Opposition and Adjustment to Industrial 'Greening'

-

The Swedish Forest Industry's (Re)Actions regarding Energy Transition – 1989-2009

Mikael Ottosson

Linköping University
FACULTY OF ARTS AND SCIENCES

Linköping Studies in Arts and Science No. 526
The Department of Thematic studies – Technology and Social Change
Linköping University,
Linköping 2011

Linköping Studies in Arts and Science • No. 526

At the Faculty of Arts and Science 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 Science. This thesis comes from the Department of Thematic studies – Technology and Social Change.

Distribution:
The Department of Thematic studies – Technology and Social Change
Linköping University
581 83 Linköping
Sweden

Mikael Ottosson
Opposition and Adjustment to Industrial 'Greening'
The Swedish Forest Industry's (Re)Actions regarding Energy Transition – 1989-2009

Edition 1:1
ISBN 978-91-7393-216-5
ISSN 0282-9800

Printed by: LiU-tryck, Linköping, 2011
Cover photography of Billerud Skärblacka pulp and paper mill by Martin Pedersen

This thesis is based on work conducted within the interdisciplinary graduate school Energy Systems. The national Energy Systems Programme aims at creating competence in solving complex energy problems by combining technical and social sciences. The research programme analyzes processes for the conversion, transmission and utilisation of energy, combined together in order to fulfil specific needs.

The research groups that participate in the Energy Systems Programme are the Department of Engineering Sciences at Uppsala University, the Division of Energy Systems at Linköping Institute of Technology, the Department of Technology and Social Change at Linköping University, the Division of Heat and Power Technology at Chalmers University of Technology in Göteborg as well as the Division of Energy Processes at the Royal Institute of Technology in Stockholm.

www.liu.se/energi

"Forestry is an almost spiritual mission. It uses a time horizon of generations, since it involves accepting responsibility for something that is growing and developing, something that we ourselves may never harvest. It is part of our environment and our cultural heritage, yet also production, naturally. The forest genuinely is Sweden's major export resource, whose exports are Swedish through and through. And that says something about how important the forest industry is".

Göran Persson, former Prime Minister of Sweden, today a major forest owner (SFIF, 2005, p. 3).

Constituent papers

Paper I

Patrik Thollander, Mikael Ottosson

Exploring energy management in the Swedish pulp and paper industry

Peer reviewed conference paper presented at the European Council for an Energy Efficient Economy (ECEEE) Summer Study France (2009).

Paper II

Mikael Ottosson

Material resources in strategy formation processes: Translations of electricity and forest assets in three Swedish forest industry companies, 1990-2008

Under review in European Management Review.

Paper III

Mikael Ottosson

Between industrial modernity and ecological modernization?: The Swedish forest industry's response to increased environmental demands regarding the electricity

Under review in Environmental innovation and Societal Transitions.

Paper IV

Mikael Ottosson, Vasilis Galis, Jonas Anshelm

Configuring the 'industrial collective': a controversy on the use of Swedish forests, 1989–2009

Under review in Bulletin of science technology & society.

Co-author statements

In Paper I, the data collection (i.e., the questionnaire) was administered by Mikael Ottosson while the results were analysed jointly with Patrik Thollander.

Papers II and III were written solely by Mikael Ottosson.

In Paper IV, the theoretical concepts of confined industry and industrialists in the wild were forumlated by Mikael Ottosson. All empirical material regarding the Swedish forest industry was collected and analysed by Mikael Ottosson. The empirical material regarding concerned groups was collected and analysed by Jonas Anshelm. The theoretical concepts in the paper were further refined by Vasilis Galis, while the final version of the paper was co-written by all three authors.

Acknowledgements

This thesis research was carried out under the auspices of the Energy System Programme, which is financed primarily by the Swedish Energy Agency. Thanks for the financial support!

Making a PhD is very much a continuous process of finding balance between creativity and monotonous writing. You need to sit down by the computer almost every day to get the different texts together. Still you also need to be able to leave the computer and read other researchers papers, visit seminars, as well as take a walk with the dog and think about other things for an hour to get new exciting creative ideas in place. By alternating between monotonous writing and moments of creativity almost every day over the last five years, the project has had its ups and downs. Lucky me I had a supervisor – *Jonas Anshelm* – who has helped me finding a balance between creativity and the hours tapping on the keyboard. Jonas has put the brake on when I have been too quick to tap new papers with new concepts, and new research problems, without really taking the necessary creative walk with my dog. Simultaneously Jonas has given freely of his time to discuss issues and problems, often every day, and thus provided me with invaluable support during the projects gloom as well as joyful periods. By combining a critical perspective on my project with a personal devotion, Jonas' work as a supervisor has improved every aspect of this thesis. Thanks for everything!

My associate supervisor *C-F Helgesson* has provided several very incisive readings of manuscripts throughout the project. His theoretical research interests has further enriched this project and turned this thesis into a multidisciplinary hybrid. Thanks for your encouragement and support! My other associate supervisor, *Hans Andersson*, at the division of Business administration, has as the only 'true' economist provided the project with competencies within diverse fields such as accounting, organization studies, and strategic management. Your large interest and appreciation for my empirical material has provided me with much delight. You have also provided a number of excellent readings that, taken together, have truly improved the quality of the thesis. Many thanks!

Vasilis Galis was the co-writer of paper IV in this thesis and has besides from this also provided this project with tremendous support. Thanks for all the readings of my manuscripts, for all the discussions of ANT, for all books I borrowed, but most of all thanks for being a fantastic friend! Efharisto! I would also like to thank *Patrik Thollander* who was the co-writer of paper I. Thank you for very productive cooperation and much inspiration during these years. *Anders Hansson* was the one who got me interested in the energy issue from the beginning. Thanks for making my days at work much more fun. Your coolheadedness is a source of both inspiration and irritation. *Mats Bladh* provided the project with support in its initial phase, thanks!

Kjell Tryggestad, at Copenhagen business school, did an excellent job as opponent at my final seminar. Thanks to your encouragement I felt that this project could really become something fine! *Fredrik Tell*, at the division of Business administration, was the opponent at my 60% seminar. Thanks! I would also like to thank *Sven Widmalm*, *Kajsa Ellegård*, and *Boel Berner*, who all have read my manuscripts and contributed to the project at various seminars throughout the Ph.D. process.

I have had the benefit of sharing room with *Ann-Sofie Kall* for several years. I also enjoyed writing the multidisciplinary research report within the Energy Systems Programme with

Inger-Lise Svensson at the division of Energy systems and *Johanna Jönsson* at Heat and power technology, Chalmers.

This thesis is also a product of me being part of the TVOPP (Technology, Values, and Political processes) working seminars. Thanks to all of the members of the seminar for helping me improve my texts! In the first part of 2006, I took courses together with the other newly employed ph. d. candidates (D05 and D06), *Lisa Hansson*, *Karin Thoresson*, *Maria Björkman*, *Sofia Norling*, *Alma Persson*, *Merith Fröberg*, *Magdalena Fallde*, and *Ann-Sofie Kall*. Thanks for interesting discussions! I would also like to thank the ph. d. colleagues within the Energy systems programme such as *Elisabeth Wetterlund* and *Kristina Difs* at the division of Energy systems for making the years 2006–2007, when we took courses together really fun!

Christina Lärkner and *Eva Danielsson* have helped me with administration, thanks! Other people at Tema T who have helped me with various issues and to whom I owe thanks are *Per Gyberg*, *Francis Lee*, and *Dick Magnusson*.

I would like to thank my family, my *mother* and *father* (who passed away during the writing of this thesis), and my three sisters. Thanks to mum for encouraging me to do whatever I please in life and thanks to dad for getting me interested in the amazing world of industries, firms, stocks, etc. Thanks to my three *sisters* for supporting me. When I moved to Linköping from Stockholm in early 2006, my fiancée *Susanne* followed me. During my Ph.D. research, you have not only taken a masters degree in business administration but also worked with numerous things. Sharing these years with you has been truly amazing despite all the work. It is my wish and expectation that our future shared life projects will be even more fantastic.

I guess it would be to exaggerate to say that the forest industry always played a central part of my life. Growing up in Norrköping, situated in southeast Sweden and surrounded be several pulp and paper mills, the industry always had some peripheral part of everyday life. In the early 1990s, a sharp, acid smell often swept over the city when the winds were blowing from the direction of the Billerud pulp and paper mill in Skärblacka. When I grew older and finished upper secondary school one of my best friends – *Tomasz*- started working at the other industry colossus close to Norrköping, the Braviken pulp and paper mill. His father and uncle had already been working there for decades. Several other friends later followed this path and in the year 2000 I was also offered job at the mill. The beginning of my university studies in sociology, however, came between me and the industry that time. More than one decade later, when writing the last words of this thesis, the forest industry has without doubt become central to my life.

Linköping, February 2011

TABLE OF CONTENTS

1 INTRODUCTION 1
1.1 The research problem and purpose 1
1.2 What constitutes the Swedish forest industry? 3
1.3 Philosophical position and research design 5
1.4 Positioning the thesis in relation to previous research 8
1.5 The outline of the thesis 20
2 THE ENERGY TRANSITION AND ITS EFFECTS UPON THE SWEDISH FOREST INDUSTRY 1989-2009 21
2.1 The scientific and political call for transition of the European energy systems 21
2.2 The Swedish policy on sustainable development 22
2.3 Energy- related changes affecting the Swedish forest industry 26
3 ASSEMBLING THE THEORETICAL FRAMEWORKS 31
3.1 Introduction: from a traditional economic perspective... 31
3.2 …to a constructivist view of material resources 34
3.3 Managing resource heterogeneity 36
3.4 Industries as subpolitical actors embedded in techno-economic and socio-political issues 37
3.5 From confined industries to industrialism in the wild 39
3.6 Confined industry, concerned groups, and industrialists in the wild 40
4 METHODOLOGICAL CONSIDERATIONS 43
4.1 Position regarding reality and knowledge production 43
4.2 The questionnaire 44
4.3 Interviews and site visits 46
4.4 Text and document analysis 48
5 SUMMARIZING RESULTS OF THE FOUR PAPERS 53
5.1 Managing energy at the mill level 53
5.2 Translations of electricity and forest resources in Holmen, SCA, and Stora Enso 54
5.3 The Swedish forest industry: between industrial modernity and ecological modernization? 55
5.4 The conflicts and translations concerning the use of the forests 56
6 REFLECTIONS AND SUGGESTIONS FOR FUTURE RESEARCH ... 57
6.1 The effects of the energy transition: from a homogenous to a heterogeneous industry? 58
6.2 The performative role of economic theories in shaping the industry 64
6.3 The problem of representing a ‘black’ and ‘green’ industry 69
6.4 Final remarks 73
References 74
Litterature 74
Empirical material 86

Chapter 1

1 INTRODUCTION

1.1 The research problem and purpose

> *"Perhaps mankind's greatest challenge today is to stop global warming. We have to switch to renewable resources and renewable energy. That is why forests and forest based industries are part of the answer"* (SFIF, 2008a, p. 6).

How does an industry highly dependent on electricity, and forests, handle a process of drastic change affecting these resources? Should the industry put up a fight, opposing and blaming researchers and politicians for exaggerating and creating problems for the industry? Should it stick to its traditional strategies and businesses? Or should it instead turn its dirty 'black' industry into a 'greener' one, making money on climate change? As the opening quotation implies, the Swedish Forest Industry Federation (SFIF), the trade, industrial policy, and employers' organization for the Swedish pulp, paper, and wood mechanical industries, launched a major advertising campaign in 2008 portraying the Swedish forest industry as part of the solution to climate change. According to SFIF, the forest's ability to absorb carbon dioxide means that large-scale industrialized forestry, managed to optimize production capacity on the ground, is a major means of reducing climate change. What makes the above quotation more interesting, however, is that, in the same year, 2008, SFIF stated in its consideration statement to the Swedish Climate Committee that it did not support the Committee's proposition to reduce Sweden's overall greenhouse gas emissions by 38% (SFIF, 2008b).

The trustworthiness of SFIF's message, that the forest industry was part of the solution to climate change, was questioned when one of the Swedish forest industry's most powerful figures,[1] Sverker Martin-Löf, questioned the scientific evidence supporting climate change (DN, 2008, p. 14). According to Martin-Löf, "a lot of scientific results indicate that the effects

[1] As board chair of the forest industry firm SCA, steel corporation SSAB, investment company Industrivärden, and construction corporation Skanska, as of June 2010, Sverker Martin-Löf controlled assets valued at SEK 570 billion (DI, 2010).

are not as harmful as some claim" (DN, 2008, p. 14). In 2006, Martin-Löf had previously accused the Swedish government of jeopardizing hundreds of thousands of industrial jobs due to "paralysis in the energy policy" (DN, 2006), i.e., the increasing and unstable electricity prices. Simultaneously, the 2005–2009 period saw the forest industry firm Södra become Sweden's largest producer of 'green' electricity from burning biofuels, a shift that would not have come about had it not been for the "colourization" of the electricity resource due to the CO_2 emissions associated with various electricity sources. SCA was investing billions of Swedish kronor in 400 wind turbines expected to produce 2.8 TWh of electricity per year to capitalize on the growing and publicly supported 'green' electricity market. Furthermore, in the first quarter of 2008, the traditional forest industry firm Holmen made 60% of its profit from its forests and electricity assets alone, rather than from its higher-value-added newsprint production.

Taken together, these examples demonstrate that the Swedish forest industry has not chosen a single homogeneous strategy or response in relation to the energy transition from 1989 to 2009. For one of the most energy-intensive industries in Europe, these changes and increased demands for all industries to become 'greener' have obviously triggered (re)actions. Growing awareness of climate change, increased energy prices, new public policy instruments coping with the ecological crisis, the construction of 'green' electricity, etc., are all issues that have been confronted simultaneously at various levels in the Swedish forest industry by energy management practices at individual pulp and/or paper mills, in corporate strategies by CEOs and boards of directors, and by the business association, SFIF. An industry needs to interpret, manage, oppose, and handle (i.e., act or not act), i.e., what I refer to as (re)act, regarding calls for change in multiple ways and at several different yet highly interconnected levels, to avoid industrial decline and even bankruptcy. It should be emphasized that the industry has not acted alone and unopposed on these matters. On the contrary, time and time again during the 1989–2009 period, the Swedish forest industry's decisions, arguments, presented 'facts', and visions have been contested, deconstructed, and even opposed by non-industrial actors such as politicians, researchers, and environmental groups.

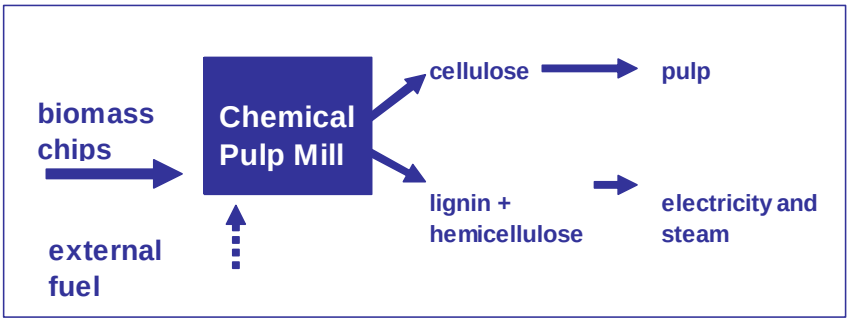
The aim of this thesis is to analyse how the Swedish forest industry has (re)acted regarding the energy transition and, in particular, to the reconstruction of the electricity and forest resources in Sweden during the 1989–2009 period. This thesis raises questions concerning industrial stability and change in relation to mounting political and public demands for the industry to become 'greener', i.e., industrial 'greening' processes. Here, these processes primarily refer to issues related to the industry's substantial use and management of electricity and forest resources. Specifically, this thesis centres on the patterns of conflict and reconstruction that various forest industry representatives (e.g., CEOs) and entities (e.g., mills and resources) have experienced in relation to the opposition and/or adjustment to energy transition. In a wider research context, the Swedish forest industry may serve as an interesting case illustrating how an industry highly dependent on electricity and forests (re)acts regarding increasing environmental and energy-related demands and concerns. However, this thesis also hints at a more analytical and theoretical overall research problem, namely, to increase our knowledge of how an industry might handle demands for change regarding its strategic key resources. In that sense, I first owe the reader a definition of the Swedish forest industry.

1.2 What constitutes the Swedish forest industry?

As mentioned above, this thesis centres on the patterns of conflict and reconstruction that various forest industry representatives and entities have experienced in relation to the adjustment or opposition to changes in the industry's use and management of energy, electricity, and forests. I do not view the Swedish forest industry as a single homogenous and static entity, but rather as something constantly in the (re)making. One might argue that to decide à priori what constitutes the Swedish forest industry may distort this complex, contradictory, and incoherent industry. I still believe it is important to help the reader understand traditional definitions and statistics concerning the Swedish forest industry as being presented, for example, by its business association, SFIF. We first need to look at how the concept of "industry" can be defined.

What is an industry? Brusoni et al. (2009) argue that: "Economics, but also sociology, strategy, and other management and technology-related disciplines have taken discrete, bounded 'industries' as a given" (Brusoni et al., 2009, p. 209). In the taken-for-granted view, industries are viewed as homogeneous groups of firms involved in a specific part of the production process of an economy (Brusoni et al., 2009). This notion could also be traced to official national statistics. The Swedish official statistical authority Statistiska centralbyrån (SCB) uses the Svensk Näringsgrensindelning (SNI)[2] codes to classify firms as belonging to one or several industries. One common way of defining an industry is to look at what the included firms produce, i.e., their output.

In economics and official statistics, an industry is often defined as a group of companies producing the same principal products or, more broadly, a group of companies producing products that are close substitutes for each other (e.g., Porter, 1980). The Swedish forest industry could to some degree be defined using this type of categorization. At least traditionally, the industry has produced forest products (e.g., lumber) and pulp and paper products (e.g., newsprint). Over the last two decades, however, some firms in the industry have also increased their production of other products, such as 'green' electricity, biofuels, and pellets. In that sense, the industry's output has changed. The input factors in this industry are also similar: the industry uses electricity and/or forest resources (and a relatively smaller amount of oil) in substantial amounts to produce the above products. Figure 1 illustrates the inputs and outputs of a typical chemical pulp mill.



[2] For example, paper production is represented by SNI code 17 (SCB, 2011).

***Figure 1**. Inputs and outputs of a typical chemical pulp mill (Retrieved from Berntsson et al. 2006, p. 3).*

Regarding the production process inputs, it should be noted that the industry's input of oil has decreased since the 1970s (Ekheimer, 2006). Recognizing these changes, the input and output factors still give us a fairly clear idea of the common resource flows in the industry. The industry's input and output factors are at the centre of SFIF's definition of the industry. SFIF's Facts and figures 2008 defines the forest industry as the various (sub)industries relying on the same raw material (forest resources), such as the pulp and paper industry, the sawmill industry, the wood board industry, packaging production (from wood, paper, and board), and the joinery industry (cf. SFIF, 2008c). In addition, many companies that produce pulp and paper also produce lumber and wood products in integrated operations, such as sawmills located near paper mills.

According to SFIF, the Swedish forest industry, as part of the global forest industry cluster, is crucial to Sweden from the economic and social perspectives (SFIF, 2008c). The industry is especially important to smaller economies such as the Swedish economy, but also plays a prominent role in the global economy (SFIF, 2008c). Ojala et al. (2006) state that the total value of forest industry production in the world economy was USD 414 billion in 2003. The same year, 26% of the total production of the global forest industry was for communication products (e.g., newsprint, printing, and writing paper), 34% packaging and hygiene products, 20% sawn timber, 16% various kinds of timber slabs, and the remaining 4% market pulp (Ojala et al., 2006 p. 258).

Globally, Sweden is a major forest industry nation with a highly export-oriented industry. In total, more than 85% of Sweden's pulp and paper products are exported, while the equivalent figure for sawn timber is approximately 70%. Sweden is the world's second largest overall exporter of paper, pulp, and sawn timber (SFIF, 2008c). According to SFIF (2008c), the trend in Sweden has historically been to increase the production of higher-value-added products, such as personal care products, while reducing the production of lower-value-added products, such as market pulp.

The forest industry is important to the Swedish economy, and in 2008 accounted for 10–12% of total employment, turnover, and value added in all Swedish industrial enterprises (SFIF, 2008c, pp. 4–5); furthermore, the industry accounted for 11% of Sweden's exports. In several Swedish regions, the forest industry accounts for over 20% of regional industrial employment. In total, the industry employs some 85,000 people directly, with up to 150,000 jobs (e.g., service, R&D, and maintenance) indirectly dependent on the industry, according to SFIF (2010a) and the Royal Swedish Academy of Engineering Sciences (IVA, 2006).

In the early twentieth century, there were over 4000 forest industry production facilities (including pulp mills, pulp and paper mills, and sawmills) worldwide, according to Ojala et al. (2006), and approximately 1700 at the beginning of the twenty-first century. The trend has been similar in Sweden, since small and medium-sized firms have either been closed down or consolidated with larger companies. In 1954, 84 companies owned 138 pulp and paper mills, while by 1994, 25 companies owned 64 pulp and paper mills (SIA, 1994). In 2010, the Swedish industry was dominated by three players, namely, SCA, Holmen, and Swedish–Finnish Stora Enso, which together own 17 pulp mills or integrated pulp and paper mills and a number of other assets including forests, electricity production, and sawmills (SFIF, 2010b).

Among the mid-sized players, Billerud (with three Swedish pulp and paper mills), Rottneros (with two Swedish market pulp mills), and Södra Cell (with three Swedish market pulp mills) are notable. Several foreign corporations also own mills in Sweden, such as Smurfit Kappa Group and M-real (SFIF, 2010b).

Technically, pulp production is of three basic types: mechanical, chemical, and chemical–thermomechanical pulping (CTMP) (Theliander et al., 2002). In 2002, approximately 70% of the pulp produced in Sweden was chemical pulp and approximately 30% was mechanical (Möllersten, 2002). The process used depends on the end product being produced. For example, a mechanical process is used to produce newsprint, resulting in paper with better printing qualities. A chemical process is used when producing end products that need to be stronger. Chemical pulping mainly uses biomass as the primary energy source, while mechanical pulping mainly uses electricity. On the other hand, when grinding the wood in mechanical pulping, up to 95% of the wood is used for end products, while approximately 50% is used when boiling the wood in the chemical process (Theliander et al., 2002).

I argued in section 1.1 that several drastic change processes have affected the Swedish forest industry and its use of electricity and forest resources over the last two decades. Still, when reading SFIF's Facts and figures 2008 (SFIF, 2008c), for example, the industry appears fairly stable. Pulp and paper exports rise or fall a little bit, depending on what year's statistics I read. Even though fewer firms are producing forest-based products today, the remaining mills are bigger, and the industry still seems to believe it is very important to Sweden. This background – which is based, obviously, on the sources I have selected – gives us few signs as to the industry's (re)actions regarding energy transition.

1.3 Philosophical position and research design

How should I try to capture how the industry has (re)acted regarding the energy transition in Sweden during the 1989–2009 period? This has been a complicated task. Very early in this project, I realized that I would never, despite my efforts, capture the whole, full, 'truth' of the industry's (re)actions in relation to the energy transition. This thesis therefore attempts to grasp some fragments of this complicated process, or "matter of concern", to use the term of French science and technology studies (STS) researcher Bruno Latour, i.e., an issue based on political, scientific, economic, constructions, calculations, arguments, assumptions, reasoning, overlays, and forecasts (cf. Latour, 2004, pp. 23–24). Rather than choosing a single homogeneous research design, this thesis is based on four papers treating different research problems, considering different analytical levels, applying different theoretical frameworks, and arriving at four different sets of results, providing multifaceted glimpses of the process. Furthermore, in the final chapter of this thesis, I will provide tentative reflections based on overall findings from my empirical material that are underdeveloped in the four papers. I therefore intend to gaze above and even beyond the individual papers, and discuss certain identified phenomena and processes that might provide new and/or complementary insights into the Swedish forest industry's (re)actions regarding the energy transition. Although my aim is that this thesis should do more than just reprise the individual papers, I should also point out that this is not an attempt to write a full and coherent story.

On the contrary, I would instead like to present a classic metaphor in the social sciences that emphasizes what this thesis, with its present research design, actually captures. I, the

researcher, am looking at a landscape from various locations and angles using different sets of binoculars. This landscape, however, is not plain and clean but rather "rugged" (Kauffman, 1995), i.e., full of valleys, crevasses, and cliffs. Furthermore, the landscape changes with the seasons. If the landscape is rugged, replete with inconsistencies, non-linearity, and contradictions, any traditional linear and homogeneous way of traversing it would be doomed. What, then, are the benefits of gazing from these various levels? Why study the industry's (re)actions in relation to the energy transition in a range of ways? I argue that, by examining the issue from several levels, though I may still not see the whole landscape (which I believe is impossible), what I will see from the various levels are sharp and distinctive images. I argue that in these individual images we might see clear, though partial, representations, recognizing that even these images are far from pure representations of the phenomenal world.

The philosophical position guiding this thesis is that it is impossible to produce a total, coherent, and true analysis, since no superior assessment foundation exists on the basis of which the various versions of reality can be judged. Attempting to produce such a thesis would only be indulging myself in meta-narratives, to use Jean-François Lyotard's (1984) term, i.e., grand, large-scale theories and philosophies of the world. Therefore, to write such an all-encompassing thesis about the Swedish forest industry's (re)actions in relation to the energy transition would only result in my distorting the complex and incoherent processes studied. Though recognizing the above, I have accepted that my arguments, notions, analyses, and reflections are based on reductionism – this is inevitable – but these reductions will not be of a totalizing and grand-scale kind, since I do not claim that my stories are exhaustive or, taken together, tell a coherent story. I have therefore chosen to write four individual papers and, in my final chapter in this thesis, I will present additional tentative reflections, discussions, and suggestions for future research into the studied phenomena.

With this said, it is also important to point out the obvious similarities between the four constituent papers, which could be considered case studies of different aspects of how the industry has (re)acted regarding the energy transition in Sweden during the 1989–2009 period.

Briefly stated, the above discussion articulates the philosophical position underlying this thesis. How, then, did I apply this philosophy in practice, and using the chosen research design? The methodological choices underlying the four papers will be further discussed in chapter four; the four constituent papers are summarized in Table 1.

	Paper I	Paper II	Paper III	Paper IV
Title	Exploring energy management in the Swedish pulp and paper industry	Material resources in strategy formation processes: translations of electricity and forest assets in three Swedish forest industry companies, 1990–2008	Between industrial modernity and ecological modernization? The Swedish forest industry's response to increased environmental demands regarding the electricity resource	Configuring the 'industrial collective': a controversy on the use of Swedish forests, 1989–2009
Level of analysis	Mill level	Corporate strategic level	Firm and industry level	Industry level, industrialists in the wild, and concerned groups
Major research problem	How are energy management practices being carried out in Swedish pulp and/or paper mills?	Why did Holmen, SCA, and Stora Enso manage their electricity and forest resources in increasingly different ways after the early 1990s?	How has the electricity-intensive Swedish forest industry responded to increased environmental demands in general, and specifically in relation to one of its strategic resources, i.e., electricity?	How is it possible for the industrial collective to have changed so radically over twenty years, regarding its translations of forests, and what has prompted this change?
Theoretical framework and concepts	Bounded rationality, Principal–agent relationships, Split incentives	Resource-based view, Actor–network theory, Translation	Modernization theory, Industrial modernity, Ecological modernization, Subpolitics	Concerned groups, Industrialism in the wild, Translation, Obligatory passage point
Methodology	Questionnaire	Text and document analysis	Interviews, site visits, text and document analysis	Text and document analysis
Main findings	The results indicate that energy issues have been given increasingly higher priority over the past 10 years. Despite this, overall questionnaire results indicate that there is still potential to improve energy management practices at the studied mills.	Barney and Hesterley's (2005) VRIO criteria treat resources as static, so actor–network theory may be a more useful way of understanding the ongoing process of resource management. The empirical findings demonstrate how the electricity and forest resources changed not only between companies in the industry, but also within individual firms over the study period.	Influential representatives of the Swedish forest industry strove to portray the industry and its products as sustainable, while proposed investments in electricity production indicate little or no actual concern for the environment. The industry currently seems caught between industrial modernity and ecological modernization.	The conflicts between industrialists in the wild and the confined forest industry forced the latter to enter novel business fields. The result is that several forest industry firms today make money selling 'green' electricity and other bioenergy products.

Table 1 *Summary of the four constituent papers.*

What is obvious from Table 1 is that different levels of analysis, theoretical perspectives, and methodological approaches have been used in the four papers. These papers' theoretical

frameworks are thoroughly discussed in chapter three, while the results of the four papers are summarized in chapter five. Based on the above discussion of my philosophical position and on the thesis research design, I can now more precisely situate my thesis in relation to previous research.

1.4 Positioning the thesis in relation to previous research

The aim of this thesis can be tackled using multiple methods and theories. Previously, research in broad fields such as economics, STS, strategic management (SM), economic sociology, environmental sociology, and organization studies has dealt with questions central to this thesis. This underlines the multidisciplinary nature of this thesis, i.e., I draw on several theoretical schools, traditions, frameworks, etc. In that sense, this thesis is a *bricolage* and I as the researcher the *bricoleur*.[3]

Hence, the aim of the following section is to discuss previous research that has significantly influenced me when writing this thesis. Despite the considerable attention paid climate change and the energy transition in general, and specifically to the role of energy-intensive industries in this process, the great majority of all research examining the Swedish forest industry's (re)actions regarding this process has been technical in nature (e.g., Möllersten, 2002; Wising et al., 2005; Bengtsson et al., 2001; Andersson et al., 2006; Klugman et al., 2007). The current study represents an attempt to bolster social science research into the Swedish forest industry's (re)actions regarding the energy transition. This thesis also deals with a more analytical and theoretical overall research aim, namely, to increase our knowledge of how an industry might deal with demands for change regarding its strategic key resources.

In the following, I intend to focus on presenting and discussing previous primarily social science research into (1) the Swedish and Nordic forest industry, (2) industries' and firms' (re)actions regarding energy transition, and (3) the path towards 'greening' – i.e., the ecological modernization, constructivist, and treadmill perspectives. Most of this previous research derives from disciplines such as STS, economic history, sociology, energy system studies, and SM. Finally, in section 1.4.4, I intend to position the thesis specifically in relation to previous research.

1.4.1 Previous economic research into the forest industry, 1945-2006

Previous economic research into the Swedish and Nordic forest industry can be divided into three categories in terms of their theoretical perspectives and overall results. The first category consists of the work of Anders Melander (1997, 2005) who has analysed the changes in the Swedish forest industry over the 1945–1990 period. This research is based on the theoretical framework of *industry-wide beliefs*. At the end of the 1980s and throughout the 1990s, an increasing number of studies argued that analysing structures of shared beliefs at the industry level is a useful way to gain knowledge of industrial change (Spender, 1989;

[3] *Claude Lévi-Strauss* discusses two ideal types, i.e., the *engineer* and the *bricoleur*, in the first chapter of *The Savage Mind* (Lévi-Strauss, 1966). While the bricoleur is forced to build and repair things with the material at hand, discharging several tasks at once by putting pre-existing things together in new ways, the engineer deals with well-managed projects in their entirety. If we view the social scientist as a bricoleur, she/he is forced to create a bricolage using the heterogeneous materials and tools at hand to conduct research. Time and time again, she/he needs to use new tools to examine the results regarding the material, to ask new questions and receive new answers.

Hellgren and Melin, 1992; Easton et al., 1993; Melander, 1997). One of the more influential of these scholars, Spender (1989), studied the business-specific world view of experts in three industries. The assumption in his theoretical framework is that industry managers strive to reduce uncertainty by applying industry recipes, i.e., knowledge bases specific to particular industries. These industry recipes guide the managers in their strategic considerations, by providing an accepted rationality (or ideology) for a given industry (Spender, 1989, p. 63). Notably, industry-wide beliefs are not success recipes for a given industry. On the contrary, in some cases they could instead serve to block certain strategic changes that could become future success stories for the industry. Melander (2008, p. 44) argues that industry-wide beliefs instead should be understood as mental maps that create order in a chaotic world. Through shared beliefs, managers can link various courses of events to understandable processes. The fact that the industry-wide beliefs are shared by a collective of managers in the same industry makes it easier to conduct industry debate, since it is clear what basic principles are important in the conversation (Melander, 2008).

How, then, according to these scholars, do industry-wide beliefs affect company strategy formation processes? The fact that industry beliefs are shared by a collective of managers in the same industry makes it easier to make strategic changes that have strong legitimacy according to the industry's shared beliefs. In contrast, strategic changes that radically challenge the shared beliefs of the industry are more difficult for individual firms to implement. The industry-wide beliefs of an industry, however, are constantly changing, enabling them to contain conflicting rationalities and permitting the existence of more than one shared belief in a given industry (Lilja et al., 1992; Spender, 1989). The existence of two sets of industry-wide beliefs in an industry suggests an ongoing change process.

The theoretical explanations for why these changes take place, however, differ between researchers. According to Spender (1989), changes in the industrial recipes at the industry level are caused by changes taking place in single organizations in the industry. The change process thus originates from strategic changes from one or a few of the firms in an industry, from which it might 'trickle up' to the industry level. Another explanation rests on the assumption that it is the nature of the wider environment that explains strategic changes in given industries (Gordon, 1991). A contrasting explanation stresses that the companies are free at any time to contest the prevalent belief structures in an industry; if they succeed, the dominant industry-wide belief will erode (Porac et al., 1995). The final alternative argues that the nature of the change has to be taken into account. Melander (2005), for example, argues that the strength of the influence of industry-wide beliefs on an individual company's strategy formation depends greatly on the intensity of the debate and the unanimity concerning the experienced problem and solution. Melander states: "Decision-makers participate in an ongoing discourse. They are both exposed to arguments and views and obliged to provide arguments and justifications for their own strategic behaviour" (Melander, 2005, p. 95).

Indeed, Anders Melander (1997), in the most extensive longitudinal empirical study of the Swedish forest industry, provides necessary historical context for my thesis. Melander (1997) argues in his dissertation that, up to the late 1980s, the Swedish forest industry was a mature industry, stable, and highly homogeneous in belief structure and strategy formation. According to Melander (1997), the dominant industrial belief in the Swedish forest industry after 1945 was in increasing investment in the integrated production of pulp and paper, bulk products, and large-scale production. The basis for this production concept was the evolution of the North American industry. Other arguments for the large-scale production of bulk

products were provided by Sweden's competitive advantages. Melander (1997, p. 306) states that arguments from the Swedish industry were in line with SM researcher Michael Porter's theory of national competitive advantages (Porter, 1990). According to this theory, the combination of natural forest resources, the location of the industry and its markets, and cheap hydroelectric power conferred a natural advantage on the Swedish industry over its competitors in producing pulp and paper products. These circumstances made the manufacture of bulk products on integrated production lines the core production concept in the post-WWII decades in the Swedish forest industry (Melander, 1997, pp. 306–311).

Melander (1997) argues that the North American forest industry became a role model for the future development of the Swedish industry in terms of technology, marketing, and strategy in the period immediately after WWII. The integrated production of pulp and paper, the ambition to achieve a higher degree of value added by improved quality, large-scale production, specialized and rapid machines, and the development of new consumer products were all North American developments of high relevance to the Swedish industry, according to Melander (1997). The references to North American industry were also confirmed in actions. For example, following the example set by the North American industry, the Swedish industry invested in Kraftliner in the 1960s. Melander (1997) argues that the comparisons with the North American industry acted as a point of reference for the Swedish industry but, when North American companies started to sell their products in Europe, their role changed to being perceived as the biggest competitor of the Swedish industry.

The first theme identified in previous economic research into the Swedish and Nordic forest industry is that, due to shared industrial beliefs, the Swedish forest industry at end of the 1980s was a mature industry, stable, and highly homogeneous in belief structure and strategy formation. The second identified theme concerns the *evolutionary economic* tradition. Scholars associated with an evolutionary economic perspective, such as Afuah and Utterback (1997) and Utterback (1996), stress that industries are dynamic and undergo constant change and evolution. Afuah and Utterback (1997) argue that technological changes are what finally change industries. An industry's structure constantly changes due to product and process innovation and emerging and disruptive technologies, which means that the kinds of strategies and capabilities needed for survival may vary over time, suggesting the dominance of different strategies in different phases. The notion of dynamic industrial change following certain phases was proposed by Joseph Schumpeter (1975) in 1942. Schumpeter argued that the driving force of the capitalist economy comes from the "new consumers, the new goods, the new methods of production or transportation, the new markets, the new forms of industrial organization that capitalist enterprise creates" (Schumpeter, 1975, p. 83).

Hence, Schumpeter recognized innovation as a catalyst of industrial change, rather than capital accumulation as argued by many neoclassical economists of his time (cf. Fagerberg, 2004). Schumpeter saw industries evolving from birth through their maturity and death, new products and processes finally replacing the old ones. This process of 'creative destruction' was driven by innovation in general and specifically by the work of individual entrepreneurs and/or big firms with considerable resources. Schumpeter's notions have been empirically examined in research into how firms fail to foresee and adapt to great changes and new technology (e.g., Tushman and Andersson, 1986).

Research influenced by evolutionary economics has focused on overall technological change and economic growth in the Swedish and Nordic forest industry. According to research

conducted by Jari Ojala, Juha-Antti Lamberg, Anna Ahola, and Anders Melander (Ojala et al., 2006), Nordic (especially Finnish) companies, instead of North American companies as described by Melander (1997), became serious competitors of the Swedish industry in the 1980s. From 1985 to 1995, a number of relatively small Nordic companies were merged to form larger units. According to Ojala et al. (2006), this enabled the Nordic companies to carry out larger and more expensive investment projects. The authors argue that the Nordic companies' increasing share of the global market is demonstrated when studying its share of total global turnover. From the 1940s to the 1970s, the Nordic companies' share of total turnover was approximately 20%. In the 1980s, however, this share grew to approximately 25% and in 2005 it was approximately 33%, while the US companies' share of the total turnover diminished correspondingly (Ojala et al., 2006, pp. 259–261).

Why, then, have the Nordic companies grown so rapidly in recent decades? Ojala et al. (2006, pp. 259–260) argue that there are a number of similar explanations of Finnish and Swedish companies' global growth in this period. Large-scale production facilities were created either through the consolidation of smaller firms or through large-scale investments in new mills. The forest cluster has also played an important role in both the Swedish and Finnish economies, which has led to public economic policies intended to foster growth in these industries. One of the most important explanations, according to the authors, has been access to historically cheap electricity supplies and reliable access to forest raw materials. The authors further note that the demand for forest industry products grew faster in Europe than in the USA in the 1980s and 1990s (Ojala et al., 2006).

Notably, the main growth of the global forest industry, or as much as approximately 50% of post-war sales, were achieved during the 13 years from 1990 to 2003 (Ojala et al., 2006). In the Nordic companies, this share of growth was even higher, at up to 61%. According to Ojala et al. (2006), this indicates that growth was especially high in the Nordic companies at the turn of the millennium (Ojala et al., 2006). Vaara et al. (2006) argue that the high growth rates might be due to the global industrial restructuring prevalent in the global forest industry in the 1995–2005 period. In particular, Swedish (e.g., SCA and Stora Enso) and Finnish firms conducted massive acquisitions and mergers during this period, enabling them to strongly increase their share of global sales (Vaara et al., 2006). Paper II examines how the corporate strategies of SCA and Stora Enso were highly focused on global growth during the 1990–2008 period.

Besides focusing on market growth, the above-noted research tradition has also concentrated on technological changes and key products in the forest industry. As demonstrated above, both Melander (1997) and Ojala et al. (2006) have argued that, in the 1980s and 1990s, the Nordic forest industry focused its investments on producing high-tech, high-value-added products. Ojala et al. (2006, p. 262) stresses that a pulp and/or paper mill is technically very complex and very capital intensive. Producing pulp and paper in a competitive manner, according to these authors, requires significant scale economies and thus large amounts of invested capital (Ojala et al., 2006). Still, it takes several years for a large-scale investment to actually come into production and several more years before the investment will be paid off. Ojala et al. (2006) says this leads to major cyclicality in the industry, in which large-scale investments are often made nearly simultaneously, limiting the shareholders' short-term earnings (Ojala et al., 2006). According to previous research by Melander (1997) and Ojala et al. (2006), investments are further related to the technological and product shifts in the industry. Table 2 summarizes the major technologies and products in the pulp and paper

industry from 1850 to 2007, based on previous research by Melander (1997), Ekheimer (2006), and Ojala et al. (2006).

Period	Major Technologies	Major products
1850 – 1945	Virgin timber as the main source for pulp production, major mechanization, sulphite and sulphate pulp	Newsprint, paperboard
1946 – 1960	Integrating and mechanizing of production processes, rationalizing production	Newsprint, fine papers
1961 – 1980	Automating and computerizing of production control systems, from sulphite to sulphate pulp	Coated magazine papers, fine papers, Light Weight Coated papers (LWC)
1981 – 2006	Recycled fibres, environmental regulations, energy efficiency, integrated mills, larger paper machines	Coated papers, "recycled" papers, "glossy" papers

Table 2 *Major technologies and major products in the forest industry 1850-2006 according to previous research (Ojala et al. 2006, Melander 1997, and Ekheimer, 2006).*

As shown in Table 2 and demonstrated by previous research, both major technologies and major products have shifted over the past one and a half centuries. Among other recent research associated with my second theme, i.e., research into the Swedish and Nordic forest industry based on evolutionary economics, Patrik Ekheimer's (2006) dissertation is notable. Ekheimer (2006) also focuses on the technological changes in the Swedish forest industry and analyses "background factors" (i.e., technical innovations, investments, and institutions) and motives underlying the changes in Swedish newsprint production. The study uses the Hylte mill as a case in analysing the introduction of recycled paper in newsprint production. Ekheimer (2006) argues that environmentally friendlier technology (paper recycling) can be introduced to the Swedish forest industry with positive economic results.

Although the above research gives the impression of major technological changes in the Swedish forest industry (and sometimes the Nordic and global industries), several other previous studies based on an evolutionary economic perspective have argued that the industry instead displays a high reluctance to embrace major change. Both Staffan Laestadius (2000) and Anna Bergek (2002) argue that the technologies used in the forest industry are well known and widely disseminated, and that radically new technologies or processes have not been adopted on a large scale in the industry. Both the aforementioned researchers were heavily influenced by the evolutionary economic tradition (cf. Nelson and Winter, 1982; Dosi, 1984; Utterback, 1996) and further argue that the Swedish forest industry is an industry that displays almost every attribute of a mature industry. This means that, when a given technological process is developed in a certain direction in an industry, the industry matures, and innovation and changes in the industry often become incremental within the context of the current technology, product, and market.

Bergek (2002) illustrates the above notion by analysing why black liquor gasification (BLG) has not been implemented in the Swedish forest industry.[4] Although BLG has received considerable political attention since the 1980s, and despite the promise of substantial government investment subsidies, Swedish forest industry firms have been uninterested in the new technology, according to Bergek (2002, pp. 2–3). BLG yields combustible gas instead of steam; this increases energy efficiency and the amount of electricity produced, possibly doubling the electricity produced by the industry. Bergek (2002) says that several reasons were cited by the forest industry firms for not investing in BLG pilot facilities; one of the most important was that "the technology no longer fit the plans or the strategic recipes of the industry" (Bergek, 2002, p. 24). Central to the second research theme is the role of technological change and innovation in explaining industrial change. This research also stresses, as does research into industry-wide beliefs, like that of Melander (1997), that mature industries, such as the Swedish forest industry, are often highly reluctant to change.

The third research theme also focuses on the role of technology in explaining industrial change in the Swedish forest industry, but emphasizes how technology is intertwined in networks not only of industry firms but also of suppliers and customers. Since the late 1980s, researchers associated with the *Industrial Marketing and Purchasing Group* (IMP) have analysed these matters. Waluszewski (1989), Wedin (2001), and Håkansson and Waluszewski (2002) have studied the development and managing of business relationships across a network of companies in the forest industry, including customers and suppliers. This research demonstrates that individual pulp and paper mills are integrated into a network of suppliers, competitors, etc., that all participate actively in technologically developing mill products. The view that the industry is constituted in socio–technical networks was an important inspiration of paper II, although I chose to use the translation concept rather than "heterogeneous resources" to explain the changes in how the three forest industry firms managed their electricity and forest resources. In sum, the previous research into the Swedish forest industry has been an important influence when writing this thesis; I will return to many of the theoretical notions and arguments from the three themes identified above.

1.4.2 Previous research into industry (re)actions regarding energy transition

In this section, I will present previous research into industry (re)actions regarding energy transition. Several previous studies have identified energy efficiency potential in the Swedish forest industry. The estimated figures for improved energy efficiency range from just a few per cent (Ottosson and Petersson, 2007) up to approximately 30% (Nilsson et al., 1996). The lower figure was based on the evaluation findings of the Swedish Programme for improving energy efficiency in energy-intensive industries (PFE) that indicated an electricity efficiency potential of approximately 3% with payback periods of about three years (Ottosson and Petersson, 2007). A considerably higher figure was presented by Nilsson et al. (1996), who identified approximately 30% in electricity efficiency potential by focusing, for example, on replacing worn pumps, downsizing oversized equipment, and installing variable-speed drives for pumps greater than 50 kW (Nilsson et al., 1996). Two Swedish case studies of chemical pulp mills stated that it was not unlikely that Nilsson et al.'s (1996) findings considering electricity efficiency potential may also hold for the studied mills (Klugman, 2008; Klugman et al., 2007).

[4] In 2005, a BLG pilot plant opened at the Smurfit Kappa Kraftliner mill in Piteå in northern Sweden. The Swedish Energy Agency partly financed the pilot plant.

Patrik Thollander and Mikael Ottosson conducted a case study analysing barriers to and driving forces for energy efficiency in the Swedish pulp and paper industry (Thollander and Ottosson, 2008). The results indicate that the energy managers identified the risk of production disruptions as the key barrier to improved energy efficiency, while the cost of such disruptions was rated second. According to Thollander and Ottosson (2008), both these barriers could be interpreted as hidden costs of investment (e.g., production disruptions and staff time) and as risks associated with any new technology that affects core production processes. These results highlight the materiality of the industry, in which investments that involve interruptions to the main production process may only be considered practical if the project can be completed within the normal scheduled downtime or as part of a larger strategic investment project. This is consistent with earlier findings for the cement industry and, according to Sorrell et al. (2010), is likely to be a common situation in many energy-intensive industries. The driving forces for energy efficiency in the industry ranked highest by respondents were, according to the study, all related to organizational factors in the mills, such as cost reductions resulting from lower energy use, the presence of people with the desire to work continuously on energy issues, and the existence of a long-term energy strategy (Thollander and Ottosson, 2008).

Why, then, should industries in the first place allocate resources for energy and environmental issues? Previous research has identified several answers to this question. The first and most obvious answer is that industries should always focus on reducing costs. Efficient use of energy is crucial to industries, since it leads to direct economic benefits, such as increased competitiveness (Hirst and Brown, 1990) and increased productivity (Worrell et al., 2003). Where many resources are used we might, according to previous research, also expect to find inefficiency. SM researchers Michael Porter and Claas van der Linde (1995a, 1995b), for example, argue that environmental performance is strongly connected to firm competitiveness. According to the authors, all waste, pollution, and energy discharged into the air are signs that resources have been used incompletely, inefficiently, or ineffectively. This waste creates additional activities for companies that add cost but create no value for customers, such as waste handling and disposal discharges. Porter and van der Linde (1995a, 1995b) argue that, instead of acting defensively, firms should act offensively, since empirical evidence indicates that it is possible to command price premiums for “green” products and that companies could create new market segments through environmental process and product innovation. Consequently, Porter and van der Linde (1995a, 1995b) claim that improved energy and environmental performance could open new strategic windows on novel products and markets.

Satu Pätäri (2009) argues in a similar way as Porter and van der Linde (1995a, 1995b) in her doctoral thesis about the evolving Finnish bioenergy market in the intersection between the Finnish forest and energy industries. According to Pätäri (2009), the changing nature of the competitive environment makes the traditional forest industry an excellent example of an industry that should be eagerly promoting new value-creating strategies to create competitive advantage. Pätäri (2009, p. 13) argues that the long-term strategy of most of the industry has been to emphasize productivity, cost-effectiveness, and cost-efficiency in its core business activities, i.e., traditional forest industry products (and, in some firms over the last two decades, personal care products). These corporate strategies have usually resulted in value destruction rather than value creation and growth (Pätäri, 2009, p. 14). Pätäri (2009) analyses the business opportunities associated with bioenergy, and discusses the challenges and threats influencing collaborations between forest and energy companies. According to Pätäri (2009),

climate change, which calls for increased energy efficiency and increased use of renewable energy sources, represents not only a problem to the forest industry but also an opportunity to develop novel value-creating business opportunities. In this context, forest industry firms' know-how about producing 'green' electricity, heat, and biofuels could create much-needed value for the industry in the emerging markets for renewable energy products (Pätäri, 2009, p. 15).

This line of reasoning has also been discussed in technical research in recent years, which suggests that the forest industry could make energy a core business activity by becoming a biorefinery-based industry (Berntsson et al., 2006). According to Berntsson et al. (2006), increasing competition from tropical countries (e.g., South American) with fast-growing forests means the Swedish industry must increase its competitiveness and find new, highly refined products that complement existing pulp-based products. The authors argue that techniques can be developed for refining almost the entirety of the harvested tree, including pulp mill by-products and bark compounds, into platform chemicals, electricity, high-quality fuels, and structured feedstock for chemicals and materials (Berntsson et al., 2006, p. 1). These biorefineries may either be "standalone" units for upgrading biomass or be integrated into existing pulp and/or pulp and paper mills. The general objective of such biorefineries, according to the authors, is to refine biomass into a number of more valuable end products, thereby increasing the Swedish forest industry's value creation and chances of long-term survival. Berntsson et al. (2006, p. 68) state that Sweden has strong incentives to realize the pulp mill/biorefinery vision to reduce dependence on petroleum as a raw material, compensate for current decreasing profitability of standard pulp production due to competition from countries with fast-growing eucalyptus, and reduce greenhouse gas emissions from consuming fossil raw material.

1.4.3 Previous research into the path towards 'greening' - ecological modernization, constructivist perspectives, and the treadmill

The above research does not generally view the changes associated with climate change and energy issue as problems for future businesses or the capitalist system. Dobers et al. (2001) analyse the most influential writings associated with corporate environmental management over the 1992–2000 period in terms of their citations in the journal Business Strategy and the Environment. They found that the majority of the most influential writings about business and its relationship with the environment were not concerned with change on a radical basis. Instead, several of the most influential writings argued in a technologically optimistic manner that acute environmental problems could be solved using methods such as environmental auditing and life-cycle assessment (e.g., Welford and Gouldson, 1993). Hart (1995) also exemplifies very influential research based on the notion that firms may go 'greener' by developing their capabilities. Hart's (1995) framework focuses on taking evolutionary steps from having a pollution prevention strategy towards product development for 'greener' market segments. Although focusing more on firm ability to develop its abilities in these areas, Hart (1995) shares the technologically optimistic view prevalent in Porter and van der Linde (1995a, 1995b) and Welford and Gouldson (1993).

We should view this research in a wider discursive context. Arthur Mol (1996) argues that, in contrast to the early 1970s' criticism of the modern project and economic growth, since the early 1990s, the environment has entered the economic agenda. Maarten Hajer (1995, p. 25) believes that this new turn in environmental policy was a compromise between environmental movement demands and demands from industrialists and other supporters of a traditional

business-as-usual perspective. This *ecological modernization* model of thought has, according to Mol (1996, p. 309), become dominant in Western industrialized societies and, according to Hajer (1995), enabled the end of the ecology versus economy conflict. Spaargaren and Mol (1992, p. 334) argue that: "Ecological modernization stands for a major transformation, an ecological switch of the industrialization process into a direction that takes into account maintaining the sustenance base". The concept of ecological modernization closely resembles the concept of sustainable development as expressed in the 'Brundtland report', published in 1987 by the United Nations World Commission on Environment and Development (WCED) under the title *Our Common Future* (WCED, 1987). Spaargaren and Mol (1992, p. 334) state that the concept of ecological modernization, like sustainable development, provides: "the possibility of overcoming the environmental crisis without leaving the path of modernization". In that sense, Mol (1996) argues that the environment is becoming a crucial factor in the transformation of modernity.

Ecological modernization differs in significant ways from previous perspectives that viewed industries as only creating environmental damage. Both Hajer (1995) and Beck (1997) discuss this overall change in modernity as a shift from what Beck calls *industrial modernity* (Beck, 1997, p. 113) towards what Hajer (1995) calls ecological modernization and Beck (1997) calls *reflexive modernization*. According to Beck (1997), industrial modernity was based on notions of never-ending economic growth and prosperity and informed and shaped Western societies from WW2 until at least the 1970s. In the logic of the industrial modernity, nature and energy were resources to be conquered and used to build the modern industrial society. Unlike the anti-modernity notions prevalent among environmental groups in the 1970s, notions that questioned economic growth (Anshelm (2002, p. 35), scholarship associated with both ecological modernization and Beck's (1997) theory of reflexive modernization is based on the notion that the ecological crisis will actually not only save, but deepen modernity.

As Langhelle (2000) argues, the concept of ecological modernization suggests that the process of modernization can continue while addressing environmental issues without the need for profound structural change in the capitalist system. According to Mol and Spaargaren (2000), advocates of ecological modernization do not perceive economic growth and industrialization as threats to the environment, but possibly as the only realistic way out of ecological and environmental crisis. Many researchers supportive of ecological modernization, such as Porter and van der Linde (1995a, 1995b), articulate a techno–optimistic view that business and industry can offset the problems and costs associated with environmental and energy issues through new innovations. Enthusiasm for the capitalist system's ability to become 'greener' differs among scholars of ecological modernization. According to Mol and Spaargaren (2000, p. 23), its mainstream advocates view it as enabling a process of transformation towards industrial 'greening' and a general shift to a more environmentally sound process of modernization. Although Beck (1997) is much more critical of the current political system's ability to resolve the ecological crisis than are advocates of ecological modernization (e.g., Mol, 1996), both factions argue that the environmental crisis that industrial societies face will force these deeper into another type of modernity based on environmental considerations.

The shift towards industrial 'greening', however, is not always smooth and without conflict, as demonstrated by previous work by another researcher associated with ecological modernization. David Sonnenfeld's (1998) study of the changes in Thailand's pulp and paper industry in the 1990s demonstrates that it was the combination of ecological disaster, political turmoil, social protest, and timing that made Thailand's pulp and paper industry one of the

most technologically advanced (and 'cleanest') in the world. The influence of various non-industrial stakeholders on industrial 'greening' has also been analysed in other studies. Sharma and Henriques (2005) analyse the influence of social and ecological stakeholders on managers' views and opinions in the Canadian forest industry. They found that various stakeholders (e.g., local communities, activists, and government) had affected the practices in the Canadian industry, including movements towards increased pollution control and energy efficiency. However, more advanced changes, such as the redefinition of business and industrial ecosystems, have not occurred. The changes in the industry have instead emphasized reusing materials and sustainably harvesting forests, rather than investing in new mills and entering new market segments. In paper III, I specifically situated the Swedish forest industry's reactions to environmental sustainability in general to the environmental demands associated with the electricity use in particular in relation to previous ecological modernization research.

Sonnenfeld (1998) and Sharma and Henriques (2005) view progress towards 'greening' and organizational change as largely concerning industrial change as responses to external stimuli from, for example, stakeholders. Susse Georg and Lanni Füssel (2000) instead focus on the interpretations, emotions, and actions of organizations regarding 'greening'. Although the work of Georg and Füssel (2000) is not directly associated with ecological modernization, it merits consideration since it provide a constructivist critique of research into the 'greening' of business. Georg and Füssels (2000) argue that organizational 'greening' should be viewed as an emergent process within a given organization rather than only organizational adjustments to the external context. According to the authors, environmental management technologies attain their significance and performative meaning through the organizational context in which they become embedded. Another example of a constructivist approach to 'greening' is found in Satu Reijonen's (2008) dissertation. Reijonen (2008) analyses how an environmentally friendlier product – in this case, a urine bag – comes into existence and how it maintains its 'greenness' through various market practices. The author was particularly interested in how environmental friendliness is stabilized and destabilized as a product quality by market actors. Both these studies differ from much of the abovementioned research since they are constructivist, and view the 'greening' process as an ongoing achievement, rather than something forced on an organization or product by forces 'out there'. Indeed, both studies are somewhat similar to this thesis (especially papers II and IV) in that, using a constructivist approach, I seek to analyse how the configuration of various industrial (and firm-level) practices and entities are (re)stabilized in the Swedish forest industry.

I believe it is crucial to emphasize that scholars of ecological modernization have also been criticized. Sociologist Allan Schnaiberg's *treadmill of production* model has in recent decades become one of the most influential in environmental sociology regarding the possibility of making capitalism 'green' (for an overview of Schnaiberg's work, see Foster, 2005). Schnaiberg's (1980) basic assumption, often characterized as neo-Marxist, is that individual examples of firm or industry 'greening' should not be seen as examples or evidence of wider system-level change. As Pulver (2007, p. 49) notes, treadmill scholars argue that short-term efficiency gains in single firms or industries are negated by the wider environmental impacts of long-term increases in production and consumption in the capitalist system as a whole. The treadmill metaphor, i.e., running in place without moving forward, illustrates how incremental change is insufficient to solve the problems associated with the modern project, since these changes are always overwhelmed by larger changes and forces in the global economic system. In many respects, researchers associated with the treadmill perspective share the anti-

modernity stance prevalent in the 1970s in many Western societies (Anshelm, 2000). Environmental problems cannot be solved in a system dependent on economic growth, since this puts ever-increasing demands on the environment by extracting limited natural resources and generating various types of pollution.

Rather than sharing the positive belief of ecological modernization scholars in the ability of technology, and in the possibility of cooperative solutions between societal spheres, to resolve the ecological and environmental crisis, treadmill theorists argue that environmental sustainability requires a radical restructuring of the political economy and moving away from dependence on economic growth. Since not only the bourgeoisie (the owners of the means of production), but also the state, labour unions, and private capital, depend on economic growth, this leads to inter-dependency in a cycle of production demanding more production to solve problems such as unemployment. After presenting previous research, I believe that it is also important to underline the specific contribution of this thesis in relation to previous research.

1.4.4 The specific positioning of the thesis

Influential scholars have analysed what constitutes industries and what factors create industrial change in general (e.g., Porter, 1980; Barney, 1997; Utterback, 1996; Nelson and Winter, 1982; Dosi, 1984; Teece et al., 1997). Although some of this previous research influenced this thesis, during my research I realized that it would be impossible for me to contribute to all the traditions outlined above. There are several reasons for this. First, most previous research into industries and industrial change was inspired largely by economics, such as the industrial organization (IO) view (Bain, 1959; Porter, 1980), the resource-based view (RBV) (Rumelt, 1984; Barney, 1997; Barney and Hesterley, 2005), and transaction costs economics (TCE) (Williamson, 1979, 1981, 1985). Indeed, I found several of these perspectives problematic, based on my multidisciplinary research interest and identity. I also found that many of these perspectives (e.g., RBV) treated industries and industrial change as static, an observation developed in my theoretical chapter in this thesis and in paper II.

Although the abovementioned studies highlight key factors explaining industry-level changes, one might argue that many of these studies ignore the contributions of other important non-industrial actors, such as researchers, politicians, environmental organizations, and concerned groups, to the configuration of industries. In that sense, they are devoted to the traditional definition in economic theory that an industry is simply a group of companies producing the same principal products or, more broadly, a group of companies producing products that are close substitutes for each other (cf. Porter, 1980). This criticism marks another problem with the scholars influenced mainly by economics, and this line of reasoning has been further developed by economic sociologists Mark Granovetter and Patrik McGuire.

Granovetter and McGuire (1998) argue that economic sociology has paid too little attention to the middle level of aggregation, such as industries, resulting in these issues being left to economists. While previous research associated with evolutionary economics and innovation studies has taken a broader view of industrial change over time, including studying the influence of networks of non-industrial actors such as politicians and researchers (Malerba and Orsenigo, 1996), this particular issue, the embeddedness of industries in other societal spheres, was one of the main concerns driving an evolving *sociology of industry* (Helgesson, 1999, p. 50). Rather than limiting industrial change to explanatory factors such as changes in firms' resources, relationships with suppliers, product and process innovation, and

relationships with competitors, industries were instead viewed as embedded in the wider societal spheres of science, policy, economics, etc.

Industries could be viewed as constituted and embedded in networks of other entities (e.g., the state, resources, and science), and their configuration may change due to adjustments and redefinitions in relation to other actors and societal spheres. This implies that what might be viewed as stable or changing from one viewpoint might appear the reverse from another vantage point. Research into industrial change from this perspective has therefore focused on how the configurations of industrial and organizational practices are stabilized and destabilized, instead of viewing them as inevitable (Helgesson, 1999; Kjellberg, 2001). In this context, we can speak of this view of industrial change as 'industry in the making' rather than 'ready-made industry' (cf. Latour, 1987, ch. 1), in that it views existing configurations as ad hoc stabilizations instead of representing a natural order (cf. Helgesson, 1999, p. 3). This perspective calls for inquiry into how and why order and change are produced and what actors, including non-industrial ones, are involved in this (re)configuration.

The evolving sociology of industry described above often referred to previous work in the broad STS field to obtain tools for studying the stabilizing and destabilizing of industries. In particular, the notion of never treating the social and natural and/or the social and technological as divided is central to the STS field (e.g., Hughes, 1983; Pinch and Bijker, 1987; Latour, 1987). Central to this research is the analysis of the ongoing socio–technical processes of stabilizing and destabilizing, rather than treating technological systems, technology, or laboratories as fixed entities. Its common interest is in how, in complex matters, nature or technology (material entities) interconnect with human entities in producing socio–political and techno–economic phenomena. This marks a new turn in research into industries and industrial change, research that has historically been heavily dominated by economics. This STS turn (or perhaps economic sociological turn) has resulted in research that analyses phenomena related to research fields such as financial economics (MacKenzie, 2007), marketing and industry studies (Kjellberg and Helgesson, 2006a; Kjellberg and Helgesson 2006b; Finch and Acha, 2008), and accounting (Skaerbaek and Tryggestad, 2010). This thesis, especially papers II and IV, could be viewed as part of the sociology of industry, in that I seek to analyse how the Swedish forest industry has (re)acted regarding the changes affecting Sweden's energy resources over the 1989–2009 period, by focusing on how the configuration of various industrial (and firm-level) practices and entities are (re)stabilized.

I would also like to point out another influential way in which this thesis differs from the abovementioned general research (e.g., IO, RBV, and TCE) into industrial change. While many of the above scholars focus on hands-on issues related to industrial change, such as the importance of intangible resources (e.g., trademarks and competencies), relationships between suppliers, the threat of competitors entering the market, etc., this thesis examines the essence of modern industrial society. Inspired by German sociologist Ulrich Beck (1997), I am convinced that issues related to industrial energy use and the environment could invite deeper reflection on and problematization of contemporary society's relationship with nature, resources, power, and political structure. In that sense, I believe that it is important to view the studied industry, the Swedish forest industry, as a political actor in the processes studied. This conviction was crucial when writing papers II–IV.

The bricolage I have constructed here in many respects follows the STS turn (or perhaps the economic sociological turn) when analysing industrial change, since I view the industry as

something in the (re)making due to its wider embeddedness in other societal spheres. In particular, the changes related to the Swedish forest industry's considerable use of electricity and forest resources have, in the above context, prompted substantial changes affecting both reality and knowledge production over the studied period. By analysing these changes in light of concepts and notions that stress the evolving nature of reality and knowledge, this thesis intends to provide the research community with new insights into how an energy-intensive industry (re)acts regarding increasing environmental and energy-related demands and concerns. My research may also increase our knowledge of how an industry might deal with demands for change regarding its strategic key resources.

1.5 The outline of the thesis

Chapter two presents some of the changes and political and scientific debates related to the energy transition occurring during the 1989–2009 period, demonstrating how some of these changes have affected the Swedish forest industry. In chapter three, the theoretical concepts of the four constituent papers are discussed and problematized more thoroughly than was possible in the papers themselves. Chapter four reflects on the methodological considerations underlying this thesis and the four papers. In chapter five, the papers are presented and summarized. Chapter six offers tentative reflections that raise ideas and suggestions for future research.

Chapter 2

2 THE ENERGY TRANSITION AND ITS EFFECTS UPON THE SWEDISH FOREST INDUSTRY 1989-2009

2.1 The scientific and political call for transition of the European energy systems

This background chapter identifies some of the changes and political and scientific debates related to the energy transition during the 1989-2009 period. Further the purpose is to demonstrate how some of these changes have affected the Swedish forest industry.

Since the Intergovernmental Panel on Climate Change (IPCC) report in 2007, with its apocalyptic pronouncements, the scientific message has been that the increased global warming resulting from the use of fossil fuels is posing a major threat to the environment and humankind (IPCC, 2007). Climate change calls for adaptation and conversion of the world's energy systems. In this context, more energy-efficient industrial production is claimed by IPCC (2007) to be one of the most promising means of reducing the threat of increased global warming, as the world's industries, according to International Energy Agency (IEA) estimates, globally account for approximately 78% of annual coal consumption, 41% of electricity use, 35% of natural gas consumption, and 9% of global oil consumption (IEA, 2007).

In the European Union (EU), growing concern about increased global warming has resulted in the Climate Action and Renewable Energy Package (EU, 2008). The package of proposals has been described as "the European Union's ambitious commitments to fight climate change and promote renewable energy up to 2020 and beyond" (EU, 2008). This package, often referred to as the "20–20–20 target", states that the EU is committed to reducing its overall emissions to at least 20% below 1990 levels by 2020, and is ready to scale up this reduction to 30% under a new global climate change agreement when other developed countries make comparable efforts. The EU has further set itself the targets of increasing the share of renewable energy use to 20% and increasing energy efficiency by 20% by 2020 (EU, 2008).

Chapter 2

Central to the EU 20–20–20 target are various public policy instruments aiming to make energy use more efficient. This has led to the implementation of public policy instruments such as the European Emission Trading Scheme (ETS) and the European Energy End-use Efficiency and Energy Services Directive (ESD). Research has claimed that adopting demand-side policy instruments such as the ETS will likely result in higher European energy prices, possibly leading to competitive disadvantages for European industries versus industries located outside Europe (ECON, 2003). European industries' fear of increased energy costs due to the EU 20–20–20 target has resulted in intense political lobbying from various industry associations for exemptions from the ETS (SVD, 2008a). To reach a successful agreement, the EU agreed on a compromise plan that will allow some of the biggest CO_2-emitting industries to continue to receive free credits in the ETS.[5] Eastern European countries, which are especially dependent on fossil fuels, will receive a small percentage of revenues from the ETS to help transform their power sectors, which will be partially exempt from paying for emissions permits until 2020. The compromise deal further specifies that EU member states can import UN-approved carbon offset credits from the developing world to put towards their emission reduction targets.

Taken together, this demonstrates that it will not be easy to implement the environmental and energy-related transition that IPCC (2007), for example, considers necessary to reduce the negative impacts of climate change. The European industries' political lobbying illustrates how corporations with millions of employees and billions in annual turnover are powerful political actors by means, for example, of business associations (SVD, 2008a). At the same time, one might argue that various EU member states and their industries have diametrically different basic conditions, in terms of, for example, industrial sectors, electricity generation, and national public policy instruments. Furthermore, different countries within the EU to different extents have already begun their energy system conversion, affecting their national industries. Sweden is an EU country that wants to be perceived as having made the farthest-reaching large-scale changes in its energy system in recent decades (cf. Government Offices of Sweden, 2010).

2.2 The Swedish policy on sustainable development

Previous researchers such as Lundqvist (1997) and Sarasini (2009) have argued that Sweden has become known internationally as a "leader" or "pioneer" on a range of environmental issues by combining environmental standards with high levels of welfare and economic growth. This view of a pioneering or leading nation is also evident in the Swedish Government's website, which presents Swedish energy policy (Government Offices of Sweden, 2010). Since the advisory referendum in 1980, when Swedish citizens voted to phase out nuclear power, the Swedish parliament has worked towards a transition of the Swedish energy system (Kall, 2011). In 1997, the Swedish parliament decided to close the first Swedish nuclear reactor, located in Barsebäck, which was decommissioned in 1999. The second reactor, and hence the entire Barsebäck plant, was permanently decommissioned in 2005. Simultaneously, and despite increased industrial production, Swedish use of oil has

[5] According to a report from the Pew Center (a US-based lobbying organization) on global climate change, Italy, Germany, and France, in addition to Eastern European countries, all demanded various exemptions for their national industries in relation to the ETS (PEW, 2008).

fallen from more than 70% of the total energy supply in 1970 to approximately 30% today (Government Offices of Sweden, 2010).

The Swedish government further states that electricity production in Sweden is today mostly fossil free, since approximately 90% of the electricity comes from hydropower and nuclear sources, the remainder being biofuel based, fossil fuel based, and wind power (Government Offices of Sweden, 2010). According to the Swedish Energy Agency (SEA), this shift since the 1970s is mainly due to conversion of energy carriers from oil to electricity and more efficient use of energy. Another important factor is the large increase in renewable energy use since 1980. Biomass accounts for most of this increase, while wind energy has increased from negligible in 1994 to above 1 TWh today (SEA, 2009).

The share of biofuels in the Swedish energy system, according to statistics from SEA, has increased rapidly in recent decades, rising from approximately 10% of total energy supply in the 1980s to 19% in 2007. Biofuels are mainly used in the forest industry, in district heating systems, for electricity production, and for residential heating. In 2007, the total use of biofuels, peat, and waste amounted to approximately 120 TWh (SEA, 2009, p. 109). Swedish district heating systems are cited by the Swedish government to illustrate the transformation of Swedish energy systems in recent decades. The government states on its website: "Sweden has an extensive district heating sector. District heating accounts for approximately 40% of the heating market in Sweden. The change in the fuel mix has been dramatic. Compared with 1970, when oil was the main fuel, oil accounts for only a few per cent today. More than 62% of district heating fuel today is biomass" (Government Offices of Sweden, 2010).

The shift in Swedish environmental and energy policy, however, has not been smooth or without conflict during the 1945–2010 period. After WWII, Swedish energy-intensive basic industries, such as the forest, steel, and mining industries, demanded increasing quantities of energy to increase their production. Given Sweden's dependency on such industries, it became important to secure large-scale electricity production. Sweden has several large rivers, so hydropower was viewed as a political answer to the increasing electricity demands of industries and citizens. The major large-scale hydropower build-out in Sweden took place between the 1940s and 1960s supported by all political parties. This large-scale build-out was necessary to sustain economic growth and pay for the expanding Swedish welfare state. Complete political consensus backed the expansion of hydropower (Anshelm, 1992, p. 13).

Political plans for continued development of the remaining undeveloped rivers in northern Sweden, however, were postponed due to widespread public protests starting in the 1960s (Anshelm, 1992). The major point of contention was the impact on the local environment of constructing large hydropower dams, which had devastating effects on biological diversity and caused the removal of whole villages. Public resistance to the use of Swedish rivers was among the first examples of large-scale public opposition to environmentally damaging activities in Sweden (Anshelm, 1992). Due to these protests, parliament found it necessary to turn the remaining four large rivers into "national rivers" (i.e., the Kalix, Pite, Torne, and Vindel rivers) and protect them in the constitution by prohibiting further development.

In the early 1970s, questions regarding energy and environmental issues became increasingly associated with visions of a radically different society. The notion of a society based on never-ending economic growth was being publically contested and visions of a radically different "low-energy society" presented (Anshelm 2002, p. 34). This "low-energy" society

was associated with notions of ecological balance, zero economic growth, decentralization, local democracy, and a wider relationship in which mankind lived in harmony with nature, rather than exploiting it. Although these ideas were often supported by left-wing political groups, they were also becoming important to the Swedish Centre Party. This green shift resulted in the Centre Party under the leadership of Thorbjörn Fälldin, a committed anti-nuclear-power politician, receiving 25% of the votes in the 1973 parliamentary election (Lewin, 2002, p. 312). This marked escalating political confrontation over the ongoing Swedish nuclear power programme that had been driven since 1947 by the Social Democratic Party. In 1972, the first large-scale commercial nuclear power reactor in Sweden (Oskarshamn 1) had been started and several more were planned. The abovementioned political confrontation increased even more in the early winter of 1973. The global oil crisis that occurred that year resulted from the oil-producing countries reducing their supply of oil, which caused the global oil price to increase significantly. The Swedish Social Democratic Minister of Industries, Rune Johansson, saw the crisis as yet another argument that large-scale Swedish investments in nuclear power were an absolute necessity (Anshelm 2000, p. 147). For supporters of an alternative society based on a low use of energy, the oil crisis instead demonstrated that the march towards a nuclear society was only a path towards a new energy crisis and, even worse, towards potential nuclear accidents.

Although the Centre Party was the big winner in the 1976 Swedish parliamentary election, the Swedish nuclear power programme continued. However, it proved to be so controversial an issue that in 1978 split the right-wing/centre/liberal government, comprising the Centre, Liberal, and the Moderate parties. The ensuing minority government, comprising the Liberal and Moderate parties, failed to withdraw the nuclear power issue from the political debate. Furthermore, nuclear accidents abroad, such as the partial meltdown at the Three Mile Island Nuclear Generating Station (United States) in 1979, contributed to the holding of a 1980 referendum in Sweden about the future of nuclear power (Lewin, 2002, pp. 336–337). Due to the phase-out result of the referendum, the Swedish parliament decided in 1980 that no further nuclear power plants should be built, and that a nuclear power phase-out should be completed by 2010 (Anshelm, 2000). Still, despite the intense political controversy, six large-scale commercial reactors entered service in the 1970s and another six in the 1980s. These 12 reactors were located at four sites in Sweden, i.e., Barsebäck, Ringhals, Oskarshamn, and Forsmark.

For most of the Swedish electricity system's build-out phase, electricity prices were stable or even slightly down. However, in the late 1950s (due to the Suez crisis) and again in the mid 1970s (due to the oil crisis) there were price increases. At the end of the 1950s, the price increased by up to 30% and in the 1970s by approximately 15%. Both these periods of price increases resulted in a drop in Swedish electricity use. The subsequent response of Swedish electricity companies (including state-owned Vattenfall) was to reduce the electricity price to restore the electricity demand. In the 1960s, massive propaganda advocated increasing the use of electric heat in small homes. In the 1980s, after the massive build-out of nuclear power, the prices were once again set low to create demand for the electricity generated by the nuclear power plants. The result was another strong increase in Swedish electricity consumption in the early 1980s (Högselius and Kaijser, 2007, pp. 44–45).

The effects in Sweden of the large investments in hydro and nuclear power plants were not only homogenous and stable prices, but even falling electricity prices at certain times. Kaijser et al. (1988) argue that: "Important conditions for falling energy prices were aspects such as

that the increasing energy supply resulted in economies of scale, and that the energy resources were perceived as being almost inexhaustible" (Kaijser et al., 1988, p. 19). In the 1980s, the vision of a low-energy society espoused, for example, by the Swedish Centre Party, was toned down (Anshelm, 2002, p. 35). The fact that most Swedish citizens did not want to reduce their material and economic standards resulted in many politicians abandoning these utopian ideas. The problems and solutions associated with environmental issues changed in the late 1980s. At the Social Democratic Party convention in 1987, the environmental minister Birgitta Dahl spoke warmly of what she called "the third way of environmental policy" (Anshelm, 2002, p. 37). It was no longer necessary to choose between either economic growth or the environment, since they could both be combined. Unlike the defensive position in relation to environmental issues prevalent in the Social Democratic Party in the 1970s, the Party now took the offensive. Intellectual support for this position was found in the 'Brundtland report', published in 1987 by the United Nations World Commission on Environment and Development (WCED) under the title Our Common Future (WCED, 1987). The concept of *sustainable development* as expressed in this report captured what would become the essence of Social Democratic energy and environmental policy from that point on (Anshelm, 2002, p. 37).

In the early 1990s, influential Social Democratic politicians, such as Birgitta Dahl, Anna Lind, and Margareta Winberg, formulated in several debate articles what would later become the essence of Swedish policy in these areas. They argued that increased environmental responsibility could be combined with both economic growth and high employment by creating environmentally friendlier products and production processes. Creating such products would make Sweden a world-leading producer of green products and services, which would increase export revenues (Anshelm, 2002, p. 37). The Social Democratic prime minister Göran Persson stated in his governmental declaration of 1996 that "ecological demands may create the next leap in economic growth" (Anshelm, 2002, p. 41). As Lennart J. Lundqvist (2000, p. 23) notes, the Social Democratic Party strongly emphasized the socio–economic aspects of sustainable development. In the Party's rhetoric the welfare state, or the "people's home" (*folkhemmet*) should now become the "people's green home" (*gröna folkhemmet*). Rather then concentrating on adjusting single environmental problems in relation to specific target groups (e.g., industries), policy would now concentrate on making all of society 'green' (Lundqvist, 2000). In practice, this new shift in Sweden's policy meant governmental intervention in the economic markets by means of taxes, regulations, and public policy instruments.

Criticism of this policy was articulated by both neo-liberal think tanks (e.g., Timbro) and the right-wing Moderate Party, as well as by the Green Party and environmental groups. The arguments from neo-liberals and right-wingers were that the market itself (i.e., producers and consumers) should direct society in a 'greener' direction. Voices in the Swedish Green Party and several environmental groups questioned the central notion that economic growth and environmental sustainability could really be combined (Anshelm, 2002, pp. 56–57). The coalition Moderate, Liberal, Centre, and Christian Democratic government that has ruled Sweden since 2006 has in fact largely continued the path initiated by the Social Democratic government as described above. This is manifested by the wider acceptance of governmental interventions in the markets, using, for example, carrots (subsidies) or sticks (taxes) to influence citizen and industry decisions. What must be emphasized is that political consensus in the Swedish parliament currently holds that various types of governmental interventions in the energy markets are necessary if Sweden is to achieve its environmental targets, by making

energy use 'greener' and more efficient. In practice, several public policy instruments and taxes initiated by previous governments have continued in the 2006–2010 period, and have sometimes been made more stringent, as will be illustrated below.

2.3 Energy- related changes affecting the Swedish forest industry

The phase-out of nuclear power and the threat of climate change have, over the last two decades (i.e., the 1990s and 2000s), particularly increased Swedish political determination to increase energy efficiency and renewable energy use (Government Offices of Sweden, 2010, SEA, 2009). This has resulted in the formulation of several public policy instruments aimed at making energy use both more effective and more costly. In this context, Sweden could, according to researchers Johansson et al. (2007), be considered a forerunner, since a carbon tax of approximately EUR 21/ton had already been launched in 1991 (Johansson et al., 2007). Furthermore, in 2005 Swedish industry was faced with an electricity tax of approximately 0.55 EUR/MWh. Other public policy instruments affecting the Swedish forest industry include the Swedish Environmental Code that, among other matters, emphasizes energy efficiency. One aspect of this is that the best available technology should be used, taking into consideration the additional cost relative to the benefits. The Programme for Improving Energy Efficiency in Energy-intensive Industries (PFE) was introduced in 2005 and is a voluntary long-term agreement (LTA) between the Swedish state and energy-intensive Swedish industries. In this programme, energy-intensive firms are offered a discount on the abovementioned 0.55 EUR/MWh electricity tax if they fulfil requirements for increased energy efficiency (Ottosson and Peterson, 2007).

Since 2003, the Electricity Certificate System (ECS) has made it increasingly profitable to produce 'green' electricity from renewable sources such as wind or biomass (via combined heat and power – CHP). As a result of the ECS, all 'non-green' electricity, for example, electricity from fossil fuels, is today considered 'black'. According to SFIF et al. (2007), this has affected the Swedish forest industry, making the industry a large producer of 'green' electricity –companies with chemical pulp mills generated approximately 5 TWh of electricity in 2007 through the use of back pressure.

Another change affecting Swedish industry is that energy prices have risen significantly since the early 1990s. According to Johansson et al. (2007) and SEA (2009), between 2000 and 2006, electricity prices paid by Swedish industry nearly doubled and oil prices rose by approximately 70%. The development of the electricity price on the Nordic spot market Nordpool is shown in Figure 2 below.

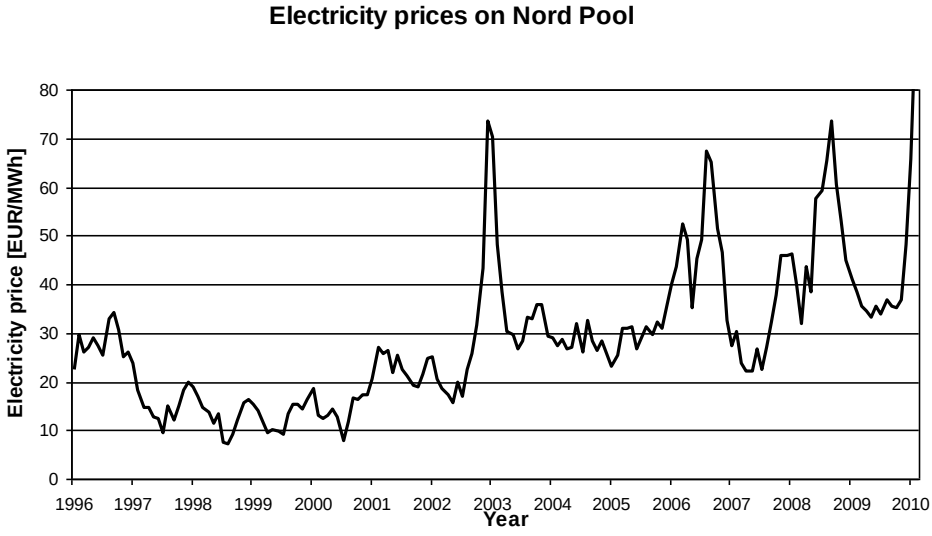


***Figure 2**. Average Swedish monthly electricity prices in EUR on NordPool for the 1996–2009 period (NordPool, 2010).*

Energy-intensive firms negotiate their electricity prices directly with the energy companies, meaning that the above figures are not 100% accurate for the forest industry; nevertheless, Figure 2 gives an indication of the general price development. Both Thollander (2008) and the European Electricity Prices Observatory (EEPO, 2003) have argued that the electricity price increases were partly due to the deregulation of the Swedish electricity market in 1996 and the liberalization of the European electricity and gas markets in 2004. According to Thollander (2008) and EEPO (2003), the liberalization caused the domestic markets to converge, which had a negative effect on Swedish prices since Sweden has historically had among the lowest electricity prices in Europe. As Thollander (2008) notes, a more homogenous and symmetrical gas and electricity market may, due to the market liberalization, cause prices in many European countries to fall. However, several studies of the effects of the European market liberalization on the Swedish markets have demonstrated that electricity prices will likely not fall because Sweden already had very low electricity prices (Trygg, 2006; Trygg and Karlsson, 2005; ECON, 2003; Dag, 2000). For example, a 2003 study of electricity prices in the EU conducted by EEPO found that Sweden had the lowest industrial electricity prices in the Union (EEPO, 2003).

Melkersson and Söderberg (2004) found that future electricity prices in Sweden can be expected to converge towards EUR 80/MWh, from 6 am to 6 pm, Monday through Friday, and towards EUR 44/MWh for the rest of the week (cf. Figure 2). The average electricity price identified by EEPO (2003) also corresponds well to the prices found by Melkersson and Söderberg (2004). According to Thollander (2008), not only are electricity price increases expected, but larger price fluctuations over the day. While spot prices in other EU member states vary considerably over the course of the day, this has historically not been the case in the Nordic marketplace (Nordpool). Thollander (2008) claims that this development has

increasingly forced the electricity-intensive forest industry to lock in its electricity price for longer periods, to avoid sudden price fluctuations.

Higher energy prices together with higher electricity use than in other European countries may, according to Thollander (2008), threaten domestic industrial activity in Sweden. Thollander (2008) argues, with support from ECON (2003), that higher energy costs negatively affect earnings, stock values, and competitiveness, which in turn may lead to lower production and perhaps even cause Swedish industrial firms to consider moving to another country. Thollander (2008) also claims, however, that industrial enterprises are affected differently by higher energy prices depending on their energy cost in relation to the value added. Thollander (2008) argues that energy-intensive industries such as the forest industry are threatened much more than are non-energy-intensive industries such as the engineering industry. According to SEA, this is because, while the non-energy-intensive engineering industry has energy costs in relation to the added value[6] of only 1–2%, energy-intensive process industries such as the forest industry face figures well over 20% (SEA, 2000).

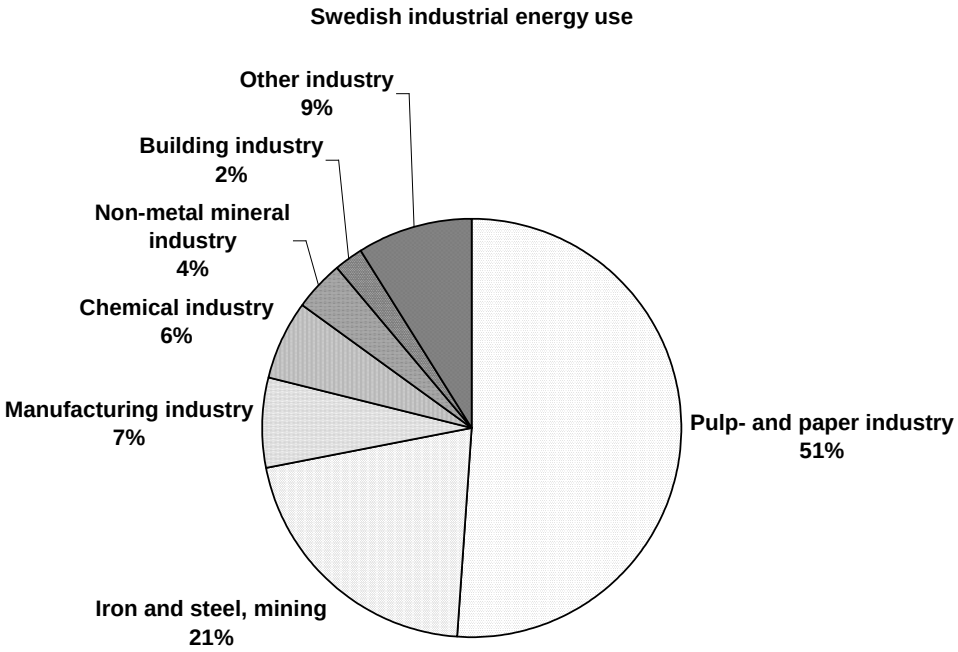


Figure 3. *Industrial energy use distributed by industrial sector in Sweden (Retrieved from Thollander, 2008, and based upon Johansson et al. 2007).*

[6] In general terms, added value refers to the difference between the sale price of a product and the cost of the resources needed to produce it. For an example of how this is calculated in relation to energy-intensive industries, see Worrell et al. (1997).

Chapter 2

The Swedish industry consists of approximately 59,200 companies using approximately 155 TWh energy annually, approximately 60 TWh of which is electricity, 54 TWh biofuel, and 20 TWh coal and coke. In addition, approximately 5 TWh of district heating and approximately 4 TWh of natural gas is used (SEA, 2009). Figure 3 presents the use of energy in various Swedish industries. As illustrated by the figure, the pulp and paper sector of the Swedish forest industry is by far the largest energy user of all Swedish industries. Industries can be categorized in terms of their energy intensity. In relation to this categorization, of the 59,200 Swedish industrial firms, 58,600 consist of non-energy-intensive firms, while approximately 600 consist of energy-intensive firms in industrial sectors such as forest, iron and steel, mining, and chemical industries (PWC, 2007). Taken together, energy-intensive industries account for approximately 75% of aggregated Swedish industrial energy use (SEA, 2009).

The Swedish forest industry is a major energy user, accounting for approximately 2% of total EU-25 industrial energy use and 51% of Swedish industrial energy use (SEA, 2009; Eurostat, 2007). In total, the industry used approximately 50 TWh of biomass, 22.5 TWh of electricity, and 7.3 TWh of fossil fuels in 2007 (SFIF, 2008c). Concerning the Swedish forest industry's energy use, several tendencies can be identified in the 1945–1989 period. One of the most striking is that the use of fossil fuels has heavily declined in the industry since the 1970s. According to Ekheimer (2006, p. 51), the amount of fuel used to produce 1 ton of newsprint has fallen from 311 litres of oil equivalent in 1973 to 72 litres in 2000. This decline can be explained by several factors. First, the use of chemical pulping processes has declined, while the use of mechanical and/or CTMP processes has increased. Second, the re-use of steam in the process has increased, often due to the integration of pulp and paper production. Consequently, the heat generated from the pulping process is used when drying the paper, resulting in less need to burn fossil fuels in external boilers to dry the paper. This has been a general ongoing trend since the 1970s, gradually making the industry less dependent on fossil fuels, due to increased energy efficiency, while its use of electricity has increased (SCB, 2006).

Although the total amount of electricity used has increased in the industry as a whole, the specific amount of electricity used to produce one ton of newsprint has remained stable from 1973 to 2000 (Ekheimer, 2006, p. 51). This could be explained by the fact that the quality of the produced paper, for example, light-weight coated (LWC) paper containing a high proportion of mechanical pulp, has increased significantly over this period, requiring greater electricity use for processing. On the other hand, the proportion of recycled fibre has increased over this period, reducing electricity use five- to six-fold compared with mechanical processes without recycled fibres (e.g., thermomechanical pulp and pressure ground wood pulp) (Ekheimer, 2006, pp. 51–52). To summarize, the Swedish forest industry's dependence on electricity seems to have increased over the 1945–1989 period, due to both increased substitution of electricity for fossil fuels in the production process, and increasing demand for higher-quality paper of various types.

Chapter 2

Chapter 3

3 ASSEMBLING THE THEORETICAL FRAMEWORKS

3.1 Introduction: from a traditional economic perspective...

This chapter discusses the theoretical concepts underlying the four papers and problematizes them more thoroughly than could be done in the individual papers. Furthermore, I will conduct meta-discussions of the various theoretical underpinnings of the constituent papers.

Paper I is theoretically based on a fairly traditional and non-constructivist economic perspective derived from mainstream economics, organizational economics, and behavioural economics. The theoretical notion underlying this paper is that previous studies have demonstrated that cost- effective energy-efficient investments are not always implemented due to various barriers to energy efficiency, resulting in a so-called *energy-efficiency gap* (Jaffe and Stavins, 1994; Sorrell et al., 2000). This means that investments that lower energy use and are considered cost-effective according to an organization's investment criteria are still not being implemented. While neo-classical economics assumes rational behaviour on the part of economic actors, the theoretical perspective in paper I is instead based on the notion of bounded rationality, i.e., that actor rationality is limited due to factors such as information asymmetries, imperfect information, and amount of time for decision making (March, 1994). By exploring such barriers in various sectors, decision makers and organizations might, for example, obtain more accurate information, which in the end might result in a 'more', though not 'fully', rational decision. In the context of paper I, 'more rational' refers to a company using its energy resources more cost-efficiently.

Besides the abovementioned notion of the energy-efficiency gap, the specific theoretical concepts used in paper I are *principal–agent* relationships and *split incentives*. Both these concepts are based on the theoretical notion of imperfect information and/or information asymmetries (Jaffe and Stavins, 1994). Principal–agent relationships refer to situations in which little trust exists between parties at different levels of an organization. The top management of a pulp and paper mill, who may not be well informed regarding site-specific criteria concerning energy-efficiency investments could, according to the principal–agent

relationship perspective, demand short pay-back rates on energy-efficiency investments. This demand is due to top management's low level of trust in the energy managers' ability to make such investment decisions, which might lead to the neglect of cost-effective energy-efficiency investments (DeCanio, 1993; Jaffe and Stavins, 1994).

The split incentive concept, according to Jaffe and Stavins (1994), refers to a situation in which the energy manager (i.e., the implementer of an energy-efficiency investment) is not the party that pays the energy bill. If the energy manager is not responsible for energy costs, she/he will likely have fewer reasons to concentrate on reducing these costs. Implementation will be more likely if the adopter can recover the investment from the party that actually enjoys the energy saving. According to Hirst and Brown (1990), this line of reasoning especially holds for energy-efficient technologies, particularly those that have higher purchasing costs but lower life-cycle costs than do traditional technologies.

While providing theoretical insights appropriate for the explorative nature of the first paper, I found this theoretical framework to be problematic for my further papers. Although paper II also studied the management of energy, more specifically, electricity and forest resources, I realized that I had to conduct a process study to gain a deeper understanding of the resource management. My first empirical observations when reading, coding, and categorizing the empirical material for paper II were that the three studied forest companies (i.e., SCA, Holmen, and Stora Enso) displayed considerable dynamism and many differences in the strategic management of their electricity and forest resources over the studied 1990–2008 period. I again turned to more traditional economic perspectives, but this time in the SM field.

I started by reading the dominant theories and debates in the SM field,[7] for example, the work of economists such as Porter (1980, 1985), Wernerfelt (1984), Barney (1986a, 1986b, 1991), Peteraf (1993), Nelson and Winter (1982), and Williamson (1975, 1985) representing subfields such as industrial organization economics (IO), the resource-based view (RBV), and transaction cost economics (TCE). A period of confusion ensued, as I asked myself why so many of these economic theories often treated industries, companies, and especially material resources in such a static manner? These thoughts are not only my own; Afuah and Utterback (1997, p. 183–184), for example, argue that work in both the IO (Porter, 1980, 1990) and RBV (Barney, 1986a, 1986b, 1991) streams treats industries and companies as static. According to Håkansson and Waluszewski (2007, p. 19), this also holds for resources, which mainstream economic theories and models often regard as having the same characteristics and values independent of how they are used or combined with other resources.

When I delved deeper into RBV, one of the most dominant perspectives in the SM field today, I was still more confused by the dominance of such a static view. RBV had for several years fostered considerable discussion of the characteristics of resources, strategic resources in particular (Priem and Butler, 2001; Barney, 2001). In response, one of the most influential RBV theorists, J. B. Barney, constructed the "VRIO" criteria to determine what resources are strategically most important: such resources are those that are valuable, rare, inimitable, and organized in a way that enables company exploitation (Barney and Hesterley, 2005). The

[7] These were identified via content analysis of the fifty most cited scholarly articles, in terms of citation and co-citation (i.e., bibliometric techniques), published in one of the most influential journals in the field – Strategic Management Journal. The content analysis indicated that the SM field is dominated by the work of economists such as Porter (1980, 1985), Wernerfelt (1984), Barney (1986a, 1991), Peteraf (1993), Nelson and Winter (1982), and Williamson (1975, 1985) (Ramos-Rodríguez and Ruíz-Navarro, 2004, p. 989).

criteria comprise an analytical tool that can be used when evaluating company resources. Later RBV-related research has put further effort into identifying resources with great specificity, which can be seen in the increased number of studies that try to introduce different models and frameworks with which scholars and practitioners may investigate a firm's different resources. Carmeli (2004), for example, introduces the strategic analysis technique (SAT) framework with which to understand firms' core resources (i.e., most valuable, rare, inimitable, and non-substitutable) that generate sustainable competitive advantage and lead to superior performance.

The VRIO and SAT criteria imply that it is possible to determine what resources firms should retain or divest to gain the best possible future returns. Hughes and Morgan (2008) argue that this holds for most studies that use a resource-based perspective in attempting "to identify a set of resources and examine their performance effect" (Hughes and Morgan, 2008, p. 323). According to many RBV researchers, it is possible to objectively determine the exact characteristics and values of resources, using the analytical tools and models described above, resulting in different resource compositions over time among companies in the same industry. In practice, this means that different firms ought to buy and sell different resources to gain better returns than their competitors'.

In general terms, RBV assumes that a company's resources are the fundamental determinants of its competitive advantages or disadvantages. Firms grow in accordance with their slowly changing resources, which both constrain and catalyse further growth. In any industry, companies are often heterogeneous in the bundle of resources they control; this resource heterogeneity may persist, since resources are not perfectly mobile. Firms are thus perceived as bundles of resources that are often immobile, i.e., some resources are either very costly to reproduce or inelastic in their supply (Barney, 1997; Barney and Hesterley, 2005). RBV researchers focus on heterogeneity in industries perceived as a result of different competing companies owning different sets of resources. In that sense, the main task of RBV researchers is to seek the best set of resources for a given industry, i.e., the one that creates competitive advantage. Rather than problematizing the abilities of given resources to change in relation to their wider context, the intrinsic assumption of completely standardized resources in RBV makes resource price the only relevant piece of information for strategic managers.

Another feature of RBV is its categorization of resources as tangible or intangible, a distinction already made by Wernerfelt (1984) and since used in much influential research in the field (Barney, 1991; Barney, 2001). This in turn could be seen as expressing economists' general eagerness to classify resources in various boxes, models, and categories. Another key example from the economic literature strengthens my argument. An influential theorist associated with both SM and TCE, Williamson (1985, p. 56), argues that various resources, or assets, can be categorized in relation to their characteristics and usefulness to companies. The similarities to Barney and Hesterley's (2005) VRIO criteria are many. Williamson's asset specificity means that different resources have different degrees of specificity, implying that nonmaterial resources are more elastic and can be used in more ways than can material resources such as forests and electricity assets (cf. Williamson, 1983, 1985). In practice, this has resulted in material resources being treated as static, categorized as only available at a given location and only useful in one or a few ways, i.e., site specificity and physical asset specificity (Williamson, 1983). Hence, dominant economic perspectives such as RBV and TCE, and their notion of classifying resources in accordance with predetermined frameworks and models, marks a static view of resources, material resources in particular.

As paper II demonstrates, however, this assumption of static resources is problematic. This is demonstrated by the fact that, while they are looking at a resource's current characteristics, use, and value, managers might miss other, not yet obvious, services and values intrinsic to the resource. In contrast, a dynamic view of resources implies that a resource's current uses present a limited picture of both its history and future: a resource probably has many qualities that have been used before and/or are waiting to be used. This is in fact exactly what economist Edith Penrose suggested as early as 1959 (Penrose, 1959). Firm uniqueness and development can be explained by how a company combines heterogeneous resources in particular business activities. Penrose's (1959) main assumption, which stresses all resources' intrinsic heterogeneity, actually marks a significant difference from many RBV researchers' static and homogenous view of resources. Rather than focusing on trying to determine what resources are strategically most important *today*, a dynamic view of resources stresses that the services resources might contribute to firms are always changing. What I needed to explain my main research problem in paper II – why the studied Swedish forest industry companies came to manage their electricity and forest resources in increasingly different ways after the early 1990s – was a theoretical framework that could explain resource management and did not treat firms and resources in a static and predetermined manner. I required concepts and notions that captured the dynamic processes present in my empirical cases. This meant moving away from the dominance of economic theories, such as RBV, and their view of reality and knowledge in which industries, companies, and resources in practice seem 'black boxed' and understudied.

3.2 …to a constructivist view of material resources

In recent years the theoretical notions developed within the (broad) STS field, has spread into the economic research field (e.g Callon, 1998, MacKenzie, 2007). These scholars share an interest in how, in complex matters, nature, technology, and material entities interconnect with humans in producing socio–political and techno–economic phenomena. This marks a new turn in these research fields that have historically often been heavily dominated by economics. However, the theoretical notions of STS do not seem to have reached the field of SM on a wider basis yet, Steen (2010) and Kreiner and Tryggestad (2002) being exemptions to this claim. In that sense, the work presented in paper II and, as will be discussed later, paper IV let me import theories, concepts, and notions from STS into research into industries, companies, and resources, i.e., traditional SM research issues.

Although Penrose's view of resources, as noted above, seems to have been more dynamic then the one prevalent in RBV (e.g., Barney and Hesterley, 2005), it should be emphasized that Penrose did not pay much attention to the complexity of material resources. However, Penrose's main argument, in 1959, that no resource has only one potential use would later be developed by researchers associated with STS. In the 1980s, questions concerning the relationship between material resources (e.g., technologies, laboratories, and objects), humans, culture, and society were attracting increased interest among STS researchers. The work of Michel Callon (1986) and Bruno Latour (1987) would especially challenge the view of material resources as natural and objectively existing. The work of the aforementioned scholars and of John Law (1987) would mark the start of one of the more influential STS perspectives, namely, actor network theory (ANT). While the social constructivist position presented by Berger and Luckman (1966) recognized that knowledge and reality were

products of different social and cultural contexts, material resources were still considered to be objective and natural. STS researchers, however, not only studied science and knowledge as constructed in various social and cultural contexts, but also regarded the construction of nature, including treating the natural and life sciences as research phenomena. In particular, scientific laboratories, instead of objectively studying material objects, manipulate them, for example, cleaning and placing them in artificial situations, to see how they will react (Knorr Cetina, 1981; Latour and Woolgar, 1979).

A common approach when chronicling ANT is to divide it into two phases, ANT I and ANT II (Law and Hassard, 1999). Roughly speaking, ANT I focused on producing concepts (e.g., translation and obligatory passage point) that could be used when analysing the intermingling of human and non-human entities, i.e., actor networks (Callon, 1986; Latour, 1987). ANT II has instead focused on the performative dimensions of, for example, models, theories, and devices in producing realities. While many of the influential empirical cases underlining ANT I were based on lab studies (Latour, 1987, 1988), research associated with ANT II has spread into several other empirical domains, such as economic research (e.g., Callon, 1998, 2007). In papers II and IV, I employ concepts associated with ANT I, i.e., *translation*, *problematization*, and *obligatory passage point* (OPP).

The translation concept proved especially useful to me in paper II, since it enabled me to analyse why Holmen (Modo), SCA, and Stora Enso came to manage their electricity and forest resources in increasingly different ways after the early 1990s. Rather then treating firms and resources in a static and predetermined manner, a core assumption of ANT is that entities such as industries, firms, and resources represent ongoing achievements. The translation concept in that sense provided me with an analytical tool for explaining the processes by which industries, firms, and resources are constantly reconfigured. As Francis Lee (2009, p. 40) notes, the translation concept has been used in at least three ways in research associated with ANT. In both papers II and IV, I am primarily interested in how 'facts', measures, characteristics, uses, values, etc., are being moved into material objects (e.g., electricity assets and forests) and then back again. The concept stresses that associations such as ideas and values can be imputed in to a material resource, creating contingent stability in the actor network (Latour, 1995). The stability in the actor network, however, is always temporary, in that these networks are never complete; they are always subject to fragile chains of associations (Latour, 1986).

In paper II, I treated the three forest industry firms as socio–technical networks consisting of both humans (e.g., CEOs and boards of directors) and material resources (e.g., electricity and forest assets). In this context, resource management and the strategy formation process were analysed as processes by which the CEOs and boards of directors attempted to (re)construct and (re)stabilize the electricity and forest resources. I especially followed how various associations were being used by CEOs and boards of directors and how these later moved into concrete translations of the electricity assets and forests. I especially found that valuation metrics, such as level of self-sufficiency, were important tools used by the firm representatives to attach certain qualities to the electricity and forest assets. I argued in paper II, in line with Latour's (1995) translation concept, that while numerous associations could be mobilized regarding a certain resource, translations are the particular stabilizations that occur as outcomes of these practices.

In paper IV, I used two additional concepts associated with ANT, i.e., problematization and OPP. Problematization refers to how actors formulate and define problems, and attempt to build momentum heading in a certain direction (Callon, 1986). OPP refers to actors (human or non-human) who are legitimate gatekeepers and sole deciders on given issues (Callon, 1986). In paper IV, these concepts were used to demonstrate that all actors involved in industrial forest use had to pass through specific locations, for example, SFIF, to accomplish their interests. To be an OPP means that actors in the network must interest and enrol other actors to secure their position as a legitimate translator (cf. Callon, 1986; Galis, 2006, p. 29). The translation concept emphasizes activity, since no initial or inherent force is ascribed to any resource in itself. Using the translation concept analytically means following those who act since, if no one picks up the material resources, nothing happens (Callon, 1986). As demonstrated in both papers II and IV, translations are stabilized due to various actors' imputed associations with the material resources.

3.3 Managing resource heterogeneity

What does the view of material resources presented above, i.e., that their current form, use, and value represent only temporary stabilizations, mean in relation to companies' strategy process? As demonstrated in paper II, it is not self-evident what resources actually are. Therefore, putting them into predetermined categories capturing only temporary characteristics. Sooner or later, as demonstrated in paper II, these categories explode and the resources are once again linked to chains of associations resulting in new translations. Indeed, I believe that this underlies the complexity of resource management.

However, since paper II studies corporate strategy, a definition of "strategy" is necessary. SM researcher Henry Mintzberg has previously demonstrated that strategy can be considered a pattern in a stream of actions, an understanding that makes the strategy formation process worth studying (Mintzberg, 1991). Studying the strategy formation process includes focusing on the dimensions both of action and of argumentation and justification (Melander, 1997, p. 13). In this definition, strategy is consistency in behaviour, whether or not this behaviour was intended. This marks a difference in relation to the dominant view of strategy as a plan, since the view of strategy as a pattern enables me to follow strategy as resulting from unintended consequences and (re)constructions. While plans are intended strategy, patterns are realized strategy; while plans give the strategic actor a very high degree of impact, patterns recognize that the strategy process is being carried out in a social and material context.

According to the theoretical perspective of paper II, it is not self-evident what services given resources may render; in fact, these services may change because of how resources are (re)stabilized and (re)managed. These notions also emphasize the main theoretical point of departure of paper II, namely, that one can always expect multiple associations to be related to a material resource. The ability to recognize the multiplicity of a given resource and use it is, according to Alchian and Demsetz (1972), closely related to firm efficiency. Research associated with the Industrial Marketing and Purchasing (IMP) group takes a fairly similar view of resources to that prevalent in paper II. Håkan Håkansson and Alexandra Waluszewski (2002, p. 32) argue that resources always have hidden qualities, since they can always be combined with other resources in new ways. This means that efficient production results from understanding the relative productive performance of particular resources more accurately,

rather than from having better resources than competitors do. What is strategically important is recognizing more accurately the changing potential of resources.

Even material resources, such as raw materials, traditionally regarded as static and homogeneous by many economists, are heterogeneous; taking forests as an example, different tree species have different characteristics as biofuel or pulp raw material and can be transformed into various end products, such as electricity, paper, and tissue (cf. Håkansson and Waluszewski, 2002). As Håkansson and Waluszewski (2002) state, the resource heterogeneity perspective implies that any resource already in use could give rise to new qualities without any change in the resource itself. Rather than static and stable resources, we can expect an endless stream of associations and translations of the material resources that companies strategically manage. By incorporating theoretical notions from STS into my theoretical perspective, I can explain the empirical observations reported in paper II, i.e., why the studied Swedish forest industry companies came to manage their electricity and forest resources in increasingly different ways after the early 1990s.

3.4 Industries as subpolitical actors embedded in techno-economic and socio-political issues

While papers I and II differ in many respects, for example, in terms of their theoretical underpinnings and concepts, they still both represent an internal view of resources, firms, and industries. This also marks the major difference between the first two papers in this thesis and papers III and IV, which instead analyse the Swedish forest industry as an actor embedded in particular techno–economic and socio–political issues.

Industries, firms, and resources arguably do not exist in isolation. On the contrary, these entities are embedded – to use Granovetter's (1985) term – in relationships with various actors, making the roles of these relationships worth studying. This notion has also been the main focus of previous research associated with the IMP Group. Since the late 1980s, numerous of researchers associated with the Group have studied the development and management of business relationships across a network of organizations, interfaces, and companies (Håkansson and Snehota, 1989; Håkansson and Waluszewski, 2002). This research has demonstrated that strategic decisions and uses of company resources are the product of networks of many actors external to the firm, such as suppliers, customers, and competing firms. Like Granovetter (1985), this IMP research has illustrated and criticized the view that economic actors and resources exist in isolation from society and culture. Hence, one might argue that many economic researchers have not only treated resources as static entities, but also as highly isolated from their social contexts. Granovetter (1985) argues that many economists, especially Williamson (1981), have an under-socialized view of economic actions and resources.

In paper III, I analysed how the Swedish forest industry has responded to the increased European and Swedish environmental demands regarding the electricity resource during the 1990–2009 period. In the paper, I am specifically interested in the arguments proposed by various industry representatives and in the strategic decisions made in response to these increased environmental demands. Like Ulrich Beck (1997), I view important aspects of politics as emerging from various realms of *subpolitics*, i.e., forms of politics operative outside the representative institutions of the formal political system. According to Beck

(1997), many controversial political issues today, for example, those involving technology and ecology, are being raised and mobilized by business associations, environmental groups, and researchers, all fighting for their own interests. In paper III, I follow how one influential subpolitical group, the Swedish forest industry as represented by SFIF, has questioned and called for the rethinking of various issues associated with electricity. Influential Swedish forest industry representatives, have, for example, been calling for the reregulation of the electricity market, blaming and putting pressure on politicians, questioning researchers, questioning the reality of climate change, and in various ways conducted subpolitics to improve the industry's position vis-à-vis the electricity resource. Unlike paper II, paper III analyses not only the firm level but also the subpolitics, especially as conducted by SFIF. As demonstrated by previous research, industry associations are important actors meriting study in order to understand processes of, for example, lobbying, common representation, rulemaking, and information (Granovetter and McGuire, 1998; Rosen et al., 2002; Berk and Schneiberg, 2005).

Two central concepts used in paper III derived from environmental sociology and the history of ideas are *industrial modernity* and *ecological modernization*. These two concepts derive from a wider discussion of the general notions guiding the development of industrialized Western societies. According to Beck (1997, p. 24), industrial modernity was embedded in a rationalization process in which a linear and one-dimensional instrumental rationality was hegemonic. In practice, this implied societal dependence on large complex technical systems, such as nuclear power, and great dependence on experts and scientists. In Sweden, ideological belief in notions representative of industrial modernity was high after WWII; in particular, the Swedish Social Democratic Party believed that the "good" society could be built according to an ethos of progress (Linderström, 2001). As demonstrated in paper III, the evolution of Swedish energy and economic policy has been closely intertwined with the evolution of the Swedish forest industry during the 1945–1989 period. After 1945, the forest industry increasingly invested in the integrated production of pulp and paper, bulk products, and large-scale production; the latter especially increased with the industry's access to, and dependency on, a cheap and stable electricity supply (Melander, 1997). Simultaneously, the Swedish government agency Vattenfall built two large-scale electricity production systems, i.e., hydropower and nuclear power.

In light of the strong interdependency between the state and the forest industry during the industrial modernity era, it is perhaps not surprising that the major energy transition in Sweden has prompted (re)actions from forest industry representatives, as demonstrated in paper III. The major shift towards ecological modernization in Swedish energy policy, as described in section 2.2, however, could also be viewed as processes of differentiation of industrial society, as described by Ulrich Beck (1997, p. 113). While nature and the environment were abstract entities in the industrial modernity era, according to Beck (1997, p. 114), the wider integration of nature and the environment into today's societies leads towards reflexive modernization. The integration of the environment into everyday life forces self-confrontation on contemporary societies regarding the negative consequences associated with the use of energy and natural resources (Beck, 1986). The risks produced by industrial societies and their modern institutions strike their engendering institutions like boomerangs (Mol, 2003, p. 308), creating conflict regarding, for example, the risk management of nuclear fuel. Science, technology, the state, and the market are no longer viewed as the only legitimate actors; instead, the fact that the risks associated with the environmental crisis are

equally apportioned, in that they affect everyone regardless of gender, age, income, etc., means that all people are stakeholders.

Although Ulrich Beck's writings about contemporary industrial societies are more apocalyptic in undertone, both Beck (1997) and scholars associated with ecological modernization (Mol, 2003, p. 309) are convinced that the environmental problems that Western industrial societies have created will not result in anti-modernity, but rather will deepen modernity. The ecological crisis will lead to the gradual remodelling of modern institutions in a 'greener' direction. Mol (2003, p. 309) states: "Ecological modernization can thus be interpreted as the reflexive reorganization of industrial society's institutions to cope with the ecological crisis". Both Beck (1986, 1997) and Mol (2003), however, emphasize that it is an open empirical question to what extent given modern institutions will be transformed and whether this ongoing restructuring can in all cases overcome the self-destructive tendencies of industrial society.

Beck (1997, p. 113) maintains that the above process involves the redistribution of power from the capital owners and the business/middle class elites to environmental and social groups that question the knowledge claims made by the former groups regarding environmental issues. I believed that these ideas were so important that I devoted paper IV to them.

3.5 From confined industries to industrialism in the wild

As demonstrated above, paper III stressed the analysis of industrial change by studying firm strategies and by analysing industry subpolitics as conducted by the industry association SFIF. Paper III viewed industrial change as a result of processes of opposition and adjustment in relation to Sweden's wider energy and environmental policy. Historically, however, the industry studied in this thesis has often, according to previous research by Melander (1997, 2005), been secluded, from other social groups and spheres in Swedish society concerning its industrial use of electricity and forest resources. Melander (1997, 2005) has demonstrated that, during the 1945–1990 period, the Swedish forest industry organized its responses to major issues concerning, for example, reduced felling of forests, more efficient pulp technology, collaboration on capacity issues, and reduced investments in new mills, all by itself. In this period, actors not representing the forest industry were repeatedly met with scepticism, and the industry often felt obstructed by the authorities. In the 1950s, for example, industry leader Markus Wallenberg expressed concerns about Swedish bureaucracy, as permits had to be sought from one authority or another concerning exports, imports, and new mill construction. In the 1970s, the industry's relationship with the authorities was becoming even tenser due to increased attention paid to environmental issues concerning industrialized forestry. Although some environmental laws were finally passed by the Swedish parliament in the 1970s, the industry's constant resistance to all non-industrial actors' interference with industry matters marks an obvious divide between the industry and the surrounding society (Ekheimer, 2006; Melander, 1997, 2005).

The above discussion is developed in paper IV, and emphasizes that the Swedish forest industry acted as a highly *confined industry*, at least until the end of the 1980s. By this I mean that the industry resolved and managed its agendas, and businesses in milieus removed from the public sphere, in this case, in private meetings, at industry conferences, and in closed

boardrooms. However, and as demonstrated in papers III and IV, the seclusion of the industry, in which the industry as an isolated entity could define its use and management of the electricity and forest resources by itself, has changed since the end of the 1980s. Since 1989, both the resources studied here have become complicated techno–economic and socio–political issues, reducing the industry's confinement. This can be seen as a subprocess of a larger process of change affecting many societal spheres.

French STS researcher Michel Callon (2003, pp. 33–36) has described how the end of WWII and the beginning of the cold war marked a divide between various spheres in Western societies, for example, between ordinary citizens and elected representatives and between laypeople and experts. These types of separations led to overlaps between the economy, society, and technology often being resolved and managed in milieus removed from public scrutiny, in laboratories, closed boardrooms, private meetings, etc. However, the more techno–economic and socio–political issues have become key factors in Western societies, the less the exclusion of concerned groups can be accepted (Callon and Rabeharisoa, 2003). This has led previously excluded groups to strive to make the above separations illegitimate, i.e., concerned groups refuse the monopoly on knowledge held by confined 'experts' and seek to intervene in techno–economic and socio–political issues. Obviously, there are great resemblances between Callon's (2003) argument and the changes in modernization as described by Beck (1997). As a result of these processes, the research community has in recent years become increasingly interested in conflicts between different groups and different forms of knowledge (e.g., Anshelm and Galis, 2009; Galis, 2006; Wynne, 1996).

The above theoretical discussion is the point of departure of paper IV. My argument in that paper is that the changes affecting the Swedish forest industry, and its key resource, the forests, cannot be fully examined without analysing the influence exercised by *concerned groups*, that is, all the actors concerned with the industrial activity and the resources it uses and who participate in configuring industries (cf. Callon, 2003). I argue that, to understand the (re)making of forests as (heterogeneous) resources, one cannot ignore the contribution of concerned groups such as researchers, politicians, environmental organizations, and public managers. This means that even industries traditionally separated from the public sphere, as the Swedish forest industry was from approximately 1945 to 1990, might today be forced to compete and to compare their knowledge and arguments with those of other actors and groups seeking to intervene in (re)making the forest industry and forest resources. I argue in paper IV that these changes also call for new theoretical concepts in order to understand these processes.

3.6 Confined industry, concerned groups, and industrialists in the wild

Hence, in paper IV I use and redevelop theoretical concepts and notions developed by Callon (2003, 2007) and Callon and Rabeharisoa (2003) when analysing and explaining industrial change. This means that paper IV, like papers II and III, also uses theoretical concepts developed in another research field, in this case STS, to explain various aspects of industrial stability and change. The obvious benefit of this approach is that it helps me explain empirical observations that cannot be understood using many of the more traditional theories, described in section 1.4, explaining industrial change.

Paper IV analyses how concerned groups (e.g., researchers, politicians, and environmental organizations) linked to or influenced by industrial use of the forests and the interpretations, decisions, and controversies this implies, seek to participate in (re)configuring this techno–economic phenomena. In that sense, paper IV follows Callon and Rabeharisoa's (2003) suggestion that the contribution and involvement of concerned groups are essential when analysing conflicts between different groups and different forms of knowledge. In paper IV, concerned groups refers to those actors and social groups linked in some way to the industrialized use of Swedish forests. In that sense, concerned groups constitute actors that also seek to intervene in the configuration of industries (cf. Galis, 2006, p. 35). Callon states that concerned groups can be large or small, may already exist as consolidated groups with spokespeople, or may simply be loose aggregations of unrelated individuals who suddenly learn that they share interests. The main point, however, is that concerned groups gradually acquire collective identities that reshape their individual identities (Callon, 2003, p. 56). The process towards forming a collective identity, i.e., the perception of a joint condition or relationship, leads concerned groups to stress their existence and formulate their demands, interfering with science, technology, the economy, and politics (Callon, 2001).

I believe there are at least two differences between the concept of subpolitics (Beck, 1997) used in paper III and the concept of concerned groups used in paper IV. First, concerned groups may, as argued above, differ in size and level of professionalization, while groups that conduct subpolitics, such as SFIF as discussed in paper III, are well organized though, like concerned groups, situated outside of traditional political arenas. Second, 'concerned groups', as an ANT concept, would be more concerned with the actor's role in actor network reconfiguration, than is Beck's (1997) concept of subpolitics, which instead describes a general process of change in the making of politics. By using concerned groups as an analytical concept in paper IV, I strongly emphasize the roles not only of industrial actors but also of non-industrial actors in (re)configuring the use of Swedish forests.

The involvement of concerned groups may lead to industrial issues, previously resolved and managed in milieus removed from the public sphere (e.g., in confined industry, private meetings, industry conferences, and closed boardrooms), becoming phenomena open to public discussion, debate, and controversy/conflict between different interest groups and different forms of knowledge (cf. Callon, 2003). The analytical study of concerned groups therefore means following a dynamic process by which various types of groups and knowledge evolve and transform depending on their ability to mobilize and negotiate the configurations of techno–economic phenomena (Callon, 2003; Galis, 2006). The theoretical focus described above, i.e., on the participation of concerned groups, implies a shift away from traditional models and theories when studying industrial configuration. As argued in paper IV, this means that the involvement of concerned groups makes the traditional divide between industry actors and non-industrial actors irrelevant. In paper IV, we refer to this process as *industrialism in the wild*, i.e., the process whereby some concerned groups accumulate and compare their members' experiences and build collective expertise that is equally valid to that of confined industry, and on that basis, take action and participate in industrial reconfiguration (cf. Callon, 2003). This process is characterized by establishing new practices, questioning existing knowledge, negotiating with other groups, and forming new organizational configurations.

In this context, the forest industry world will be treated as a world of conflict and compromise, both within the confined industry and between confined industrialists and

industrialists in the wild. Industrialists in the wild are not pure industrialists (in this case, conventional members of the forest industry, such as SFIF); rather, they originate from diverse organizations and backgrounds, representing a complexity that constitutes the heterogeneity of the industrial collective. This does not mean that all concerned groups are industrialists in the wild. In paper IV, we use the latter concept to denote all agents that participate in translating and transforming forest use and do not belong to confined industry. In this context, industrialists in the wild not only question the current industrial collectives, but also reformulate them (cf. Callon, 2007, p. 336) by means of debate articles, reports, calculations, optimizations, and estimates in relation to the management of industries and their resources.

The notion of industrialists in the wild thus presents a broader definition of how industries are constructed. The concept emphasizes that industrial configuration is no longer determined solely via traditional routes through private meetings, industry conferences, and closed boardrooms. Instead, industrialists in the wild challenge the confined industry's 'facts', presenting new and often multiple, mixed, and infected realities (Callon, 2003, p. 46). This forces the confined industry to defend its position and truth claims by participating in media debate. Hence, in paper IV, I argue that the paths that even stable and mature industries (e.g., the Swedish forest industry) today follow are highly irregular and depend on the groups participating, how they organize and perform, and their reconfiguration of industrial activity (cf. Callon et al., 2009, p. 26).

Finally, the various multidisciplinary theoretical traditions, concepts, and notions on which this thesis is based reflect my research process, the methodological choices made, and the levels of analysis presented in the four papers. This chapter has highlighted in a much more thorough way the theoretical meta-discussions that laid the foundation for the theoretical choices made in the individual papers. Furthermore, the chapter highlights the long research process behind an individual paper, during which much of the theoretical discussion must be compressed into the final version, to fit the framework of an academic article. In the following chapter, I will discuss the methodological choices made in this thesis.

Chapter 4

4 METHODOLOGICAL CONSIDERATIONS

4.1 Position regarding reality and knowledge production

This chapter provides the reader with a much more thorough reflection on the methodological considerations underlying this thesis than was possible in the individual papers. Even though I, as a researcher, strive to be as honest and direct as possible concerning the methodological choices underlying this thesis, at the end of the day it is the reader who evaluates the research and decides for her/himself whether or not it is convincing. In the latter case, it is the research argument, rather than the research scaffolding, that needs to be convincing. In principle, I believe it is impossible to describe all the relevant characteristics of myself as a researcher (and person) and of my research. Still, in practice I believe that I should describe those properties that are most relevant to this thesis.

The view of reality that informs this thesis has largely been inspired by the constructivist traditions in social sciences in general (Berger and Luckmann, 1966), and particularly by research associated with STS. The philosophical and theoretical ideas developed by STS researchers Bruno Latour, Michel Callon, and John Law in the early 1980s (e.g., Latour, 1987; Callon, 1986; Law, 1994) were inspired by another and earlier intellectual approach developed in the 1970s known as *the sociology of scientific knowledge* (SSK). Researchers affiliated with the SSK approach examine the social aspects that become interwoven in scientific knowledge and practice. SSK emphasizes the social construction of knowledge, which implies that material resources are viewed as social constructs produced by the knowledge surrounding them.

The work of Latour (1987) and Callon (1986), a.k.a. *the sociology of translation* or ANT, emerged as both a sequel to and a critique of SSK. The influence of David Bloor and his 1976 book *Knowledge and Social Imagery*, with its statements concerning symmetry, would be especially influential for the early texts in the sociology of translation stream (Callon, 1986). Bloor's (1976) argument was that the same types of explanations should be used for both successful and unsuccessful knowledge claims, i.e., they should be symmetrical. This means

that both 'true' and 'false' scientific theories are products of social conditions and cultural context and that all human knowledge is therefore based on social components. This claim was stretched into a generalized symmetry by sociology of translation researchers, meaning that not only 'true' and 'false' but also human and non-human entities should be treated symmetrically when analysing phenomena.[8]

The position of this thesis, which stresses the emergent character of reality as well as the view that science becomes part of the world it studies (Law and Urry (2004, p. 392), raises several questions. While the process I am analysing is also a construct, the usual methodological explanation typically found in books of research methodology for students, the linear research process, says nothing to me about *my* process. This thesis did not start with predetermined and functioning research design, aim, research questions, collection of empirical material, analysis, and finally a presentation of results. Well it may have to some degree, but more often the process was much rougher, as I attempted to find some interplay and connection between various theories, notions, problems, and my empirical material. I think that my more process-oriented practice, with its continuous interplay, adjustments, search for new theory, and new empirical material, has allowed for alternate approaches to and interpretations and explanations of the phenomena studied. This openness in my research would have been impossible had I chosen a single given theory or research problem and stuck to it throughout the research process and the writing of the four papers.

Viewing my role as a researcher as part of the reality I will try to (de)construct, according to Barbara Czarniawska (1995, p. 26), raises some questions concerning the scientific ethos. If I, as a researcher, may no longer hide behind notions of 'truth' and its correspondence to 'external reality', social science instead asks questions such as: "Does it work? Is it beautiful? Who is it for?" (Czarniawska, 1995, p. 26). This brings me back to the opening part of this chapter, since I feel that the aesthetic qualities of my approach lie in my ability to convince the reader of the plausibility of my argument, while supporting it methodologically. In that sense, I do not view my standpoint as a relativistic one. To borrow Law and Urry's (2004) language, it is again my conviction that neither realities nor knowledge could be produced in just any way. There is always the need to prove relevance to convince readers. In the following section, I will try to convey the most relevant methodological considerations underlying the writing of this thesis.

4.2 The questionnaire

Paper I differs from the three other papers in significant ways. First, it is not a historical process study but rather a contemporary study (contemporary as of autumn 2007, to be precise). Second, it is not based on text analysis but on a questionnaire. Paper I was a product of the year (2007) I spent taking courses in the interdisciplinary Energy Systems Programme (Program Energisystem) and was co-written with an engineering Ph.D. candidate, Patrik

[8] Although inspired by ANT concepts, this thesis is not based on the idea of generalized symmetry between material and human entities. The widened symmetry approach proposed by Callon (1986) was criticized by Collins and Yearley (1992), who argued that followers of ANT removed humans from their pivotal role by delegating agency to non-human actors. Callon and Latour's (1992) answer to this criticism was that the generalized symmetry principle implies that both human and non-human entities could be delegated agency depending on their roles in a network. Callon and Law (1995) develop this discussion by arguing that neither material things nor humans act, but are instead involved in relationships, interactions, practices, and negotiations.

Thollander. In many ways, paper I could be viewed as a preliminary study, used to test some research ideas on energy managers in all Swedish pulp and paper mills.

The questionnaire was constructed as follows. The report by Jönsson et al. (2007), co-written in the Energy Systems Programme in spring 2007 with two engineering Ph.D. candidates, provided me with valuable technical knowledge of the forest industry and its energy use. The preparation phase before formulating the questionnaire was based on five interviews conducted by me and reported in Jönsson et al. (2007). The questionnaire was further influenced by several previous studies of other Swedish industries (i.e., the foundry industry and SMEs) (Thollander et al., 2005; Rohdin and Thollander, 2006; Rohdin et al., 2007). The questionnaire was then sent to representatives of SFIF and SEA for further comments on the questions' relevance. Yin (2003) argues for the positive aspects of quality control exercised by having colleagues listen to ideas and examine a questionnaire before actually sending it out. This was done while constructing the questionnaire through numerous discussion seminars, formal and informal, with colleagues both at the Department of Thematic Studies – Technology and Social Change and in the Energy Systems Programme.

What, then, are the methodological advantages and disadvantages of a questionnaire? Obviously, a questionnaire differs from an interview in that it lacks actual contact with the respondent, which makes the design of the questionnaire particularly important (Bryman, 2004). In practice, this means that a questionnaire should, compared with interviews, have fewer open-ended questions to make it easier to answer, have an easy-to-follow design to minimize the risk that the respondent will fail to follow filter questions, and be short to reduce the risk that respondents may lose interest (Bryman, 2004). When formulating the questionnaire, we limited the number of follow-up questions and made sure that only one question was asked at time. Furthermore, we tried to use simple yet correct language with short questions, avoiding negations and emotionally charged words. Enclosed with the questionnaire we also sent a short letter introducing ourselves, the research project and aim, the university and department, the research funder, and a contact person for the study (Trost, 2001).

The questionnaire was sent to 59 Swedish pulp mills, paper mills, or integrated pulp and paper mills in autumn 2007 and was intended to be answered by energy managers or people in charge of energy issues. This personnel category was chosen based on the insight from the interviews presented in Jönsson et al. (2007) that these people have knowledge of the technical and economic issues related to energy at the mill. Energy managers possess this knowledge because they are often in charge of, for example, a mill's energy purchasing and contact with Swedish authorities. They are the ones who will likely be able to answer questions, for example, about the mill's energy priorities, how energy costs are allocated at the mill, and whether the mill has a long-term energy strategy.

Information about the mills and respondents was obtained from SEA's contact list for the Swedish long-term agreements (LTA) programme, the PFE programme, and the business association SFIF. We received 40 replies, for a 68% response rate, which was high compared with those obtained in similar studies, for example, Velthuijsen (1995) and de Groot et al. (2001). The mills differed in size, reflecting industry composition, 71% of the studied mills having more than 250 employees. The results were also initially split into two groups, one consisting of mills using a mechanical pulping process and the other of mills using a chemical

pulping process. However, no major differences in answers were found between the two groups, so the results were presented at an aggregated level.

What, then, was actually 'measured' using this methodological approach? Advantages of the method include easy compilation and processing of even considerable amounts of data as well as the possibility of covering a large number of respondents (Bryman, 2004). A general challenge when conducting research involving people and social interactions, however, is social desirability biases. This may appear on questionnaires and in interviews, and is based on the notion that respondents may like to appear to be 'different' from what they 'are' or 'how' they perform. Examples of the latter in the present study could be over-claiming, for example, regarding the environmental friendliness of the behaviour the respondents describe (Brace, 2004). A common type of social desirability bias is found when respondents try to maintain their self-esteem by convincing themselves that they think and behave in socially responsible ways (Brace, 2004). This bias often affects future projections of likely behaviour, as respondents might well exaggerate their future behaviour (Brace, 2004). Yet another type of bias is instrumentation bias, meaning that respondents give answers designed to bring about a socially desirable outcome, such as wishes that a new strategy be put into action. Rather than responding according to actual conditions, respondents may instead respond based on what they want the conditions to be. The usual method of reducing these biases is to promise confidentiality to the respondents, which was done in the present study (Brace, 2004).

Hence, when analysing the results of this study, I had to remember that respondents' answers might include a degree of bias, for example, personal opinions might affect their answers. The respondents completing the questionnaire also likely worked at mills that work more proactively on energy management than did the non-responders. Although this possibility should not be ignored, it is worth noting that the response rate in this study was very high, which at least to some degree reduces the severity of this problem. Still, the 'black box' of the non-responders should always be taken into account when interpreting questionnaire results. In practice, this meant I had to be careful when interpreting the results of this study.

4.3 Interviews and site visits

The purpose of this section is to present the conducted interviews and the visits to various pulp and/or paper mills, and discuss how these were significant to the thesis. While writing this thesis, I visited a number of energy-related sites (e.g., the Oskarshamn nuclear power plant, Tekniska verken combined heat and power plants, Kemira chemical production plants, and the SSAB Oxelösund steel production plant). The choice of visited sites was partly determined by the Ph.D. courses taken in the Energy Systems Programme, and partly because I was initially uncertain that I would only study the forest industry. I also attended a number of energy conferences. These site visits, as well as meetings with energy and industrial personnel during the project period, provided me with considerable knowledge of issues such as industrial energy use, energy sources, energy markets, and the materiality of large-scale industrial sites, which has been crucial when writing this thesis. Although it is impossible to make all this 'know-how' explicit to the reader, I believe it is still important to highlight some of my experiences. Especially in the early stages of this project, between 2006 and 2008, I visited several pulp and/or paper mills. Six formal interviews were conducted during this project. I also took notes on speeches given by forest industry representatives at the energy

conferences I visited. If possible, I also asked the speakers to send me their presentations afterwards.

The interviews are presented in Table 3 below.

When?	Who?	What?
2006-11-22	Rikard Wallin, mill manager at Braviken pulp and paper mill part of the Holmen corporation	Walk around at site, presentation of the entire mill, answers about the mills and the firms views on the energy issues
2007-04-12	Hannu Thomasfolk, mill manager at Vallvik pulp mill part of the Rottneros corporation	Recorded interview on site at Vallvik, walk around site
2007-04-16	Christian Andersson, energy manager at Värö pulp mill part of the Södra corporation	Recorded interview on site at Värö, walk around at site
2008-02-29	Håkan Edvinsson, energy manager at Mönsterås pulp mill part of the Södra corporation	Interview on site at Mönsterås, presentation of the mill's and firm's energy strategy and investments
2008-05-23	Anders Kyösti, energy and environmental manager at Munksund pulp and paper mill part of the SCA corporation	Recorded telephone interview
2008-09-08	Willy Lindell, energy and maintenance manager at Kisa paper mill part of the Swedish Tissue corporation	Recorded interview on site, presentation of the mills energy strategy and investments

Table 3 *Interviews and site visits 2006-2008.*

Two categories of personnel, i.e., people responsible for the energy issues (energy managers) and the mill managers, were interviewed at the mills. The energy managers were interviewed because, as stated above, they are the ones most likely able to answer questions regarding, for example, the mill's energy priorities, how energy costs are allocated at the mill, and whether the mill has a long-term energy strategy. Mill managers were interviewed to obtain answers to more business–strategic questions, for example, concerning the mill's and the corporation's future business strategy. These people were chosen for site-specific reasons, such as whether the specific mill had recently invested in new infrastructure (e.g., the Kisa paper mill's new boiler). Since these interviews were conducted at an early stage of the project, when I had not yet decided on the exact type of papers to write, I asked broad questions related to issues such as energy use, energy strategy, energy management, energy investments, and cost allocation.

According to Steinar Kvale (1996), interviews are of three basic types, namely, unstructured, semi-structured, and structured (Kvale, 1996). An unstructured interview is one in which the respondent is encouraged to speak freely about a subject or research theme. In a structured interview, on the other hand, the researcher asks the respondent questions based on a previously established array of questions or an interview scheme. A semi-structured interview is a mixture of the two other types, and was chosen for all interviews conducted in this project (Kvale, 1996). Since these interviews were conducted at an early stage of the project, when I had not yet decided on the exact type of papers to write, I asked wide-ranging questions concerning issues such as energy use, energy strategy, energy management, energy investments, and cost allocation. I constructed themes related to wider issues, and asked

specific questions about details based on the information given by the respondent. Obviously, I had previously read many environmental reports and articles in the business and industry press, for example, and talked to other informants before conducting the actual interviews.

Initially, I informed the respondents of the background, aim, scope, etc., of the project (cf. Merriam, 1998). In all cases, I used the thematic interview scheme described above and took notes. The length of interviews ranged from 45 minutes to two hours; if a presentation of the mill and, for example, a lunch was included, the whole process could take up to four hours. It was initially my intention to record all interviews, but I soon noticed that certain issues were sensitive – these were often referred to as "business secrets". I therefore chose to turn off the tape recorder when sensitive issues were being discussed, or not to use one at all in interviews likely to touch on such matters. In all but one case, due to geographical distance, the interviews were carried out at the mills. This made it easier for me to grasp what the informants were actually talking about, in terms of boilers, turbines, etc. My 'know-how' of the technical and material systems of pulp and/or paper mills increased significantly during these interviews and site visits.

Many reliability problems are associated with interviews. Memories fade and are selective. The respondents might hide or exaggerate certain issues, or they might have vested interests in, for example, projecting the image of a 'green' mill or firm. 'Real' motives, hidden agendas, etc., remain hidden even after the interviews. My strategy for coping with these potential problems was to use as many other sources as possible when writing papers II–IV. I ended up citing only a few interviews explicitly in paper III. I believe that, even though the interviews were not referred to in the other papers, they still provided me with valuable background insights that helped me better understand the processes and phenomena studied.

4.4 Text and document analysis

Papers II–IV have many similarities in terms of their delimitations. These papers analyse the 1989–2009, 1990–2008, or 1990–2009 periods, i.e., essentially the same period. I chose to analyse this period because, in many respects, the changes in Swedish energy policy affecting the forest industry started in 1989 with intense debate concerning the future use of Swedish forests. This debate preceded Government Bill 1990/91:88, *Om Energipolitiken* [On energy policy], which recognized the forests' energy potential and identified biofuels as a future option for Sweden. Several other bills, governmental reports, laws, and public policy instruments that all affected, for example, industry, industrial energy use, forests, and electricity, would follow from 1991 to 2009, as demonstrated in this thesis and in the four papers, making this period one of intense shifts for the industry.

Although papers II–IV differ in terms of, for example, level of analysis and theoretical perspective, they can all be seen as historical process studies. What is a process and how do I, as a researcher, analyse it? Andrew Pettigrew argues that a process is "a sequence of individual and collective events, actions, and activities unfolding over time in context" (1997, p. 338). How, then, have I analysed these processes of events, actions, and activities? In many respects, I have striven "to write history forwards" to use Göran B. Nilsson's (1981) terms. In practice, this means that I, as a historically informed researcher, should take the thinking and acting person's situation in the past as a starting point, rather than confronting her/him with my current armour of hindsight wisdom and scientific scrutiny (Nilsson, 1981, p. 10). Of

course, in practice it is never possible to write a story without drawing to some extent on current knowledge, but it still serves as an ideal when writing the stories. Nilsson's (1981) methodological approach bears many similarities to the "follow the actors" approach found among STS researchers such as Callon (1986) and Latour (1987). Latour's (1987) notion that researchers should follow those who act, irrespective of their composition, as they construct reality is very similar to Nilsson's idea of writing history forwards rather than backwards. A similar comment could be made about Callon's (1986) methodological notion of not imposing value scales on the actors that themselves may be the result of the studied process. This means that I should not, for example, use my current knowledge of the energy system when analysing the plausibility of actor statements from the early 1990s. In practice, then, how did I do it?

Papers II–IV are all based on the same main methodological approach (although paper III is a slight exemption, since it also uses some interview material), i.e., text and document analysis, which will be described below. The material analysed in paper II comprises mainly annual reports and press releases from the studied companies, and articles from the business press from the 1990–2008 period. Paper III is based on debate articles in newspapers, articles in industry journals, official reports, governmental bills, consideration statements, annual reports, press releases, interviews, and books. Finally, paper IV draws on debate articles in newspapers and industry journal articles, official reports, government bills, consideration statements, press releases, advertising campaigns, PowerPoint presentations, and books. Taken together, this material comprises approximately 1000 documents and was collected for several years throughout the project.

The debate articles were collected through extensive searches of Swedish databases (i.e., Artikelsök, Presstext, Mediaarkivet, and Biblioteksstjänsts tidnings- and tidskriftsindex) covering many Swedish newspapers and journals. All major Swedish newspapers and a large number of local and regional newspapers are represented in the collected material. Furthermore, technical and popular science journals as well as labour union journals are also included. I searched the databases several times using search strings such as 'Swedish Forest Industry Federation', 'Swedish forest industry', 'Forest industry', 'Pulp and paper industry', 'Electricity price', 'Svebio', 'bioenergy', 'biomass', 'biofuel', 'forest fuel', and 'energy forests'. The debate articles were then situated in relation to all major governmental reports, governmental bills, SEA reports, EU reports and press releases, etc., that deal with issues concerning, for example, energy, electricity, and biomass, during the 1989–2009 period.

All annual reports (and also often environmental reports) from SCA, Stora Enso, Holmen (MoDo), Rottneros, Billerud, and Södra for the 1990–2009 period have been read. "The president's letter" in these reports was read with special care, as were other parts of the reports dealing with issues such as strategy, environmental goals, and energy. Furthermore, I read a rich selection of empirical material from SFIF – the trade, industrial policy, and employers association for the Swedish forest industry – and Skogen, Kemin, Gruvan, Stålet (SKGS) – the business association representing electricity-intensive industries in Sweden, namely, the forest, chemical, mining, and steel industries. This material includes consideration statements, industry statistics, press releases, reports, books, PowerPoint presentations, advertising photographs, figures, pictures, and advertising campaigns. This material was gathered either from the two business associations' websites or through personal communication with them.

Individual texts and documents were coded based on content and then read in relation to one other, enabling patterns to be detected. By coding, I have therefore been able to recognize and (re)contextualize my material (Coffey and Atkinson, 1996, p. 45). However, it is important to emphasize that coding the material is not a non-analytical practice. Rather, as Coffey and Atkinson (1996 p. 46) maintain, when coding empirical material, the researcher in practice reads the material over and over again, making selections that inevitably entails analysis. Many research methodology scholars (e.g., Yin, 2003) argue for the need for full clarity and full description of all chains of evidence, so that the reader can understand precisely how the results have been achieved. The researcher should accurately describe how the classification, identification of themes, and linking of key points have been done. However, as Coffey and Atkinson (1996, p. 26) argue, it is important to state that coding is only one part of the analytical process, and even a detailed and clearly defined coding procedure could never be a substitute for poor analysis.

My method of reading and coding texts could be compared to Strauss and Corbin's (1990) approach, although I do not aspire to having my approach seen as a grounded theory procedure. In the first phase of the coding process, the open coding phase (Strauss and Corbin, 1990, ch. 8), I tried to identify recurring themes in the various texts, thereafter sorting them in groups with different names. For me, this process often created confusion between my research questions, various theories, and the empirical material. Given that this is a thesis consisting of four papers, I have in practice numerous times closely read all the empirical material. Based on the papers' research problems, research questions, aims, etc., I have therefore categorized the material several times to identify key meanings and themes. Examples of these themes are "conflicts regarding the use of the forests" and "industry representatives' views regarding the electricity price".

In the second phase of coding, axial coding (Strauss and Corbin, 1990), I identified groups of codes and linked them to each other. In this phase, the concrete research questions and various theoretical perspectives informing the papers became much more important. This resulted in a focus on similarity and grouping in relation to a more specific research question. This phase also meant that I needed to situate and reconstruct the individual codes into one or several super-codes, i.e., larger categories. It should be stressed that the two phases described above often ran as one continuous iterative phase, moving back and forth, merging codes, renaming them again, and often removing them since the research question had changed.

Concerning the debate articles analysed in papers III and IV, I believe that they represent a wide range of interests, arguments, actors, and organizations in the Swedish forest industry. In paper IV, this also holds for groups concerned with the use of the forests. While certain questions are central to these debates, others have been peripheral. Because the texts and documents were produced over two decades, it was possible to detect shifts in the argumentation, strategies, goals, and actions over time. It should be emphasized that the material is not complete, since some journals and newspapers were not included in the databases used. Even though the selection of debate articles is not complete, I argue that it is rich enough to be representative of the studied period and I doubt that I missed any major opinions articulated in the public debate in journals and newspapers by forest industry representatives (cf. Anshelm, 2006, pp. 12–13). Previous research conducted by Anshelm (1992, 2000, 2006) has used a similar methodological approach to collecting and analysing debate articles. Concerning the material produced by the business associations SFIF and SKGS, my aim was to use as many different sources as possible to gain a thorough

understanding of their standpoints. Often, as illustrated in papers III and IV, their standpoints on specific issues have changed over time and appear differently depending on the source.

The analysis conducted in papers II–IV, besides analysing concrete actions such as investment decisions and divestments, also analyses various actors' statements and argumentation. The texts and documents, however, are not only a rich collection of statements, but also expressions of meaningful social action in terms of conducting corporate strategy and subpolitics. Analysing these texts involves interpretation, and inquiry into their meaning and significance. Meaning is by no means observable, but has to be interpreted and understood in a creative and analytical process (cf. Kvale 1997, pp. 49–52). I want to make clear that my interpretations of the empirical material are by no means exhaustive or the only possible ones. However, I am confident that my interpretations are solidly grounded in the rich empirical material underlying this thesis.

Finally, I wish to stress that there is no simple way of describing the complexity of the research process. I believe that this also holds for the analytical process. As Coffey and Atkinson (1996, p. 6) argue, analysis is not the isolated final step of the research practice but rather something done throughout the whole process. Analysis is indeed done when working with the empirical material but also when reading previous research and actually writing. The analytical process is therefore a process of repeatedly moving between the centre and the periphery. Continuing this practice throughout the research process, relating my empirical material to my theoretical concepts and to previous research, deepens my analysis.

Chapter 4

.

Chapter 5

5 SUMMARIZING RESULTS OF THE FOUR PAPERS

5.1 Managing energy at the mill level

In this chapter, I present and summarize the main results of the four papers.

Paper I analysed concrete energy management practices at the mill level in 40 Swedish pulp and/or paper mills. A questionnaire, which was sent to 59 Swedish pulp or pulp and paper mills in autumn 2007, was completed by energy managers or people in charge of energy issues. Previous studies of obstacles to energy efficiency have demonstrated that these differ depending on, for example, type of industrial production, region, and country-specific conditions (Sorrell et al., 2000). Swedish pulp and paper mills' substantial energy use makes it particularly important to study the energy efficiency of this industry. To increase industrial energy efficiency, research into the actual energy management practices of industries with regard to strategic, organizational, and financial issues is crucial. The paper asked four research questions in order to grasp these issues:

• How have the mill's energy priorities changed between 1996 and 2007?

• How are energy costs allocated at the mill?

• Does the mill have an existing long-term energy strategy and, if so, what period does it cover?

• What payoff criteria are used when investing in energy-efficiency measures at the mill?

The results reveal that energy managers believed that their practice in relation to energy issues became increasingly important over the 1996–2007 period. With this said, overall results of the questionnaire still indicate possibilities to improve energy management practices at the

studied mills. One such result is that one third of the studied mills do not allocate energy costs by means of sub-metering. Instead, other means are used, such as allocating per square metre, which might contribute to split incentives at the mill regarding these costs.

Another result indicating possibilities to improve energy management practices is that 20% of the studied mills lack a long-term energy strategy, and that fewer than half have an energy strategy with at least a five-year timeframe. These results are interesting considering that pulp and paper mills are technically very complex and capital intensive. Competitively producing pulp and paper requires significant scale economies and large amounts of invested capital. It is surprising that energy, though crucial to profitability in this industry, one of the most energy-intensive in the world, seems not to be a highly prioritized issue for many of the studied mills.

Regarding the pay-off criteria, most of the mills applied payoff periods of three years, from which I conclude that the principal–agent problem, leading to strict monitoring and control of the implementation of energy-efficiency measures, seems less important at the studied mills. Still, it is useful to problematize the accuracy of these results, since it is difficult to categorize various investments given that, for example, both energy-efficiency and production-related investments could increase the mill's total energy efficiency.

5.2 Translations of electricity and forest resources in Holmen, SCA, and Stora Enso

Paper II demonstrates that material resources such as forests, nuclear reactors, and hydroelectric power stations are far from purely static assets for companies; on the contrary, the translations of the resources that provide necessary functions and thus value are linked to temporary and evolving socio–political and techno–economic associations. In the paper, I argue that, to understand why firms in similar contexts behave in strategically different ways, one must study the ongoing associations articulated by firm representatives regarding the material resources studied. Dominant economic perspectives such as RBV, however, have treated material resources as static, as demonstrated by the various models, categories, and frameworks used to classify resources. Leading RBV theorists Jay Barney and William Hesterley's (2005) "VRIO" criteria exemplify this, and are used to determine what resources are strategically the most important: namely, resources that are valuable, rare, inimitable, and organized in a way that enables company exploitation.

In paper II, I argue that, by looking at resources' current characteristics, use, and value, managers might miss other not yet obvious qualities the resources might possess. While the VRIO criteria view material resources as stable entities with set performance, I instead use the translation concept from ANT to analyse and follow how CEOs and boards of directors attempt to advance their interests into the resources by attributing certain features to them, and how this process results in temporary translations.

Paper II analyses how Holmen, SCA, and Stora Enso, which together own approximately two thirds of the pulp and paper mills in Sweden, managed their electricity and forest resources during the studied 1990–2008 period. The paper is based on Melander's (1997, 2005) finding that, until the early 1990s, the Swedish forest industry was highly homogeneous in belief structure and strategy formation. I further argue that this homogeneity also applied to the

forest industry's two key resources, electricity and forests. Since the early 1990s, however, this situation has changed rapidly in response to changed contextual conditions. While Stora Enso and SCA divested part or all of their electricity and forest resources, Holmen kept theirs.

Paper II therefore sought to determine why the studied Swedish forest industry companies came to manage their electricity and forest resources in increasingly different ways after the early 1990s. The three cases demonstrate that the stability prevalent before the early 1990s represented only a temporary stability in the relationship between the three firms and their key material resources. During the 1990–2008 period, the non-static entity of these resources became explicit when reality changed, illustrated in the cases by, for example, electricity market deregulation, drastic price increases, increased price fluctuation, new public policy instruments, the construction of 'green' electricity, and increased competition for forest resources. The management of electricity and forest resources changed over the studied period, differing between companies in the industry and changing with time in individual firms. In practice, these changes resulted in socio–technical processes of adjustments between the CEOs and boards of directors and the electricity and forest resources throughout the period. My concluding argument in paper II is that ANT may offer a more useful way of understanding resource strategy formation than does VRIO, which is based on idealized, predetermined criteria.

5.3 The Swedish forest industry: between industrial modernity and ecological modernization?

Paper III analyses how the Swedish forest industry has responded to increased European and Swedish environmental demands regarding the electricity resource over the 1990–2009 period. The paper examines how an electricity-intensive industry responds to increased environmental demands in general, and specifically in relation to one of its strategic resources. In the paper, I analyse the arguments proposed by various industry representatives (e.g., SFIF) and the strategic decisions made in relation to the electricity reconstruction in Sweden.

To understand the processes of change in energy and environmental policy, I situate the paper in relation to a wider discussion of Sweden's modernization process. I argue, based on previous research (Anshelm, 2000), that since WWII, Swedish development has been based on the notion of what sociologist Ulrich Beck calls industrial modernity (Beck, 1997, p. 113). This refers to a belief in notions such as never-ending economic growth, large-scale technological systems, and expert and scientific solutions to perceived societal problems. In industrial modernity, the environment and nature were viewed as resources to be tamed to provide the foundations for continuing economic growth. In the mid 1990s, however, a change occurred in Swedish energy and environmental policy, with increased focus on building an ecologically sustainable society. This shift in Swedish policy was part of a wider international shift towards ecological modernization that, according to Mol (1996, p. 309), became the dominant model in Western industrialized societies in those years. The notions associated with ecological modernization, namely, that economic growth and environmental protection could be combined, became important for Sweden's energy policy and affected the electricity resource and the Swedish forest industry.

The analysis reveals that influential representatives of the Swedish forest industry put effort into portraying the industry and its products as sustainable, while proposing investment decisions in electricity production that paid little or no attention to the environment. For the Swedish forest industry, the shift from governmental policy of industrial modernity towards one of ecological modernization has been a challenge. While the mechanical pulping process necessary for producing, for example, printing paper, in all its materiality, is strongly enmeshed in industrial modernity, the chemical pulp processing of renewable forest resources into 'green' electricity and many other products exemplifies ecological modernization. In that sense, the Swedish forest industry is situated between industrial modernity and ecological modernization and may be considered both a 'black' and a 'green' industry.

5.4 The conflicts and translations concerning the use of the forests

Paper IV identifies, analyses, and discusses the development and configuration of various truth claims and standpoints regarding the characteristics and potential uses of Sweden's forest resources from 1989 to 2009. The paper empirically examines the development of the Swedish forest industry, regarding the seclusion of the 'industrial collective' and the efforts of exogenous actors to participate in configuring industrial forest use. By 'industrial collective', I mean the shared beliefs, truth claims, policies, practices, and actors (both human and non-human) in an industry that enact the collective. The paper's point of departure is that today's industries cannot be fully understood without analysing the influence exercised by concerned groups, that is, all actors who are concerned with an industrial activity and are thus participants in configuring the industrial collective (cf. Callon, 2003).

Our empirical case demonstrates how discussion of possible large-scale extraction of bioenergy from Swedish forests, which began in the late 1980s, suddenly brought the forest industry and the forests to the forefront of public and political debate, being presented as the energy future of Sweden. By the end of the 1980s, the industry association SFIF, however, strongly opposed all forms of biofuel from Swedish forests. SFIF, which represents all Swedish pulp and paper mills and sawmills, dismissed all forms of forest and biofuels on both economic and ecological grounds. Twenty years later, the use of biofuels has increased significantly in Sweden, and SFIF is portraying itself as part of the solution to climate change, due to its use of renewable forest resources.

In paper IV, we follow the translation of the forest industry from producing solely timber and pulp and paper products to producing electricity, heat, and biofuels. We argue that the conflict between industrialists in the wild and the confined forest industry forced the latter to enter novel business fields, resulting in certain forest firms earning more from selling 'green' electricity than from pulp or timber products by the end of the studied period. Paper IV concludes that, without the pressure of concerned groups and 'industrialists in the wild' on the forest industry, the industrial activity would never have been reconfigured.

Chapter 6

6 REFLECTIONS AND SUGGESTIONS FOR FUTURE RESEARCH

The purpose of this thesis was to analyse how the Swedish forest industry has (re)acted regarding the energy transition, in particular, to the reconstruction of the electricity and forest resources in Sweden during the 1989–2009 period. As demonstrated in chapter five, the four constituent papers of this thesis present several conclusions and findings contributing to various research debates. By analysing the industry's (re)actions in terms of energy management practices at the mills, corporate strategy processes in the three largest industry firms, and SFIF's subpolitical work regarding the electricity and forest resources, this thesis has given several answers to how the forest industry has (re)acted regarding the energy transition. My ambition in this chapter is not to summarize or conclude what has already been written in the four papers, but to convey new reflections on my empirical findings that are underdeveloped in the four papers in their current form. It must be emphasized that this chapter does not present overall results or a concluding discussion, but rather reflections, discussions, and suggestions for future research.

In this chapter, I intend to gaze above and even beyond the individual papers and tentatively discuss some observed phenomena and processes that might provide new and/or complementary insights into the Swedish forest industry's (re)actions regarding the energy transition. Given that the individual papers' results are determined, for example, by the theoretical concepts used and methodological considerations, in this chapter I will present some new theoretical discussions and use some new empirical material to expand on certain points that I have found interesting. By moving beyond the individual papers, I may also reflect on why the industry might have (re)acted in certain ways. The tentative reflections below are not the only ones possible, but I argue that they raise interesting ideas and questions for future research.

This chapter is organized as follows: In section 6.1, I discuss the effects of the energy transition on the Swedish forest industry. I argue that, even though the industry has resisted many of the changes that have occurred in relation to the energy transition, change has

nevertheless taken place. I view these changes as part of a wider process of industry embeddedness, in which the industry has moved from being homogeneous towards being increasingly heterogeneous. I argue that non-industrial actors such as politicians, bioenergy representatives, and researchers in the wild were the entrepreneurs who laid the foundation that enabled the transition towards industrial 'greening' and biorefineries that is occurring today.

In section 6.2, I discuss the performative role of economic theories and tools in (re)creating the industry (Callon, 1998). I discuss the wider implications of economics as shaping modes of calculation, the latter of which may problematize some of the results of the individual papers regarding why certain (re)actions have occurred. Specifically, I discuss the results presented in paper I concerning the relationship between various types of cost allocation, payoff methods, and actual energy management practices at pulp and/or paper mills. Furthermore, Stora Enso's corporate strategy, as described in paper II, is reviewed in relation to a wider discussion of general SM theories, industry-specific theories, and different valuation devices.

In section 6.3, I reflect on and discuss changes in SFIF's agency over the 1989–2009 period and the wider roles scientific calculations, models, and theories have played in these changes. Finally, in section 6.4, I present some final remarks regarding the overall research contributions of this thesis.

6.1 The effects of the energy transition: from a homogenous to a heterogeneous industry?

6.1.1 Introduction – a homogenous, stable industry facing the energy transition

"We also need to think beyond the printing paper. Otherwise there is a risk that the forest industry is viewed upon as an industry for yesterday's products." (Hall in Skog & Industri, 2010, p. 14)

"It is important that the research is innovative and focuses on creating new products and new uses for cellulose fibre, apart from improving the current processes and products. In that context we may willingly stimulate new smaller actors, in order to let many flowers bloom." (Hall in Skog & Industri, 2010, p. 14)

The picture presented in previous research by Melander (1997) is that the Swedish forest industry, until the end of the 1980s, was a mature industry, stable and highly homogeneous in its belief structure and strategy formation. According to Melander (1997), these industrial beliefs led to increasing investment in the integrated production of pulp and paper, bulk products, and large-scale production. The above quotations from Magnus Hall, CEO of Holmen and newly elected chair of SFIF, however, demonstrate that the Swedish forest industry is currently undergoing processes of change. Rather than viewing traditional products such as printing papers, based on economies of scale and economies of scope, as a success recipe for the future, Magnus Hall is advocating new innovations, new entrepreneurs, and new smaller firms. In the following discussion, I view the above words of Hall as reflecting a wider process of industry embeddedness, in which the Swedish forest industry has moved from being homogeneous towards becoming increasingly heterogeneous. I argue that non-

industrial actors in particular, such as politicians, bioenergy representatives, and researchers, have been the entrepreneurs laying the foundation that has enabled the ongoing transition towards industrial 'greening'.

As Satu Pätäri has argued, the long-term strategy of most of the US and European forest industries has been to stress productivity, cost-effectiveness, and cost-efficiency within their core business activities, i.e., traditional forest industry products such as market pulp, newsprint, and printing paper (and in some firms, in the last two decades, personal care products) (Pätäri, 2009). Pätäri (2009, p. 14) notes that these corporate strategies have usually resulted in value destruction rather than value creation and growth. Both papers II and III note that, in the last two decades, the Swedish forest industry has faced significant overcapacity due to lower demand, increased competition globally, and downward price pressure on, for example, newsprint, and heavily increasing prices on the most important input factors, i.e., forest and electricity resources. These ongoing negative trends have led several forest industry firms in Sweden, towards the end of the first decade of the twenty-first century, to announce the closure of a number of mechanical pulp and/or paper mills to regain profitability (SVD, 2008b, pp. 12–13).

On one hand, one might argue that this is part of the long-term trend in this industry, as described above in section 1.2, in which small and medium-sized firms (and mills) have either closed down or consolidated with larger companies. On the other hand, one might argue that forest and electricity resource factors have become increasingly difficult for this industry to tackle in the last two decades, more difficult, in fact, than questions concerning, for example, lower demand for newsprint due to the advent of electronic media. While the industry can manage that certain products could, at least in the long run, be displaced by new, non-forest industry products, issues related to climate change, the negative environmental effects of the industry's energy use, and drastic energy price increases threaten the very existence of this industry.

As presented in paper III, Melander (1997, p. 306) argued that the evolution of the Swedish forest industry exemplified SM researcher Michael Porter's theory of *national competitive advantages* (Porter, 1990). According to Porter (1990), the combination of a cheap and stable supply of forest resources, cheap electricity, and the location of the Swedish industry and its European markets conferred a national advantage on the Swedish industry over its competitors after 1945. One might argue, and, as demonstrated in papers II–IV, influential industry representatives have argued, that this industry's national competitive advantage is now threatened or perhaps even lost. However, threats also mean opportunities, just as risks also mean potential returns. The future is not only gloomy. Growing environmental concerns and the energy transition provide the forest industry not only with problems, but also with windows of opportunity. By incremental change in current technology as well as larger strategic investments, the Swedish forest industry could transform itself into a biorefinery-based industry producing biobased products that help mitigate climate change. Furthermore, the forest industry has great opportunities to become a major producer of 'green' electricity from wind turbines, given that these firms own massive tracts of land and have traditionally been, and in some cases still are, major electricity producers.

6.1.2 A mature industry's opposition to demands to go 'greener'

How, then, have Swedish forest industry representatives (re)acted in relation to the overall threats and possibilities presented by energy and environmental issues? Several answers could

be suggested based on the present findings. One tendency that has been apparent throughout my four papers is industry reluctance and even opposition to several of the changes regarding the transformation of its energy resources.

The various papers provide several examples of the widespread opposition of Swedish forest industry representatives to environmental and energy-related changes during the 1989–2009 period. In paper II, for example, I mention that the CEO of MoDo wrote in the 1997 annual report: "Competition for raw materials is increasing. The pulp and paper industry in Sweden and Finland has increased its wood consumption in recent years. There is also a risk that the tax-subsidized biofuel sector will use wood and chips that could otherwise be used to produce pulp" (MoDo, 1997, p. 41). The possibility that the forest resource would give rise to 'new' products, such as bioenergy, was at the time interpreted as threatening to the company. The conflict between traditional uses of forest resources and the 'new' use of them for energy (e.g., electricity, heat, and fuel) was a focus of paper IV. In 1989, the industry (via SFIF) used a number of arguments, such as limited forest resources, cost-ineffective power production, and critical environmental issues, to position itself as the only legitimate user of the forests. When the Swedish forest industry's monopoly on the forest resources was weakening, industry representatives, rather than opening a new strategic window into the bioenergy market, for several years tried to disseminate the story that biofuel was something premodern.

In 1997, director Lennart Gedda and expert Rolf Edlund, from Stora, the largest forest industry firm in Sweden at the time, published a debate article arguing that "investing in biofuels created a picture of Sweden as a nervous industrial country seeking a new identity through a model that many countries perceived as old fashioned" (Edlund and Gedda, 1997, p. 3). Similar examples could be cited from paper III concerning electricity. Although the forest industry had great incentives (e.g., ECS support and increased electricity prices) to increase its production of 'green' electricity, influential industry representatives strongly called for the reregulation of the electricity market, blaming and putting pressure on politicians, questioning researchers, and, in one case, even questioning the reality of climate change. Rather than capitalizing on the new 'green' markets and embracing their opportunities and potential returns, influential industry representatives instead often opposed the environmental concerns and energy transition during the 1989–2009 period.

One might seek to explain the above industry resistance to the changes brought by the ongoing energy transition in several ways. As presented in section 1.4.1, scholars associated with innovation studies and evolutionary economics have recognized that calls for change and new innovations can be perceived as threats by industry representatives in relation to existing lines of business. Nelson and Winter (1982), Dosi (1984), and Utterback (1996) all argue that, when a given technological process is developed in a certain direction in an industry, the industry matures, and innovation and changes in the industry often become incremental, staying within the confines of current technology, products, and markets. This inertia is due to shared cognitive and/or ideological beliefs – technological paradigms, to use Dosi's (1984, ch. 2) term – which causes individuals and organizations to lock themselves into current technologies, products, and markets. According to evolutionary economists, industries have a tendency towards inertia or inability to change (Nelson and Winter, 1982). Amit and Schoemaker (1993) similarly argue that insecurity about future risks associated with changes in strategies and businesses tend to increase the homogeneity in industries. Later studies have argued that these mature industries, besides all using well-known technology, also share a

high level of inter-organizational communication and high involvement in business associations (Easton et al., 1993; Melander, 2005; Melander, 1997).

Papers II–IV provided evidence of widespread industry resistance to the changes affecting its electricity and forest resources. Despite the fact that influential industry representatives (including SFIF) blamed politicians and researchers for increased energy prices, ignored the electricity resource's negative environmental effects, and employed various arguments (e.g., limited forest resources, cost-ineffective power production, and critical environmental problems) to cast itself as the only legitimate forest user, change has indeed occurred, resulting in a much more heterogeneous industry today than in 1989. The industry's homogeneity, described above in terms of a mature and stable industry with highly homogeneous belief structures and strategy formation, had resulted in vertically integrated electricity and forest assets, integrated production of pulp and paper, bulk products, and large-scale production based on economies of scope and scale, has decreased since 1989. The industry's increased heterogeneity is demonstrated by the fact that the industry today consists of firms that differ in a way not found in 1989, with complementary assets, products, and markets for these products. Substantial changes have occurred in both the industry's input and its output. The increased heterogeneity in this industry, and actual steps away from the traditional forest industry path, could especially be observed in two interesting examples.

The first example is that of Södra forest industry group. The construction of 'green' electricity and public policy instruments intended to increase the amount of renewable electricity have resulted in a situation in which the electricity resource (and especially its price increases) no longer constitutes a problem for the forest industry group, but instead yields profits and value through the sale of 'green' electricity. This process has made Södra the biggest producer of 'green' electricity from biomass in Sweden today, producing approximately 1.8 TWh per year (Södra, 2009). The firm has repositioned itself as a renewable energy and forest products group over the last decade. This has resulted not only in investments in wind turbines on land owned by the group and its members, but also in constant process optimization and innovation to increase the energy efficiency of its mills, enabling it to produce more 'green' electricity from its three Swedish chemical pulp mills. As reported in paper III, in 2006 and 2007, 50–60% of Södra's investments were energy related, and that figure had reached 80% by 2008 (Edvinsson, 2008; Andersson, 2007).

Södra CEO Leif Brodén argued as follows in 2008: "The dilemma for the Swedish forest industry is how it should respond to 'green' industry. It has been viewed as a competitor for raw materials, so the industry must battle subsidies, for example. We, however, are owned by forest owners, and can put less prestige into this matter. Our owners will not be sad if wood prices increase" (DN, Ekonomi, 2008, p. 4). Taken together, Södra's corporate strategy, focusing on chemical pulp mills, energy investments and innovations, 'green' electricity sales, and even delivering excess heat to surrounding district heating systems, generated stable operating profits over the 2005–2009 period, when most of the other firms in the industry faced crisis, recession, and mill closure (Södra, 2009).

The second example consists of an even more radical strategic deviation from the traditional homogeneous forest industry path – the Domsjö fabriker biorefinery. This mill, which has now been converted into a biorefinery, was divested by Holmen in 2000 to a consortium that today focuses on refining renewable forest resources into products with environmental friendly qualities. In cooperation with Svensk Etanolkemi AB, Domsjö is producing

bioethanol for the transport sector from forest resources (Domsjoe, 2010). One of the leading figures in this strategic shift to biofuel production, Per Carstedt, was as late as 2009 mocked in the Swedish mass media as a liar and given the sarcastic nickname "Ethanol Jesus" (Collin, 2009). Interestingly, the ideas developed by Carstedt and others associated with Domsjö fabriker have today proved themselves so attractive that even the traditional forest industry firm Holmen announced in 2010 that it was developing the Holmen Biorefinery Development Center (HBC) at its mill in Iggesund. HBC was tasked identifying and analysing opportunities to use forest resources and excess industrial materials in new products at all of Holmen's mills. There is a particular focus on developing energy products, such as biofuels, biogas, and 'green' electricity (Svensk Papperstidning, 2010, pp. 24–25). The biorefinery concept is now becoming the way of the future even for one of Sweden's most traditional forest industry firms, Holmen, which historically, as demonstrated in papers II and III, had not given these issues any major consideration, but instead advocated lower electricity prices.

What has driven this type of heterogeneous change in the industry? Obviously, one might argue that the changes are part of the long-term consolidation trend in the industry, that they are part of a process of Schumpeterian creative destruction in which newsprint and printing papers are being displaced by e-media, or that they are perhaps due to general overcapacity in the global forest industry. Indeed, all these explanations are plausible, but I believe that they still omit important aspects of the ongoing changes in the Swedish forest industry. Although the abovementioned scholars associated with innovation studies and evolutionary economics highlight important factors, e.g., shared ideological beliefs and innovations, that explain industry-level changes, one might argue that many of these studies still omit the contribution of other key non-industrial actors, such as researchers, politicians, and environmental organizations, in configuring industries. In that sense, they are still often devoted to the traditional definition in economic theory that an industry is simply regarded as a group of companies producing the same principal products or, more broadly, a group of companies producing products that are close substitutes for each other (cf. Porter, 1980).

6.1.3 The role of concerned groups and industrialists in the wild in (re)creating the industry

However, as argued in section 1.4.4, considering the embeddedness of industries in wider societal spheres, it is important to analyse the influence of networks of non-industrial actors such as politicians and researchers in explaining industrial change. Indeed, the importance of this view is conveyed in paper IV. As demonstrated there, the forest industry's stability and change regarding the industrialized use of forests was not simply constituted via traditional routes, such as private meetings, industry conferences, and closed boardrooms. Instead, paper IV argued that, to understand the processes of industrial change undergone by the Swedish forest industry, we need to study all the agents that participated in analysing and transforming the industry (cf. Callon, 2007, p. 336). Studying the role of concerned groups and industrialists in the wild highlights how confined industry's 'facts' and subpolitics are today being contested by new realities (cf. Callon, 2003, p. 46). Indeed, the involvement of these non-industrial actors underpins the dynamic controversies and political decisions and explains why the Swedish forest industry came to change its position concerning forests over the 1989–2009 period.

As argued in paper IV, if such industrial change was analysed using conventional economic models of rational behaviour, i.e., economic man, the Swedish forest industry's reconfigurations would likely be treated as effects of internal economic assessments, that is,

higher electricity production as an instrument for creating profitability in the branch. The obvious problem with this approach, however, is that it 'black boxes' the fact that SFIF and forest industry firms, as demonstrated in paper IV, were forced by concerned groups to reconfigure existing forest uses. SFIF and other forest industry representatives not only opposed new uses of forest materials, but lacked enthusiasm even when forest industry firms started making money on bioenergy. Indeed, the observations of Nelson and Winter (1982), Dosi (1984), and Utterback (1996), that these types of industries are often reluctant to embrace change, have been confirmed. However, this industry confinement today seems to be under reconstruction due to, among other reasons as mentioned above, the conflicts with non-industrial groups analysed in paper IV that later enabled the reconstruction of how forests could be used.

What does this new situation mean to mature (confined) industries more generally? I am convinced that the trajectory that this type of industries now follow has become increasingly unpredictable and depends on the nature and number of groups participating in the industry debate, the alliances formed, technological solutions proposed or ruled out, and therefore the 'facts' produced and explored (cf. Callon et al., 2009, p. 26). This may result in increasing conflicts between mature confined industries and concerned groups, since industry 'facts' and firm strategies are no longer solely produced in closed boardrooms and at industry conferences. On the contrary, the management of industrial firms, associated knowledge, and resource considerations are today the products of complicated matters of concern, i.e., complex political, environmental, chemical, and economic constructs accentuated through arguments, assumptions, reasoning, and forecasts (cf. Latour, 2004, pp. 23–24).

On the other hand, these dynamic controversies and conflicts may give rise to new versions of the groundbreaking "creative destruction" that Schumpeter (1975) saw as the key factor in industrial innovation and change. Indeed, one might argue that, had it not been for the problematization of the forest's energy potential conducted by industrialists in the wild in the late 1980s, the Swedish parliament might not have had sufficient ecological and economic information and 'facts' to pass Government Bill 1990/91:88, Om Energipolitiken [On energy policy]. This bill not only recognized the forest's energy potential but also identified biofuels as a future energy source for Sweden. The implementation of various support systems for bioenergy as well as the carbon tax that followed in the early 1990s were also influenced by arguments proposed by the Swedish Bioenergy Association (Svebio) and researchers at Swedish University of Agricultural Sciences, as demonstrated in paper IV. These changes, as well as the ongoing Swedish energy policy aiming to move Sweden towards increased ecological sustainability, increased the heterogeneity of the Swedish forest industry and created the prerequisites for firms such as Södra and the Domsjö fabriker biorefinery to move towards industrial 'greening'.

In that sense, the process of industrialism in the wild and the involvement of concerned groups may be a process both of conflict and controversy and of entrepreneurship, closely related to Schumpeter's (1975) notion of entrepreneurs as "wild spirits". However, and this is important, it was not within the confined forest industry that these wild spirits with bright ideas were found back in 1989; on the contrary, they were all non-industrial actors situated in the wild. Indeed, these findings suggest that the involvement of concerned groups and industrialists in the wild may trigger dynamic change in mature industries long dominated by conservatism. Whether this holds for other industries is a question worth exploring in further

research analysing other industries facing the same drastic changes as the forest industry, such as the steel, energy, and cement industries.

6.2 The performative role of economic theories in shaping the industry

6.2.1 Introduction – rethinking the role of economic theories and metrics

Below I will discuss the potential performative role of economic theories in shaping the forest industry's (re)actions regarding the energy transition. By reflecting on the wider implications of economics as shaping calculative agencies, I will problematize some of the results presented in the individual papers regarding why certain (re)actions have occurred. Scholars have recently initiated debate regarding the role of economic theory, in particular, of its various theoretical concepts and valuation metrics (Callon, 1998; MacKenzie, 2007). According to Callon (1998, p. 26), economic science plays a key role not only in describing how the economy functions but also in framing actual economic behaviour. The *performativity* of economic theories refers to how various economic ideas and apparatuses serve not only as passive tools describing phenomenal reality, but also participate in the formulation of strategies, calculations, transactions, decision making, etc. Hence, a performative theory or model does not simply reflect reality but intervenes in it. An economic theory and/or model becomes performative when its use actually increases its predictive abilities.

In recent years, a number of contributions in the fields of financial economics (MacKenzie, 2006, 2007; MacKenzie and Milo, 2003; Lépinay, 2007), marketing (Kjellberg and Helgesson, 2006a; Kjellberg and Helgesson 2006b), statistics (Didier, 2007), and accounting (Skaerbaek and Tryggestad, 2010) have empirically discussed relationships and feedback loops between economic ideas and economic practices. However, I am unaware of any studies addressing the role of economics in shaping or intervening in industrial 'greening'. Kjellberg and Helgesson (2006a, p. 840) have argued that additional theoretical and empirical work is needed to increase our understanding of the feedback loops and relationships between economic theory and practice. In that sense, my ambition in the following section is to discuss and reflect on the relationship between various economic ideas and financial metrics, and the management and strategic practices of firms in this industry in relation to the energy transition. By considering the performative role of economic theories and tools in the industry during the 1989–2009 period, it may be possible to reflect on why the industry might have (re)acted as it did.

6.2.2 The potential performative role of calculative methods in the studied pulp and paper mills

Some of the findings of my four papers could be further problematized in relation to the above discussion. Let us start with paper I, which focused on the pulp and paper producing part of the Swedish forest industry's energy end-use. As argued in chapter three, the paper indeed provided some interesting findings, but used quite traditional economic theories and concepts, such as energy cost allocation, the existence and timeframe of an energy strategy, and the payoff method.

The paper could be viewed as part of a sub-field of energy studies that analyses the implementation of cost-effective energy conservation measures (Thollander and Ottosson, 2008; Sorrell et al., 2000; Jaffe and Stavins, 1994). The general theoretical understanding informing such studies is that energy-efficiency measures are not always implemented because of the existence of various barriers to energy efficiency, such as imperfect information, split incentives, adverse selection, and principal–agent relationships, resulting in a so-called energy-efficiency gap. This gap refers to the notion that investments that lower energy use in an organization and that are considered cost-effective according to the organization's investment criteria are still not being implemented. As argued in section 3.1, the theoretical perspective in paper I is based on the notion of bounded rationality, i.e., the rationality of actors is limited due to factors such as information asymmetries, imperfect information, and the amount of time for decision making (March, 1994).

Thollander and Ottosson (2008) have demonstrated that the highest ranked driving forces of energy efficiency in the Swedish pulp and paper industry are related to organizational factors within the mills, such as cost reductions resulting from lowered energy use, the presence of energy managers committed to the issue, and the existence of a long-term energy strategy emphasizing the need to study the existing energy management activities of the pulp and paper sector of the Swedish forest industry. Paper I aimed to describe and analyse energy management practices in the Swedish pulp and paper industry, and four specific research questions were formulated:

• How have the mill's energy priorities changed between 1996 and 2007?

• How are energy costs allocated at the mill?

• Does the mill have an existing long-term energy strategy and, if so, what is the timeframe of the strategy?

• What payoff criteria are used when investing in energy-efficiency measures at the mill?

If we omit the first question, I believe that the other three research questions, could be further problematized based on Callon's (1998, p. 26) proposition. The basic idea is that economics and its various tools (e.g., the payoff method) not only provide guidance for economic decisions but also participate in their configuration. In other words, economics performs economic actions rather than simply observing or explaining how they function (Callon, 1998). In this text, the concept of performativity refers to 'generic performativity' in which various theories (e.g., cost allocation and payoff method) partake in formatting practices (e.g., the energy management practices of a Swedish pulp and paper mill) (cf. MacKenzie, 2004, p. 305; Kjellberg and Helgesson, 2006a, p. 845).

While the basic notion within a traditional economic approach, and I am guilty of having used such an approach in paper I, is that strategy is subordinated to accounting and calculation. From a performativity perspective, we may instead ask whether it might be the other way around, i.e., might a specific mill's energy cost allocation and payoff method determine its wider energy management practice, including its energy strategy? In a wider discursive context, the research of Hansen and Mouritsen (2005) and Skærbæk and Tryggestad (2010) may explain why these issues have not been further problematized in traditional streams of economics. While both the SM and accounting fields have grown and branched off in many

sub-disciplines over the last 40 years, recent research (Hansen and Mouritsen, 2005; Skærbæk and Tryggestad, 2010) has illustrated that these two fields have often neglected each other when studying strategy. While accounting has overlooked strategy, SM research has often considered accounting metrics and financial targets as passive tools used for implementing rather than formulating strategy.

Rather than simply viewing the existence and timeframe of an energy strategy at the mills as a separate issue, it would be interesting to further study the relationship between this issue and the energy cost allocation chosen by the various mills as well as the payoff periods chosen for various energy efficient investments. Given the results presented in paper I, which indicate opportunities to improve energy management practices at the studied mills, and given that previous studies have argued that the efficiency potential in the Swedish forest industry could be up to approximately 30% (Nilsson et al., 1996; Klugman, 2008; Klugman et al., 2007), the performative role of the mills' cost allocation and payoff methods merit further study. However, fully analysing the performative relationship between the calculative and accounting methods used in the mills, and the mills' energy management practices and strategies, would call for a complementary study involving site visits and interviews with several energy managers and CEOs. The empirical findings of paper I indicate a need for additional research in this context, using a more in-depth research method than a questionnaire.

6.2.3 The corporate strategic practice of Stora Enso 1990-2008

It is apparent in both papers II and III that industry representatives such as SFIF and individual CEOs have been highly critical of Swedish politicians for allowing the electricity price to rise, especially due to taxes, public policy instruments, and the ETS. The Swedish forest industry, however, is not only a large electricity user but has also been, and in some cases still is, a major electricity producer. At the beginning of the 1990s, the three largest Swedish forest companies, SCA, Holmen, and Stora Enso, were all major electricity asset owners. In 1992, however, SCA divested all its electricity production while Stora Enso, as detailed in paper II, sold its electricity production early in the first decade of this century. Stora Enso went one step further than SCA by also divesting its forests. On 16 May 2002, Stora Enso stated in a press release that it had divested a total of 600,000 hectares of forestlands to Finnish company Tornator Oy, while another 130,000 hectares had been sold to institutional forest owners in the USA. According to Stora Enso: "The decision is in line with the Company's strategy of releasing capital to develop its core businesses and reduce debt" (Stora Enso, 2002, p. 2). In 2003, the Swedish forest assets were also divested, to the new company Bergvik Skog Ltd. Stora Enso retained a minority stake in the new company while the rest was sold to institutional investors (Stora Enso, 2003, p. 3). By 2003, the company had left behind energy- and forest-related vertical integration that, as we shall see in the following, at least historically had been a prevalent organizational structure in this industry.

Figure 4 shows the organization of a traditional forest industry firm producing pulp and paper products.

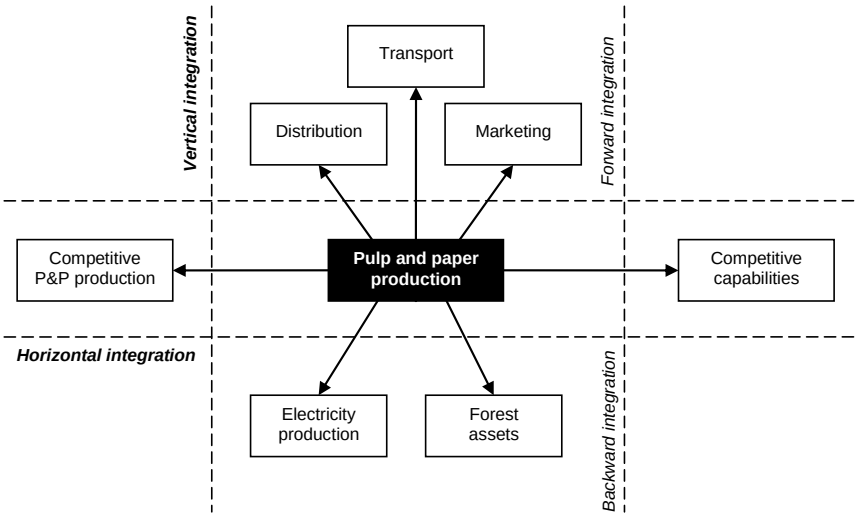


***Figure 4**. Vertical and horizontal integration in a typical forest industry firm producing pulp and paper (design inspired by Johnson et al. 2005 p. 286)*

In fact, all three firms analysed in paper II, Holmen (MoDo), SCA, and Stora Enso, were organized in accordance with Figure 4 in the early 1990s. Melander (1997, 2005) has demonstrated that, in the early 1990s, there was a central industry-wide belief in the Swedish forest industry that it was crucial to own forest and electricity assets, to enable a high degree of self-sufficiency in energy and raw material. This implies that vertical integration was historically a dominant organizational form in the forest industry (Bjuggren, 1985). The concept of vertical integration, according to Bjuggren (1985), refers to "the extent to which different stages in a chain are under the ownership, management and control of a single firm" (Bjuggren, 1985, p. 1). The theoretical underpinning of vertical integration is that all steps in the production chain of a firm should be controlled by a single entity. This means that one firm alone is engaged in many aspects of the production chain, such as growing raw materials, producing energy for industrial processes, and the manufacturing, transport, marketing, and sale of end products.

Bengtsson and Kalling (2007, p. 123) argue that vertical integration is needed in the Swedish forest industry because the industry is highly capital intensive, making it of utmost importance to control all parts of the value chain – from forest to end product. Forest industry firms cannot afford the risk of not having any wood or having to buy it on the open market at high cost. According to the same authors, the presence of this industry-wide belief has increased the strategic homogeneity of the forest industry (Bengtsson and Kalling (2007, p. 123). In his study of SCA, Hägglund (2004) identified this strong belief in vertical integration in the industry, and stated that this belief often has a severe impact on the value of forest industry stocks. According to Hägglund (2004, p. 133–134), the forest industry is a very difficult industry in terms of predicting future profits and therefore the correct stock price. This is because a firm's profits regularly fluctuate with the global pulp price, which is often very volatile. This creates uncertainty for forest industry firms, which, to avoid being too dependent on the global pulp price, often own sawmills, forests, and electricity production. In

recent decades, many firms have also moved into various consumer-related products, such as tissue, paper, and personal care products.

Forest industry profitability is generally shaped by the cyclical nature of the industry. Historically, periods of high profitability have alternated with periods of low profitability (Lamberg et al., 2007; Romme, 1994). An important factor that affects this cyclicality is that profitability is determined largely by the balance between capacity and demand. Investments in pulp mills and paper machines are highly capital intensive, and each investment contributes to major capacity increases on specific markets. In addition, external factors such as the dollar exchange rate, increased energy and wood prices, and growth rates of specific markets reinforce the cyclical nature of profitability in the forest industry (Romme, 1994). As industry-related theories dictate, producing pulp and paper in a competitive manner requires significant scale economies and considerable invested capital (Lamberg et al., 2007). Furthermore, it takes several years for a large-scale investment to be available for actual production and years for it to be paid off. This has led to major cyclicality in the industry, in which large-scale investments are often made nearly simultaneously, limiting the shareowners' short-term earnings (Lamberg et al., 2007).

In view of the above discussion of widespread industrial ideas and practices, the empirical case of Swedish/Finnish forest industry company Stora Enso is interesting in relation to performativity, since major shifts occurred in its corporate strategy during the 1990–2008 period. As presented in paper II, the company's corporate strategy shifted from being based on theoretical concepts from the SM field, such as vertical integration and diversification, to being based on concepts such as divestment of non-core assets, core business focus, and global market growth. As demonstrated in paper II, Stora Enso's choice of return on capital employed (ROCE) and debt/equity ratio as key financial metrics (Stora Enso, 1999, p. 4) was also central to the implementation of the firm's corporate strategy.

The strategic decisions made by Stora Enso have been criticized for causing higher production costs, job loss, and mill closure, as well as several billion Swedish kronor in non-value increases (Ottosson, 2007). One possible explanation for the divestments worth further consideration is the wider influence of various strategic theories and financial metrics on the practice of Stora Enso's corporate strategy. From a performativity perspective, it might be useful to discuss how SM theories, financial ratios, and financial targets are translated into concrete corporate strategies. Might SM theories and valuation metrics play other roles, apart from helping managers implement strategy? This question indicates the possibility that particular SM theories and economic metrics may play an active role not only in promoting efficient strategy implementation, but also in structuring and (re)formulating it (cf. Skærbæk and Tryggestad, 2010).

I argue that, to understand and explain the major shifts in Stora Enso's corporate strategy over the 1990–2008 period, I would need to further investigate how general theories in the SM field (e.g., divestment of non-core assets, core business focus, and global market growth) co-exist, interrelate, and conflict with the above cited industry-wide ideas and practices regarding vertical integration and diversification in the implementation of Stora Enso's corporate strategy. Furthermore, it is important to problematize the role of valuation metrics. In this regard, it would be useful to expand Callon's (1998) approach by testing the analytical framework of performativity in the case of Stora Enso. In my opinion, and to some degree this is demonstrated in paper II, the Stora Enso case may indicate that the corporate strategy of a

firm is the product of various translations that coexist and interplay with each other. The performance of multiplicity means analysing general SM theories (e.g., divestment of non-core assets), industry-wide beliefs (e.g., vertical integration), and valuation metrics (e.g., ROCE and debt/equity ratio), all of which may conflict during the creation of corporate strategic practice.

For example, Stora Enso's corporate strategy in the 1998–2004 period in many respects strongly diverged from industry-wide ideas (cf. Bjuggren, 1985; Bengtsson and Kalling, 2007), i.e., abandoning vertical integration including both forest and electricity assets. However, in the last years of the case study presented in paper II, the company implemented a changed strategy, resulting in reinvestment in new electricity assets. This meant that the company was again organizing itself in a vertically integrated way, investing in new electricity production to secure lower prices for its pulp and paper production. A firm like Stora Enso needs to act in a complex environment in which various industrial and economic ideas, sometimes even incompatible ones, participate in shaping corporate strategic practice. It is my conviction that the Stora Enso case, in future research, could contribute to new theoretical insights that would improve our understanding of the performative role of economic theories and valuation metrics in forming corporate strategy. Regarding corporate strategy, in this multifaceted context, the increasing demand for industrial 'greening' could be viewed as yet another factor that a firm such as Stora Enso must consider when implementing corporate strategy. In this complicated context, the coexistence of several theories, ideas, and valuation metrics, together with their roles in shaping a firm's strategic practices, can help us answer future research questions, such as why a company did not implement energy-efficiency measures even though they were cost-efficient.

6.3 The problem of representing a 'black' and 'green' industry

6.3.1 Introduction - SFIFs dilemma regarding representativity

"We are now looking forward to more concrete measures that give the Swedish forest industry the ability to be a part of the solution to climate change simultaneously as we can continue to be one of the corner stone's of the Swedish economy" (Arwidson, 2007).

By 2005–2009, the end of the studied period, the Swedish forest industry, primarily by means of its industry association, SFIF, became increasingly focused on portraying the Swedish forest industry as an important part of the solution to climate change. As argued by the CEO of SFIF, Marie S. Arwidson, in the above quotation, the forest industry wants to combine environmental concern with economic growth and thus become a 'greener' industry. In this section, I will reflect on and discuss SFIF's wider dilemma regarding representativity, given that the Swedish forest industry is currently both a 'black' and a 'green' industry.

Industry associations are complex 'organizations of organizations', mandated by the member industry firms to assume a number of shared representative tasks. Previous research has demonstrated that business and industry associations deal with, for example, lobbying, shared representation, rulemaking, and information (Granovetter and McGuire, 1998; Meisner Rosen et al., 2002; Berk and Schneiberg, 2005). Liv Fries (2008) notes in her review that much of the literature on business associations has focused on their role as part of either the political

system or the market. Another central question, according to Fries (2008), is whether business associations are actually good or bad for the firms they represent. Recent ANT research, however, has problematized the view of given and stable agency (Callon, 2007). As Callon (2007) argues, an actor's agency can shift depending on the context in which it is performed. This suggestion is not news. Goffman (1959) argued that people will attempt to control others' impressions of them by changing or fixing their setting, appearance, and manner in relation to the specific context. Central to much of the work on multiple agency related to ANT, however, has been how economic actors acquire agential capacities by being equipped with theories and tools for calculation and action (Callon, 2007; MacKenzie, 2006). MacKenzie (2006) and Callon (2007) argue that scientific calculations, models, and theories play a central role in providing actors with a given kind of agency.

In the following, I will reflect on and discuss changes in SFIF's agency over the 1989–2009 period, and the possible wider roles scientific calculations, models, and theories have played in these changes.

6.3.2 From denying the environmental damage caused by the industry to a climate saviour?

In the early 1990s, SFIF questioned almost every demand the government put on the industry to go 'greener' (DI, 1991 DN, 1993a). For example, SFIF opposed increased use of recycled paper and cardboard (DN, 1993b) as well as efforts to further reduce its emissions into the air and water (DI, 1991). As demonstrated in paper IV, SFIF was highly critical of the use of forest resources for other purposes than pulp and paper in the early 1990s. Regarding the industry's high use of electricity, several researchers and politicians argued throughout the studied period that the industry could significantly reduce its electricity consumption by implementing more efficient technology (Bryntse, 2007; DA, 2007). Such claims were often opposed by the industry association (SKGS, 2004).

It would be no exaggeration to argue that SFIF was often highly critical of the demands to become 'greener' directed towards the industry by non-industrial actors such as politicians and researchers during the 1989–2009 period. However, especially in the latter part of the 2000–2009 period, SFIF changed its position, at least in relation to the use of the forests. Part of this change was presented in paper IV, which describes how SFIF went from denying that the forests could be used for bioenergy to arguing that the Swedish forest industry and its use of forests (including for producing 'green' electricity) were part of the solution to climate change.

The industry's investments in electricity production have also changed. The Swedish forest industry is today the biggest investor in wind power in Sweden. SCA, together with energy company Statkraft, is planning to build over 400 wind turbines producing 2.8 TWh of 'green' electricity per year, making the firm Sweden's biggest producer of electricity from wind power. Furthermore, Södra is planning to build 150 wind turbines on its members' land, and Holmen and Stora Enso have also presented plans to invest in wind turbines (Skog and industri, 2008, p. 16). Taken together, these plans will cost tens of billions of Swedish kronor and heavily increase 'green' electricity production in Sweden. Indeed, as argued in paper III, these investments represent steps in a 'greener' direction, towards ecological modernization. However, these 'green' changes, i.e., investments in wind power and increased production of electricity from biofuels in many forest industry firms, have not caused SFIF to completely drop its historical opposition to demands for 'green' change.

Chapter 6

Two diverging tendencies are discernable in my empirical material. On one hand, since about 2005, SFIF has heavily increased its 'green' advertising (e.g., newspaper submissions and TV commercials) and publications (e.g., reports and consideration statements) regarding the forest's potential to act as a carbon sink. As described in paper IV, SFIF launched a major climate campaign focusing on 'well-managed forestry and how it is related to a better climate' (SFIF, 2008d, p. 1). The essence of SFIF's argument was that, starting in 2005, optimal large-scale industrialized use of forests was the best solution not only for the industry but also for the climate. SFIF argued: 'the more growth there is in the forests and the more we use forest products, the better it is for the climate' (SFIF, 2005, p. 13). SFIF argued that its industry was almost a climate saviour.

While SFIF, as demonstrated in paper III, argued defensively in the early 1990s that it had resolved many environmental problems, specifically by applying end-of-pipe techniques, climate change has instead been met with offensive industry rhetoric. The complexity of the climate change issue also meant that SFIF turned to scientists and consulting firms to assemble its arguments. Leif Brodén, board chair of SFIF in 2008, for example, stated that he had consulted "three professors and consulting firm McKinsey" to get answers on how climate change should be solved (DN Ekonomi, 2008, p. 4). SFIS's answers to these complex issues were often expressed directly, for example, by Leif Brodén: "The tree should not stand and rot, since it then releases carbon dioxide. Instead, you should cut it down when it has reached its maximum size and nail it into a wood house as its final destination" (DN Ekonomi, 2008, p. 4). As demonstrated in paper IV, SFIF similarly argued that LWC papers were the best end product from the forests in terms of export revenues and the need to import oil. Although various environmental groups heavily opposed SFIF's environmental campaigns and arguments by questioning their scientific validity (Naturskyddsföreningen, 2009), SFIF appears to have become considerably more offensive in its subpolitics by 2010.

On the other hand, the second tendency discerned in my empirical material seems to demonstrate that the industry's position is still fairly intact. While SFIF's 'green' campaigns and rhetoric were more proactive than they had been in the past, the industry association's opposition to external demands to go 'greener' remained at the end of the studied period. SFIF's consideration statement to the Swedish Climate Committee in 2008 emphasizes this. As demonstrated in paper III, SFIF did not support the committee's overall suggestion that Sweden should reduce its greenhouse gas emissions by 38%. It further argued that the forest industry must be compensated by the EU for the negative effects of the ETS on the electricity price and that the forest industry should receive its emission trading credits for free, i.e., being part of the so-called carbon leakage group. The 38% reduction target was rejected for the same reasons that had been mobilized throughout the studied period, namely, that such a target would damage the industry's ability to compete and reduce the industry's ability to invest in Sweden. SFIF argued: "In the worst-case scenario, this leads to reduced revenues for Sweden and increased global emissions of CO_2 if production is forced to move outside of the borders of the EU" (SFIF, 2008b, p. 3). Despite what Marie S. Arwidson stated in the quotation heading this section, SFIF was not willing to accept concrete initiatives. On the contrary, SFIF's arguments were again, as paper III demonstrated has often been the case, based on the logic of industrial modernity. No consideration was given to the external environmental costs of the industry's existence. On the contrary, traditional economic arguments (export revenues) were again mobilized and the industry even threatened to move its operations abroad.

6.3.3 The effects of climate change and the difficulty of producing a coherent agency

How can the inconsistency between SFIF's 'green' advertising campaigns and rhetoric and its 'black' subpolitics, evidenced in the consideration statement to the Swedish Climate Committee, be explained? The simple answer to this question would be that SFIF is simply dishonest and is trying to clean up a dirty industry with a history of paying inadequate attention to the environment. SFIF has recently increased its emphasis on marketing, advertising, and communication, hiring a new communication director in 2008 and contracting an advertising firm to handle its climate campaign (dagensmedia, 2008). Obviously, climate change has become much more central to the industry's campaigns. Climate change, however, is a complex matter highly constructed in the scientific sphere by means of assumptions, and forecasts. In that sense, SFIF's agency is increasingly being constructed using science.

SFIF is acting in accordance with the logic of how scientific results are often presented in the mass media. SFIF omits or only mentions in a footnote all its assumptions and forecasts regarding, for example, whether a house built of wood is better for the climate than one built of concrete (SFIF, 2008e, p. 8). The increased complexity regarding climate change and its potential solutions have forced SFIF to try to increase the scientific legitimacy of its subpolitics. In that sense, SFIF's agency has changed, depending on the assumptions and forecasts chosen and that can be omitted when turning the industry 'greener'. I believe that more research is needed into the role of science and the making of scientific results in the processes of industrial 'greening'. For example, to what extent have industries and firms been able to finance and thus co-construct research results that favour a particular technology or production process for potentially reducing CO_2 emissions?

The inconsistency between SFIF's 'green' campaigns and arguments, and its 'black' subpolitics, evidenced by its consideration statement submitted to the Swedish Climate Committee, may also be viewed in relation to the industry association's general problem regarding its role as representative of this complex industry. The conflicts between values that have permeated the environmental debate since the 1960s have largely been dominated by environmental groups, on one hand, and multinational firms, on the other. Environmental groups have historically criticized industries for exploiting natural resources and focusing only on profit maximizing (Anshelm and Hansson, 2011). Up to the 1990s, businesses in general – indeed, this also holds for SFIF and other representatives of the Swedish forest industry – very often rejected such criticism. During the studied period, changes in energy and environmental policy as well as the wider energy transition have put demands on the Swedish forest industry to go 'greener'. Simultaneously, influential economic scholars such as Porter and van der Linde (1995a, 1995b) have argued that firm 'greening', for example, by pollution control or reduced raw material use, increases firms' profitability in relation to competitors'.

In that sense, both reality and knowledge production have reconstructed the industry and its role in relation to the environment. For one of the largest industrial energy users in Europe, the general increased demand on the industry to become 'greener' obviously triggers multiple (re)actions. The business association's role in this process is to organize its subpolitics in a manner that optimizes the industry's future. But how should an industry divided between electricity-dependent mechanical pulp production and chemical pulp production, with distinct basic working processes, be optimally represented? What should SFIF propose when 70% of

Sweden's pulp production is subsidized by schemes such as the ECS, while the other 30% is driven towards bankruptcy? What is the best option for the industry in the long run? To use its current 'black' capital-intensive investments to continue producing pulp and paper, or to become 'green' biorefineries? Taken together, these questions indicate that SFIF's role has changed in an era of growing awareness of climate change, increased energy prices, new public policy instruments, etc., making it more difficult for the industry association to produce a coherent agency. The complexity regarding representativity, multiple agency, and a business association's wider role in industrial 'greening' calls for further research.

6.4 Final remarks

As argued initially in this thesis, the Swedish forest industry may not only serve as an interesting case of how an industry highly dependent on electricity and forests (re)acts regarding increasing environmental and energy-related demands and concerns, but may also increase our knowledge of how an industry deals with demands for change regarding its strategic key resources. The reflections in this chapter highlight the wider contribution of this thesis. The changes taking place between 1989 and 2009 affected not only 'reality' but also knowledge production. While the Swedish forest industry from 1945 to 1990, and the theories used to analyse it, were based on assumptions of a mature industry, stable and highly homogeneous in belief structure and strategy formation (Melander, 1997, 2005), my thesis has demonstrated that the industry today is an 'industry in the making' rather than a 'ready-made industry' (cf. Latour, 1987, ch. 1).

I have demonstrated the importance of a broader analysis of industrial change over time, including studying the influence of networks of non-industrial actors such as politicians, industry associations, environmental groups, and researchers. As argued in section 1.4.4, this issue, namely, the embeddedness of industries in other societal spheres, is one of the main concerns for what Helgesson (1999, p. 50) has called a "sociology of industry". Rather than reducing industrial change to explanatory factors present within industries, this thesis stresses the importance of viewing industries as embedded in the wider societal and material spheres of science, policy, and material resources. This thesis has, by considering this wider embeddedness, contributed new knowledge of how an industry can deal with demands for change regarding its strategic resources, and suggested possible explanations for why certain (re)actions have occurred.

By considering that the Swedish forest industry has not chosen a single homogeneous strategy or response in relation to the energy transition from 1989 to 2009, and by analysing and problematizing this in multiple ways, I have also been a co-producer in writing a new chapter in the story of this industry. The changes analysed and the knowledge produced in this thesis are not inherently stable but, like the Swedish forest industry, subject to the fragility of the future.

References

Litterature

Afuah, A. & Utterback, J.M. (1997) ”Responding to structural industry changes: a technological evolution perspective”. *Industrial and Corporate Change*, **6**, 183–202.

Alchian, A. A. & Demsetz, H. (1972) “Production, information costs and economic organization”. *American Economic Review*, **62**, 777–795.

Amit, R. & Shoemaker, P. J. H. (1993) “Strategic assets and organizational rent”. *Strategic Management Journal*, **14**, 33–46.

Andersson, E., Harvey, S. & Berntsson, T. (2006) “Energy efficient upgrading of biofuel integrated with a pulp mill”. *Energy*, **31**, 1384–1394.

Anshelm, J. (1992) *Vattenkraft och naturskydd. En analys av opinionen mot vattenkraftsutbyggnaden i Sverige 1950–1990*. Linköping: Tema T.

Anshelm, J. (2000) *Mellan frälsning och domedag. Om kärnkraftens politiska idéhistoria i Sverige 1945-1999*. Stockholm: Brutus Östlings Bokförlag Symposion.

Anshelm, J. (2002) ”Det gröna folkhemmet. Striden om den ekologiska moderniseringen av Sverige”. In *Naturen som brytpunkt. Om miljöfrågans mystifieringar, konflikter och motsägelser*, (ed.) Hedrén, J. Stockholm: Brutus Östlings Bokförlag Symposion.

Anshelm, J. (2006) *Bergsäkert eller våghalsigt? Frågan om kärnavfallets hantering i det offentliga samtalet i Sverige 1950-2002*. Lund: Arkiv.

Anshelm, J. & Galis, V. (2009) ”The politics of high-level nuclear waste management in Sweden: Confined research versus research in the wild”. *Environmental Policy and Governance*, **19**, 269–80.

Anshelm, J. & Hansson, A. (2011) “Climate change and the convergence between ENGOs and business: on the loss of utopian energies”. *Environmental Values*, **20**, 75-94.

Bain, J. S. (1959) *Industrial Organization*. New York: John Wiley & Sons.

Barney, J. B. (1986a) “Strategic factor markets: expectations, luck and business strategy”. *Management Science*, **32**, 1231–1241.

Barney, J. B. (1986b) “Organizational culture: can it be a source of sustained competitive advantage?”. *Academy of Management Review*, **11**, 656–665.

Barney, J. B. (1991) “Firm resources and sustained competitive advantage”. *Journal of Management*, **17**, 99–120.

References

Barney, J. B. (1997) *Gaining and sustaining competitive advantages*. Reading: Addison Wesley.

Barney, J. B. (2001) "Is the resource-based "view" a useful perspective for strategic management research? Yes". *The Academy of Management Review*, **26**, 41–56.

Barney, J. B. & Hesterley, W. S. (2005) *Strategic management and competitive advantage*. New Jersey: Pearson – Prentice Hall.

Beck, U. (1986) *Risk Society: Towards a New Modernity*. London: Sage.

Beck, U. (1997) *The reinvention of politics: Rethinking modernity in the global social order.* Cambridge: Polity Press.

Bengtsson, C., Karlsson, M., Berntsson, T. & Soderstrom, M. (2001) "Co-ordination of pinch technology and the MIND method". *Applied Thermal Engineering*, **22**, 133–144.

Bengtsson, L. & Kalling, T. (2007) *Kärnkompetens – specialisering eller diversifiering*. Malmö: Liber.

Bergek, A. (2002) "Responses to a technological opportunity: The case of black liquor gasification in Sweden". In *Shaping and exploiting Technological opportunities: The case of renewable energy technology in Sweden.* Göteborg: Chalmers University of technology.

Berger, P. L. & Luckmann, T. (1966) *The Social Construction of Reality*. New York: Doubleday.

Berk, G. & Schneiberg, M. (2005) "Varieties in Capitalism, Varieties of Association: Collaborative Learning in American Industry, 1900 to 1925". *Politics and Society*, **33**, 46–86.

Berntsson, T., Axegard, P., Backlund, B., Samuelsson, A., Berglin, N. & Lindgren, K. (2006) *Swedish Pulp Mill Biorefi neries – A Vision of Future Possibilities*. Report commissioned by the Swedish Energy Agency. Publication forthcoming.

Bjuggren, P-O. (1985) *A Transaction Cost Approach to Vertical Integration: The Case of the Swedish Pulp and Paper Industry*. Lund: Lunds University.

Bloor, D. (1976) *Knowledge and Social Imagery*. London: Routledge & Kegan Paul.

Brace, I. (2004) *Questionnaire design: how to plan, structure and write survey material for effective market research.* London: Kogan Page.

Brusoni, S., Jacobides, M. G. & Prencipe, A. (2009) "Strategic Dynamics in Industry Architectures: The Challenges of Knowledge Integration". *European Management Review*, **6**, 209-216.

Bryman, A. (2004) *Social Research Methods*. Oxford: Oxford University Press.

References

Callon, M. (1986) "Some Elements of a Sociology of Translation: Domestication of the Scallops and the Fishermen of St Brieuc Bay." *In Power, Action and Belief: A New Sociology of Knowledge,* (ed.) Law, J. London: Routledge & Kegan Paul.

Callon, M. (1998) "The embeddedness of economic markets in economics". In *The laws of the markets,* (ed.) Callon, M. Oxford: Blackwell Publishers/The Sociological Review.

Callon, M. (2001) "Economy of Qualities, Researchers in the Wild and the Rise of Technical Democracy". Unpublished article.

Callon, M. (2003) "The increasing involvement of concerned groups in R&D policies: what lessons for public powers?" In *Science and Innovation, Rethinking the Rationales for Funding and Governance,* (eds.) Geuna A., Salter A.J. & Steinmueller, W.E. Cheltenham: Edward Elgar.

Callon, M. (2007) "What does it mean to say that economics is performative?" In *Do Economists make markets? On the performativity of economics,* (eds.) MacKenzie, D., Muniesa, F. & Siu, L. Princeton: Princeton University Press.

Callon, M. & Latour, B. (1992) "Don't Throw the Baby Out with the Bath School! A Reply to Collins and Yearley.". In *Science as Practice and Culture,* (ed.) Pickering, A. Chicago: Chicago University Press.

Callon, M. & Law, J. (1995) "Agency and the Hybrid Collectif". *The South Atlantic Quarterly*, **94**, 481-507.

Callon, M. & Rabeharisoa, V. (2003) "Research 'in the wild' and the shaping of new social identities". *Technology & Society*, **25**, 193–204.

Callon, M., Barthe, Y. & Lascoumes, P. (2009) *Acting in an uncertain world: An essay on technical democracy.* London: MIT Press.

Carmeli, A. (2004) "Assessing Core Intangible Resources". *European Management Journal*, **22**, 110–122.

Coffey, A. & Atkinson, P. (1996) *Making Sense of Qualitative Data Analysis: Complementary Strategies.* Thousand Oaks CA: Sage.

Collins, H. & Yearley, S. (1992) "Epistemological Chicken". In *Science as Practice and Culture,* (ed.) Pickering, A. Chicago: The University of Chicago Press.

Czarniawska, B. (1995) "Narration or Science? Collapsing the Division in Organization Studies". *Organization,* **2**, 11-33.

Dag, S. (2000) *Volvo faces a deregulated European electricity-market*. Linköping: Linköping University.

References

DeCanio, S. (1993) “Barriers within firms to energy efficient investments”. *Energy Policy*, **9**, 906–914.

de Groot, H., Verhoef, E. & Nijkamp, P. (2001) ”Energy saving by firms: decision-making, barriers and policies”. *Energy Economics*, **23**, 717-740.

Didier, E. (2007) “Do statistics “perform” the economy?”. In *Do Economists make markets? On the performativity of economics* (eds.) MacKenzie D., Muniesa F. & Siu, L. Oxford: Princeton University Press.

Dobers, P., Strannegård, L. & Wolff, R. (2001) “Knowledge interests in corporate environmental management”. *Business Strategy and the Environment*, **10**, 335-343.

Dosi, G. (1984) *Technical Change and Industrial Transformation*. Basingstoke: Macmillan.

Easton, G., Burrell, G., Rotschild, R. & Shearman, C. (1993) *Managers and competiton.* Oxford: Blackwell publishers.

Ekheimer, P. (2006) *Tidningspapper av returpapper – Den svenska massa- och pappersindustrins omvandling under senare delen av 1900-talet.* Göteborg: Chalmers University of Technology.

Fagerberg, J. (2004) “Innovation: A Guide to the Literature”. In *Oxford Handbook of Innovation,* (eds.) Fagerberg, J., Mowery, D. C. & Nelson, R. R. Oxford: Oxford University Press.

Finch, J. H. & Acha, V. L. (2008) “Making and exchanging a second-hand oil field, considered in an industrial marketing setting”. *Marketing Theory*, **8**, 45-66.

Foster, J. B. (2005) “The Treadmill of Accumulation. Schnaiberg’s Environment and Marxian Political Economy” *Organization and environment*, **18**, 7-18.

Fries, L. (2008) “Boundarians that Shape Market Actors. A Review of the Literature on Business Associations”, *24th annual IMP conference*. Uppsala.

Galis, V. (2006) *From shrieks to technical reports: Technology, disability and political processes in building Athens metro*. Linköping: Linköping University.

Georg, S. & Füssel, L. (2000) “Making sense of greening and organizational change”. *Business Strategy and the Environment*, **9**, 175–185.

Goffman, E. (1959) *The Presentation of Self in Everyday Life*. New York: Doubleday Anchor.

Gordon, G. G. (1991) “Industry Determinants of Organizational Culture”. *Academy of Management Review*, **2**, 396–415.

Granovetter, M. (1985) “Economic action and social structure: the problem of embeddedness”. *American Journal of Sociology*, **91**, 481–510.

References

Granovetter, M. & McGuire, P. (1998) "The Making of an Industry: Electricity in the United States". In *The Laws of the Markets*, (ed.) Callon, M. Oxford: Blackwell.

Hajer, M. A. (1995) *The Politics of Environmental Discourse*. Oxford: Oxford University Press.

Hansen, A. & Mouritsen, J. (2005) "Strategies and organizational problems: Constructing corporate value and coherence in balanced scorecard processes". In *Controlling strategy: Management, accounting, and performance measurement*, (ed.) Chapman, C. S. Oxford: Oxford University Press.

Hart, S. (1995) "A natural-resource-based view of the firm". *Academy of Management Review*, **20**, 986-1014.

Helgesson, C-F. (1999) *Making a natural monopoly. The configuration of a techno-economic order in Swedish telecommunications.* Stockholm: Stockholm School of Economics.

Hellgren, B. & Melin, L. (1992) "Industrial wisdom and corporate strategies". In *European Business Systems*, (eds.) Whitley, R. London: Sage.

Hirst, E. & Brown, M. A. (1990) "Closing the efficiency gap: Barriers to the efficient use of energy". *Resources, Conservation and Recycling*, **3**, 267–281.

Hughes, T. P. (1983) *Networks of power: Electrification in Western society, 1880-1930*. Baltimore : Johns Hopkins University Press.

Hughes, P. & Morgan, R. E. (2008) "Fitting strategic resources with product-market strategy: performance implications". *Journal of Business Research*, **61**, 323–331.

Håkansson, H. & Snehota, I. (1989) "No Business is an Island: The Network Concept of Business Strategy". *Scandinavian Journal of Management*, **5**, 187-200.

Håkansson, H. & Waluszewski, A. (2002) *Managing technological development: IKEA, the environment and technology*. London: Routledge.

Håkansson, H. & Waluszwski, A. (2007) "Economic use of knowledge". In *Knowledge and Innovation in Business and Industry. The importance of using others*, (eds.) Håkansson, H. & Waluszewski, A. London: Routledge.

Hägglund, P. B. (2004) "Från företag till aktie: hur aktieanalysen gör aktien till en produkt". In *Den där marknaden: Om utbyten, normer och* bilder, (eds.) Helgesson, C-F., Kjellberg, H. & Liljenberg, A. Lund: Studentlitteratur.

Högselius, P. & Kaijser, A. (2007) *När folkhemselen blev internationell*. Stockholm: SNS Förlag.

References

Jaffe, A. & Stavins, R. (1994) "The energy-efficiency gap. What does it mean". *Energy Policy*, **22**, 804–810.

Johnson, G., Scholes, K. & Whittington, R. (2005*) Exploring Corporate Strategy: Text and Cases*. Harlow: Prentice Hall.

Johansson, B., Modig, G. & Nilsson, L. J. (2007) "Policy instruments and industrial responses: experiences from Sweden". European Council for an Energy-Efficient Economy (ECEEE) summer study "Saving energy – just do it", Panel 7, 1413–1421.

Jönsson, J., Svensson, I-L. & Ottosson, M. (2007) *Överskottsvärme från kemiska massabruk - En socioteknisk analys av interna och externa användningspotentialer.* Linköping: Program Energisystem.

Kaijser, A., Mogren, A. & Steen, P. (1988) *Att ändra riktning. Villkor för ny energiteknik.* Stockholm: Allmänna förlaget.

Kall, A-S. (2011) *Förnyelse med förhinder. Den riksdagspolitiska debatten om omställningen av energisystemet 1980-2010.* Linköping: Linköpings universitet.

Kauffman, S. A. (1995) *At Home in the Universe: the search for laws of self-organization and complexity.* New York: Oxford University Press.

Kjellberg, H. (2001) *Organising distribution. Hakonbolaget and the efforts to rationalise food distribution, 1940-1960.* Stockholm: Stockholm School of Economics.

Kjellberg, H. & Helgesson, C-F. (2006a) "Multiple versions of markets: Multiplicity and performativity in market practice". *Industrial marketing management*, **35**, 839-855.

Kjellberg, H. & Helgesson, C-F. (2006b) "The mode of exchange and shaping of markets: Distributor influence in the Swedish post-war food industry. *Industrial marketing management*, **36**, 861-878.

Klugman, S., Karlsson, M. & Moshfegh, B. (2007) "A Scandinavian chemical wood pulp mill. Part 1. Energy audit aiming at efficiency measures". *Applied Energy*, **84**, 326–339.

Klugman, S. (2008) *Energy systems analysis of Swedish pulp and paper industries from a regional cooperation perspective - Case study modelling and optimization.* Linköping: Linköping University.

Knorr Cetina, K. (1981) *The Manufacture of Knowledge - An Essay on the Constructivist and contextual Nature of Science*. Oxford: Pergamon Press.

Kreiner, K. & Tryggestad, K. (2002) "The Co-production of Chip and Society: Unpacking Packaged Knowledge". *Scandinavian Journal of Management*, **18**, 421-449.

Kvale, S. (1996) *Interviews: an introduction to qualitative research*. Beverley Hills: Sage publications.

References

Kvale, S. (1997) *Den kvalitativa forskningsintervjun*. Lund: Studentlitteratur.

Laestadius, S. (2000) "Biotechnology and the Potential for a Radical Shift of Technology in Forest Industry". *Technology Analysis & Strategic Management*, **12**, 193-212.

Lamberg, J-A., Näsi, J., Ojala, J. & Sajasalo, J. (2007) *The evolution of competitive strategies in global forestry industries: Comparative perspectives*. Dordrecht: Springer.

Langhelle, O. (2000) "Why Ecological Modernization and Sustainable Development Should Not Be Conflated". *Journal of Environmental Policy & Planning*. **2**, 303-322.

Latour, B. (1986) "The Powers of Association". *In Power, Action and Belief. A new sociology of knowledge?*, (ed.) Law, J. London: Routledge & Kegan Paul.

Latour, B. (1987) *Science in action: How to follow scientists and engineers through society*. Milton Keynes: Open University Press.

Latour, B. (1988) *The Pasteurization of France*. Cambridge: Harvard University Press.

Latour, B. (1995) "Mixing humans and non-humans together: The sociology of the door-closer." In *Ecologies of knowledge: Work and politics in science and technology*, (ed.) Star, S. L. Albany: State University of New York Press.

Latour, B. (2004) *Politics of nature. How to bring the sciences into politics.* Cambridge: Harvard University Press.

Latour, B. & Woolgar, S. (1979) *Laboratory Life: the Social Construction of Scientific Facts*. New Jersey: Princeton University Press.

Law, J. (1987) "Technology and Heterogeneous Engineering: The Case of Portuguese Expansion." In *The Social Construction of Technological Systems: New Directions in the Sociology and History of Technology*, (eds.) Bijker, W. E., Hughes T. P. & Pinch T. J. Cambridge, Massachusetts: The MIT Press.

Law, J. (1994) *Organizing Modernity*. Oxford: Blackwell.

Law, J. & Hassard, J. (1999) *Actor Network Theory and after.* Oxford: Blackwell Publishing.

Law, J. & Urry, J. (2004) "Enacting the Social". *Economy and Society*, **33**, 390-410.

Lee, F. (2009) *Letters & Bytes. Sociotechnical Studies of Distance Education.* Linköping: Linköping University.

Lépinay, V-A. (2007) "Decoding finance: Articulation and liquidity around a trading room". In *Do economists make markets? On the performativity of economics*, (eds.) MacKenzie D., Muniesa F. & Siu, L. Oxford: Princeton University Press.

Lévi-Strauss, C. (1966) *The Savage Mind*. Chicago: University of Chicago Press.

References

Lewin, L. (2002) *Ideologi och Strategi. Svensk politik under 130 år*. Stockholm: Norstedts Juridik AB.

Lilja, K., Rasanen, K. & Tainio, R. (1992) ”A dominant business recipe: The forest sector in Finland”. In *European business systems*, (ed.) Whitley, R. London: Sage.

Linderström, M. (2001) *Industrimoderniteten och Miljöfrågans utmaningar. En analys av LO, SAF, Industriförbundet och Miljöpolitiken 1965-2000*. Linköping: Linköpings University.

Lundqvist, L. J. (1997) "Sweden". In *A Comparative Study of Capacity-Building National Environmental Policies*, (eds.) Jänicke, M. & Weidner, H. Berlin: Springer.

Lundqvist, L. J. (2000) “Capacity-building or social construction? Explaining Sweden’s shift towards ecological modernisation”. *Geoforum*, **31**, 21-32.

Lyotard, J-F. (1984) *The Postmodern Condition: A Report on Knowledge.* Minneapolis: University of Minnesota Press.

MacKenzie, D. (2004) “The big, bad wolf and the rational market: portfolio insurance, the 1987 crash and the performativity of economics”. *Economy and Society*, **33**, 303−334.

MacKenzie, D. (2006) *An engine not a camera: How financial models shape markets*. Cambridge and London: MIT Press.

MacKenzie, D. (2007) “Is economics performative? option theory and the construction of derivative markets”. In *Do economists make markets? On the performativity of economics*, (eds.) MacKenzie D., Muniesa F., & Siu, L. Oxford: Princeton University Press.

MacKenzie, D. & Millo, Y. (2003) “Constructing a market, performing theory: The historical sociology of a financial derivatives exchange.” *American Journal of Sociology*, **109**, 107−145.

Malerba, F. & Orsenigo, L. (1996) “The Dynamics and Evolution of Industries”. *Industrial and Corporate Change*, **5**, 51-87.

March, J. G. (1994) *A Primer on Decision Making: How Decisions Happen*. New York: The Free Press.

Meisner Rosen, C., Beckman, S. L. & Bercovitz, J. (2002) “The Role of Voluntary Industry Standards in Environmental Supply-Chain Management: An Institutional Economics Perspective”. *Journal of Industrial* Ecology, **6**, 103-123.

Melander, A. (1997) *Industrial wisdom and strategic change: The Swedish pulp and paper industry, 1945–1990.* Jönköping: International Business School.

Melander, A. (2005) “Industry-wide belief structure and strategic behaviour: the Swedish pulp and paper industry, 1945–1980”. *Scandinavian Economic History Review*, **53**, 91–118.

References

Melander, A. (2008) "Industriell visdom och formering av strategi". In *Att förstå strategi. Process och kontext*, (eds.) Melander, A. & Nordqvist, M. Lund: Studentlitteratur.

Melkersson, M. & Söderberg S. O. (2004) *Dynamiska Elpriser - elprissättning på en integrerad europeisk elmarknad*. Master's thesis, Division of Energy Systems, Linköping: Linköping University.

Merriam, S. B. (1998) *Qualitative research and case study applications in education*. San Francisco: Jossey-Bass Publishers.

Mintzberg, H. (1991) "Five Ps for strategy". In *The strategy process*, (eds.) Mintzberg H. & Quinn, J. B. Englewood Cliffs: Prentice Hall.

Mol, A. P. J. (1996) "Ecological Modernization and Institutional Reflexivity: Environmental Reform in the Late Modern Age". *Environmental Politics*, **5**, 302-323.

Mol, A. P. J. (2003) "The environmental transformation of the modern order". In *Modernity and Technology*, (eds.) Misa, T.J., Brey, P. & Feenberg, A. Cambridge: MIT press.

Mol, A. P. J. & Spaargaren, G. (2000) "Ecological Modernisation Theory in Debate". *Environmental Politics*, **9**, 17-49.

Möllersten, K. (2002) *Opportunities for CO2 Reductions and CO2-Lean Energy Systems in Pulp and Paper Mills.* Stockholm: Royal Institute of Technology.

Nelson, R. R. & Winter S. G. (1982) *An Evolutionary Theory of Economic Change*. Cambridge: The Belknap Press.

Nilsson, G. B. (1981) *Banker i brytningstid, A O Wallenberg i svensk bankpolitik 1850-1856.* Stockholm: Handelshögskolan.

Nilsson, L., Larson, E., Gilbreath, K. & Gupta, A. (1996) "Energy efficiency and the pulp and paper industry". Report Energy Efficiency number IE962. Washington, DC: American Council for an Energy-Efficient Economy.

Ojala, J., Lamberg, J-A., Ahola, A. & Melander, A. (2006) "The ephemera of success: Strategy, structure and performance in the forestry industries". In *The evolution of competitive strategies in global forestry industries. Comparative perspectives*. (eds.) Lamberg J.-A., Näsi, J., Ojala, J. & Sajasalo, P. Dordrecht: Springer.

Ottosson, C. & Peterson, K. (2007) "First results from the Swedish LTA program for energy efficiency in industry". European Council for an Energy-Efficient Economy (ECEEE) summer study "Saving energy – just do it", Panel 7, 1517–1525.

Penrose, E. T. (1959) *The Theory of the Growth of the Firm*. Oxford: Oxford University Press.

References

Peteraf, M. A. (1993) "The cornerstones of competitive advantage: a resource-based view". *Strategic Management Journal*, **14**, 179–191.

Pettigrew, A. M. (1997) "What is a processual analysis?". *Scandinavian Journal of Management*, **13**, 337–348.

Pinch, T. J. & Bijker, W. E. (1987) "The Social Construction of Facts and Artifacts: Or How the Sociology of Science and the Sociology of Technology Might Benefit Each Other". In *The Social Construction of Technological Systems: New Directions in the Sociology and History of Technology*, (eds.) Bijker, W. E., Hughes T. P. & Pinch T. J. Cambridge, Massachusetts: The MIT Press.

Porac, J. F., Thomas, H., Wilson, F., Paton, D. & Kanfer, A. (1995) "Rivalry and the Industry Model of Scottish Knitwear Producers". *Adminstrative Science Quarterly*, **40**, 203-227.

Porter, M. E. (1980) *Competitive strategy*. New York: The Free Press.

Porter, M. E. (1985) *Competitive Advantage*. New York: The Free Press.

Porter, M. E. (1990) *The Competitive Advantage of Nations*. New York: The Free Press.

Porter, M. E & van der Linde, C. (1995a) "Green and competitive: Ending the stalemate". *Harward Business Review*, September-October, 120-134.

Porter, M. E & van der Linde, C. (1995b) "Toward a New Conception of the Environment-Competitiveness Relationship". *Journal of Economic Perspectives*, **9**, 97-118.

Priem, R. L. & Butler, J. E. (2001) "Is the resource based "view" a useful perspective for strategic management research?". *The Academy of Management Review*, **26**, 22–40.

Pulver, S. (2007) "Making Sense of Corporate Environmentalism: An environmental contestation approach to analyzing the causes and consequences of the climate change policy split in the oil industry". *Organization & Environment*, **20**, 44-83.

Pätäri, S. (2009) *On Value Creation at an Industrial Intersection – Bioenergy in the Forest and Energy Sectors*. Lappeenranta: Lappeenranta University of Technology.

Ramos-Rodrigues, A. R. & Ruiz-Navarro, J. (2004) "Changes in the intellectual structure of strategic management research: a bibliometric study of the Strategic Management Journal 1980-2000". *Strategic Management Journal*, **25**, 981-1004.

Reijonen, S. (2008) *Green and fragile : A study on markets and the natural environment.* Köpenhamn: Copenhagen Business School Press.

Rohdin, P. & Thollander, P. (2006) "Barriers to and driving forces for energy efficiency in the non-energy intensive manufacturing industry in Sweden". *Energy*, **31**, 1836–1844.

References

Rohdin, P., Thollander, P. & Solding, P. (2007) "Barriers to and drivers for energy efficiency in the Swedish foundry industry". *Energy Policy*, **35**, 672–677.

Romme, G. (1994) "Changing business systems in the European paper and pulp industry". *European Management Journal*, **12**, 469–479.

Rosen, C. M., Beckman, S. L. & Bercovitz, J. (2002) "The Role of Voluntary Industry Standards in Environmental Supply-Chain Management: An Institutional Economics Perspective". *Journal of Industrial Ecology*, **6**, 103–123.

Rumelt, R. P. (1984) "Towards a strategic theory of the firm". In *Competitive Strategic Management*, (ed.) Lamp, R. B. Englewood Cliffs: Prentice-Hall.

Sarasini, S. (2009) "Constituting leadership via policy: Sweden as a pioneer of climate change mitigation". *Mitigation and Adaptation Strategies for Global Change*, **14**, 635-653.

Schumpeter, J. (1975) *Capitalism, Socialism, and Democracy*. New York: Harper.

Schnaiberg, A. (1980) *The Environment: From Surplus to Scarcity*. New York: Oxford University Press.

Sharma, S. & Henriques, I. (2005) "Stakeholder Influences on sustainability practices in the Canadian forest products industry". *Strategic Management Journal*, **26**, 159-180.

Skærbaek, P. & Tryggestad, K. (2010) "The role of accounting devices in performing corporate strategy". *Accounting, Organizations and Society*, **35**, 108–124.

Spaargaren, G. & Mol, A. (1992) "Sociology, Environment and Modernity". *Society and Natural Resources*, **5**, 323-344.

Spender, J-C. (1989) *Industry recipes: An enquiry into the nature and sources of managerial judgement.* Oxford: Basil Blackwell.

Sonnenfeld, D. A. (1998) "From Brown to Green?: Late Industrialization, Social Conflict, and Adoption of Environmental Technologies in Thailand's Pulp Industry". *Organization Environment*, **11**, 59-87.

Sorrell, S., Schleich, J., Scott, S., O'Malley, E., Trace, F., Boede, E., Ostertag, K. & Radgen, P. (2000) *Reducing Barriers to Energy Efficiency in Public and Private Organizations.* Brighton: Science and Technology Policy Research.

Sorrell, S., Mallett, A. & Nye, S. (2010) *Barriers to industrial energy efficiency: a literature review*. Background study for the UNIDO Industrial Development Report (IDR) 'Industrial energy efficiency pays, why is it not happening?'.

Steen, J. (2010) "Actor-network theory and the dilemma of the resource concept in strategic management". *Scandinavian Journal of Management*, **26**, 324-331.

References

Strauss, A. & Corbin, J. (1990) *Basics of qualitative research: Grounded theory procedures and techniques*. London: Sage.

Teece, D., Pisano, G. & Shuen, A. (1997) "Dynamic capabilities and strategic management". *Journal of Strategic Management*, **7**, 509–533.

Theliander, H. M., Paulsson, H. & Brelid, H. (2002) *Introduktion till Massa- och Pappersframställning.* Göteborg: Chalmers Tekniska Högskola.

Thollander, P., Karlsson, M., Söderström, M. & Creutz, D. (2005) "Reducing industrial energy costs through energy efficiency measures in a liberalized European electricity market - case study of a Swedish iron foundry". *Applied Energy*, **81**, 115–126.

Thollander, P. (2008) *Towards increased energy efficiency in Swedish industry: Barriers, driving forces & policies.* Linköping: Linköping University.

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.

Trost, K. (2001) *Enkätboken*. Lund: Studentlitteratur.

Trygg, L. (2006) *Swedish industrial and energy supply measures in a European Perspective.* Linköping: Linköping University.

Trygg, L. & Karlsson B. (2005) "Industrial DSM in a deregulated European electricity market - a case study of 11 plants in Sweden". *Energy Policy*, **33**, 1445-1459.

Tushman, M. & Anderson, P. (1986) "Technological discontinuities and organizational environments". *Administrative Science Quarterly*, **31**, 439–465.

Utterback, J. M. (1996) *Mastering the Dynamics of Innovation*. Boston: Harvard Business School Press.

Vaara, E., Tienari, J. & Laurila, J. (2006) "Pulp and paper fiction: On the discursive legitimation of global industrial restructuring". *Organization Studies*, **27**, 789–813.

Velthuijsen, J. W. (1995) *Determinants of investments in energy conservation*, Amsterdam: Rijksuniversiteit Groningen.

Waluszewski, A. (1989) *Framväxten av en ny mekanisk massateknik - en utvecklingshistoria*. Uppsala: Uppsala universitet.

Wedin, T. (2001) *Network and Demand. The Use of Electricity in an Industrial Process.* Uppsala: Uppsala universitet.

Welford, R. & Gouldson, A. (1993) *Environmental Management and Business Strategy.* London: Pitman Publishing.

References

Wernerfelt, B. (1984) “A resource-based view of the firm”. *Strategic Management Journal*, **5**, 272–280.

Williamson, O. E. (1975) *Markets and Hierarchies: Analysis and Antitrust Implications*. New York: The Free Press.

Williamson, O. E. (1979) “Transaction Cost Economics: The Governance of Contractual Relations". *Journal of Law and Economics*, **22**, 233-261.

Williamson, O.E. (1981) “The modern corporation: origins, evolution, attributes”. *Journal of Economic Literature*, **19**, 1537–1568.

Williamson, O. E. (1983) "Credible Commitments: Using Hostages to Support Exchange". *American Economic Review*, **73**, 519-40.

Williamson, O. E. (1985) *The Economic Institutions of Capitalism*. New York: The Free Press.

Wising, U., Berntsson, T. & Stuart, P. (2005) “The potential for energy savings when reducing the water consumption in a Kraft Pulp Mill”. *Applied Thermal Engineering*, **25**, 1057–1066.

Worrell, E., Price, L., Martin, N., Farla J. & Schaeffer, R. (1997) “Energy intensity in the iron and steel industry: a comparison of physical and economic indicators”. *Energy Policy*, **25**, 727-744.

Worrell, E., Laitner, J., Ruth, M. & Finman, H. (2003) “Productivity benefits of industrial energy efficiency measures”. *Energy*, **28**, 1081-1098.

Wynne, B. (1996) “May the sheep safely graze? A reflexive view of the expert–lay knowledge divide”. In *Risk, environment and modernity: Towards a new ecology*, (eds.) Lash, S., Szerszynski, B. & Wynne, B. London: Sage.

Yin, R. K. (2003) *Case study research, design and methods*. Newbury Park: Sage Publications.

Empirical material

Printed material

Arwidson, M. S. (2007) *Skogsindustrierna välkomnar satsningar på hållbart uttag av bioenergi*. Skogsindustrierna pressmeddelande, 2007-09-20.

Bill 1990/91:88. *Om Energipolitiken*.

DI (Dagens industri) (1991) *Ny miljöproposition tvingar skogsindustrin minska utsläpp.* 1991-02-19.

References

DN (Dagens Nyheter) (1993a) *"Returpapper hotar sysselsättningen"* 1993-02-10.

DN (Dagens Nyheter) (1993b) *Miljökrav möter motstånd.* 1993-01-20.

DN (Dagens Nyheter) (2008) *Larmen om klimathot är inte övertygande*. 2008-06-14, p. 14.

DN (Dagens Nyheter) Ekonomi (2008) *Skogens konung tror på lösning av växthusproblemen*. 2008-01-13, p. 4.

ECON (ECON centre for economic analysis AB) (2003) *Konsekvenser på elpriset av införandet av handel med utsläppsrätter*. ECON rapport 29/03. Stockholm: ECON.

Edlund, R. & Gedda, L. (1997). *Ska Sveriges skog bli biobränsle?*. Nya Wermlands-Tidningen, 1997-03-06.

EEPO (European Electricity Prices Obervatory) (2003) *Year 2002 Results*. Brussels: European Electricity Prices Observatory.

IEA (International Energy Agency) (2007) *Key world energy statistics 2007*. Head of Communication and Information Office, Paris.

IPCC (Intergovernmental Panel on Climate Change) (2007) "Contribution of Working Group III to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change". *Summary for Policymakers*. *IPCC Fourth Assessment Report*: Climate Change 2007.

IVA (Ingenjörsvetenskapsakademin) (2006) *Ökad konkurrenskraft för svensk processindustri*. Stockholm: IVA.

MoDo (1997) *Annual report*.

Ottosson, M. (2007) "Fel strategi bakgrunden till Stora Ensos problem". *Dagens industri*, 2007-12-13, 4.

PWC (Pricewaterhouse Coopers) (2007) *Incitamentsformer för ökade energieffektiva investeringar utanför energiintensiv industry*. Stockholm: Pricewaterhouse Coopers.

SEA (Swedish Energy Agency) (2000) *Energianvändning inom industrin*. Eskilstuna: Swedish Energy Agency Publication Department.

SEA (Swedish Energy Agency) (2009) *Energy in Sweden 2008.* Eskilstuna: Swedish Energy Agency Publication Department.

SFIF (Swedish Forest Industry Federation) (2005) *The role of the Swedish forest industry in sustainable development.* Stockholm: Skogsindustrierna.

References

SFIF (Swedish Forest Industry Federation) (2007) Svebio, Swedish District Heating Association, and Swedish Energy. *Rapport om kraftvärmeutbyggnad 2007-2015*. Stockholm: Svensk fjärrvärme.

SFIF (Swedish Forest Industry Federation) (2008a) *The forest industry – A natural part of Sweden.* Stockholm: Skogsindustrierna.

SFIF (Swedish Forest Industry Federation) (2008b) *Remissyttrande Klimatberedningen 2008-06-18*. Stockholm: Skogsindustrierna.

SFIF (Swedish Forest Industry Federation) (2008c) *The Swedish forest industries. Facts and figures 2008.* Stockholm: Skogsindustrierna.

SFIF (Swedish Forest Industry Federation) (2008d). *Skogsindustriernas klimatkampanj 2008*. Stockholm: Skogsindustrierna.

SFIF (Swedish Forest Industry Federation) (2008e). *The Forest Industry – A natural part of Sweden.* Skogsindustrierna: Stockholm.

SIA (Skogsindustriarbetaren) (1994) "Skogsindustrin i Sverige: 40 år av förändringar". *Skogsindustriarbetaren*, **3**, 15–17.

SKGS (Skogen, Kemin, Gruvorna och Stålet) (2004). *Statsministern är fel ute*. SKGS press release 2004-10-06.

Skog & Industri (2008) *Kraftig satsning på vind.* **2**, 15-16. Stockholm: Skogsindustrierna.

Skog & Industri (2010) *Ser bortom papperet. Holmens VD Magnus Hall ny ordförande i Skogsindustrierna*, **1**, 14-16. Stockholm: Skogsindustrierna.

Stora Enso, (1999) *Annual report*.

Stora Enso, (2003) *Annual report*.

SVD (Svenska Dagbladet) (2008b) *Skenande kostnader fäller pappersbruken*. Svenska Dagbladet Näringsliv 2008-01-15, 12–13.

Svensk Papperstidning, (2010) *Här finns oanade möjligheter*. **8**, 24-25.

WCED (World Commission on Environment and Development), (1987) *Our Common Future*. Oxford: Oxford University Press.

Webpages

Bryntse, G. (2007) *Spara el och sluta klaga på priserna*. http://etc.se/artikel/14183/spara-el-och-sluta-klaga-pa-priserna. 2010-04-14.

References

Collin, R. (2009) *Vem tar ansvar för Etanol-Jesus lögner?* http://www.aftonbladet.se/bil/collin/article4444103.ab. 2011-02-13.

EU (European Union) (2008) *The EU climate and energy package*. http://ec.europa.eu/environment/climat/climate_action.htm. 2011-01-30.

DA (Dagens arbete), (2007). *Fortsatt slöseri hotar industrijobben*. http://www.fackliganyheter.nu/home/da/home.NSF/unid/47484A05E5E83F42C125735200432AFB?OpenDocument. 2010-04-14.

Dagens media (2008) *Skogsindustrierna värvar kommunikationschef från Fortum*. http://www.dagensmedia.se/karriar/article12773.ece. 2011-02-14.

DI (Dagens Industri) (2010) *De är mäktigast på börsen.* http://di.se/Default.aspx?pid=208788__ArticlePageProvider. 2010-06-23.

DN (Dagens Nyheter) (2006). *SCA-ordförande: Hundratusentals jobb hotade.* http://www.dn.se/ekonomi/sca-ordforande-hundratusentals-jobb-hotade-1.434909. 2010-04-14.

Domsjoe, (2010) *Domsjö Fabriker. Det unika bioraffinaderiet.* http://www.domsjoe.com/. 2011-02-13.

Eurostat, (2007) *Final energy consumption, by sector*. http://epp.eurostat.ec.europa.eu/. 2007-10-25.

Government offices of Sweden, (2010) *Energy policy*. Swedish Ministry of Enterprise, Energy and Communications. http://www.sweden.gov.se/sb/d/5745/a/19594. 2010-07-15.

Naturskyddsföreningen (2009) *Skogsindustrierna har fel om klimatet*. http://www.naturskyddsforeningen.se/natur-och-miljo/skog/skogen-och-klimatet/skogsindustrierna-har-fel/ 2011-02-07.

Nordpool, (2010) *Nordic Power Exchange*. http://www.nordpool.no. 2010-05-09.

PEW, (2008) *The European Union Climate Package* http://www.pewglobalwarming.org/ourwork/international/bonn/EUClimatePackage.pdf 2011-02-12.

SCB, (Statistiska Centralbyrån) (2006) *Statistikdatabas*. www.scb.se. 2008-10-07

SCB (Statistiska Centralbyrån) (2011) *Hierarkisk visning från avdelningsnivå och nedåt - SNI 2007*. http://www.sni2007.scb.se/snihierarki2007.asp?sniniva=2&snikod=17. 2011-01-30.

SFIF (Swedish Forest Industry Federation) (2010a) *Anställda i skogsnäringen*. http://www.skogsindustrierna.org/web/Anstallda_i_skogsnaringen.aspx. 2011-01-30.

References

SFIF (Swedish Forest Industry Federation) (2010b) *Facts and figures. Pulp and paper companies in Sweden*. http://www.forestindustries.se/web/Facts_and_figures.aspx. 2011-01-30.

Stora Enso, (2002) *Questions and answers related to Stora Enso forest restructuring*. http://www.storaenso.com/investors/presentations/2002/Documents/0516-forest-restructuring-qa.pdf. 2009-10-26.

SVD (Svenska Dagbladet) (2008a) *Kamp om EU:s klimatpaket*. http://www.svd.se/nyheter/utrikes/kamp-om-eus-klimatpaket_1892243.svd. 2011-01-30

Södra, (2009) *Södra i siffror*. http://www.sodra.com/sv/Om-Sodra/Sodra-i-siffror/. 2010-04-10.

Interviews

Andersson, C. (2007) *Interview with Christian Andersson*, Energy manager at Södra Värö pulp mill, 2007-04-16.

Edvinsson, H. (2008) *Interview with Håkan Edvinsson*, Energy manager at Södra Mönsterås pulp mill, 2008-02-29.