions can also be strategic decisions (Haka, 2007; Lumijärvi, 1991) involving actors and processes taking place both on and between operational and strategic levels. Paper III draws upon, among others, Bower's (1970) seminal work where the investment process is defined as a delegated, multistep process which involves different managers, divisions, and functions. This is also reflected in the activities and procedures related to coordination and

authorisation, which functioned as a means of control (Segelod, 1996) from the strategic—group and mill—to the operational levels. Hence, the operational and strategic dimensions of energy management and the undertaking of energy efficiency investments are reflected in different ways through the companies' management control activities and procedures. This includes controls related to both strategic and operational boundaries as well as performance and investment activities and procedures spanning different levels, functions, and departments.

5.2.1 The role of addressing the organisational levels of management control

In addition to examining how the operational and strategic dimensions of energy management are reflected in the companies' management control activities and procedures, the second research question also sought to illuminate the role of acknowledging the organisational levels of management control for energy management and, by extension, of sustainability management control. Taking this perspective has enabled for identifying tensions, such as differences in how energy management and energy efficiency are motivated for (i.e. as a means for sustainability or as a cost-related matter for production), which also has been noted in previous studies (Virtanen et al., 2013). Due to its role for sustainability, resource efficiency, and cost savings potentials, energy was considered a strategic priority. However, the cost-efficiency focus dominated the operational level. The findings of Paper III illuminate potential consequences for investment decisions due to this discrepancy. As the strategic priority was lost on the operational (unit) level, energy efficiency investments lost priority as they were considered to be "just money" (Division manager, Alpha). There was also a lack of integration in (strategic) investment planning which had implications for the investment possibilities on operational levels.

Identifying these tensions is one step towards overcoming known barriers of energy management, such as lack of integration and awareness. It enables the identification of which controls may be necessary for improving the MCS for energy management. The studies conducted in this thesis identified, for instance, a need for (or improved) controls related to investments (e.g. criteria for budget funding, integration in planning), communication and information, and strategic controls. Paper IV also identified an imbalance between strategic and operational controls which had resulted in excessive measurement but a lack of analysis. Improving strategic controls, such as clarifying energy management in terms of strategic priorities, i.e. strategic boundary controls, is one possible means to overcome this issue. Another is to clarify the role description for the energy manager, which is addressed further in 5.2.2. Related to this is also the importance of organisational structure and arrangements as enablers for SMCS, indicated both in

this thesis and in previous studies (e.g. Arjaliés and Mundy, 2013; Battaglia et al., 2016; Ditillo and Lisi, 2016; George et al., 2016). This includes an engaged top management, an established energy manager, and energy committees and working groups, i.e. enforcing energy efficiency drivers such as real ambition and commitment (Brunke et al., 2014; Del Río González, 2005; Thollander and Ottosson, 2008).

The role of having someone with ‘real ambition’, or a ‘champion’ (for example, an energy manager or an engaged top management), has been highlighted in previous research; they are important for enforcing values and routines and creating awareness, influencing corporate culture (May et al., 2016; Rotzek et al., 2018), for energy management and energy efficiency, and overcoming behavioural barriers, e.g. related to priorities, lack of interest, and not sharing objectives (Trianni et al., 2017b). Having committees or steering groups is then an important means for the champion to establish these values and routines throughout the organisation and to improve interaction between strategic and operational management control practices. Dixon-Fowler et al. (2017) discuss the role of sustainability managers and board committees and how firms may fail to implement proactive environmental strategies if they lack complementary organisational resources and capabilities. Such resources and capabilities may include cross-functionality and acknowledging different stakeholder views, capabilities for integration and communication, and commitment (Dixon-Fowler et al., 2017; Hart, 1995; Hart and Dowell, 2011; Russo and Fouts, 1997). These groups should thus preferably be cross-functional (Schaltegger et al., 2014) and diverse (for example, in terms of skills and background) to better cope with the challenges related to adoption of sustainability strategies (Naranjo-Gil, 2016).

The findings of Paper III and Paper IV are in line with these claims. Energy management involves different actors on different levels (Paper III, Paper IV) and energy committees, steering groups, and other arrangements are important enablers for integration and an interactive use of the MCS for energy management (Paper IV) and for supporting a proactive orientation. Hence, this thesis adds to the line of thought of Tessier and Otley (2012) in advocating for the need to acknowledge the organisational levels of management control. In particular, for sustainability issues such as energy management, this approach may enable an integration of sustainability on strategic and operational levels (Bui and de Villiers, 2017). Additionally, it may also ensure aligning organisational levels, overcoming known barriers (Trianni et al., 2017b), and reducing tensions (Virtanen et al., 2013).

5.2.2 The energy manager

Throughout the different studies undertaken within this thesis, the role of the energy manager has been scrutinised. In general, energy managers have overall responsibility of the unit and group levels (the latter are, in the thesis, referred to as senior energy managers) including coordination of energy work and an advisory role in, for example, goal setting and investment decisions (Paper II, Paper III, Paper IV). Evident in Paper IV, they are also often responsible for, or involved in, the control activities for energy management. Previous studies have highlighted the need for reflecting the internal practice perspective in terms of respondents as many SMCS studies are based on data from respondents related to marketing or communication and triangulated with publicly available information such as sustainability reports (Lueg and Radlach, 2016). However, actions and practices of SMCS are not necessarily the same as what is being reported and communicated externally (Cho et al., 2012; Milne et al., 2009), which further argues for acknowledging both the operational and strategic levels of sustainability management control. Sustainability managers are often also oriented towards communication. For example, the senior (group) sustainability director interviewed in Paper III was also the communications director and 25 percent of the CSR managers of Arjaliés and Mundy (2013) also belonged to financial communications and/or investor relations. The energy manager has instead an internal, often operational, focus and can thus provide insights into operational energy management work: sustainability in practice.

Similar to the stream of research that has identified the need for supporting functions and organisational arrangements for sustainability management control, this was also indicated as crucial for energy management, such as the role of energy committees and steering groups, to support the energy manager. However, deficiencies related to the role of the energy manager was also indicated. The energy manager lacked decisive power and a direct connection to executive management (although an implicit link was, in some cases, present through energy steering committees). Along with a lack of resources and sometimes unclear role descriptions, this was discussed as a barrier for the work of the energy manager (Paper IV). Control measures could thus be undertaken to strengthen the role of the energy manager, such as improvements regarding the formal assignments of duties (Bui and de Villiers, 2018), which would potentially help dismantle organisational barriers such as complex decision chains and low status of energy efficiency (Cagno et al., 2013; Trianni et al., 2017b). Paper III also indicated how other actors and decision-makers on both strategic and operational levels are involved in management control activities related to energy management (for the specific case of energy efficiency investments). Hence, the role of the

energy manager spans different organisational levels, and its interconnectedness with other actors in the MCS should be given attention in future studies.

5.3 The role of non-energy benefits

This section seeks to add to the discussion on the role of non-energy benefits in the investment process for energy efficiency investments (Nehler, 2018) and how non-energy benefits may drive the adoption of energy efficiency investments, thus responding to the third research question: *How can the configuration of investment activities and procedures enable for non-energy benefits in acting as a driver for energy efficiency investments?*

5.3.1 The instrumental role vs. the strategic role of non-energy benefits

A growing body of literature has discussed non-energy benefits in relation to energy efficiency investments and their potential to improve the business case for energy efficiency investments (for example Pye and McKane, 2000; Worrell et al., 2003). They have been noted as attributes that should be considered when evaluating such investments (Fleiter et al., 2012; Trianni et al., 2017b), providing information important for “selling” the investment within the organisation (Lumijärvi, 1991). They could be expressed according to the business case arguments as proposed by, for instance, Carroll and Shabana (2010) , i.e. implying an instrumental role of non-energy benefits for investment decisions on energy efficiency investments, for which they are used as informational input to discriminate between options and to make more well-informed decisions (Hirst and Baxter, 1993).

In this thesis, the potential of non-energy benefits in relation to the business case and the ‘win-win’ perspective of improving energy efficiency has been addressed in Papers I, II, and III. First, Paper I reviewed the literature concerned with the additional benefits of improving energy efficiency³¹. Non-energy benefits were identified as the adequate term for an industrial context. It is in the paper defined as the additional benefits stemming from an energy efficiency investment, besides energy savings. These can be both quantifiable and qualitative and arise in a short- or long-term perspective, which is operationalised through a suggested framework for categorising non-energy benefits (Paper I, Figure 4, p. 1413). Such a framework may also provide a shared language for expressing these benefits (Hirst and Baxter, 1993) and enable for an increased

³¹ These conclusions are also partly addressed in my licentiate thesis, in particular the conclusions drawn from Paper I and II (Rasmussen, 2016).

awareness of such aspects (Paper III). Second, the empirical studies carried out through Papers II and III confirmed both the potential of acknowledging non-energy benefits, as well as the heterogeneity of them and the energy efficiency measures to which they are associated.

One business case argument relating to the instrumental role of acknowledging energy efficiency and non-energy benefits concerns cost and risk reduction, i.e. justifications based on reduction in costs and risks stemming from the implementation of sustainability activities (Carroll and Shabana, 2010). Such benefits, including for example reduction in maintenance costs or more reliable production, have been addressed by several authors in relation to energy efficiency investments (e.g. Cooremans 2012, 2011; Nehler et al., 2018; Pye and McKane, 2000; Worrell et al., 2003) and were identified in this thesis (Papers I-III). An improved and safer work environment is a qualitative non-energy benefit that could be addressed in this regard (Paper I, Paper II). Another business case argument relevant to this thesis is related to developing reputation and legitimacy, including for example the non-energy benefit improved public image (Carroll and Shabana, 2010), which also has been noted in previous literature (e.g. Worrell et al., 2003) as well as in this thesis (Paper II, Paper III).

Even though non-energy benefits were considered important from an instrumental perspective, and could, if being integrated in activities and procedures contribute to increasing awareness on aspects that would otherwise be overlooked (Paper III), they were often not included in the investment process (Paper II). In Paper III, the different roles of information delineated a more complex situation for the way in which additional benefits of an investment could be acknowledged, emphasising a limited number of main benefits. This differed from the findings from Paper II that rather emphasised the need to acknowledge all available benefits, in line with the existing literature on non-energy benefits (e.g. Pye and McKane, 2000). Based on Paper III, such an approach could instead risk “blurring the picture” and have the opposite effect than that of enabling for energy efficiency investments.

The case study findings in Paper III illuminated the strategic role of information for investment decisions, i.e. how it was used more selectively to promote an investment (Hirst and Baxter, 1993). Early in the investment process, there was more room to collect and evaluate various benefits (i.e. to assess a variety of information) to pass the stages of the investment process (Figure 1, Paper III). However, due to the means of control stipulated through the authorisation route (Segelod, 1996), there were requirements for simplicity and clarity in the investment proposals, which had implications for what information was addressed. Emphasis was placed on the main aim of the

investment and alignment with strategic goals, giving little room for additional benefits. For example, for the case investment studied in Paper III, several additional benefits had been excluded or only briefly mentioned in the investment application as a result of this reasoning. Hence, there is a strategic role of information in the investment process with implications for the way in which energy efficiency and non-energy benefits can be acknowledged, i.e. there is an ambiguity with, on the one hand, a broad scope and wide assessment of different benefits and, on the other hand, an emphasis on few, strategic benefits.

5.3.2 Non-energy benefits driving energy efficiency investments?

With this ambiguity in mind, the question is what role non-energy benefits have for investments in energy efficiency. Recent developments in the literature have advocated for knowledge of non-energy benefits as a driver and that a broad evaluation of energy efficiency investments is necessary, including sustainability analysis and non-energy benefits (Trianni et al., 2017b). From an instrumental perspective, including non-energy benefits (both qualitative and quantitative), known barriers such as long payback periods and low priority may be counteracted (Paper I). Improved public image and potential cost savings are also known drivers (Brunke et al., 2014; Thollander and Ottosson, 2008), which further justify accounting for non-energy benefits from an instrumental business case perspective.

However, the ambiguous role of information in the investment process complicates the position of non-energy benefits in acting as a driver for energy efficiency investments; it goes beyond the mere acknowledgement of the benefits as important for the business case. Cooremans (2012, 2011) advocated for the need of making energy efficiency investments strategic in order to increase the adoption rate of these investments and close the energy efficiency gap; the study also argued for the role of non-energy benefits in this regard. While the findings of this thesis also agree on the potential strategic nature of non-energy benefits, especially since energy efficiency alone may not be enough to justify the investment (Paper II, Paper III), the role of the MCS has to be acknowledged. As discussed in Paper III, the activities and procedures of the investment process stipulate requirements for what is needed to pass the different stages and this also impacts the work in between the stages (Jørgenssen and Messner, 2010). Hence, there are potential tensions stemming from these ambiguous roles of information. The strategic role at the gates may also influence the investment process and the activities in between the gates. This may have further implications since the case investment in Paper III also illustrated how the activities and procedures of the investment process influenced the way in which the investment was executed,

i.e. the development and technical solution. This implies that the case of non-energy benefits as a driving factor not only concerns assessment and evaluation to improve the business case, but it is also dependent on the investment activities and procedures allowing for such information to be considered; i.e. the configuration of the MCS must enable for non-energy benefits to function as a driving factor for energy efficiency investments.

As discussed above, the integration of non-energy (and energy) benefits in standard processes and documents encouraged reflection on these aspects that would otherwise have risked being overlooked (as, for example, expressed by the financial manager at Alpha). By being an integrated investment criterion, it indirectly influences the decision-making process for all investments. Hence, it contributes to increasing awareness and creating legitimacy for these aspects and, in the end, enables for energy targets and strategies to be fulfilled (Pérez et al., 2007). An integrative approach can therefore be a means to overcome resistance within the organisation, which has been identified as a barrier for cognitive integration of SMCS (Battaglia et al., 2016).

Research within the energy stream has also highlighted organisational and behavioural barriers such as lack of information, lack of interest, and deficient integration of energy-related information in procedures (e.g. Cagno et al., 2013; Rohdin et al., 2007; Venmans, 2014). Paper III pointed to a need for seeking alignment with strategic priorities and investment activities. This further strengthens the call for strategic controls as discussed previously in this chapter, related to, for example, investment planning and having integrated evaluation criteria related to energy efficiency and non-energy benefits. The strategic priority of energy efficiency needs to be integrated in the companies' goals and strategies and throughout the organisation. This again stresses the need for strengthened communication controls and organisational arrangements, here in terms of relevant investment committees, to enable more sustainable and proactive solutions, as for the case investment in Paper III. To conclude, non-energy benefits can play both an instrumental and a strategic role for energy efficiency investments and their journey through the investment decision-making process. However, the configuration of the management control activities and procedures applied to the investment process must enable for non-energy benefits in order for them to function as a driving factor for energy efficiency investments, as stipulated by previous research (e.g. Pye and McKane, 2000; Trianni et al., 2017b).

5.4 Cross-paper comparison

Through four separate studies, this thesis has delved into the management control activities and procedures related to energy management and improving energy efficiency. Altogether, the four studies advance the understanding of the internal activities and procedures for energy management. Making energy efficiency investments is a key activity within energy management and the first three papers are concerned with this particular part of energy management. Paper I and II are focused on non-energy benefits and their role regarding the adoption of energy efficiency investments. These papers seek to contribute insights on how non-energy benefits can be assessed to provide arguments to improve the business case for energy efficiency investments. Paper III continues along this path and examines the investment process for energy efficiency investments and how energy efficiency and non-energy benefits are accounted for in investment activities and procedures. The paper supports the integrative approach (e.g. Gond et al., 2012) by indicating how the integration of these aspects in investment activities and procedures enables for creating awareness of, as well as legitimacy for, sustainability aspects during the investment decision-making process. It also adds insight on the role of information in the investment process by illuminating ambiguities with plausible implications on the extent to which non-energy benefits can drive energy efficiency investments. Paper IV takes a comprehensive perspective on the MCS for energy management. It provides new insights on what controls are applied and on the way in which they are used based on Tessier and Otley (2012). It also illuminates the role of acknowledging both the strategic and operational levels of sustainability management control and the role of sustainability orientation for configurations in a sustainability management control context.

While the four studies have the same underlying purpose of improving the understanding of the internal management processes for industrial energy management, they have been conducted with different approaches, both empirically and theoretically. This has enabled for the illumination of internal management of energy management from different perspectives. The studies are similar in terms of the role of non-energy benefits for the business case and the need for acknowledging both the operational and strategic dimensions of energy management and recognising that this should be reflected in its MCS. However, the studies also indicate results that may be considered as nonconforming. Paper II and Paper III indicated how non-energy benefits often are not the *additional* benefit, as is commonly defined in the literature (e.g. Pye and McKane, 2000; Worrell et al., 2003) and in Paper I; rather, it is the other way around (Paper III). 'Energy efficiency investments' are often not motivated based on energy efficiency alone (Paper II, Paper

III), which further problematise the present discussion on non-energy benefits and their role on energy efficiency investments. That this was indicated in Paper II also signals that this is not specific for the PPI (Paper III), as Paper II includes companies operating in five different industries.

This has implications for the configuration of investment activities and procedures and the role of energy and non-energy related information. The differences between the studies indicate the need to approach energy management and energy efficiency investments from perspectives other than the predominating 'implementation-of-technologies' perspective (Schulze et al., 2018, 2016). This also has provided new insights on energy management. It has problematised the role of non-energy benefits beyond the otherwise well-established business case argument for them. While this argument still appears to hold, based on the findings herein, this thesis also illuminates the role of management control activities and procedures for that argument to be realised in practice.

5.5 Supporting strategies and decision-making in a sustainability direction

The thesis has sought to bridge streams of literature from different theoretical domains, with the aim to provide constructive knowledge on management control for energy management. This thesis has bridged literature from energy management with that of sustainability management control. It has taken an inside-out perspective (Burritt and Schaltegger, 2010) and explored sustainability management control through what organisations do (Gond et al., 2012) by examining the way in which it is operationalised through activities and procedures and, in turn, how these are used for energy management. This last section will seek to synthesise the discussion and delineate the key results.

The notion that management control spans both operational and strategic levels together with the predomination in previous studies on energy management from an operational perspective highlighted the need for a multilevel approach to management control for energy management. In Paper IV, the revised LoC framework (Tessier and Otley, 2012) was therefore used as an analytical framework. The core of the framework consists of technical and social controls related to strategic and operational performance or boundaries. The objective and use (enabling/constraining, interactive/diagnostic) of these control systems may then be influenced by managerial intention. To summarise the discussion, the MCS for energy management has been delineated in four control systems: strategic boundary controls, strategic performance controls, operational boundary controls, and operational performance controls (Bui and de Villiers, 2017;

Tessier and Otle, 2012). Energy management has varying aims on both strategic and operational levels (Paper IV), and there needs to be alignment between these two. The strategic priority of energy issues should be communicated to lower levels (Virtanen et al., 2013). Taking this perspective can also contribute to identify where organisational arrangements and communication controls are needed or should be improved, as these are recognised as important enablers for an interactive use and to enhance integration (Ditillo and Lisi, 2016). Two of the empirical studies (Paper III, Paper IV) especially note the need for adequate organisational arrangements (Battaglia et al., 2016; Ditillo and Lisi, 2016), such as an established senior energy manager and committees (Bui and de Villiers, 2017; Dixon-Fowler et al., 2017), and financial resources, e.g. appointed budget funding (Ditillo and Lisi, 2016). These are enablers that also could support the energy managers in their role and provide a link to executive management (Paper IV).

The thesis, through Paper IV, adds sustainability orientation (Ditillo and Lisi, 2016) to Tessier and Otle (2012) as an important dimension in the context of management control for sustainability (Paper IV) to enable a proactive sustainability management. Establishing controls to promote shared vision and top management engagement can be a means to shared cognitions (Gond et al., 2012) and facilitate in managing the organisational and behavioural barriers to energy management and energy efficiency (Cagno et al., 2013; Cagno and Trianni, 2014; Chiaroni et al., 2017; Rohdin et al., 2007; Venmans, 2014). As discussed above, the thesis also highlights the role of enablers, particularly organisational arrangements, to bridge the strategic and operational levels and overcome incongruencies (e.g. Virtanen et al., 2013) and ambiguities (Paper III). These are also important in enabling a proactive SMCS (Ditillo and Lisi, 2016). Hence, for energy management and, by extension, sustainability, the thesis adds sustainability orientation to the Tessier and Otle (2012) framework (i.e. the outer circle of Figure 3) and highlights the role of organisational arrangements and structures, illustrated as an enabler for interaction between strategic and operational management control practices (middle of Figure 3).

Figure 3. The role of sustainability orientation and organisational arrangements for SMCS. Adapted from Tessier and Otley (2012, figure 1, p. 173).

As discussed by Tessier and Otley (2012) and indicated in Paper IV, controls can be used with different objectives and on different organisational levels, with the implication that there are potential synergies between the control systems (illustrated by the lines between the operational and strategic control systems). The findings of Paper IV, for instance, illuminate energy measurement and monitoring systems and energy performance review processes as well as target setting examples of controls relating to both strategic and operational performance (please refer to Table A1, Paper IV for an overview). Organisational arrangements thus function as an enabler of such synergies. In addition, they also function as a means to improve communication, reducing tensions between operational and strategic levels (Virtanen et al., 2013). In their framework, Tessier and Otley (2012) exclude aspects related to organisational structure due to its absence in the original LoC framework (Simons, 1995). The explicit consideration of organisational arrangements and structures taken here thus constitutes a development of the revised LoC framework (Tessier and Otley, 2012).

The thesis has also delved into energy efficiency investments specifically, identifying them as a key part of energy management. By using capital investment decision-making literature as an analytical lens, i.e. method theory (Lukka and Vinnari, 2014), a multilevel perspective was applied on the investment process for energy efficiency investments (Paper III). This added further insights to the discussion on the importance of addressing the strategic and operational levels of management control, also in an investment context. Ambiguities related to the role of information in the investment process and for the way in which non-energy benefits are acknowledged (Paper I-III) further indicates the role of MCS for energy management and how the configuration of the MCS must enable for non-energy benefits to function as a driving factor for energy efficiency investments. It is indicated that the management control activities and procedures may have implications both for (i) the extent to which energy and non-energy related information is addressed and (ii) the implementation of energy efficiency investments, as they may affect both the decision-making process and the way in which the investment is executed. Integration has therefore an even more profound role for investment-related management control activities and procedures, such as manuals (operational boundaries), but also in the form of established investment criteria and strategic goals (strategic boundaries).

Based on the preceding discussion and the findings of the appended papers, key activities and procedures have been identified for an MCS for energy management that can enable proactive energy management beyond compliance (Table 10). These span both operational and strategic levels and relate to both performance and boundary control (Tessier and Otley, 2012).

Table 10. Management control for a proactive energy management.

Key activities and procedures	
Strategic performance	Senior energy manager and committee(s) on strategic level. Resources, e.g. budget funding, for energy efficiency projects.
Operational performance	Performance measurement and review processes. Communication processes include both reporting and discussions, i.e. enabling for an interactive use.
Strategic boundary	Energy established as a strategic priority, communicated and integrated with operational levels. Energy included as an investment criterion.
Operational boundary	Guidelines and routines for <ul style="list-style-type: none"> – Energy management activities – Investment procedures (including energy and non-energy benefits) Clearly defined role for the energy manager.

To conclude, the thesis rests upon the 'win-win arguments' of improving resource efficiency, i.e. a pollution prevention strategy (e.g. Hart, 1995; Hart and Dowell, 2011; Porter and van der Linde, 1995a). Pollution prevention strategies create sustained competitive advantage by lowering costs due to a minimisation of emissions and waste, and they are embedded within sustainable development (Hart, 1995). Although the notion of the 'win-win' possibilities associated with improving resource efficiency is far from new, the persisting energy efficiency gap (Backlund et al., 2012; Paramonova et al., 2015) implies that there remain unexploited opportunities for improving energy efficiency and energy management. By bridging the theoretical domains of management control for sustainability and energy management, this thesis provides insights on the configurations of SMCS in order to support the decision-making and implementation of sustainability management activities. The thesis contributes to energy management literature in particular with insights on energy management and energy efficiency investments as both operational and strategic phenomena and the way in which this should be reflected in management control practices.

Chapter 6

Conclusions and implications

This chapter will delineate the conclusions of the thesis and reflect on its contributions and implications. The chapter ends by discussing avenues for future research.

6.1 Conclusions

This thesis has been concerned with management control for energy management in the industrial sector. Energy management is positioned as a means for sustainability (e.g. Cagno et al., 2018) and the thesis bridges two theoretical domains: energy management and sustainability management control. The aim of the thesis is to examine the management control activities and procedures for energy management, taking an inside-out approach on management control for sustainability (Burritt and Schaltegger, 2010) in light of recent calls in the literature (e.g. Lueg and Radlach, 2016). This aim has been achieved via three research questions focusing on (i) applied activities and procedures and their use; (ii) the organisational levels of control and the role of addressing this in a sustainability setting, such as energy management; and (iii) the role of non-energy benefits as a driving factor for energy efficiency investments. The aim and research questions have in turn been addressed through four papers, including a literature review and three empirical studies.

Through Paper IV, the thesis takes a holistic perspective on management control for energy management that encompasses both performance and boundary controls. The relevance of

considering the organisational, i.e. operational and strategic, levels of control is highlighted in the literature (Bui and de Villiers, 2017; Tessier and Otley, 2012) and in this thesis. Energy management is both an operational and strategic phenomenon (Schulze et al., 2016) and this should therefore be reflected through the MCS for energy management. Having established organisational arrangements and structures spanning different functions and levels is identified as important both for overcoming barriers and tensions but also to enable interaction and alignment between operational and strategic levels. Another contribution is the identification of sustainability orientation as a dimension that should be considered in the context of SMCS, building on recent studies (Ditillo and Lisi, 2016), as this is indicated as influential for the configuration of management control activities and procedures.

Energy efficiency investments, a key element of energy management, has been given particular attention in this thesis, along with the role of non-energy benefits of these investments (Paper I-III). By taking a management control approach on the investment decision-making process, it is concluded that the configuration of investment activities and procedures play an important role for increasing awareness and legitimising sustainability aspects. A framework for categorising non-energy benefits is developed and applied in the thesis (Paper I-II). This framework provides a terminology and common language for expressing these benefits in a way that may facilitate their inclusion in investment activities and procedures. However, it is also noted that the configuration of the management control activities and procedures applied for the investment process must consider non-energy benefits in order for them to function as a driving factor for energy efficiency investments, as stipulated in previous research (e.g. Trianni et al., 2017b).

Altogether, the thesis concludes that there is a need for adequate tools and methods in the transition to sustainability in the industrial sector, and the role of MCSs in this regard. Configurations of SMCS and the need for important enablers to go beyond mere compliance are delineated in the thesis, contributing constructive knowledge and implications for how management control activities and procedures can improve decision-making and support strategies in a sustainability direction, i.e. towards a more proactive approach for sustainability and energy management. Specifically, the thesis identifies key activities and procedures, relating to both performance and boundary control systems, for both operational and strategic levels (Table 10). These include, but are not limited to, having resources (e.g. budget funding) for energy efficiency projects; establishing performance measurement and review processes; establishing energy as a strategic priority; establishing guidelines for energy management activities and an

integrated (i.e. for energy) investment manual; having an energy manager whose role is clearly defined; and communication controls beyond reporting.

Finally, this thesis identifies tensions and ambiguities related to energy management and sustainability management control that warrants further attention. Controls, activities, and procedures may be used for different objectives with enabling and constraining intents and on operational or strategic levels or, in some cases, both. At the same time, there are incongruencies between these organisational levels regarding, for instance, the views on the strategic role of energy management. This thesis also indicates a duality regarding the role of information, particularly for investment decisions, as it may have both instrumental and strategic purposes, with implications for how such information is considered in investment activities and procedures.

6.2 Managerial implications

The thesis has aimed to develop constructive knowledge on the configurations of management control for energy management and provides several managerial implications. First, the thesis identifies numerous controls used for energy management, relating to performance and boundary controls on both operational and strategic levels (Table 9). This illustrates the role of a holistic approach to the MCS for energy management, not only focusing on single controls such as operational measurement and monitoring (which was indicated as an example for one of the case companies in Paper IV). Hence, performance controls should be balanced with boundary controls, such as energy policy, guidelines, investment criterion, and a clear role description for the energy manager (Bui and de Villiers, 2018). Also, as described above, the thesis delineates key activities and procedures (Table 10) that can support companies in developing and maintaining a proactive energy management work. Thus, the thesis provides managers with insights on the configurations of MCS for sustainability in general and energy management in particular. It highlights activities and procedures that should be prioritised to enable energy management work beyond compliance.

Second, the thesis identifies enablers for MCS for energy management, in line with previous studies (Ditillo and Lisi, 2016), that should be given particular attention by industrial companies, especially organisational arrangements and budget funding. Budget funding, a strategic performance control (Table 9), provides resources for energy management efforts such as implementing energy efficiency investments but also has a strong symbolic value as it signals a strategic priority of energy management. It is thus a control that can be used in an enabling way,

which should be acknowledged by top management. Organisational arrangements, such as energy committees, are in turn indicated to play several important roles. They support the energy manager in his/her role and function as a channel for disseminating information on energy management activities, exchanging ideas and fostering creativity, as well as being a part of the review process and communicating strategic priorities. As visualised in Figure 3, organisational arrangements can function as a bridge between strategic and operational levels, providing a link between operational energy management and strategic decision-making.

Third, the thesis provides insights on non-energy benefits that should be valuable for companies and their configuration of investment activities and procedures. With the framework developed in Paper I and discussed further in Paper II, the thesis provides a terminology for expressing and categorising these benefits to facilitate their inclusion in investment decision-making, i.e. expressing non-energy benefits according to a common (business logic) language (Hirst and Baxter, 1993). This can, in turn, facilitate for non-energy benefits being considered during the investment process, reinforcing drivers and overcoming barriers (Paper I). However, the thesis also highlights the need for integrative configurations of investment activities and procedures and the need for having a multilevel approach, addressing both the strategic and operational levels of the investment process, which should be acknowledged by managers involved with energy efficiency investments.

6.3 Theoretical implications

In chapter two, this thesis followed Lukka and Vinnari (2014) to distinguish between domain and method theories. This distinction is also useful for clarifying the theoretical contributions of this thesis. This thesis bridges and contributes to the theoretical domains of energy management and sustainability management control. In particular, it identifies key management control activities and procedures, and contributes new knowledge on the configurations and use of management control for energy management. Drawing from the sustainability management control domain enabled for new, called for, theoretical perspectives on energy management (May et al., 2017; Schulze et al., 2016). Examining energy management from the inside-out approach within the managerial path of SMCS (Burritt and Schaltegger, 2010) has contributed insights on how to operationalise management control for energy management, which has been neglected in the energy management literature (Schulze et al., 2018).

Energy management is, to a large extent, an operational matter, and bridging energy management with sustainability management control provides theoretical insights on the operational dimension of management control for sustainability. However, energy management also has a strategic dimension (Schulze et al., 2016). The case of energy management therefore implies a setting that is both operational and strategic, involving managers on different levels and functions. By examining the management control activities and procedures for energy management, this thesis thus contributes to sustainability management control and advances the understanding on the configurations of SMCS with both operational and strategic insights. Specifically, the conclusions of the thesis add to the literature advocating a holistic approach to MCS and SMCS (e.g. Crutzen and Herzig, 2013; Lueg and Radlach, 2016) in which the organisational levels of control are also considered (Tessier and Otley, 2012). In addition, the thesis identifies the role of sustainability orientation for the configurations of SMCS, adding to recent developments in the field (e.g. Ditillo and Lisi, 2016).

The thesis also contributes to energy management literature with an advanced understanding of energy efficiency investments by applying investment decision-making theory (considered a method theory in this thesis). This has led to insights on the configuration of investment activities and procedures, including the integration of sustainability-related factors, such as energy efficiency and non-energy benefits, which adds an *ex-ante* perspective on non-energy benefits as called for recently (e.g. Nehler, 2018). In particular, the thesis provides a definition of the concept *non-energy benefits* (Paper I) as well as a framework (Paper I, Paper II) for categorising and expressing these benefits. However, the thesis also shows how solely focusing on the measurement and monetisation of non-energy benefits is not enough. By illuminating ambiguities on (i) the role of information in investment decision-making and (ii) how these roles vary during the course of the investment process, the thesis advances the understanding of the role of non-energy (and energy) benefits during the investment process. This draws attention to tensions that might develop and in turn how these can be resolved, particularly regarding the role of the configurations of investment activities and procedures.

Method theory can shape the understanding of a domain (Lukka and Vinnari, 2014), and the insights from applying the revised LoC framework by Tessier and Otley (2012) could be viewed as such an example. Discrepancies relating to organisational levels, for example, in communicating strategic priorities, have been indicated in SMCS studies (Arjaliés and Mundy, 2013; Virtanen et al., 2013). This thesis has, by applying Tessier and Otley (2012), contributed to a yet limited amount of literature (e.g. Bui and de Villiers, 2017) by empirically addressing the organisational

levels of sustainability management control. The thesis develops Tessier and Otley (2012) as a method theory in this sustainability context by adding sustainability orientation (Ditillo and Lisi, 2016) and explicating the role of organisational arrangements as an enabler for interaction between operational and strategic MCS (Figure 3).

6.4 Implications for sustainable development

The thesis started with a quote from the now infamous Brundtland report (1987) on the role of energy for sustainable development and the escalating need for measures to mitigate climate change (e.g. IPCC, 2018). In light of this, the thesis explores energy management in the industrial sector, framed as an important means for sustainability. The industrial sector accounts for about 38 percent of the energy use in Sweden, dominated by three industries: the PPI, iron and steel, and chemical industries (SEA, 2017). On a global level, energy-intensive process industries alone accounts for over 70 percent of all direct energy- and process-related CO₂ emissions (Fischedick et al., 2014), and it is a crucial sector for the transition towards decarbonisation (Wesseling et al., 2017). The industrial sector also accounts for a third of Sweden's CO₂ emissions (Swedish Environmental Protection Agency (SEPA), 2018). Emissions from the industrial sector in Sweden is decreasing and the PPI is the industry which has decreased its emissions the most over the past decade due to its transition from fossil fuels (mainly oil) to electricity and biomass, combined with a decrease in production (SEPA, 2018). Although CO₂ emissions from the Swedish industrial sector is decreasing, there is a great potential for improving energy efficiency globally. Scenarios building on assumptions of low energy use, together with low use of other materials and climate-friendly food consumption, create the largest synergies with the global sustainable development goals (SEPA, 2018). Further, improving energy efficiency is the largest contributor to mitigating emissions (IEA, 2019). This emphasises the importance for further studies on energy management in the industrial sector.

The thesis' empirical studies particularly emphasise the PPI. Although the Swedish PPI is not a large contributor to industrial CO₂ emissions (5 percent (SEA, 2018a)), it is the industry accounting for the largest share of energy use and is also the most electricity-intensive (SEA, 2018b). Due to its electricity intensity, this industry has the potential to contribute to a reduced electricity use, which in turn can contribute to balance control³² (SEA, 2018b). Globally, energy use is increasing and during 2018, more than half of the growth in energy needs could be

³² In Swedish: ett minskat effekttuttag som kan bidra till effektbalansen (SEA 2018b, p. 59).

attributed to a higher electricity demand (IEA, 2019). As a result, energy-related CO₂ emissions also increased, and the power sector accounted for two-thirds of this growth due to the increased generation from coal- and gas-fired power plants to meet the increased electricity demand (IEA, 2019). Hence, improving industrial energy efficiency can, in addition to reducing emissions, also provide positive effects on energy demand, both in Sweden and globally. This thesis therefore provides implications for how industrial energy efficiency can be improved 'from within' that can, in turn, contribute to sustainable development and mitigate climate change.

6.5 Avenues for future research

The conclusions of this thesis give rise to several suggestions for future research, including theoretical, empirical, and methodological avenues.

6.5.1 A matter of integration

Management control constitutes one success factor for implementing sustainability strategies (Engert and Baumgartner, 2016) and influencing triple bottom line performance (Gond et al., 2012; Guenther et al., 2016). Previous studies have emphasised the role of integration of SMCS with regular MCS, and this was also indicated in the thesis, particularly for investments (Paper III). However, this thesis is limited in the extent to which it considers integration (except for empirical indications) as it has been concerned with MCS for energy management. Integration of SMCS and MCS can contribute to the elevation of sustainability strategies in organisations (Gond et al., 2012) and the implementation of sustainability into firms' activities and practices (Guenther et al., 2016), i.e. it is important both for strategy-making and implementation. Improved sustainability performance has also been indicated for a higher degree of integration (George et al., 2016). Due to its role for strategy development, going to an interactive rather than diagnostic use, referred to as strategic mobilisation, can facilitate for an integration of sustainability within strategy (Gond et al., 2012). Hence, the integration of control systems and the way in which they are used can enable integration of sustainability into strategies and organisational practices (Gond et al., 2012). This should be given further attention in future studies (Guenther et al., 2016).

Integration can also be discussed in terms of integrating the outside-in and the inside-out approach (Schaltegger and Wagner, 2006), i.e. the twin-track approach (Burritt and Schaltegger, 2010). Carroll and Shabana (2010) acknowledges synergistic value creation, i.e. to both satisfy the company's own interests and the demands of the stakeholders. For instance, Ambec and Lanoie (2008) argue that improved environmental performance, which related to this thesis could be

reduced energy use or lowered emissions, may reduce the risk associated with future regulation as well as make it easier to deal with other external stakeholders (e.g. the surrounding community). Hence, future studies on sustainability in general and energy management in particular could focus on the development of integrative frameworks in line with for example Schaltegger and Wagner (2006), i.e. integrating SMCS, sustainability accounting, and sustainability reporting.

6.5.2 The 'win-win' thinking

This thesis positions improving energy efficiency and energy management as a 'win-win' strategy (Porter and van der Linde, 1995a). This in turn draws upon the line of thought inherent in the NRBV and improving energy efficiency as a pollution-prevention strategy (Hart, 1995; Hart and Dowell, 2011). Building on the RBV, Henri (2006) suggests considering MCS as a source of competitive advantage and to develop our understanding of MCS as a capability. He finds empirical support for how the use of MCS may work as an antecedent to organisational capabilities, such as innovativeness and organisational learning, that, in turn, are influential for the development and implementation of strategy. Dangelico and Pontrandolfo (2015) examined capabilities for implementing environmental management and found that companies' capabilities to implement environmental actions related to energy and pollution may positively influence market performance³³, in line with the 'win-win argument'. Yet, with few exceptions (e.g. Wijethilake et al., 2018), the RBV and the extended NRBV have been neglected in empirical studies on sustainability management control (Crutzen and Herzig, 2013). Hence, there are arguments for future research to (i) delve into management control for sustainability while (ii) drawing on the thoughts of the NRBV. However, critical voices have also been raised that the win-win thinking is not enough, and that it is "not sufficient for sustainable development" (Bebbington and Thomson, 2013, p. 282) and reinforces business-as-usual, and that there is a need for research with a critical perspective (Åhlström et al., 2007). From a management control perspective, this would also call for studies along the critical path (Burritt and Schaltegger, 2010).

6.5.3 The industrial setting

As argued in the method chapter, the findings of this thesis are plausibly transferable to similar industries, i.e. energy-intensive manufacturing and process industries. As this is a subject still in its infancy, further studies in similar industries are necessary due to the potentials stemming from

³³ By increasing margins through its effect on reducing costs (Dangelico and Pontrandolfo, 2015).

improving energy management in the industrial sector for sustainable development. However, it would also be interesting to conduct studies in non-energy intensive sectors, especially with respect to sustainability orientation and its role for configurations of SMCS. Crutzen and Herzig (2013), in their review of empirical studies within sustainability management control, also establish how large, private, European companies are overrepresented in the literature. However, as this is an emerging field, the thesis still provides contributions—in particular for energy management—despite this limitation. Studies including other types of companies, such as small- and medium-sized companies, are however called for. Also, since the Swedish energy-intensive industrial sector has been subject to external pressures (e.g. the PFE programme and EKL) that have contributed to push energy as a prioritised issue, it would be interesting to see similar studies in other countries that have not experienced such pressures.

6.5.4 Methodological avenues

This thesis is based on three empirical studies, including an interview study combined with a limited questionnaire, a single case study, and a multiple case study. Other methodological approaches to sustainability management control as well as energy management could be beneficial in developing the field further. First, this thesis only provides a snapshot of current practices. Longitudinal studies are called for with respect to, for instance, how configurations develop over time (Gond et al., 2012; Ditillo and Lisi, 2016; Lueg and Radlach, 2016) since the focus on performance or compliance is not static (Bui and de Villiers, 2017), which also is indicated by the development of Alpha. Second, large-scale surveys and questionnaires can provide necessary insights on SMCS in, for example, small- and medium-sized companies as well as different sectors and countries (Crutzen et al., 2017; Crutzen and Herzig, 2013). Third, practice perspectives have been advocated for by previous studies (Gond et al., 2012), which suggest further studies within the inside-out view (Burritt and Schaltegger, 2010), such as in-depth case studies and/or observation studies (e.g. ethnographies). Future case studies should also include perspectives from employees with different roles, from different functions and organisational levels (Lueg and Radlach, 2016), such as controllers (Crutzen and Herzig, 2013). This thesis has also indicated the way in which the role of the energy manager is related to different functions and levels within the companies, which calls for broader approaches within the energy management field, such as including a wider range of decision-makers for energy efficiency investments (Cagno et al., 2018).

References

- Ahrens, T., Chapman, C. S. (2007). Management accounting as practice. *Accounting, Organizations and Society*, 32: 1-27.
- Albelda, E. (2011). The role of management accounting practice as facilitators of the environmental management: Evidence from EMAS organisations. *Sustainability Accounting, Management and Policy Journal*, 2(1): 76-100.
- Alvesson, M. (2003). Beyond Neopositivists, Romantics, and Localists: A Reflexive Approach to Interviews in Organizational Research. *The Academy of Management Review*, 28(1): 13-33.
- Ambec, S., Lanoie, P. (2008). Does it Pay to be Green? A Systematic Overview. *Academy of Management Perspectives*, 22: 45-62.
- Andersson, E., Arfwidsson, O., Thollander, P. (2018). Benchmarking energy performance of industrial small and medium-sized enterprises using an energy efficiency index: Results based on an energy audit policy program. *Journal of Cleaner Production*, 182: 883-895.
- Anthony, R. N., Govindarajan, V. (2007), *Management Control Systems*, 12th ed., McGraw-Hill, Singapore.
- Aras, G., Crowther, D. (2008). Corporate sustainability reporting: A study in disingenuity? *Journal of Business Ethics*, 87: 279-288.
- Arjaliés, D-L., Mundy, J. (2013). The use of management control systems to manage CSR strategy: A levers of control perspective. *Management Accounting Research*, 24: 284-300.
- Ates, S. A., Durakbasa, N. M. (2012). Evaluation of corporate energy management practices of energy intensive industries in Turkey. *Energy*, 45: 81-91.
- Ayres, L., Kavanaugh, K., Knafl, K. A. (2003). Within-Case and Across-Case Approaches to Qualitative Data Analysis. *Qualitative Health Research*, 13(6): 871-883.
- Backlund, S., Thollander, P., Palm, J., Ottosson, M. (2012). Extending the energy efficiency gap. *Energy Policy*, 51: 392-396.
- Bansal, P. (2005). Evolving sustainably: A longitudinal study of corporate sustainable development. *Strategic Management Journal*, 26: 197-218.
- Barney, J. B. (1991). Firm resources and sustained competitive advantage. *Journal of Management*, 17: 99-120.
- Barney, J. B., Ketchen Jr., D. J., Wright, M. (2011). The Future of the Resource-Based Theory: Revitalization or Decline? *Journal of Management*, 37(5): 1299-1315.

- Battaglia, M., Passetti, E., Bianchi, L., Frey, M. (2016). Managing for integration: a longitudinal analysis of management control for sustainability. *Journal of Cleaner Production*, 136: 213-225.
- Baxter, J. A., Chua, W. F. (2009). Studying Accounting in Action: The Challenge of Engaging with Management Accounting Practice, in Chapman, C. S., Cooper, D. J., Miller, P. B. (Ed) *Accounting, organizations, & institutions, Essays in Honour of Anthony Hopwood*, Oxford University Press.
- Baxter, J. A., Chua, W. F. (1998). Doing Field Research: Practice and Meta-Theory in Counterpoint. *Journal of Management Accounting Research* 10: 69-87.
- Bebbington, J., Thomson, I. (2013). Sustainable development, management and accounting: Boundary crossing. *Management Accounting Research*, 24: 277-283.
- Bedford, D. S., Malmi, T. (2015). Configurations of control: An exploratory analysis. *Management Accounting Research*, 27: 2-26.
- Benbasat, I., Goldstein, D. K., Mead, M. (1987). The Case Research Strategy in Studies of Information Systems. *MIS Quarterly*, 11(3): 369-386.
- Berry, A. J., Coad, A. F., Harris, E. P., Otley, D. T., Stringer, C. (2009). Emerging themes in management control: A review of recent literature. *The British Accounting Review*, 41: 2-20.
- Bower, J. L. (1970). *Managing the Resource Allocation Process*. Harvard Business School Press Books.
- Boyd, G. A., Curtis, E. M. (2014). Evidence of an “Energy-Management Gap” in U.S. manufacturing: Spillovers from firm management practices to energy efficiency. *Journal of Environmental Economics and Management*, 68: 463-479.
- Brinkmann, S. (2018). The Interview. In Denzin, N. K., Lincoln, Y. S. *The SAGE Handbook of Qualitative Research*, chapter 26, 5th ed. SAGE Publications, Inc., United States of America.
- Brohé, A., Burniaux, S. (2015). The impact of the EU ETS on firms’ investment decisions: evidence from a survey. *Carbon Management*, 6(5-6): 221-231.
- Bromwich, M., Scapens, R. W. (2016). Management Accounting Research: 25 years on. *Management Accounting Research*, 31: 1-9.
- Brundtland, G. H. (1987). *Our Common Future*. WCED, World Commission on Environment and Development. Oxford University Press.
- Brunke, J-C., Johansson, M., Thollander, P. (2014). Empirical investigation of barriers and drivers to the adoption of energy conservation measures, energy management practices and energy services in the Swedish iron and steel industry. *Journal of Cleaner Production*, 84: 509-525.

- Bui, B., de Villiers, C. (2018). Management Control Systems to support Sustainability and Integrated Reporting. In De Villiers, C., Maroun, W. (Eds.) *Sustainability accounting and integrated reporting*, Routledge, United Kingdom.
- Bui, B., de Villiers, C. (2017). Carbon emissions management control systems: Field study evidence. *Journal of Cleaner Production*, 166: 1283-1294.
- Bunse, K., Vodicka, M., Schönsleben, P., Brühlhart, M., Ernst, P. O. (2011). Integrating energy efficiency performance in production management – gap analysis between industrial needs and scientific literature. *Journal of Cleaner Production*, 19: 667-679.
- Burritt, R. L., Schaltegger, S. (2010). Sustainability accounting and reporting: fad or trend? *Accounting, Auditing & Accountability Journal*, 23(7): 829-846.
- Böttcher, C., Müller, M. (2016). Insights on the impact of energy management systems on carbon and corporate performance: An empirical analysis with data from German automotive suppliers. *Journal of Cleaner Production*, 137: 1449-1457.
- Cagno, E., Neri, A., Trianni, A. (2018). Broadening to sustainability the perspective of industrial decision-makers on the energy efficiency adoption: Some empirical evidence. *Energy Efficiency*, 11: 1193-1210.
- Cagno, E., Trianni, A. (2014). Evaluating the barriers to specific industrial energy efficiency measures: An exploratory study in small and medium-sized enterprises. *Journal of Cleaner Production*, 82: 70-83.
- Cagno, E., Worrell, E., Trianni, A., Pugliese, G. (2013). A novel approach for barriers to industrial energy efficiency. *Renewable and Sustainable Energy Reviews*, 19: 290-308.
- Caiado, R. G. G., de Freitas Dias, R., Veiga Mattos, L., Quelhas, O. L. G., Filho, W.L. (2017). Towards sustainable development through the perspective of eco-efficiency – A systematic literature review. *Journal of Cleaner Production*, 165: 890-904.
- Carroll, A. B., Shabana, K. M. (2010). The Business Case for Corporate Social Responsibility: A Review of Concepts, Research and Practice. *International Journal of Management Reviews*, 12(1): 85-105.
- Cheng, M. M., Mahama, H. (2011). The impact of capital proposal guidelines and perceived preparer biases on reviewers' investment evaluation decisions. *Australian Journal of Management*, 36(3): 349-370.
- Chenhall, R. H. (2003). Management control systems design within its organizational context: findings from contingency-based research and directions for the future. *Accounting, Organizations and Society*, 28: 127-168.
- Chiaroni, D., Chiesa, V., Franzó, S., Frattini, F., Latilla, V. M. (2017). Overcoming internal barriers to industrial energy efficiency through energy audit: A case study of a large manufacturing

- company in the home appliances industry. *Clean Technology and Environmental Policy*, 19: 1031-1046.
- Cho, C. H., Guidry, R. P., Hageman, A. M., Patten, D. M. (2012). Do actions speak louder than words? An empirical investigation of corporate environmental reputation. *Accounting, Organizations and Society*, 37: 14-25.
- Cho, J., Trent, A. (2006). Validity in qualitative research revisited. *Qualitative Research*, 6(3): 319-340.
- Christensen, B., Himme, A. (2017). Improving environmental management accounting: how to use statistics to better determine energy consumption. *Journal of Management Control*, 28: 227-243.
- Christoffersen, L. B., Larsen, A., Togeby, M. (2006). Empirical analysis of energy management in Danish industry. *Journal of Cleaner Production*, 14: 516-526.
- Clancy, D. K., Collins, D. (2014). Capital budgeting research and practice: The state of the art. *Advances in Management Accounting*, 24: 117-161.
- Cooremans, C., Schönenberger, A. (2019). Energy management: A key driver of energy-efficiency investment? *Journal of Cleaner Production*, 230: 264-275.
- Cooremans, C. (2012). Investments in energy efficiency: Do the characteristics of the investments matter? *Energy Efficiency*, 5: 497-518.
- Cooremans, C. (2011). Make it strategic! Financial investment logic is not enough. *Energy Efficiency*, 4(4): 473-492.
- Creswell, J. W., Miller, D. L. (2000). Determining validity in qualitative inquiry. *Theory into Practice*, 39(3): 124-30.
- Crutzen, N., Herzig, C. (2013). A review of the empirical research in management control, strategy and sustainability. In L. Songini, A. Pistoni, C. Herzig (Eds.), *Studies in Managerial and Financial Accounting - Accounting and Control for Sustainability*, vol. 26, Emerald, 165-195.
- Crutzen, N., Zvezdov, D., Schaltegger, S. (2017). Sustainability and management control. Exploring and theorizing control patterns in large European firms. *Journal of Cleaner Production*, 143: 1291-1301.
- Czarniawska, B. (2014). *Ute vid fältet, inne vid skrivbordet*. Studentlitteratur, Lund.
- Dangelico, R. M., Pontrandolfo, P. (2015). Being 'Green and Competitive': The Impact of Environmental Actions and Collaborations on Firm Performance. *Business Strategy and the Environment*, 24: 413-430.
- Darke, P., Shanks, G., Broadbent, M. (1998). Successfully completing case study research: Combining rigour, relevance and pragmatism. *Information Systems Journal*, 8: 273-289.
- De Groot, H. L.F., Verhoef, E. T., Nijkamp, P. (2001). Energy saving by firms: Decision-making, barriers and policies. *Energy Economics*, 23: 717-740.

- Del Río González, P. (2005). Analysing the Factors Influencing Clean Technology Adoption: A Study of the Spanish Pulp and Paper Industry. *Business Strategy and the Environment*, 14: 20-37.
- Dijkers, M. P. J. M. (2009). The Value of “Traditional” Reviews in the Era of Systematic Reviewing. *American Journal of Physical Medicine & Rehabilitation*, 88: 423-230.
- Ditillo, A., Lisi, I. E. (2016). Exploring Sustainability Control Systems’ Integration: The Relevance of Sustainability Orientation. *Journal of Management Accounting Research*, 28(2): 125-148.
- Ditillo, A., Lisi, I. E. (2014). Towards a more comprehensive framework for sustainability control systems research. *Advances in Environmental Accounting & Management*, 5: 23-47.
- Dixon-Fowler, H. R., Ellstrand, A. E., Johnson, J. L. (2017). The role of board environmental committees in corporate environmental performance. *Journal of Business Ethics*, 140: 423-438.
- EC (2019). European Commission. EU ETS. https://ec.europa.eu/clima/policies/ets_en [Retrieved 2019-12-02]
- Eisenberg, R. S. (1988). Academic Freedom and Academic Values in Sponsored Research. *Texas Law Review*, 66: 1363-1404.
- Eisenhardt, K. M. (1989). Building Theories from Case Study Research. *The Academy of Management Review*, 14(4): 532-550.
- Eisenhardt, K. M., Graebner, M. E. (2007). Theory Building from Cases: Opportunities and Challenges. *The Academy of Management Journal*, 50(1): 25-32.
- EKL (2014:266). Lag om energikartläggning i stora företag. Retrieved from website of the Swedish parliament. https://www.riksdagen.se/sv/dokument-lagar/dokument/svensk-forfattningssamling/lag-2014266-om-energikartlaggning-i-stora_sfs-2014-266 [Retrieved 2019-12-04]
- Elkington, J. (1999). *Cannibals with forks: The Triple Bottom Line of 21st century business*. Capstone Publishing Ltd, United Kingdom.
- Energy Efficiency Directive (2012/27/EU). Retrieved from website of EUR-Lex. <https://eur-lex.europa.eu/legalcontent/EN/TXT/?qid=1399375464230&uri=CELEX%3A32012L0027> [Retrieved 2019-05-18]
- Engert, S., Baumgartner, R. J. (2016). Corporate sustainability strategy – bridging the gap between formulation and implementation. *Journal of Cleaner Production*, 113: 822-834.
- Epstein, M. J., Yuthas, K. (2012). Analyzing Sustainability Impacts. *Strategic Finance*, 93: 27-33.

- EU ETS (2018/410). Directive (2018/410) amending Directive (2003/87/EU). Retrieved from website of EUR-Lex. https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=uriserv:OJ.L_.2018.076.01.0003.01.ENG [Retrieved 2019-12-04]
- Feilzer, M. Y. (2010). Doing mixed method research pragmatically: Implications for the rediscovery of pragmatism as a research paradigm. *Journal of Mixed Methods Research*, 4(1): 6-16.
- Ferreira, A., Otley, D. (2009). The design and use of performance management systems: An extended framework for analysis. *Management Accounting Research*, 20: 263-282.
- Figge, F. Hahn, T., Schaltegger, S., Wagner, M. (2002). The sustainability balanced scorecard – linking sustainability management to business strategy. *Business Strategy and the Environment*, 11: 269-284.
- Finster, M. P., Hernke, M. T. (2014). Benefits Organizations Pursue when Seeking Competitive Advantage by Improving Environmental Performance. *Industrial Ecology*, 18(5): 652-662.
- Fischedick, M., Roy, J., Abdel-Aziz, A., Acquaye, A., Allwood, J. M., Ceron, C-P., Geng, Y., Kheshgi, H., Lanza, A., Perczyk, D., Price, L., Santalla, E., Sheinbaum, C., Tanaka, K.: Industry, In Edenhofer, O., Pichs-Madruga, R., Sokona, Y., Farahani, E., Kadner, S., Seyboth, K., Adler, A., Baum, I., Brunner, S., Eickemeier, P. Kriemann, B., Savolainen, J., Schlömer, S., von Stechow, C., Zwickel, T., Minx, J. C. (Eds.), *Climate Change 2014: Mitigation of Climate Change. Contributions of Working Group III to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change*. Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA.
- Fleiter, T., Hirzel, S., Worrell, E. (2012). The characteristics of energy-efficiency measures – a neglected dimension. *Energy Policy*, 51: 502-513.
- George, R. A., Siti-Nabiha, A. K., Jalaludin, D., Abdalla, Y. A. (2016). Barriers and enablers of sustainability integration in the performance management systems of an oil and gas company. *Journal of Cleaner Production*, 136: 197-212.
- Gibassier, D., Schaltegger, S. (2015). Carbon management accounting and reporting in practice: A case study on converging emergent approaches. *Sustainability Accounting, Management and Policy Journal*, 6(3): 340-365.
- Gimenez, C., Sierra, V., Rodon, J. (2012). Sustainable operations: Their impact on the triple bottom line. *International Journal of Production Economics*, 140: 149-159.
- Gioia, D. A., Corley, K. G., Hamilton, A. L. (2012). Seeking Qualitative Rigor in Inductive Research: Notes on the Gioia Methodology. *Organizational Research Methods*, 00(0): 1-17.

- Glavič, P., Lukman, R. (2007). Review of sustainability terms and their definitions. *Journal of Cleaner Production*, 15: 1875-1885.
- Goldkuhl, G. (2012). Pragmatism vs interpretivism in qualitative information systems research. *European Journal of Information Systems*, 21: 135-146.
- Gond, J-P., Grubnic, S., Herzig, C., Moon, J. (2012). Configuring management control systems: Theorizing the integration of strategy and sustainability. *Management Accounting Research*, 23: 205-223.
- Graham, J. R., Harvey, C. R., Puri, M. (2015). Capital allocation and delegation of decision-making authority within firms. *Journal of Financial Economics*, 115: 449-470.
- Gray, R., Adams, C. A., Owen, D. (2014). *Accountability, Social Responsibility and Sustainability – Accounting for Society and the Environment*. Pearson Education Limited, United Kingdom.
- Guba, E. G. (1981). Criteria for Assessing the Trustworthiness of Naturalistic Inquires. *Educational Communication and Technology* 29(2): 75-91.
- Guenther, E., Endrikat, J., Guenther, T. W. (2016). Environmental management control systems: a conceptualization and a review of the empirical evidence. *Journal of Cleaner Production*, 136: 147-171.
- Guenther, K. M. (2009). The politics of names: rethinking the methodological and ethical significance of naming people, organizations, and places. *Qualitative Research* 9(4): 411-421.
- Haka, S. (2007). A Review of the Literature on Capital Budgeting and Investment Appraisal: Past, Present, and Future Musings. In Chapman, C. S., Hopwood, A. G., Shields, M. D. (Ed.), *Handbook of Management Accounting Research*, Volume 2, Chapter 10. Elsevier Ltd.
- Hales, J., Matsumura, E. M., Moser, D. V., Payne, R. (2016). Becoming sustainable: A rational decision based on sound information and effective processes? *Journal of Management Accounting Research*, 28(2): 13-28.
- Hall, N. P., Roth, J. A. (2003). Non-energy benefits from commercial and industrial energy efficiency programs: Energy efficiency may not be the best story. *Energy Program Evaluation Conference, Seattle*: 689-702.
- Harris, J., Anderson, J., Shafron, W. (2000). Investment in energy efficiency: A survey of Australian firms. *Energy Policy*, 28: 867-876.
- Harris, E. P., El-Massri, M. (2011). Capital investment appraisal. In Abdel-Kader, M. (Ed.), *Review of Management Accounting Research*, Basingstoke, Palgrave.
- Hart, S. L. (1995). A Natural-Resource-Based View of the Firm. *The Academy of Management Review*, 20(4): 986-1014.

- Hart, S. L., Dowell, G. (2011). A Natural-Resource-Based View of the Firm: Fifteen Years After. *Journal of Management*, 37(5): 1464-1479.
- Henri, J-F. (2006). Management control systems and strategy: A resource-based perspective. *Accounting, Organizations and Society*, 31: 529-558.
- Henri, J-F., Journeault, M., Brousseau, C. (2017). Eco-control change and environmental performance: a longitudinal perspective. *Journal of Accounting & Organizational Change*, 13(2): 188-215.
- Henri, J-F., Journeault, M. (2010). Eco-control: The influence of management control systems on environmental and economic performance. *Accounting, Organizations and Society*, 35: 63-80.
- Henri, J-F., Journeault, M. (2009). Eco-efficiency and organizational practices: An exploratory study of manufacturing firms. *Environment and Planning C: Government and Policy*, 27: 894-921.
- Herremans, I. M., Nazari, J. A. (2016). Sustainability Reporting Driving Forces and Management Control Systems. *Journal of Management Accounting Research*, 28(2): 103-124.
- Hirst, M. K., Baxter, J.A. (1993). A capital budgeting case study: an analysis of a choice process and roles of information. *Behavioral Research in Accounting*, 5: 187-209.
- Hirst, E., Brown, M. (1990). Closing the efficiency gap: barriers to the efficient use of energy. *Resources, Conservation and Recycling*, 3: 267-281.
- Hosoda, M., Suzuki, K. (2015). Using Management Control Systems to Implement CSR Activities: An Empirical Analysis of 12 Japanese Companies. *Business Strategy and the Environment*, 24: 628-642.
- IEA (2019), International Energy Agency. *Global Energy and CO2 Status Report. The latest trends in energy and emissions in 2018*. OECD/IEA Paris, March 2019.
- IEA (2015), International Energy Agency. *Energy and Climate Change – World Energy Outlook Special Report*. OECD/IEA Paris.
- IEA (2014), International Energy Agency. *Capturing the Multiple Benefits of Energy Efficiency*. OECD/IEA, Paris.
- IEA (2012), International Energy Agency. *Spreading the Net: The Multiple Benefits of Energy Efficiency Improvements, Insight Series 2012*, Paris, OECD/IEA.
- IPCC (2018). *GLOBAL WARMING OF 1.5 °C. Summary for policy makers*. formally approved at the First Joint Session of Working Groups I, II and III of the IPCC and accepted by the 48th Session of the IPCC, Incheon, Republic of Korea, 6 October 2018. http://report.ipcc.ch/sr15/pdf/sr15_spm_final.pdf

- IPCC (2014). Climate Change 2014: Synthesis Report. Contribution of Working Groups I, II and III to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change [Core Writing Team, R.K. Pachauri and L.A. Meyer (eds.)]. IPCC, Geneva, Switzerland.
- ISO (2018), International Organization for Standardisation. ISO 50001 standard for energy management. <https://www.iso.org/iso-50001-energy-management.html> [Retrieved 2018-10-31].
- Jack, E. P., Raturi, A. S. (2006). Lessons learned from methodological triangulation in management research. *Management Research News*, 29(6): 345-357.
- Johansson, M., Thollander, P. (2018). A review of barriers to and driving forces for improved energy efficiency in Swedish industry – Recommendations for successful in-house energy management. *Renewable and Sustainable Energy Reviews*, 82: 618-628.
- Johnstone, L. (2018). Theorising and modelling social control in environmental management accounting research. *Social and Environmental Accountability Journal*, 38(1): 30-48.
- Joshi, S., Li, Y. (2016), Editorial. What is corporate sustainability and how do firms practice it? A management accounting research perspective. *Journal of Management Accounting Research*, 28(2): 1-11.
- Journeault, M. (2016). The Influence of the Eco-Control Package on Environmental and Economic Performance: A Natural Resource-Based Approach. *Journal of Management Accounting Research*, 28(2): 149-178.
- Journeault, M., De Ronge, Y., Henri, J-F. (2016). Levers of eco-control and competitive environmental strategy. *The British Accounting Review*, 48: 316-340.
- Jørgensen, B., Messner, M. (2010). Accounting and strategising: A case study from new product development. *Accounting, Organizations and Society*, 35: 184-204.
- Kakkuri-Knuuttila, M-L., Lukka, K., Kuorikoski, J. (2008). Straddling between paradigms: A naturalistic philosophical case study on interpretive research in management accounting. *Accounting, Organizations and Society*, 33: 267-291.
- Kaushik, V., Walsh, C. A. (2019). Pragmatism as a research paradigm and its implications for social work research. *Social Sciences*, 8: 255.
- Kruis, A-M., Speklé, R. F., Widener, S. D. (2016). The Levers of Control Framework: An exploratory analysis of balance. *Management Accounting Research*, 27-44.
- Kvale, S. (1997). *Den kvalitative forskningsintervju*. Studentlitteratur, Lund.
- Langfield-Smith, K. (1997). Management Control Systems and Strategy: a Critical Review. *Accounting, Organizations and Society*, 22(2): 207-232.

- Lawrence, A., Nehler, T., Andersson, E., Karlsson, M., Thollander, P. (2019). Drivers, barriers and success factors for energy management in the Swedish pulp and paper industry. *Journal of Cleaner Production*, 223: 67-82.
- Leech, B. (2002). Asking Questions: Techniques for Semistructured Interviews. *PS: Political Science and Politics*, 35(4): 665-668.
- Lincoln, Y. S. and Guba, E. G. (1986). But Is It Rigorous? Trustworthiness and Authenticity in Naturalistic Evaluation. *New Directions for Program Evaluation* 30: 15-25.
- Lincoln, Y. S. and Guba, E. G. (1985). *Naturalistic Inquiry*. SAGE Publications.
- Liu, X., Niu, D., Bao, C., Suk, S., Shishime, T. (2012). A survey study of energy saving activities of industrial companies in Taicang, China. *Journal of Cleaner Production*, 26: 79-89.
- Lueg, R., Radlach, R. (2016). Managing sustainable development with management control systems: A literature review. *European Management Journal*, 34: 158-171.
- Lukka, K., Vinnari, E. (2014). Domain theory and method theory in management accounting research. *Accounting, Auditing & Accountability Journal*, 27(8): 1308-1338.
- Lumijärvi, O. P. (1991). Selling of capital investments to top management. *Management Accounting Research*, 2: 171-188.
- Lung, R. B., McKane, A., Leach, R., Marsh, D. (2005). Ancillary savings and production benefits in the evolution of industrial energy efficiency measures. *Proceedings ACEEE Summer Study on Energy Efficiency in Industry*: 104-114.
- Maas, K., Schaltegger, S., Crutzen, N. (2016). Integrating corporate sustainability assessment, management accounting, control, and reporting. *Journal of Cleaner Production*, 136: 237-248.
- Malmi, T., Brown, D. A. (2008). Management control systems as a package – Opportunities, challenges and research directions. *Management Accounting Research*, 19: 287-300.
- Malmi, T., Granlund, M. (2009). In Search of Management Accounting Theory. *European Accounting Review*, 18(3): 597-620.
- Martyn, P., Sweeney, B., Curtis, E. (2016). Strategy and control: 25 years of empirical use of Simons' Levers of Control. *Journal of Accounting & Organizational Change*, 12(3): 281-324.
- Maxwell, J. (2009). Designing a qualitative study. In Bickman, L. and Rog, D.J. *The Sage handbook of applied social research methods*, 2nd ed. Thousand Oaks, SAGE.
- May, G., Stahl, B., Taisch, M., Kiritsis, D. (2017). Energy management in manufacturing: From literature review to a conceptual framework. *Journal of Cleaner Production*, 167: 1464-1489.
- May, G., Stahl, B., Taisch, M. (2016). Energy management in manufacturing: Toward eco-factories of the future – A focus group study. *Applied Energy*, 164: 628-638.

- Merchant, K. A., Van der Stede, W. A. (2017). *Management Control Systems, Performance Measurement, Evaluation and Incentives*, 4th ed. Pearson, London, United Kingdom.
- Meredith, J. (1998). Building operations management theory through case and field research. *Journal of Operations Management*, 16: 441-454.
- Messner, M. (2016). Does industry matter? How industry context shapes management accounting practice. *Management Accounting Research*, 31: 103-111.
- Milne, M. J., Tregidga, H., Walton, S. (2009). Words not actions! The ideological role of sustainable development reporting. *Accounting, Auditing & Accountability Journal*, 22(8): 1211-1257.
- Mkhaimer, L. G., Arafeh, M., Sakhrieh, A. H. (2017). Effective implementation of ISO 50001 energy management system: Applying Lean Six Sigma approach. *International Journal of Engineering Business Management*, 9: 1-12.
- Morgan, D. L. (2014). Pragmatism as a paradigm for social research. *Qualitative Inquiry*, 20(8): 1045-1053.
- Morse, J. (2018). Reframing Rigor in Qualitative Inquiry. In Denzin, N. K., Lincoln, Y. S (Eds). *The SAGE Handbook of Qualitative Research*, chapter 26, 5th ed. SAGE Publications, Inc., United States of America.
- Namey, E., Guest, G., Thairu, L., Johnson, L. (2008). Data reduction techniques for large qualitative data sets. In Guest, G., MacQueen, K. M. (Eds.) *Handbook for team-based qualitative research*. AltaMira Press, United Kingdom.
- Naranjo-Gil, D. (2016). The role of management controls systems and top management teams in implementing environmental sustainability policies. *Sustainability*, 8: 359.
- Needleman, I. G. (2002). A guide to systematic reviews. *Journal of Clinical Periodontology* 29(3): 6-9.
- Nehler, T. (2018). A systematic literature review of methods for improved utilisation of the non-energy benefits of industrial energy efficiency. *Energies*, 11: 3241.
- Nehler, T., Parra, R., Thollander, P. (2018). Implementation of energy efficiency measures in compressed air systems: barriers, drivers and non-energy benefits. *Energy Efficiency*, 11: 1281-1302.
- Nehler, T., Thollander, P., Ottosson, M., Dahlgren, M. (2014). Including non-energy benefits in investment calculations in industry – empirical findings from Sweden. *Proceedings ECEEE Industrial Summer Study – Retool for a Competitive and Sustainable Industry*: 711-719.
- Otley, D. (2016). The contingency theory of management accounting and control: 1980-2014. *Management Accounting Research*, 31: 45-62.

- Palm, J., Thollander, P. (2010). An interdisciplinary perspective on industrial energy efficiency. *Applied Energy*, 87: 3255-3261.
- Paramonova, S., Thollander, P., Ottosson, M. (2015). Quantifying the extended energy efficiency gap – evidence from Swedish electricity-intensive industries. *Renewable and Sustainable Energy Reviews*, 51: 472-483.
- Patterson, M. G. (1996). What is energy efficiency? Concepts, indicators and methodological issues. *Energy Policy*, 24(5): 377-390.
- Patton, M. Q. (2015). *Qualitative Research and Evaluation Methods*, 4th ed. SAGE Publications, Inc.
- Paunescu, C., Blid, L. (2016). Effective energy planning for improving the organization's energy performance. *Management & Marketing. Challenges for the Knowledge Society*, 11(3): 513-531.
- Pérez, E. A., Ruiz, C. C., Fenech, F. C. (2007). Environmental management systems as an embedding mechanism: a research note. *Accounting, Auditing & Accountability Journal*, 20(3): 403-422.
- Pérez-Lombard, L., Ortiz, J., Velázquez, D. (2013). Revisiting energy efficiency fundamentals. *Energy Efficiency*, 6: 239-254.
- PFE (2004:1196). Lag om program för energieffektivisering. Retrieved from website of Swedish parliament. https://www.riksdagen.se/sv/dokument-lagar/dokument/svensk-forfattningssamling/lag-20041196-om-program-for_sfs-2004-1196 [Retrieved 2019-12-04]
- Pondeville, S., Swaen, V., De Rongé, Y. (2013). Environmental management control systems: The role of contextual and strategic factors. *Management Accounting Research*, 24: 317-332.
- Porter, M. E., van der Linde, C., (1995a). Green and Competitive: Ending the Stalemate. *Harvard Business Review*, 73: 120-134.
- Porter, M. E., van der Linde, C., (1995b). Toward a new conception of the environment-competitiveness relationship. *Journal of Economic Perspectives*, 9(4): 97-118.
- Posch, A., Brudermann, T., Braschel, N., Gabriel, M. (2015). Strategic energy management in energy-intensive enterprises: a quantitative analysis of relevant factors in the Austrian paper and pulp industry. *Journal of Cleaner Production*, 90: 291-299.
- Pritchard, K. (2012). Combining qualitative methods. In Symon, G., Cassell, C. (Eds.), *Qualitative Organisational Research*, SAGE Publications Ltd.
- Pye, M., McKane, A. (2000). Making a stronger case for industrial energy efficiency by quantifying non-energy benefits. *Resources, Conservation and Recycling* 28:171-183.

- Rasmussen, J. (2016). The Investment Process for Capital Investments – The Case of Industrial Energy-efficiency Investments and Non-energy Benefits. Licentiate thesis, No. 117. Linköping Studies in Art and Science.
- Rasmussen, J. (2014). Energy-efficiency investments and the concepts of non-energy benefits and investment behaviour. *Proceedings ECEEE Industrial Summer Study – Retool for a Competitive and Sustainable Industry* 733-744.
- Rockström, J., Steffen, W., Noone, K., Persson, Å., Chapin, F. S., Lambin, E. F., Lenton, T. M., Scheffer, M., Folke, C., Schellnhuber, H. J., Nykvist, B., de Wit, C. A., Hughes, T., van der Leeuw, S., Rodhe, H., Sörlin, S., Snyder, P. K., Costanza, R., Svedin, U., Falkenmark, M., Karlberg, L., Corell, R. W., Fabry, V. J., Hansen, J., Walker, B., Liverman, D., Richardson, K., Crutzen, P., Foley, J. A. (2009). A Safe Operating Space for Humanity. *Nature*, 461: 472–475.
- Rogelj, J., D. Shindell, K. Jiang, S. Fifita, P. Forster, V. Ginzburg, C. Handa, H. Kheshgi, S. Kobayashi, E. Kriegler, L. Mundaca, R. Séférian, and M.V. Vilarino, (2018). Mitigation Pathways Compatible with 1.5°C in the Context of Sustainable Development. In Masson-Delmotte, V., P. Zhai, H.-O. Pörtner, D. Roberts, J. Skea, P.R. Shukla, A. Pirani, W. Moufouma-Okia, C. Péan, R. Pidcock, S. Connors, J.B.R. Matthews, Y. Chen, X. Zhou, M.I. Gomis, E. Lonnoy, T. Maycock, M. Tignor, and T. Waterfield (Eds.), *Global Warming of 1.5°C. An IPCC Special Report on the impacts of global warming of 1.5°C above pre-industrial levels and related global greenhouse gas emission pathways, in the context of strengthening the global response to the threat of climate change, sustainable development, and efforts to eradicate poverty*. In Press.
- Rohdin, P., Thollander, P., Solding, P. (2007). Barriers to and drivers for energy efficiency in the Swedish foundry industry. *Energy Policy*, 35: 672-677.
- Rotzek, J. N., Scope, C., Günther, E. (2018). What energy management practice can learn from research on energy culture? *Sustainability Accounting, Management and Policy Journal*, 9(4): 515-551.
- Rowley, J. (2012). Conducting research interviews. *Management Research Review*, 35(3/4): 260-271.
- Rudberg, M., Waldermarsson, M., Lidestam, H. (2013). Strategic perspectives on energy management: A case study in the process industry. *Applied Energy*, 104: 487-496.
- Russo, M. V., Fouts, P. A. (1997). A Resource-Based Perspective on Corporate Environmental Performance and Profitability. *Academy of Management Journal*, 40(3): 534-559.
- Saldaña, J. (2009). *The Coding Manual for Qualitative Researchers*. SAGE Publications.

- Salzmann, O., Ionescu-Somers, A., Steger, U. (2005). The Business Case for Corporate Sustainability: Literature Review and Research Options. *European Management Journal*, 23(1): 27-36.
- Sandberg, P., Söderström, M. (2003). Industrial energy efficiency: the need for investment decision support from a manager perspective. *Energy Policy*, 31: 1623-1634.
- Schaltegger, S., Burritt, R. L. (2010). Sustainability accounting for companies: Catchphrase or decision support for business leaders? *Journal of World Business*, 45: 375-384.
- Schaltegger, S., Harms, D., Windolf, S. E., Hörisch, J. (2014). Involving corporate functions: Who contributes to sustainable development? *Sustainability*, 6: 3064-3085.
- Schaltegger, S., Wagner, M. (2006). Integrative management of sustainability performance, measurement and reporting. *International Journal of Accounting, Auditing and Performance Evaluation*, 3(1): 1-19.
- Schatzki, T. R. (2001). Practice theory: An introduction. In Schatzki, T. R., Knorr Cetina, K., von Savigny, E. (Eds.), *The practice turn in contemporary theory* (pp. 1-14). Routledge, London, United Kingdom.
- Schulze, M., Heidenreich, S., Spieth, P. (2018). The Impact of Energy Management Control Systems on Energy Efficiency in the German Manufacturing Industry. *Journal of Industrial Ecology*, 22(4): 813-826.
- Schulze, M., Nehler, H., Ottosson, M., Thollander, P. (2016). Energy management in industry – a systematic review of previous findings and an integrative conceptual framework. *Journal of Cleaner Production* 112: 3692-3708.
- Schwandt, T. A., Gates, E. F. (2018). Case Study Methodology. In Denzin, N. K., Lincoln, Y. S (Eds.). *The SAGE Handbook of Qualitative Research*, chapter 14, 5th ed. SAGE Publications, Inc., United States of America.
- SEA (2019), Swedish Energy Agency. *Energiläget 2019 En översikt*, ET 2019:2. April 2019.
- SEA (2018a), Swedish Energy Agency. *Industrins processrelaterade utsläpp av växthusgaser och hur de kan minskas. En nulägesanalys inom regeringsuppdraget Industriklivet*. ER 2018:24, Reviderad upplaga.
- SEA, (2018b), Swedish Energy Agency. *Sektorsstrategier för energieffektivisering. Sverige ska bli världsbäst på energieffektivisering*, ER 2018:04. March 2018.
- SEA (2018c), Swedish Energy Agency, EKL.
<http://www.energimyndigheten.se/energieffektivisering/jag-vill-energieffektivisera-min-organisation/energikartlaggning/energikartlaggning-i-stora-foretag/> [Retrieved 2019-05-18].

SEA (2018d), Swedish Energy Agency, EKL.

<http://www.energimyndigheten.se/energieffektivisering/jag-vill-energieffektivisera-min-organisation/energikartlaggning/energikartlaggning-i-stora-foretag/genomfora-energikartlaggning/> [Retrieved 2019-05-18].

SEA (2017), Swedish Energy Agency. *Energiläget 2017*, ET 2017:12. October 2017.

SEA, (2016), Swedish Energy Agency, PFE.

<http://www.energimyndigheten.se/energieffektivisering/program-och-uppdrag/avslutade-program/pfe/> [Retrieved 2019-05-07]

SEA (2015a), Swedish Energy Agency. *Energy in Sweden 2015*, ET015:19. December 2015.

SEA (2015b), Swedish Energy Agency. *UP-rapport Energiintensiv industri. Rådgivande underlag från utvecklingsplattformen Energiintensiv industri till Energimyndighetens FOKUS-process*. ER 2015:28.

SEA (2015c), Swedish Energy Agency. *Industrins långsiktiga utveckling i samspel med energisystemet*. ER 2015:18.

Segelod, E. (1997). The content and role of the investment manual – a research note. *Management Accounting Research*, 8: 221-231.

Segelod, E. (1996). Corporate control of investments and management styles. *International Journal of Production Economics*, 43: 227-237.

SEPA (2018), Swedish Environmental Protection Agency. *Fördjupad analys av svensk klimatstatistik 2018*. Rapport 6848, December 2018.

Shrivastava, P. (1995). Environmental Technologies and Competitive Advantage. *Strategic Management Journal*, 16: 183-200.

Simons, R. (2000). *Performance measurement & control systems for implementing strategy*. Prentice Hall, New Jersey.

Simons, R. (1995). *Levers of Control: How Managers Use Innovative Control Systems to Drive Strategic Renewal*. Harvard Business School Press, USA.

Sivill, L., Manninen, J., Hippinen, I. Ahtila, P. (2013). Success factor of energy management in energy-intensive industries: Development priority energy performance measurement. *International Journal of Energy Research*, 37: 936-951.

Slagmulder, R. (1997). Using management control systems to achieve alignment between strategic investment decision and strategy. *Management Accounting Research*, 8: 103-139.

Solnørdal, M., Foss, L. (2018). Closing the Energy Efficiency Gap – A Systematic Review of Empirical Articles on Drivers to Energy Efficiency in Manufacturing Firms. *Energies*, 11, 518.

- Sorrell, S., Schleich, J., Scott, S., O'Malley, E., Trace, F., Boede, U., Ostertag, K., Radgen, P. (2000). *Reducing barriers to energy efficiency in public and private organizations*. Energy research centre – science and technology policy research (SPRU), University of Sussex, Brighton.
- Stenqvist, C. (2014). *Industrial energy efficiency improvement, The role of policy and evaluation*. Doctoral dissertation, Environmental and Energy System Studies, Faculty of Engineering, Lund University.
- Strauch, M., Pidun, U., Knyphausen-Aufseß (2019). Process matters – How strategic decision-making process characteristics impact capital allocation efficiency. *Long Range Planning*, 52: 202-220.
- Suk, S., Liu, X., Sudo, K. (2013). A survey study of energy saving activities of industrial companies in the Republic of Korea. *Journal of Cleaner Production*, 41: 301-311.
- Sullivan, R., Gouldson, A. (2017). The Governance of Corporate Responses to Climate Change: An International Comparison. *Business Strategy and the Environment*, 26: 413-425.
- Swedish Energy Policy Agreement (2016). <https://www.regeringen.se/49cc5b/contentassets/b88f0d28eb0e48e39eb4411de2aa-be76/energioverenskommelse-20160610.pdf> [Retrieved 2019-05-18].
- Tellis, W. M. (1997). Introduction to Case Study. *The Qualitative Report*, 3(2): 1-14.
- Tessier, S., Otley, D. (2012). A conceptual development of Simons' Levers of Control framework. *Management Accounting Research*, 23: 171-185.
- Thollander, P., Ottosson, M. (2010). Energy management practices in Swedish energy-intensive industries. *Journal of Cleaner Production*, 18: 1125-1133.
- Thollander, P., Ottosson, M. (2008). An energy efficient Swedish pulp and paper industry – exploring barriers to and driving forces for cost-effective energy efficiency investments. *Energy Efficiency*, 1: 21-34.
- Tranfield D., Denyer, D., Smart, P. (2003). Towards a Methodology for Developing Evidence-Informed Management Knowledge by Means of Systematic Review. *British Journal of Management* 14: 207-222.
- Trianni, A., Cagno, E., Neri, A. (2017a). Modelling barriers to the adoption of industrial sustainability measures. *Journal of Cleaner Production*, 168: 1482-1504.
- Trianni, A., Cagno, E., Marchesani, F., Spallina, G. (2017b). Classification of drivers for industrial energy efficiency and their effect on the barriers affecting the investment decision-making process. *Energy Efficiency*, 10: 199-215.
- Trianni, A., Cagno, E., De Donatis, A. (2014). A framework to characterize energy efficiency measures. *Applied Energy*, 118: 207-220.

- Trianni, A., Cagno, E., Thollander, P., Backlund, S. (2013). Barriers to industrial energy efficiency in foundries: a European comparison. *Journal of Cleaner Production*, 40: 161-176.
- Unander, F. (2005). Energy indicators and sustainable development: the International Energy Agency approach. *Natural Resources Forum*, 29: 377-391.
- UN (2018), United Nations. *The Sustainable Development Goals Report 2018*. <https://unstats.un.org/sdgs/files/report/2018/TheSustainableDevelopmentGoalsReport2018-EN.pdf>. New York 2018.
- UNEP (2014), United Nations Environment Programme. *UNEP Year Book 2014, Emerging Issues in Our Global Environment*.
- US Energy Star Program (2019). Environmental Protection Agency. <https://www.energystar.gov/> [Retrieved 2019-12-04]
- Van Cauwenbergh, A., Durinck, E., Martens, R., Laveren, E., Bogaert, I. (1996). On the role and function of formal analysis in strategic investment decision processes: results from an empirical study in Belgium. *Management Accounting Research*, 7: 169-184.
- Van de Ven, A. H. (2007). *Engaged Scholarship, A Guide for Organizational and Social Research*. Oxford University Press.
- Venmans, F. (2014). Triggers and barriers to energy efficiency measures in the ceramic, cement and lime sectors. *Journal of Cleaner Production*, 69: 133-142.
- Virtanen, T., Tuomaala, M., Pentti, E. (2013). Energy efficiency complexities: A technical and managerial investigation. *Management Accounting Research*, 24: 401-416.
- Voss, C., Tsikrikitis, N., Frohlich, M. (2002). Case research in operations management. *International Journal of Operations & Production Management*, 22(2): 195-219.
- Wernerfelt, B. (1984). A Resource-based View of the Firm. *Strategic Management Journal*, 5: 171-180.
- Wesseling, J.H., Lechtenböhmer, S., Åhman, M., Nilsson, L. J., Worrell, E., Coenen, L. (2017). The transition of energy intensive processing industries towards deep decarbonization: Characteristics and implications for future research. *Renewable and Sustainable Energy Reviews*, 79: 1303-1313.
- Whittemore, R., Chase, S. K., Lynn Mandle, C. (2001). Validity in Qualitative Research. *Qualitative Health Research*, 11(4): 522-537.
- Widener, S. K. (2007). An empirical analysis of the levers of control framework. *Accounting, Organizations and Society*, 32: 757-788.
- Wijethilake, C., Munir, R., Appuhami, R. (2018). Environmental innovation strategy and organizational performance: Enabling and controlling uses of management control systems. *Journal of Business Ethics*, 151: 1139-1160.

- Worrell, E., Bernstein, L., Roy, J., Price, L., Harnisch, J. (2009). Industrial energy efficiency and climate change mitigation. *Energy Efficiency*, 2: 109-123.
- Worrell, E., Laitner, J. A., Ruth, M., Finman, H. (2003). Productivity benefits of industrial energy efficiency measures. *Energy*, 28: 1081-1098.
- Yin, R. K. (2011). *Kvalitativ forskning från start till mål*. Studentlitteratur, Lund.
- Yin, R. K. (2009). *Case study research, Design and methods*, 4th ed. SAGE Publications, Inc., United States of America.
- Ylijoki, O. H. (2003). Entangled in academic capitalism? A case-study on changing ideals and practices of university research. *Higher Education* 45: 307-335.
- Ådahl, A., Harvey, S. (2006). Energy efficiency investments in Kraft pulp mills given uncertain climate policy. *International Journal of Energy Research*, 31: 486-505.
- Åhman, M., Nilsson, L. J., Johansson, B. (2017). Global climate policy and deep decarbonization of energy-intensive industries. *Climate Policy*, 15(5): 634-649.
- Ählström, J., Macquet, M., Richter, U. (2009). The lack of a critical perspective in environmental management research: Distortion in the scientific discourse. *Business Strategy and the Environment*, 18: 334-346.

Papers

The papers associated with this thesis have been removed for copyright reasons. For more details about these see:

<http://urn.kb.se/resolve?urn=urn:nbn:se:liu:diva-162652>

FACULTY OF ARTS AND SCIENCES

Linköping Studies in Arts and Sciences, No. 778, 2020
Department of Management and Engineering (IEI)

Linköping University
SE-581 83 Linköping, Sweden

www.liu.se