Towards a Greener Economy

Entrepreneurs, Clusters and Changing Markets

Helge Lea Tvedt

Thesis for the degree of Philosophiae Doctor (PhD)
University of Bergen, Norway
2021

UNIVERSITY OF BERGEN

Towards a Greener Economy

Entrepreneurs, Clusters and Changing Markets

Helge Lea Tvedt

Thesis for the degree of Philosophiae Doctor (PhD)
at the University of Bergen

Date of defense: 02.03.2021

Year: 2021

Title: Towards a Greener Economy

Name: Helge Lea Tvedt

Print: Skipnes Kommunikasjon / University of Bergen

ABSTRACT

A shift towards a greener economy is inevitable, given the urgency to deal with climate change and other pressing environmental challenges. The aim of the thesis is to contribute to the theoretical and empirical understanding of how, why, and under what circumstances green value creation unfolds. This is done by employing a research design that sees green value creation as a process that both unfolds at multiple level in the corporate sector and is shaped by interactions across the different levels. This multilevel approach is operationalised through studies of green entrepreneurship at the micro-level, cleantech clusters at the meso-level, and market conditions for environmental goods and services at macro-level. The thesis applies a qualitative case study design based on empirical evidence collected over a period of seven years, between 2013 and 2020. The empirical evidence was obtained through methodological triangulation involving interview data, survey data and desk research, mainly from Norway, but also from the United States, Austria, and Ireland.

At the micro-level, the thesis theoretically and empirically takes a close look at green value creation in the form of green entrepreneurship. The analysis reveals how the 'green' part of the entrepreneurship is brought into start-up processes and the value it delivers throughout various stages of their establishment. The thesis challenges the stereotypical conception of green entrepreneurship by demonstrating case studies where environmentally sound businesses have risen from rather conventional entrepreneurial endeavours whereby the green value has been created intrinsically through innovative technological designs. The thesis further shows that the green value of the start-ups has played a key role in attracting innovation partners and investors, recruiting personnel, and obtaining public funding. Moreover, the specific characteristics of the spatial and institutional context have had a clear impact on the success of the start-ups by offering unique knowledge bases accompanied by environmental regulations that create market demand.

The meso-level of the thesis explores the formation and structure of cleantech clusters based on three case studies, carried out respectively in the United States, Austria, and Ireland. The findings show that the cleantech clusters are much more diverse with

respect to industry composition and actor heterogeneity compared with conventional business clusters (i.e. Porterian business clusters). Moreover, the thesis shows that multiple factors have led to the formation and spatial distribution of the cleantech clusters. At the meso-level, this includes path-dependent processes that form the industrial basis from which cleantech clusters can emerge. However, in the studied cases the industrial potential for cleantech development was largely actualised by deliberate place leadership and various trigger mechanisms that took place at both the micro-level and macro-level. By demonstrating the importance of both micro-level agency and macro-level conditions in cluster formation, the thesis represents a theoretical approach that often has been neglected in conventional analyses of how regional industries emerge and develop.

The macro-level focuses on market conditions by exploring demand mechanisms for environmental goods and services. The thesis shows that green market demand is created by multiple conditions and mechanisms that work together, including cost-efficiency, environmental and social responsibility, customers' environmental awareness, CSR strategies, risk-management, regulations, and subsidies. The thesis further demonstrates how market conditions for green products and services may differ across regions and countries, due to different regulatory landscapes and public priorities, but also to other non-regulatory conditions such as the degree of environmental awareness within a market, either geographical or sectoral. The latter informs the literature by explicitly bringing the spatial dimension into discussions on green market demand.

Combined, the three analytical levels deliver insights into how green value is created in the corporate sector (RQ 1), the role of geography in these processes (RQ 2), and how the micro-, meso-, and macro-levels interact in green value creation initiatives (RQ 3). By answering these overarching research questions, the thesis provides new insights that highlight the value of cross-disciplinary thinking with respect to understanding the interplay between actors, systems, and structures involved in green value creation. This particularly concerns the way theoretical triangulation is used actively in the thesis to

inform existing theories and concepts within economic geography, but also in the green entrepreneurship literature.

ACKNOWLEDGEMENTS

As this journey for my doctoral degree is about to come to an end, I would like to thank all of the people who have supported and encouraged me along the way. First and foremost, I thank my supervisors Grete Rusten and Knut Hidle, who have guided me through my work for this thesis. I especially thank my main supervisor, Grete, for all her support, feedback and patience. I would also like to thank her for inviting me to join academic networks, as the opportunity has proved valuable throughout all the stages of my research, as well as in my current job. In this connection, I would like to thank Patrik Ström, Andrew Jones, Brita Hermelin, and other members of the Green Economies Research Network, for their constructive feedback and inspiring conversations.

I would also like to thank my employer of the last three years, NORCE Norwegian Research Centre, for being flexible and patient when I struggled to find the time and energy needed to complete what was 'almost done' when I started the job in 2017. I am truly looking forward to carrying out research projects for which deadlines has been set by someone else.

Lastly, I express my gratitude to family and friends. I thank my friends for accepting that my social life has been put on hold indefinitely, and my family for taking my mind off the thesis by not asking to many questions about its progress. Thank you for all your encouragement and support. Of course, I also thank my girlfriend, Ida, for being immensely patient and understanding. She has never stopped believing in me (as far as I am aware), despite several failed attempts on my part to reach my self-imposed deadlines. Tonight, we feast!

Helge L. Tvedt

Stavanger, 5 October, 2020

CONTENTS

1 Introduction 13

1.1 Problematisation and research questions 16

1.2 Multilevel approach: introducing three analytical levels 19

1.3 Structure of the synopsis 24

2 Business and the environment 27

2.1 Different approaches to greener economies 29

2.2 Green growth 30

2.3 Selective growth 31

2.4 Degrowth 32

3 Realisation of green growth: theoretical perspectives on actors, systems, and structures 35

3.1 Micro-level perspective: the green entrepreneur 35

3.1.1 The green entrepreneur: definitions and typologies 37

3.1.2 What is green? People, technologies, businesses, or sectors 49

3.1.3 Green entrepreneurship among start-ups in Norway: survey results and findings 53

3.1.4 Article 1: Summary 68

3.2 Meso-level perspective: cleantech clusters 71

3.2.1 Structure over agency 71

3.2.2 Business clusters 75

3.2.3 Cluster formation 79

3.2.4 Cleantech clusters 81

3.2.5 Article 2: Summary 84

3.3 Macro-level perspective: market structures and demand mechanisms 87

3.3.1 Letting people decide or deciding for people? 87

3.3.2 The immanent conflict between business and the environment? 90

3.3.3 Current and future markets for a greener economy 92

3.3.4 The role of governments in creating demand for greener solutions 95

3.3.5 Article 3: Summary 97
4 Research design and methods 99
4.1 Defining research scope and analytical framework 99
4.2 Between positivism and interpretivism: a critical realist stance 102
4.3 Qualitative case study approach 105
4.3.1 Selection of cases and interviewees 106
4.3.2 Data collection and methodological triangulation 109
4.3.3 Validity, reliability, and generalisability 110
5 Concluding discussion and future research 115
5.1 Theoretical implications and future research 123
6 References 127

LIST OF TABLES

Table 1: The research design and scope of the thesis 23
Table 2: Bergset and Fichter's typology of green entrepreneurship (Source: Bergset and Fichter, 2015). 43
Table 3: Key differences between the output approach and the process approach in terms of defining green business activities. 51
Table 4: The industries in which firms that received the survey questionnaire were registered. 55
Table 5: The criteria used to select the study sample. 57
Table 6: Research tasks, methods, and data sources. 110

LIST OF FIGURES

Figure 1: Summary of three contrasting approaches to a green economy: green growth, selective growth and degrowth. 34
Figure 2: The positioning matrix, in which green entrepreneurs are defined on the basis of market effect and environmental orientation (Source: Schaltegger, 2002: 49). 38
Figure 3: Walley and Taylor's typology of green entrepreneurs (Source: Walley and Taylor, 2002)... 40
Figure 4: Typology of green entrepreneurship introduced by Nikolau et al. (Source: Nikolau et al., 2018: 120). 44
Figure 5: Industrial distribution among the surveyed firms (n = 447). 58
Figure 6: 'Our business contributes to mitigate environmental problems by offering or making use of products and services that are greener than the dominant market standard' (n = 447)..... 59
Figure 7: 'How large share of the sales came from environmental goods and services in 2013?' (n = 447). 61
Figure 8: 'The core activity of our business is environmental improvement' (n = 447). 63
Figure 9: 'The environmental dimension was a key part of the initial business concept that led to the formation of our company' (n = 445). 64
Figure 10: 'Are your firm's products and services intentionally designed to mitigate environmental issues?' (n = 439)..... 65
Figure 11: Porter's diamond model (Porter, 2000), reproduced from Tsiligiris (2018)..... 77

LIST OF ARTICLES

Article 1

Tvedt, L. H. and Rusten, G. Green entrepreneurship in rural locations: Motivations, strategies and structures. *Organization & Environment*. [manuscript submitted for review]

Article 2

Tvedt, L. H. (2019) The formation and structure of cleantech clusters: Insights from San Diego, Dublin and Graz. *Norsk Georgrafisk Tidsskrift–Norwegian Journal of Geography* 73 (1), pp. 53–64.

Article 3

Tvedt, L. H. (2016) Market conditions for sustainable entrepreneurship: A case study of green support services. In: Jones, A., Ström, P., Hermelin, B. & Rusten, G. (eds.) *Services and the Green Economy*. London. Palgrave McMillan, pp. 125–150.

Additional related publication

Rusten, G., and Tvedt, L. H. (2018) Hvordan kan næringslivet bidra til en grønn omstilling. In: Haarstad, H. & Rusten, G. (eds.) *Grønn omstilling: norske veivalg.* Oslo. Universitetsforlaget, pp. 79–99.

1 Introduction

> In the long and tortuous evolution of the human race on this planet, a stage has been reached when, through the rapid acceleration of science and technology, man has acquired the power to transform his environment in countless ways and on an unprecedented scale.
>
> (Stockholm Declaration, 1972: 3)

Following publication of the Brundtland Report (1987), the International Chamber of Commerce (ICC) co-organised the UN Conference on Action for a Common Future to discuss the business community's role in relation to the environment (Willums, 1990). The conference, which took place in Bergen, Norway, in May 1990, was one of several smaller assemblies that were held as part of the preparation process for the Earth Summit to be held in Rio in 1992. The Bergen conference was an event of great symbolic value with respect to acknowledging the corporate sector's role and responsibilities in sustainable development issues. The conference keynote address was given by Gro Harlem Brundtland, chair of the World Commission on Environment and Development (WCED) and Norwegian prime minister (1981, 1986 - 1989, 1990 - 1996). Brundtland declared that the industry was both the cause of, but also a potential solution to deal with growing pollution and resource pressure on the natural environment (Willums, 1990). The latter statement concerning the industry's role in mitigating environmental challenges is the point of departure for this thesis.

Although more than 30 years have passed since corporate greening was first put on the agenda, the wider public interest in the topic has a shorter history. Throughout the 1990s and 2000s the role of industry in solving environmental issues was still predominantly discussed in academic and political domains, relatively secluded from the international business community and society at large. Over the last decade, the situation has changed dramatically. Not only have environmental concerns risen to become one of the most urgent issues discussed among policymakers and researchers, but they have also permeated other parts of society, including the business community and the civic domain. The progress from niche topic in the early 1990s to widespread public attention

in the 2020s has occurred gradually but has arguably intensified in the last couple of years. Stronger scientific evidence of human-induced climate change (IPCC, 2014), accompanied by the 2007–2008 financial crisis (Rusten and Haarstad, 2018), has played a key role in putting business and the environment high on the agenda. In many parts of the world, including countries in Europe, Asia, and the United States, promoting green businesses development was part of the strategy to recover from the recession (Georgeson and Maslin, 2019). The coming years will probably strengthen the priority given to green industry development due to the severe economic impact of the COVID-19 outbreak. The global pandemic is changing the economic landscape in unprecedented ways, but the full extent of the crisis is yet to be revealed. What *is* clear is that many countries have witnessed rising unemployment rates and bankruptcies. Many countries will probably face challenging recovery processes in the years to come, which would also represent an opportunity for them to take a green turn that might be of critical value for future competitive advantage.

The current attention paid to sustainability issues within industry arguably signifies that a new institutional logic is about to become consolidated. In this context, institutional logic is understood as '*patterns of beliefs, practices, values, assumptions, and rules that structure cognition and guide decision making in a given field*' (Thornton and Ocasio, 1999). Depending on the scope and scale of such institutional logics (e.g. differences between countries and sectors), 'green turns' are visible in many areas of society, such as changing consumer behaviour (e.g. growth in the global vegan food market (Grand View Research, 2019)), research funding priorities (e.g. the EU's Framework Program Horizon 2020), contemporary city planning ideals (e.g. smart cities), and corporate strategies and actions. These are just a few areas of society that are increasingly aiming at addressing environmental sustainability goals.

While there seems to be an ever-growing consensus on the need for a greener economy, the question of how to approach one still lingers. While sceptics calls for radical changes in the economy based on downscaling overall production and consumption (Schneider et al., 2010; Hickel, 2019), others believe that environmental sustainability and economic growth is compatible, asserting that environmental challenges can be solved

within the structural boundaries of capitalism (Hickel and Kallis, 2019). In line with the latter belief, the point of departure for this thesis is the notion that environmental sustainability and economic growth can be reconciled through efficiency improvements, new business models, and eco-friendly innovations. This view is rooted in the environmental discourse of ecological modernisation (Hajer, 1995), which in short rests on the notion that environmental innovations (e.g. cleaner technologies), in concert with market enabling policies, could solve environmental challenges without compromising growth and development (see section 2). This 'win-win' approach has (not surprisingly) gained particularly wide support in political circles, commonly under the self-explanatory label 'green growth' (European Union, 2020; OECD, 2020). Green growth means '*fostering economic growth and development, while ensuring that natural assets continue to provide the resources and environmental services on which our well-being relies*' (OECD, 2011: 4). At first glance, critics have argued that there is an immanent conflict in attempting to solve the environmental crisis by the same logic that caused it (i.e. economic growth) (Fletcher and Rammelt, 2017). However, this criticism tends to focus merely on businesses as the major cause of environmental degradation, rather than assimilating the possibility that corporate sector actors may also provide solutions to mitigate environmental issues, as emphasised in Brundtland's keynote address. The latter requires corporate efforts to reduce or remove environmental strains in all parts of production systems (Porter and Kramer, 2011). This depends on a myriad of innovations, including for example cleaner technologies, longer lasting products, environmental services, recycling methods, green logistics, and industrial symbiosis based on circular economy design principles (Rusten and Tvedt, 2018). The combined efforts of such innovations have the capacity to provide a substantial contribution in achieving the UN's Sustainable Development Goals, which are intended to be met by 2030 (United Nations, 2020). Given the urgency of the need to confront climate change and other environmental challenges, there is a pressing need for research that can improve our theoretical and empirical understanding of how, and under what circumstances, green value creation initiatives unfold. This is the overarching aim of this thesis.

1.1 Problematisation and research questions

This thesis explores the motives, strategies and conditions that are giving rise to green value creation initiatives. Understanding how such initiatives unfold is a complex task that requires research and insight into processes and mechanisms taking place at multiple levels in the corporate sector. This thesis addresses this task through a research design that explores green value creation from three analytical perspectives, respectively the *micro-level*, the *meso-level*, and the *macro-level*. The micro-level perspective in this thesis explores green start-up processes through the eyes of individual entrepreneurs (i.e. green entrepreneurs) (see sections 1.2 and 3.1). The meso-level perspective directs attention to cleantech clusters and how these spatial agglomerations are formed and structured (see sections 1.2 and 3.2). Lastly, the macro-level perspective explores market conditions for environmental goods and services, including how demands for green business initiatives emerge (see section 1.2 and 3.3). These three analytical levels deliver insights into how green entrepreneurial activities unfold (*micro-level*), how spatial concentrations of green businesses emerge (*meso-level*), and the market conditions that enable green economic initiatives to develop and thrive (*macro-level*). Particular attention is devoted to analysing interactions between the levels and the spatial setting encompassing the green initiatives. Each level is covered in one journal article or book chapter, resulting in three individual contributions addressing green value creation from different analytical perspectives and geographical contexts (Figure 1). The scope of the thesis can be summarised in three overarching research questions (RQs):

- *RQ1: How is green value creation unfolding in the corporate sector at the micro-, meso-, and macro-level?*

- *RQ2: How does geography impact the processes of, and conditions for green value creation at the different levels?*

- *RQ3: How do the different levels interact in green value creation initiatives?*

A brief description of each research questions is provided as follows.

RQ1: Green value creation

The first research question addresses how green value creation unfolds at different levels in the corporate sector. At the *micro-level*, this thesis scrutinises the role of individual actors, understood as green entrepreneurs (section 3.1). Like conventional entrepreneurs, green entrepreneurs are considered change agents, but differ in their ability to drive the economy towards sustainability by '*transcending the usual tension between business and the environment'* (Beveridge and Guy, 2005: 665). The *micro-level* perspective focuses on the complexity of motives, strategies and conditions that give rise to green entrepreneurship (Article 1). The second perspective explores greening processes at the *meso-level*, operationalised through studies of emerging cleantech clusters (section 3.2). Based on the inference that cleantech clusters can promote green restructuring at the regional level, the thesis explores their formation, composition, and structural characteristics (Article 2). Lastly, the *macro-level* perspective elaborates on market conditions for environmentally sound solutions (section 3.3). By means of data derived from studies of green service providers in the business-to-business (B2B) market, I discuss multiple demand mechanisms that seems to play a decisive role in driving the economy towards sustainability (Article 3). A more detailed description of each level is provided in section 1.2.

RQ2: The role of geography

The second research question addresses the link between geography and green value creation for the three analytical levels. Due to different local and regional contexts, geography is expected to have a significant impact on the pace and acceleration of green restructuring (Coenen and Truffer, 2012). However, most studies of the geography of green growth have focused on national conditions and regulations that may encourage green value creation rather than exploring conditions and mechanisms on the local and regional scales (Capasso et al., 2019). My thesis addresses this issue by incorporating

geography as an overarching dimension that is discussed in relation to each analytical level. At the *micro-level*, RQ2 addresses the role of the rural spatial settings encompassing the start-up process of two cleantech firms (see Article 1). The geographical dimension of the *meso-level* perspective is rather distinct, as the unit of analysis (i.e. cleantech clusters) represents a key spatial concept within economic geography. The meso-level perspective discusses regional conditions, path-dependent processes and system-level agency, and how the interplay between them has paved the way for emerging cleantech hotspots in the case cities, respectively Graz (Austria), Dublin (Ireland) and San Diego (USA) (see Article 2). Finally, the *macro-level* perspective discusses how market conditions for green products and services may differ across regions and countries. The latter is partly due to different regulatory landscapes and public priorities, but also to other non-regulatory conditions such as the degree of environmental awareness within a market, either geographical or sectoral (see Article 3).

RQ3: Cross-level interactions

My study of multiple analytical levels has been driven by the need to understand how green value creation initiatives at one level (e.g. micro-level) are shaped by conditions at other levels (e.g. macro-level) and vice versa. The multilevel approach employed in this thesis largely corresponds to (1) firm as agents (micro-level entrepreneurs), (2) regions as systems (meso-level clusters), and (3) markets as structures (macro-level demand conditions). The reasoning behind the use of analytical levels is that green growth cannot be fully explained or understood solely by looking at processes and mechanisms happening at one level. For example, meso-level theories that give primacy to spatially embedded structures and institutions (e.g. evolutionary economic geography) tends to omit the role of enterprising individuals or groups (micro-level agents) in their analysis (see section 3.2). By contrast, green entrepreneurship literature has not shown much interest in how green entrepreneurs are influenced by and interact with their surrounding spatial context (see section 3.1). RQ3 in not intended to explore in full how cross-level interactions encourage green value creation processes, but rather

to analyse cross-level interactions pertaining to the research cases explored in this thesis, such as how the formation of cleantech clusters (Article 2) can be viewed as the outcome of processes and mechanisms that are observed at each level, respectively strategic commitment (micro-level), regional industry composition (meso-level) and market enabling regulations (macro-level). This perspective is further discussed in Article 2.

1.2 Multilevel approach: introducing three analytical levels

The multilevel approach employed in this thesis is operationalised through studies of green entrepreneurship, cleantech clusters, and market conditions for environmental goods and services, designed to reflect three different analytical levels (section 1.1). Thematically, these three topics are closely related and have been selected to provide a holistic understanding of how agency (micro), systems (meso) and structures (macro) give rise to green value creation. However, from a theoretical perspective these three topics are more diverse and associated with different fields of study. The implication of this is a rather comprehensive theoretical framework based on insights from several disciplines and research fields (see section 3). For example, despite evolutionary economic geography's devotion to regional innovation and restructuring, it has not focused much on market conditions in aggregated analyses of how regional economies evolve over time (see section 3.2). Consequently, I have derived insights from environmental economics (see section 3.3.3) to fill this void. This cross-disciplinary orientation underpins my attempt to provide a more holistic understanding of green value creation than singular approaches might deliver. Reflections on the pros and cons of this multilevel approach are discussed further in the research design section (section 4.1).

While this thesis builds on both a holistic (cross-level interaction) approach and an eclectic (cross-disciplinary) approach, the individual articles and book chapter address

the respective research fields associated with each analytical level in greater depth. A more detailed review of these research fields is provided in the following subsections.

Micro-level perspective: understanding the green entrepreneur

Since the early 1990s, green entrepreneurship[1] has gradually emerged as a distinct subfield of the wider entrepreneurship literature. Although the concept has many definitions (see section 3.1.1), most authors agree that green entrepreneurship entails various ways of reconciling commercial activities and environmental protection (Gast et al., 2017). Enterprising individuals who engage in such endeavours are considered pivotal in the transformation towards a green economy. To date, much of the literature on green entrepreneurship has included conceptual studies discussing different types of green entrepreneurs. The latter involve numerous typology studies that employ Weberian ideal-type methodology to describe and explain different types of green entrepreneurs based on the motivations and triggers that give rise to green businesses (see section 3.1.1). A key element in these typologies is the primacy given to green idealistic motives to denote individuals who initiate environmentally sound businesses. In this thesis, green entrepreneurship is explored from a broader perspective, covering various stages of the start-up process of two cleantech businesses located in rural Norway. Thus, motivation is just one of many aspects that are discussed in relation to the green entrepreneurs' journey from opportunity discovery to market introduction. Apart from motivation, this thesis elaborates on several key elements of the start-up processes, including opportunity discovery, environmental performance, sourcing strategies, technological development, funding, market drivers, and the spatial setting in which the green entrepreneurs operate. By focusing on several crucial components of the entrepreneurial process, the micro-level perspective in this thesis contributes to a broader understanding of green entrepreneurship that goes beyond the conceptual discussions commonly found in the research literature (see section 3.1). Research

[1] Similar terms include ecopreneurship, environmental entrepreneurship, enviropreneurship, and sustainable entrepreneurship. The latter term may also appear in relation to the social dimension of sustainability as an alternative to the term social entrepreneurship.

activities that were carried out in relation to the *micro-level perspective* are discussed in Article 1, as well as in section 3.1 and section 5 of the synopsis.

Meso-level perspective: emerging cleantech clusters

While the micro-perspective largely deals with entrepreneurs starting businesses that represents a green contribution to the market, the meso-level perspective explores the surrounding business climate of which firms and entrepreneurs are a part. Within economic geography, research on innovation and restructuring is inseparably bound with the spatial setting in which firms and industries are embedded. This is demonstrated by the ample work on theories and concepts such as industrial districts (Marshall, 1919), business clusters (Porter, 1990), and regional innovation systems (Cooke et al., 1997). These concepts differ in scope (i.e. what they include) and scale (i.e. geographical reach) but are related in the sense that they all give primacy to structural conditions (e.g. industry structure, knowledge bases, cultures, institutions) and how this may encourage or impede the possibility for firms and entrepreneurs to innovate and thrive. In the last decade, some of these conventional system level concepts have been shaped by the 'green turn'. This has led to a few 'green variants' appearing in the research literature, including cleantech clusters (Gray and Caprotti, 2011; Davies, 2013; Marra et al., 2017), green innovation systems (Cooke, 2010; Bergquist and Söderholm, 201; Chapple et al., 2011) and more recently, sustainable entrepreneurial ecosystem (Volkmann et al., 2019). Like their conventional 'parents', the green variations promise to deliver economic growth, but differ in their ability to simultaneously alleviate environmental challenges. Accordingly, green business agglomerations are heralded as a key contribution to green value creation. However, our knowledge of them remains rather limited, as many of these 'green agglomerations' merely represent theoretical and conceptual constructs with limited support from empirical studies (see section 3.2). This thesis contributes to fill this research gap by exploring the formation, composition, and structural characteristics of cleantech clusters, which represent one type of green business agglomerations (see section 3.2.4). Three internationally recognised cleantech clusters located respectively in Austria,

Ireland and the United States constitute the empirical case studies for the meso-level perspective of the thesis (see Article 2 for further details regarding case selection). Research activities pertaining to the *meso-level perspective* are further discussed in Article 2, as well as in section 3.2 and section 5 of the synopsis.

Macro-level perspective: changing market conditions

From a firm perspective, prioritising environmental sustainability has traditionally been viewed as an extraordinary burden that impedes the economic growth potential (Carillo-Hermosilla et al., 2009). This view has recently been questioned by more proactive approaches proclaiming that environmental improvement represents commercial opportunities rather than liabilities (Cohen and Winn, 2007; Porter and Kramer, 2011; Rusten and Tvedt, 2018). Thus, a key part of understanding how economic and environmental concerns can be reconciled implies exploring the market conditions that give rise to innovations and business models that are less environmentally harmful than conventional offerings. This topic is examined in detail in the third and final perspective of the thesis. By means of in-depth case studies of two green service providers, the macro-level perspective discusses several demand mechanisms that appear to drive markets towards sustainability. The empirical data is based on case studies of two green service firms that provide services aimed at improving the environmental performance of their clients. The cases represent green entrepreneurship in the knowledge-intensive business service (KIBS) industry and were chosen because of their vast numbers of clients and close customer dialogue during service provision. This combination formed excellent units of observation to elaborate on why and how firms choose to improve their environmental credentials. Understanding demand mechanisms for greener solutions is key for entrepreneurs, businesses and policymakers involved in green industry development. Research activities that were carried out in relation to the *macro-level perspective* are discussed in Article 3 (book chapter), as well as section 3.3 and section 5 in this synopsis. The research design and scope of the thesis, including key information provided in sections 1.1 and 1.2 are presented in Table 1. The methodological approach is outlined in section 4.3.

Table 1: The research design and scope of the thesis

LEVEL	LITERATURE APPROACH	FOCUS	UNIT OF ANALYSIS	UNIT OF OBSERVATION	ARTICLE
Micro	Green entrepreneurship, economic geography	Agency	Green entrepreneurs	Cleantech start-ups	Article 1 Tvedt, L. H. and Rusten, G. Green entrepreneurship in rural locations: Motivations, strategies and structures. *Organization & Environment*. [manuscript submitted for review].
Meso	Economic geography, evolutionary economic geography	System	Cleantech clusters	Cluster organisations, regional development agencies, universities, firms, entrepreneurs	Article 2 Tvedt, L. H. (2019) The formation and structure of cleantech clusters: Insights from San Diego, Dublin and Graz. *Norsk Georgrafisk Tidsskrift–Norwegian Journal of Geography* 73 (1), pp. 53–64.
Macro	Environmental economics, green entrepreneurship	Structures	Market conditions	Green service providers operating business-to-business (B2B) markets	Article 3 (book chapter) Tvedt, L. H. (2016) Market conditions for sustainable entrepreneurship: A case study of green support services. In: Jones, A., Ström, P., Hermelin, B. & Rusten, G. (eds.) *Services and the Green Economy*. London. Palgrave McMillan, pp. 125–150.

Cross-level interactions

Cross-disciplinary approach

As shown in Table 1, the micro-level perspective is predominantly concerned with agency, including motivations and strategies involved in green entrepreneurship, but also how these start-ups have been shaped and realised by systems and structures (cross-level interactions). This leads us to the other two perspectives. First, the meso-level perspective explores cleantech clusters, understood as systems that may encompass businesses and entrepreneurs involved in green value creation. Theoretical deliberations suggest that such systems are likely to deliver green value by accelerating development of environmental innovations and promoting green entrepreneurship (see section 3.2.4). The focus in this thesis is not on empirically investigating these propositions, but rather on exploring how such systems may emerge by taking a closer look at cleantech clusters (see section 1.1). Lastly, the macro-level perspective focuses on structures, in this context used with reference to market conditions that enable green value creation. In a

conventional structure–agency dichotomy, both the meso-level and the macro-level constitute structures. However, the term 'system' is used to differentiate the meso-level conceptually and analytically from the macro-level. This is relatively common for territorial concepts referring to a scale larger than organisations, yet often smaller than nations, for example regional innovation systems (Cooke et al., 1997) or entrepreneurial ecosystems (Van de Ven, 1993).

Table 1 further indicates the literature approach that is chosen to explain, understand, analyse, and discuss the empirical observations connected to each analytical level. Combined, this body of literature forms the theoretical framework of the thesis, which is elaborated on in Chapter 3. Moreover, the different analytical levels are associated with different units of analysis and units of observation. The unit of analysis refers to what or whom is being studied, whereas the unit of observation refers to the entities that are observed in order to learn something about the unit of analysis (Kumar, 2018). Often, there is a one-to-one correspondence between the two, as in the case of green entrepreneurs (Table 1). In other settings, information is derived from observation units to reveal something about more aggregated analytical units. In my thesis, this is the case for both the cleantech clusters study and the market conditions study (Table 1). Lastly, the title and status of the articles related to each level is included. Article 1 has been submitted for review, whiles Article 2 and Article 3 have already been published.

1.3 Structure of the synopsis

Thus far the synopsis has presented the introduction to the topic (section 1) and outlined the research questions (section 1.1), design (section 1.2), and structure (section 1.3) of the thesis. In the next chapter (Chapter 2), I discuss the relationship between business and the environment in more detail. As already mentioned (section 1), this thesis implicitly presumes that economic growth and environmental sustainability can be reconciled. However, not all approaches to a greener economy share this optimistic view of a potential win-win scenario (Wright and Nyberg, 2014). Other approaches are

more pessimistic regarding the possibilities to achieve a green and growing economy. Chapter 2 elaborates on this debate by discussing the notion of green growth (section 2.1) in relation to other approaches to a green economy, respectively selective growth (2.2) and degrowth (2.3). Chapter 3 provides a deeper theoretical discussion based on the literature approach that has been chosen for the respective analytical levels of thesis (see section 1.2). Accordingly, Chapter 3 is divided into three sections – green entrepreneurs (3.1), cleantech clusters (3.2) and market structures (3.3) – each with references and discussions of the three corresponding articles. Chapter 3 also contains some unpublished material not included in Articles 1–3. Chapter 4 is devoted to research design and methods. The chapter starts with some reflections on the overarching research design and scope of the thesis (4.1), followed by a discussion on the ontological and epistemological positioning of the study (4.2). The research method, including case selection, data sources, methodological triangulation, data collection, and validity, is discussed in section 4.3 to complement the method sections provided in the respective articles. Lastly, Chapter 5 provides some concluding discussions and responses to the research questions outlined in section 1.1. Full text versions of the three articles are enclosed in the final section.

2 Business and the environment

The history of environmental concern is long and complex, and can be found in philosophical and religious writings as early as the 6th and 7th centuries AD (Gari, 2002). However, modern environmental history is associated with environmental consequences caused by progressive anthropogenic activities. In the latter context, industrialisation and subsequent population growth in the late 19th and early 20th centuries represent a common point of departure. That period witnessed the passage of several environmental laws, including those relating to wildlife conservation and acts to prevent air and water pollution caused by industrial activities (Platt, 2005). Pioneering environmental organisations such as the Sierra Club (established in 1892) and the National Audubon Society (established in 1905) were also formed around that time. Following a relatively gloomy period of world wars and economic depression, the post-war period (i.e. after World War II) witnessed increased public awareness of the vulnerability of the planet. A wave of publications started to reflect critically on issues concerning natural preservation and resource depletion in a time of substantial growth. Numerous of notable publications, including *Our Plundered Planet* (Osborn, 1948), *Road to Survival* (Vogt, 1948), *Silent Spring* (Carson, 1962), *The Population Bomb* (Ehrlich, 1968), and *Limits to Growth* (Meadows, 1972), jointly contributed to bring environmental concerns to new heights. At the time, environmental debates typically revolved around issues such as overpopulation, food production, resource depletion, natural preservation, and land use. While the industry often was accused of causing the problems (e.g. in Rachel Carson's critique of pesticides and the chemical industry in *Silent Spring*), much less attention was directed towards the industry's role in solving them. The 1960s and 1970s also witnessed the emergence of environmental philosophy as a distinct branch through the work of philosophers, such as Richard Sylvan (1973) and Arne Næss (1973), as well as the formation of several influential international environmental NGOs, including the World Wildlife Fund (established in 1961) and Greenpeace (established in 1971). Climate change, which arguably is the most pressing environmental issue today, received little attention at the time. The latter entered the public environmental debate in the 1990s, following publication of the IPCCs first

assessment report (1990) and the accomplishment of the first UN Climate Change Conference (COP1), held in Berlin in 1995, two years after the Framework Convention on Climate Change was ratified (UNFCCC, 2020).

With respect to acknowledgement of the role and responsibility of industry, a key event took place in Stockholm in 1972, when multiple national governments gathered to discuss the global environment at the UN Conference on the Human Environment. The assembly drew international political attention to the environmental harm caused by human activities throughout the world:

> We see around us growing evidence of man-made harm in many regions of the earth: dangerous levels of pollution in water, air, earth and living beings; major and undesirable disturbances to the ecological balance of the biosphere; destruction and depletion of irreplaceable resources.
>
> (Stockholm Declaration, 1972: 3)

The declaration further implicitly states that the corporate sector largely holds the key to solving environmental issues such as those mentioned above:

> Man is both creature and moulder of his environment. In our time, man's capability to transform his surroundings, if used wisely, can bring to all peoples the benefits of development and the opportunity to enhance the quality of life. Wrongly or heedlessly applied, the same power can do incalculable harm to human beings and the human environment.
>
> (Stockholm Declaration, 1972: 3)

Despite the environmental awakening in the 1970s, the following decade showed that the accelerating pace of industrialisation continued to deteriorate the environment in many areas. As a response to this detrimental development, the World Commission on Environment and Development (WCED, also known as the Brundtland Commission) were established in 1983 to assess environmental threats, propose strategies, and promote international collaboration to deal with issues related to the environment and development. The work of the commission culminated in the report Our Common Future (1987). The report popularised the term sustainable development, defined as '*development that meets the needs of the present without compromising the ability of*

future generations to meet their own needs' (Our Common Future, 1987: 16). While the purpose of this definition is clear, the question of how to achieve sustainability remains highly disputed. The next section discusses three different approaches to sustainable development, respectively green growth, selective growth, and degrowth. However, it should be mentioned that, apart from selective growth, these approaches do not explicitly consider the social dimension of sustainability, despite the latter being a key part of sustainable development (UN, 2020). Thus, the aforementioned approaches are more appropriately viewed as paths to a greener economy, even though 'green' and 'sustainable' tend to be used somewhat interchangeably in the popular discourse.

2.1 Different approaches to greener economies

The business community plays a crucial role in the transition towards a greener economy. Since the global financial crisis of 2007–2008, governments at national and international level have increasingly designed policies and programs to promote green industry development (Georgeson and Maslin, 2019). A recent contribution includes the European Green Deal, which is the EU's roadmap for making the European economy sustainable within 2050 (European Commission, 2020). Similar large-scale strategies have been carried out in many non-European countries too, including major economies such as China (Linster and Yang, 2018) and the United States (Georgeson and Maslin, 2019). Even the corporate sector seems to be on the verge of a paradigm shift with respect to how environmental sustainability is perceived and acted upon from a commercial point of view (see section 3.3.2). While policymakers and business leaders often seem to be on the same wavelength concerning the right way to approach a green economy (i.e. through green growth), there are other, less growth-oriented visions worth mentioning. Besides green growth (2.2), both selective growth (2.3) and degrowth (2.4) are discussed in more detail in the following sections. These three approaches do not represent a complete review of how to deal with the environmental challenges associated with economic activities. Nevertheless, they do constitute a

representative variety regarding how conventional or radical they are in relation to the current economic and political system.

2.2 Green growth

Within the last decade, green growth has manifested itself as the mainstream approach to a sustainable economy (Hickel and Kallis, 2019). Strongly endorsed by national governments, IGOs and business communities, green growth strategies are increasingly gaining momentum (OECD, 2011; European Commission, 2020). The OECD (2011: 4) states that green growth means

> fostering economic growth and development, while ensuring that natural assets continue to provide the resources and environmental services on which our well-being relies. To do this, it must catalyse investment and innovations which will underpin sustained growth and give rise to new economic opportunities.

As the definition indicates, the green growth approach suggests continuous economic growth (i.e. growth in gross world product), but simply in a more sustainable direction. Rather than radically rearranging the economic system, green growth implies that environmental problems can be solved within the current institutional and structural landscape (Jacobs, 2012). This presumption resonates with the ecological modernisation discourse,[2] which places confidence in the corporate sectors' ability to develop cleaner products, technologies, services, and business models, often in concert with market-enabling policies (Hajer, 1995; Jänicke, 2020). Drawing on the 'green growth narrative', this will lead to green job creation, green investment opportunities and eventually a green economy that will continue to grow concurrent with improvements in the natural environment. Accordingly, the green growth approach

[2] Ecological modernisation and green growth allude to very similar approaches that are based on solving environmental issues through environmentally sound innovations and technologies (see Jänicke, 2020). However, ecological modernisation is commonly used with reference to the academic discourse, whereas green growth is a more recent term that has been popularised in political circles and the corporate sector.

largely denies that there is an immanent conflict between economic growth and environmental sustainability (see section 3.2.2). Instead, the approach claims that economies can transform into green ones without any economic sacrifices (Ferguson, 2015). Regardless of business sector, innovations that improve the energy and resource efficiency of production systems are seen as steps towards a green economy (see section 3.1.3). This may include cleaner technologies, industrial symbiosis or new business models based on various take-back arrangements and sharing rather than owning (Rusten and Tvedt, 2018; European Commission, 2020). Apart from adapting to more sustainable activities, solutions and practices, green growth largely implies 'business-as-usual' (Bina, 2013). While policymakers and commercial industry developers tend to embrace green growth, several researchers have criticised this approach for failing to address the severe environmental problems we currently are facing (van der Bergh and Kallis, 2012; Bina, 2013; Hickel and Kallis, 2019). The critique revolves around trying to solve environmental problems through the same logic that caused them (Kallis, 2011; Pàdranos, 2013). In this relation, it is claimed that it is highly unlikely that economic growth could be decoupled from carbon emission and other environmental strains (Hickel and Kallis, 2019; Parrique et al., 2019). Critiques have suggested alternative approaches to a greener economy, among others selective growth and degrowth, as discussed in more detail in the following two sections.

2.3 Selective growth

The terms selective growth, or a-growth (for agnostics), are used interchangeably to describe a green economy approach positioned between green growth and degrowth (see section 2.4). This approach aims to find a balance between economic growth, environmental quality, and social well-being. The three pillars of sustainability are considered equally important, indicating that this perspective is neither pro-growth nor negative growth (van der Bergh and Kallis, 2012). This implies that reducing economic growth could be necessary in some cases to achieve desired environmental or social goals (Ferguson, 2015). For example, shutting down a coal-fired power plant to improve

local air quality could be an appropriate strategy in the selective growth regime. The approach is quite different from the green growth approach, in which the solution to the problem typically would include implementation of end-of-pipe technology. In other words, the latter strategy would aim to approach environmental sustainability through commercial applications instead of completely relinquishing the opportunity for growth. However, in other cases selective growth may encourage economic growth if environmental and social sustainability concerns allow it, for example expansion of renewable energy markets or other cleantech applications. The main purpose is to ensure sustainable societies by encouraging firms to balance their triple bottom line[3]. To create such societies, the selective growth approach suggests that the dominant 'growth mentality' should be replaced by an indifferent or neutral attitude towards growth, hence the term agnostic growth (abbreviated as a-growth) (van der Bergh, 2017). Continuous growth in gross domestic product (GDP) should not be a goal, but neither should levelling-off or decline. Instead, GDP should be reconfigured to measure how responsible a country's management of economic, ecological, and societal goals are (van der Bergh, 2017). This implies that economic performance will increase in certain periods but may also decline if it is considered necessary to downscale certain economic activities to achieve balance between the three pillars of sustainability. For example, fossil-based economies such as Norway's would probably have to cut production for environmental reasons, even if this entail economic losses. The selective growth or a-growth approach was partly introduced to depolarise the debate between green growth and degrowth.

2.4 Degrowth

The third and final approach proposes more radical economic changes involving degrowth (Bauhardt, 2014). Rather than continuously struggle for economic growth,

[3] The term *triple bottom line* (TBL) was introduced by John Elkington in 1994 to account for the environmental- and social value created by companies, in addition to the economic value (Elkington, 2004).

societies should ensure that resource use and waste stay within safe ecosystem boundaries by downscaling the overall capacity to produce and consume (Escobar, 2015; Kallis and March, 2015). In contrast to green growth, the degrowth approach argues that technology, innovation, and new markets are the root rather than the solution to environmental problems. Consequently, societies should aim at mitigating excessive consumption and material affluence through intentional downscaling of economic activities (Kallis and March, 2015). Imposing global production caps on various resources is commonly seen as an effective strategy in this regard (Douthwaite, 2011). Advocates of the degrowth approach believes in a low-carbon, low-output economy that still provides high levels of well-being. A core argument for degrowth is the rather weak relationship between material prosperity and quality of life (Schneider et al., 2010). In many respects, the degrowth approach to a sustainable economy denotes a certain lifestyle applied to the level of societies – a lifestyle that typically abstains from growth, materialism, and long working hours by devoting more time to family and community (Brossmann and Islar, 2020). While this may seem romantic and appealing, critics still question the realism of degrowth as an economic, political, and social system. Major concerns have been raised about the economic robustness of degrowth, for example its ability to support essential public goods and services such as health care and education (Tokic, 2012). Degrowth is further criticised for not recognising the potential of innovation and technology to decouple economic growth from negative environmental impact, which is the core argument that green growth builds upon (see section 2.2).

Green growth, selective growth and degrowth represent different approaches to a green economy. As discussed above, they differ significantly in many areas. The way in which the different approaches prioritise economic growth in relation to environmental responsibility, as well as how radical changes they impose on the current economic and social system is summarised in Figure 1, based on the discussion presented thus far in Chapter 2.

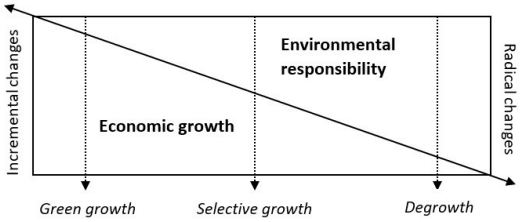

Figure 1: Summary of three contrasting approaches to a green economy: green growth, selective growth and degrowth.

Green growth mainly implies a business-as-usual perspective (Bina, 2013) but emphasises the need for a greener direction that involves decoupling economic growth from increased environmental pressure. This can be realised through environmental innovations and clean technologies in concert with regulations or public procurement that create market demand for such solutions. Supporters of green growth still consider sustained economic growth a key priority but believe that ecological sustainability can be achieved concurrently with GDP growth (see section 2.2). Selective growth calls for a balanced mix between economic growth, environmental responsibility, and social well-being. The approach suggests that triple bottom line concerns should guide businesses and policymaking (see section 2.3). However, advocates of selective growth do point out that economic growth and environmental sustainability could go hand in hand in certain cases. Unlike green growth, selective growth will require cultural and institutional changes, as the perpetual strive for GDP growth ought to be replaced by a more indifferent attitude towards economic growth. The third and final approach, degrowth, envisions the most radical changes in the economic system. Degrowth suggests that the only path to a green economy is through downscaling production and consumption. The main priority is environmental responsibility, which only can be achieved by shrinking the global economy (see section 2.4). Deliberately confining economic activities and possibilities for growth implies very radical changes, which conflicts with the cornerstone in the current political and economic landscape (Foster, 2011; Liodakis, 2018).

3 Realisation of green growth: theoretical perspectives on actors, systems, and structures

The preceding chapter (Chapter 2) has discussed different ways of approaching a greener economy. This chapter elaborates on the literature approach in the thesis, which covers research on the actors, systems and structures involved in green value creation. More specifically, this includes green entrepreneurs at the micro-level (3.1), cleantech clusters at the meso-level (3.2), and market conditions for environmental goods and services at the macro-level (3.3). A section is devoted to each level, providing a more detailed account of the respective research fields (see section 1.2) and further identifying some research gaps that are addressed in the thesis. Each section concludes with a summary of the respective articles and how they contribute to the literature.

3.1 Micro-level perspective: the green entrepreneur

The micro-level perspective in this thesis focuses on the role of individual actors that contribute to green value creation (see Table 1). This is operationalised in the thesis by taking a closer look at green entrepreneurship. The term green entrepreneur[4] first emerged in 1990, originating from the work of Blue (1990), Bennett (1991) and Berle (1991). These early publications are rather practically oriented and primarily discuss opportunities, strategies, techniques, and actions to address various environmental issues from a business perspective, such as resource management, recycling, energy efficiency. Today, many of these issues are commonly addressed in the corporate sector, for example as part of environmental management systems (e.g. the ISO-14000 certification series), mandatory reporting, or specifications required by a private or public customers (Rusten, 2016). However, in the early 1990s, addressing such environmental issues largely relied on the efforts of enterprising individuals operating within (intrapreneur) or outside (entrepreneur) firms, often referred to as *ecopreneurs*

[4] Several terms are used interchangeably with 'green entrepreneur' (see section 1.2). The pioneering publications often used the term *ecopreneur* (see Blue, 1990; Bennet, 1991).

(Blue, 1990; Berle, 1991). Throughout the 1990s, the research field started to evolve. Work carried out by Anderson (1998), Isaak (1998), Keogh and Polonsky (1998), and Larson (2000) played an important role in advancing the research field. While the early publications of 1990 and 1991 are rather 'handbook' oriented, the aforementioned contributions represent the start of explorations of green entrepreneurship from a more theoretical and conceptual perspective (Pastakia, 1998). Since then, several articles and books on the topic of green entrepreneurship have been published (Galkina and Hultman, 2016; Gast et al., 2017; Santini, 2017). Today, the term green entrepreneur or ecopreneur has become relatively established, predominantly within academia, but also increasingly in the public and private sector (Santini, 2017).

There is no unambiguous definition of *green entrepreneur*, but rather several descriptions that point towards entrepreneurs that successfully combine economic performance and environmental sustainability. In this regard, environmental sustainability is commonly understood as less harmful than conventional offerings, implicitly acknowledging that economic activities inevitably exert some form of ecological pressure (del Río González 2005). Green entrepreneurs may operate outside corporations, starting their own green businesses, or inside existing firms as individuals responsible for carrying out environmentally friendly innovations (Cohen & Winn, 2007). In other settings, the term green entrepreneur is used synonymously with green businesses (Isaak, 2002). In this thesis, green entrepreneurs refer to *individuals who have started businesses and whose product or service provides a clear environmental contribution to the market*. This includes both the cleantech start-ups explored in Article 1 and the green service firms that forms the empirical basis for Article 3.

Even though the concept of green entrepreneur lacks a uniform and widely accepted definition, considerable work has been carried out to outline whom they are and what they do, with particular attention paid to the motivation and triggers that give rise to green entrepreneurship (Galkina and Hultman, 2016; Gast et al., 2017). These contributions commonly include typology studies based on either empirical evidence or theoretical deliberations. A detailed review of these typologies is provided in the next section. The review serves two key purposes. First, it provides a thorough understanding

of how green entrepreneurs are perceived and understood in the research literature. Second, it forms a useful basis for analysing the green entrepreneurship cases in Article 1 in relation to the wider literature. In total, six typologies are discussed and compared in the synopsis, with reference to my own empirical data.

3.1.1 The green entrepreneur: definitions and typologies

Inspired by Weberian ideal type methodology (Weber, 1904), attempts to define green entrepreneurship have largely been carried out by means of typologies, with the purpose of describing and comparing different types of green entrepreneurs. These ideal types are seldom empirically observable in their 'pure' form, but rather represent logical constructs that aim to systemise individuals into analytical entities that share certain traits and similarities. Oftentimes, ideal types are derived from empirical findings, but they may also be a product of theoretical reasoning (Swedberg, 2018). The green entrepreneurship literature includes both approaches but has generally been more theoretical than based on in-depth empirical research (O'Neill and Gibbs, 2016).

One of the most comprehensive frameworks for classifying green entrepreneurs is the positioning matrix developed by Schaltegger (2002) and later extended by Schaltegger and Wagner (2011). The framework defines green entrepreneurship using two variables, market effect and environmental priority (Figure 2). The positioning matrix suggests that green entrepreneurship (i.e. ecopreneurship), in contrast to other corporate greening strategies, has environmental performance as core business goals. Additionally, the green entrepreneur needs to operate in the mass market as opposed to smaller niches typically targeting a limited number of customers. The latter is based on the argument that presence in the mass market has a more significant environmental impact than other type of green enterprises, such as alternative actors, which tend to be more idealistic than business oriented (Schaltegger, 2002).

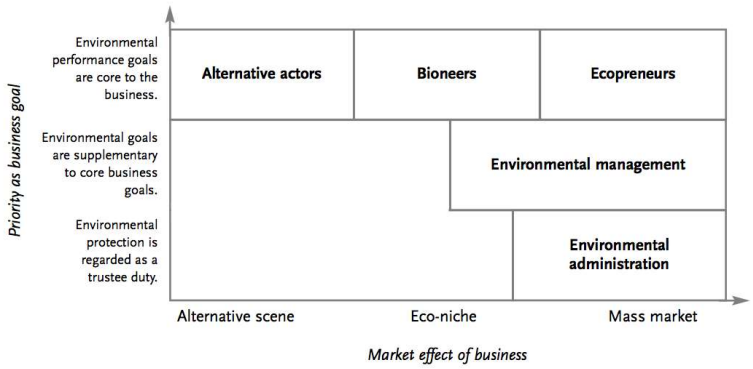

Figure 2: The positioning matrix, in which green entrepreneurs are defined on the basis of market effect and environmental orientation (Source: Schaltegger, 2002: 49).

In the positioning matrix, green entrepreneurs represent the most radical form of green value-creation initiatives and hence the most consequential in terms of mitigating environmental challenges (see Figure 2). From a market size perspective, many firms have significant potential to mitigate environmental strains, but the potential will not be actualised by firms with lower priority to environmental goals (Schaltegger, 2002). This is the case for firms that simply consider environmental issues a management task or administration duty. The latter involves conducting environmental measures and fulfilling obligations required by legal frameworks (Schaltegger, 2002), and can therefore be understood as a license-to-operate strategy (Rusten & Tvedt, 2018). By contrast, environmental management goes beyond minimum legal requirements and includes firms that actively aim at achieving greener operations and products, for example through voluntary environmental measures. Demonstrating environmental awareness through voluntary environmental management systems (i.e. ISO 14001) or renewable energy certificates (RECs) typically falls into the environmental management category (see Figure 2).

In the extended positioning matrix, Schaltegger and Wagner (2011) introduce the sustainability entrepreneur, who addresses social issues in addition to economic and environmental. Thus, the sustainability entrepreneur is a synthesis of the green entrepreneur and the social entrepreneur (Leadbeater, 1997), yet some might argue that

this distinction is somewhat redundant due to the inherent social benefits that follow environmental improvement, such as clean air. The green entrepreneurs that are studied empirically in this thesis fit rather poorly with the positioning matrix. The main reason for this is that the entrepreneurship cases in Article 1 were selected because of the green impact provided by their technologies, whereas the position matrix is concerned with the purpose or goal of the entrepreneur/business (Figure 2). Moreover, the empirical cases explored in the thesis operate in the business-to-business (B2B) market, which fits poorly with the mass market concept that is oriented more towards business-to-consumer (B2C) goods.

Isaak (2002) proposes a much simpler definition of green entrepreneurs. He distinguishes between 'green businesses' and 'green-green businesses'. A green business refers to companies that are moving towards environmental responsibility, as opposed to green-green businesses, which include companies whose products and services are designed to be green from the start. According to Isaak (2002), a green entrepreneur is therefore someone who starts a green-green business. Drawing on Schaltegger's position matrix (Figure 2), a green-green business corresponds to firms that have environmental performance as their core objective, whereas green businesses include firms that practise environmental management beyond regulatory demands.

A third framework is proposed by Walley and Taylor (2002). Their contribution draws inspiration from Gidden's structuration theory by including both internal motivation and external structures as determining factors, leading to different types of green entrepreneurship. Internal motivation is the entrepreneur's personal motivation for starting a business, whereas external structures include exogenous conditions that influence the entrepreneur in this regard. With respect to internal motivation, green entrepreneurs are positioned on a vertical axis ranging from economic orientation to sustainability orientation (Figure 3). Similarly, a horizontal axis is used to determine the external structures that influence the entrepreneur, respectively hard or soft structural influences. Hard structural influences include economic incentives, government regulations, and other tangible signals from the market (Walley and Taylor, 2002), whereas soft structural influences are influences from family and friends,

personal networks, past work experiences, and education (Walley and Taylor, 2002). According to Walley and Taylor's framework, the combination of internal motivation and external structures produces different types of green entrepreneurs, as shown in Figure 3.

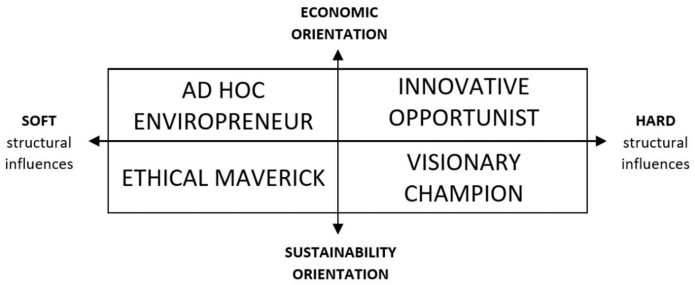

Figure 3: Walley and Taylor's typology of green entrepreneurs (Source: Walley and Taylor, 2002).

The four ideal types are the ad hoc environpreneur, the innovative opportunist, the ethical maverick, and the visionary champion. The ad hoc environpreneur is a financially oriented entrepreneur mainly influenced by soft structures such as family, friends, and personal networks. The innovative opportunist is similarly financially oriented but, in contrast to the ad hoc enviropreneur, he or she is influenced by hard structures, such as market opportunities arising from new regulations. The *ethical maverick* is characterised by sustainability orientation, with soft structures being the main significant influence on their desire to start a business (Walley and Taylor, 2002). Lastly, the visionary champion is a green entrepreneur who is driven by sustainability concerns but tends to grasp transformative opportunities resulting from hard structural change. Implicitly, the structural influences in the typology allude to the expected market size associated with the type of business that the different entrepreneurial types are likely to start. For example, the ethical maverick, who is influenced by soft structures, is likely to run what Schaltegger (2002) defines as alternative style business (see Figure 2). In contrast, visionary champions, in responding to hard structural conditions, tend to envisage fundamental market transformations with far-reaching impacts (Walley and Taylor, 2002).

A fourth typology is proposed by Linnanen (2002), who bases it solely on the entrepreneur's motivation for starting a green business. In contrast to the other three typologies, Linnanen does not include a second dimension, such as external structures (Walley and Taylor, 2002) or market effect (Schaltegger, 2002). Linnanen simply distinguishes between a desire to change the world and a desire to make money. From these two criteria he derives four ideal types: non-profit business, self-employer, opportunist, and successful idealist. The non-profit business is started by entrepreneurs with high desire to change the world, but low financial drive. The self-employer has low financial drive and low desire to change the world, whereas the opportunist has high financial motivation but low desire to change the world. Lastly, the successful idealist has both a high desire to change the world and a high desire to make money (Linnanen, 2002). This clear distinction between socially and commercially oriented green entrepreneurs has also been emphasised in similar studies, including those by Anderson (1998) and Pastakia (1998).

The above-described four typologies were published over a period of roughly five years, between 1998 and 2002, a period that marks the pioneering phase for conceptual development within the field of green entrepreneurship. Following that pioneering phase, it took more than a decade before new typology studies were added to the body of literature, respectively by Bergset and Fichter (2015) and Nikolaou et al. (2018). Arguably, these two contributions represent a period of renewed interest in the topic of green entrepreneurship research following increased attention to issues concerning business and the environment (see section 2). Typologies put forward by Bergset and Fichter (2015) and Nikolaou et al. (2018) are discussed in the following.

The typology presented by Bergset and Fichter (2015) builds upon previous contributions by Linnanen (2002), Schaltegger (2002), and Walley and Taylor (2002) but is far more complex with respect to the number of variables involved and how the interplay between variables is believed to produce different types of green entrepreneurs. For example, Linnanen (2002) bases his entire typology on motivation, whereas Bergset and Fichter suggest that motivation is just one of nine variables that should be used to classify green entrepreneurship (Bergset and Fichter, 2015). For them,

motivation is part of a dimension called *entrepreneur-related characteristics*. Their other two dimensions are *product/service-related characteristics* and *strategy-related characteristics.* For each dimension, Bergset and Fichter have defined three variables, resulting in a total of 9 (3 dimensions × 3 variables) (Table 2). First, the entrepreneur-related characteristics include: (1) their motivation, (2) to what extent they derive inspiration from sustainable systems thinking such as 'cradle-to-cradle'(i.e. circular economy), and lastly (3) the business qualifications of the entrepreneur. Second, product/service-related characteristics include: (1) the product/service quality ranging from low-quality disposable products to longer lasting products, (2) the long-term focus, which concern the duration of commercialisation before market launch and hence when earnings can be made, and (3) the need-orientation, which include the market segment targeted by their products, ranging from requisites addressing the bottom of the wealth pyramid to superfluous goods that simply feed ever-increasing consumerism (Bergset and Fichter, 2015). Lastly, the strategy-related characteristics include (1) the level of market orientation (i.e. the degree to which their business corresponds to the current market economy or requires alternative economic approaches based on bartering, sharing and so on), (2) the growth willingness of the business, and (3) the desire to maintain control and decision-making rights.

As outlined above, each dimension is coupled with three additional variables, resulting in a total of nine characteristics that are used to describe different types of green entrepreneurs. By means of these nine variables, Bergset and Fichter (2015) have identified five different types of green entrepreneurship: (1) the alternative start-up, (2) the visionary start-up, (3) the inventive start-up, (4) the ecopreneurial start-up, and (5) the unintentionally green start-up. Table 2 summarise the five entrepreneur types and their associated characteristics based on the nine variables. The typology is designed to provide a more detailed description of green entrepreneurs and their businesses compared with existing typologies. For example, according to Bergset and Fichter (2015) the alternative start-up, which largely corresponds to Schaltegger's alternative actor (Figure 2), is typically started by altruistic entrepreneurs with limited business qualifications (Table 2).

Table 2: Bergset and Fichter's typology of green entrepreneurship (Source: Bergset and Fichter, 2015).

	The alternative start-up	*The visionary start-up*	*The inventive start-up*	*The ecopreneurial start-up*	*The unintentionally green start-up*
Product/service-related characteristics					
Product/service quality	High	High	High	Low-medium	Medium-high
Long-term focus	High	High	High	Low-medium	Medium-high
Need orientation	High	High	Low-medium	Low-medium	Low-medium
Entrepreneur-related characteristics					
Sustainability-related motivation	High	High	Medium	Low	Low
Use of guiding sustainability principles	High	High	Medium	Low-medium	Low-medium
Level of business qualification	Low	Medium	Low-medium	High	Medium-high
Strategy-related characteristics					
Level of market orientation	Low	Medium	Medium-high	High	Medium-high
Growth willingness	Low	Medium-high	Medium-high	High	Low-high
Retaining control and decision-making rights	High	Medium-high	Medium	Low	Low-high

Furthermore, entrepreneurs who runs the alternative start-up prefer to maintain control of their business and tend to have a weak desire for growth (Bergset and Fichter, 2015). As shown in Table 2, the remaining four types of entrepreneurship also correspond to the ideal types suggested by Linnanen (2002), Schaltegger (2002), and Walley and Taylor (2002) but are generally ascribed far more characteristics than in the original typologies.

The sixth and final typology included in this review is the institutional and resource-based view suggested by Nikolau et al. (2018). In contrast to other five typologies, the theories underlying this typology imply that green entrepreneurship predominantly is seen as a process within incumbent firms (i.e. intrapreneurship). On this basis, the authors define four types of green entrepreneurship according to the firm's/entrepreneur's incentives to engage in environmentally sound business activities. According to Nikolau et al. (2018), the motive to invest in green entrepreneurship is determined by either resource-based incentives or institutional-based incentives, or

sometimes a combination of the two. Drawing on resource-based theory (Barney, 1991), the resource-based incentives include strategic competitive advantages that can be gained by creating unique resources internal to the firm (Nikolau et al., 2018). In the case of green entrepreneurship this could entail different forms of strategic differentiation in which environmental performance is embedded within firms (e.g. their products, services, human capital), thereby creating resources that are unique and difficult to imitate. The other type of incentives includes those derived from institutional theory (IT) (Nikolau et al., 2018). In contrast to the resource-based incentives, institutional-based incentives are external conditions in the institutional environment that might induce organisational change or give rise to new organisations. In this regard, Nikolau et al. (2018) distinguish between public and private institutions that may encourage green entrepreneurship. Public institutions include formal regulative and tax-based incentives imposed by legal authorities, whereas private institutions include norms and expectations from private and public actors that exert green pressure within markets. Such pressure, both formal (environmental regulations) and informal (norms, cultural expectations) is discussed in more detail in Article 3 with respect to market conditions for environmental goods and services (see section 3.3 and Article 3). Pressure from the institutional context may lead to coercive isomorphism, which is defined as pressure to change from external actors (individuals, organisations, authorities), which they themselves are dependent upon, for example their clients (Nikolau et al., 2018). According to the authors, green entrepreneurship can be defined depending on the influence of resource-based incentives (resource-based view, RBV), and institutional incentives (institutional theory, IT), as highlighted in Figure 4.

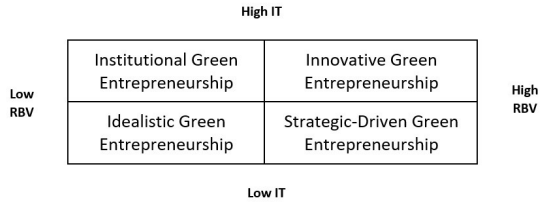

Figure 4: Typology of green entrepreneurship introduced by Nikolau et al. (Source: Nikolau et al., 2018: 120).

Nikolau et al.'s typology distinguishes between (1) Institutional Green Entrepreneurship, (2) Idealistic Green Entrepreneurship, (3) Innovative Green Entrepreneurship, and (4) Strategic-Driven Green Entrepreneurship. The idealistic type is neither encouraged by changing institutional environments nor strategic considerations, but is rather driven by a form of personal commitment to environmental issues. The institutional type tends to grasp opportunities that arise from changing institutional settings, for example by positioning their business as a potential provider in various green public procurement processes (Cheng et al., 2017). The strategic-driven entrepreneur tends to engage in green entrepreneurship for purely strategic reasons. Their key motive is to secure long-term competitiveness by developing new capabilities and resources that are presumed to be relevant in the shift towards a greener economy, regardless of any institutional incentives (Nikolau et al., 2018). The fourth and last type, innovative green entrepreneurship, is influenced by both changing institutional environments and strategic potential for environmental differentiation.

Summary and reflections on the green entrepreneurship cases in Article 1

In this thesis the micro-level perspective allows for an in-depth analysis of the entrepreneurial journey of two green entrepreneurs (and by extension their cleantech start-ups). Understanding the motives, strategies and triggers involved in these processes is a key part of this analysis (see section 3.1.4). A summary and discussion of the reviewed topologies in relation to the green entrepreneurship cases explored in Article 1 is provided in the following, to conclude section 3.1.1. The discussion concerns to what extent the research cases explored in Article 1 conform to the typologies accounted for above, and by extension, the prevalent understanding of green entrepreneurship in the research literature.

Section 3.1.1 have provided a detailed review of how green entrepreneurs and green entrepreneurship are perceived in the research literature. In general, there is a strong tendency to focus on the characteristics of the entrepreneurs themselves (i.e. their motivation, visions) or their firms (i.e. strategy and orientation of the firm). In this respect, personal motivation is frequently regarded a key variable for defining different

types of green entrepreneurs. The distinction between altruism (i.e. sustainability concern) and self-interest (i.e. profit desire) is particularly emphasised in the presented typologies. Additionally, in some of the typologies, the motivation of the entrepreneur is claimed to give an indication of their business with regards to growth ambitions, market impact and competency. While there is a tendency for most of the typologies to focus solely on the internal characteristics of the entrepreneur/firm (especially motivation), some also include external triggers to explain different types of green entrepreneurship, such as social structures (Walley and Taylor, 2002) or institutional incentives (Nikolau et al., 2018). The latter two typologies suggests that the combination of internal motivation and external triggers produces different types of green entrepreneurship.

The first area in which the cases in Article 1 deviate from the typologies is the number of entrepreneurs involved in the start-up process. Implicitly, all of the typologies tend to view green businesses as the outcome of efforts by one enterprising individual, in which his or her motive and visions play a significant role in defining the company. However, the two cases in Article 1 demonstrate green entrepreneurship that is realised by the efforts of entrepreneurial teams rather than a sole entrepreneur. Although it is possible to point to the 'lead' entrepreneur who initiated the start-up-projects, their motivation was not necessarily in accordance with the motivations of the other co-founders of the business, nor was it reflected in the vision and values of the company. For example, one of the cases explored in Article 1 reveals that the individuals in the entrepreneurial teams had rather different motives for becoming involved in the project. For some of the co-founders, environmental concern were important motives, even though the lead entrepreneur reported more conventional motives such as self-realisation, which is unaccounted for in the typologies. This points to another, yet related shortcoming in many of the topologies, namely that the entrepreneur's motivation is presumed to be either economic or environmental, or somewhere between the two. While 'economic' and 'green' arguably represent key motives, they by no means capture the diversity of motives for starting a business, regardless of whether the entrepreneurs are considered green, social, or conventional.

For example, the two cases in Article 1 shows that the lead entrepreneurs considered that self-realisation and turning their hobby into a business were far more important motives than their environmental concerns or desire for profit. A third problem in this regard includes entrepreneurship that can be perceived as 'green' for other reasons than motivation, for example in cases where products, services, technologies, and business models deliver a green contribution to the market. This has largely been the case for the two cleantech start-ups explored in Article 1, whereof the environmental impact of their technologies/services played a decisive role in making them 'green'. The latter is sometimes seen as either *accidental* or *unintentional green entrepreneurship* (Bergset and Fichter, 2015), but these are somewhat misleading terms as they imply that the entrepreneurs turned out to be green by chance. This would be an incorrect description of the two cases explored in Article 1. On the contrary, the entrepreneurs had a clear comprehension and awareness of the environmental potential of the business they envisioned from the outset, even though the 'green contribution' was a minor motivational factor for them personally.

The topologies that include external conditions certainly add another dimension to the rather biased focus on motivational triggers. External conditions, or more precisely institutions in the form of environmental regulations, have also played a key role in creating demand for one of the business cases explored in Article 1 (i.e. Clean Robotics). However, the firm was not started as a response to an institutional incentive per se, as suggested by some of the typologies (e.g. by Walley and Taylor, 2002 and by Nikolau et al., 2018). Rather, the entrepreneurs had developed a prototype before they eventually became aware of a regulation that ended up strengthening their market position (see Article 1). While the case in Article 1 probably demonstrates the exception rather than the rule, it is still important to point out that merely responding to external influences only tell parts of the story of how green entrepreneurs (micro-level) interact with market structures (macro-level). In some cases, green entrepreneurs take on the role of an institutional entrepreneur in their efforts to create or shape an ecosystem for their innovation to thrive.

For example, lobbying for environmental regulations that will create demand for a specific technology or service has become a more widely used corporate strategy in recent years (Grey, 2018). Such policy advocacy may be carried out by individual businesses/entrepreneurs, but also encouraged by business clusters or entire industries (Sjøtun, 2018). In other cases, regulations are imposed because a new technology has become available in the market (see section 3.3.4). The interaction between environmental regulations and market demand is discussed in more detail in section 3.3 and Article 3.

A final reflection on the typologies is that many of them appear to be rather stereotypical and categorical in the way they derive conclusions based on different variables, such as the way idealistic entrepreneurs are associated with soft influences, a low degree of willingness to grow and lack of business qualifications (see section 3.1.1). While there certainly are green entrepreneurs that fit these ideal types, it should be mentioned that such classifications poorly account for changing environmental attitude in society (see Chapter 2). Attitudes and behaviour that formerly were considered 'idealistic' are arguably becoming more mainstream. For example, the results of a recent survey conducted in Norway shows that more and more students aspire to work with the shift towards a green economy, for example engineering students who prefer to work within the renewable energy sector (Karrierebarometeret, 2019). This implies that environmental idealism and commercial instincts do not necessarily represent contrasting motives in green entrepreneurship.

The above discussion indicates that the green entrepreneurs explored in Article 1 fit rather poorly with prevalent conceptual understandings in the research literature. Are they simply conventional entrepreneurs who happens to run a green business? This leads us to another fundamental yet related question regarding business and the environment: In what ways are enterprises green? This question is discussed further in the next section, which introduces different conceptual and statistical definitions of 'being green'. These conceptual and statistical understandings are further analysed in relation to empirical data from a survey that I conducted in 2013, in the early stages of my doctoral research (see section 3.1.3).

3.1.2 What is green? People, technologies, businesses, or sectors

The 'green turn' within several research fields has undoubtedly led to a myriad of terms that aim to capture the relationship between business and the environment. With regards to green entrepreneurship, it is therefore important to clarify related terms and how they deviate from one another. In this section, the terms green technology, green business and green sector are discussed in relation to green entrepreneurship.

Green technology, cleantech or environmental technology refers to products, processes and services that mitigate negative environmental impacts compared to conventional offerings (OECD, 2011). Most definitions seem to acknowledge that business activities seldom are beneficial for the environment per se, and instead propose a relative understanding of 'green' as less harmful than current (or absent) solutions in the market. One definition of cleantech that illustrates this, and that also applies to the cleantech cases in Article 1, is '*changes in production processes that reduce the quantity of wastes and pollutants generated in the production process or during the whole life cycle of the product (clean products)'* (del Río González 2005: 22). It is also worth mentioning that services and other non-technological innovations tend to be integrated in definitions of cleantech despite the apparent emphasis on 'technology' (Pernick and Wilder, 2007). On this basis, a broad understanding of cleantech largely fits with the term environmental goods and services, which are defined as follows:

> technologies, goods, and services that measure, control, restore, prevent, treat, minimise, research, and sensitise environmental damages to air, water, and soil as well as problems related to waste, noise, biodiversity, and landscapes. This includes 'cleaner' technologies, goods and services that prevent or minimise pollution. (Eurostat, 2009: 29)

For the purpose of providing accounts of the environmental goods and services sector (for statistical objectives), the definition above is operationalised as products, services and associated activities designed for the main purpose of environmental protection (EP) or resource management (RM) (Eurostat, 2016). These types of 'green activities' can be extracted from other economic activities by using statistical classification

systems developed to define the environmental industry, for example the System of Environmental-Economic Accounting (SEEA). In line with the operational definition, the SEEA Central Framework includes activities that directly serve EP[5] or RM[6] purposes. EP and RM activities are identified using classifications that are harmonised with the EU industrial classification system (NACE Rev. 2, see Eurostat, 2008). In this respect, two key classification groups are worth mentioning, CEPA (Classification of Environmental Protection Activities) and CReMA (Classification of Resource Management Activities). These two classification groups, which are further broken down into classes and subclasses (e.g. CEPA6 – Protection of biodiversity and landscapes, or CREMA13B Heat/energy saving and management) comprising activities in which environmental improvement is the primary objective (Eurostat, 2016). To ease data collection and cross-country comparison, the EP and RM systems largely coincide with existing frameworks for industrial classification. For example, activities within CEPA 3.3 – Treatment and disposal of hazardous waste corresponds with (and can therefore be derived from) NACE code E38.22, which also consists of activities related to treatment and disposal of hazardous waste.

For statistical purposes, coherent guidelines and classification systems are needed to delimit the environmental goods and service sector (EGSS). However, it is also pointed out that activities included in the environmental goods and service sector (i.e. activities with EP or RM purposes) only account for parts of the green economy (OECD, 2011; Eurostat, 2016). In relation to green entrepreneurship, it is necessary to broaden our understanding of what the green economy is. This can be done by introducing a distinction between the output approach and the process approach (OECD, 2011). The output approach corresponds to business activities within the environmental goods and service sector (EGSS), in line with the statistical classification systems accounted for above. In other words, it includes businesses whose prime objective is perceived as

[5] Environmental protection (EP) activities include all activities and actions that have as their main purpose the prevention, reduction and elimination of pollution and of any other degradation of the environment (Eurostat, 2016: 12).
[6] Resource management (RM) activities include the preservation, maintenance and enhancement of the stock of natural resources and therefore the safeguarding of those resources against depletion (Eurostat, 2016: 12).

environmental improvement and accordingly restricted to parts of the economy that produce specific types of output such as cleaner air or wildlife protection (i.e. EP and RM activities). By contrast, the process approach includes businesses activities that reduce the ecological footprint in any sector of the economy (OECD, 2011). The latter may include, for example, new processes innovations that improve the environmental performance of cement; producing quality cement will remain the business's primary objective, but they may differentiate themselves from other producers by incorporating recycled material and reduce energy use. In that way, their product would become 'less environmentally harmful than conventional offerings', even though they operate outside the environmental goods and services industry (EGSS) as defined by the output approach. Some key differences between the output approach and the process approach are highlighted in Table 3, which I have developed based on readings of key literature, including that published by the OECD (2011) and Eurostat (2016).

Table 3: Key differences between the output approach and the process approach in terms of defining green business activities.

Output approach	Process approach
Restricted to firms operating in environmental core sectors producing specific types of output	Encompasses greening processes in any sector of the economy
High correspondence with standard industrial classification systems (i.e. NACE, ISIC)	Low correspondence with standard industrial classification systems (i.e. NACE, ISIC)
Environmental benefits are intrinsic to business due to environmental performance being their main objective	Environmental benefits are extrinsic to business, due to environmental performance being ancillary to core activity

With respect to green entrepreneurship, the OECD (2011) points out that both the output approach and the process approach can be used to define the concept of green entrepreneurship:

> Green entrepreneurship could be defined in terms of the technology used for production in any sector of the economy, or in terms of the sectors firms are active in, in which case our attention is restricted to parts of the economy producing specific types of output. (OECD, 2011: 24)

The OCED definition of green entrepreneurship is rather different from the conceptual understandings in the research literature (see section 3.1.1). While the latter tend to

focus on characteristics associated with individual entrepreneurs (e.g. green motivation), the OECD definition focuses on the green value delivered by technologies and is therefore much more closely aligned with the empirical cases explored in Article 1. The OECD (2011: 26) also questions the environmental relevance of intentions in cases where the technical nature of their activities is inconclusive.

The difference between *output* and *process*, as well as the additional complexity of including individual motives into the equation, certainly demonstrates some key issues that arise in attempts to define and measure green business activities. Additionally, firms may develop new (clean) technologies and enter new markets even though they retain their initial NACE codes and descriptions in national enterprise registers. This implies that it could be difficult to identify firms that are 'going green' solely by looking at industrial classifications.

This section has provided some insights into the rather fuzzy concept of *green* in relation to businesses. The academic literature on green entrepreneurship tends to focus on individuals and their motives for engaging in sustainable start-ups (section 3.1.1). This is certainly relevant from a conceptual point of view, but obviously not taken into consideration in statistical accounts. In the latter case, operational definitions tend to rely on coherent frameworks based on industrial classification systems. As a result, the environmental industry consists of certain activities whose main purpose is environmental improvement in line with the output approach. These activities are derived from industrial classification systems, in which green entrepreneurship simply equates to business start-ups registered within environmentally predefined segments, such as CEPA1 (Protection of ambient air and climate) (OECD, 2011). The same methodological challenges also apply to the terms green technology or cleantech, which by definition (i.e. less harmful than conventional offerings), often corresponds to the process approach. As indicated earlier in this section, this implies that the 'green economy' stretches well beyond the scope of the environmental goods and service sector (EGSS). This further suggests that using data from the EGSS to demonstrate environmental progress indicators, such as green export and green job creation, have some obvious limitations.

3.1.3 Green entrepreneurship among start-ups in Norway: survey results and findings

The discussions in section 3.1.1 and 3.1.2 show that there are no clear-cut answers to what green entrepreneurship is, and that the concept is both conceptually and operationally related to other terms (i.e. green businesses or start-ups in the EGSS). The following section discusses the occurrence of green entrepreneurship in the Norwegian industry, using empirical data obtained from a survey conducted in May 2014 in the early stages of my doctoral research. The survey questionnaire, which was distributed to more than 1150 recently formed businesses in Norway, had two key purposes. The first purpose was to obtain survey data to establish a database of green entrepreneurs/businesses for later case studies and fieldwork. Article 1 (micro-perspective) and Article 3 (macro-perspective) of this thesis are both based on research cases (i.e. green start-ups) that were identified from the survey. The second purpose of the survey questionnaire was to enable me to explore empirically how start-ups in Norway assess the environmental value and performance of their business, and how this relates to the theoretical and conceptual discussion in the research literature. In this regard, sections 3.1.1 and 3.1.2 provide a useful backdrop for the empirical analysis that follows, including the methodological reasoning behind the work.

Survey design and distribution

Drawing on the conceptual discussions in the research literature (3.1.1, 3.1.2), the survey incorporate several different criteria that could be used to identify and measure green entrepreneurship, including (1) turnover figures, (2) product/service portfolio, (3) strategic orientation, (4) initial business concept, and (5) intentions. These criteria were selected to include several of the characteristics frequently discussed in the research literature (see 3.1.1). With respect to the discussion on the output approach versus process approach (see section 3.1.2), the survey questionnaire was deliberately distributed exclusively to firms operating outside the environmental goods and service sector (EGSS). The purpose was to identify process firms rather than output firms, and hence to be able to map the 'hidden part' of the green economy (see section 3.1.2).

Further details on the selection process are provided in next subsection (*Population and sampling*).

The survey data were derived from self-reports by managerial staff (predominantly CEOs) of newly established companies. The survey questionnaire combined open-ended questions and fixed-response questions. The open-ended questions were used to obtain general information about the company, whereas the fixed-response questions were intended to yield information about intentions, business concept and other variables that could be used to measure green entrepreneurial activities. The fixed-response questions included Likert scales giving five possible response options anchored by two opposing positions (agree or disagree) as well as a neutral response option. The respondents could not choose more than one option for each question or statement. The questions or statements were presented in Norwegian but are shown translated into English in the captions to Figures 6–10 presented later in this section. The fixed-response questions were also complemented with a comment field that allowed the managers to elaborate on their response. The data obtained from the comment fields proved highly valuable, as many of the comments empirically demonstrated some of the complexity involved in defining what is green, as emphasised in the conceptual discussion (section 3.1.1 and 3.1.2). Before the questionnaire was distributed, it was tested and quality-assured through face-to-face interviews with entrepreneurs and CEOs of five green businesses operating in different sectors. The final questionnaire was distributed to 1154 companies, of which 447 representatives responded, giving a response rate of 39%. The questionnaire was e-mailed directly to the participant CEOs and managers and was open for response for three weeks, 5–27 May 2014.

Population and sampling

The survey questionnaire was distributed to companies that had been selected on the basis of following criteria: (1) business sector, (2) start-up year, (3) organisational form, (4) number of employees, and (5) contact information (Table 4). The selection process was carried out through Proff® Forvalt, an online service database connected to the

official register of business enterprises in Norway (Brønnøysundsregistrene). The register contains key information about all enterprises registered in Norway, including their NACE code, start-up year, organisational form, number of employees, ownership structures, and financial information. Each selection criteria is explained in more detail in the following.

Business sector. First, the companies were selected according to which business sector they belonged. Enterprises registered with the NACE codes listed in Table 4 were initially included, resulting in a preliminary sample of 84,232 enterprises (Table 5). The sectors included were based on the two-digit NACE code and represented a variety of manufacture and processing activities, professional services, engineering activities, and research and development (R&D). As mentioned earlier (see *Survey design and distribution*), this sample was deliberately chosen to exclude the EGSS (i.e. output approach) and instead to focus on activities in the wider economy that might or might not be less harmful than conventional offerings (i.e. process approach). By implication, firms that were intrinsically 'green', such as hydroelectric producers, would not be represented in the survey. Lastly, the selected sectors were adjusted to the Norwegian business context, for example by including particularly relevant industries such as petroleum-related activities, and conversely excluding less relevant sectors such as the manufacture of tobacco products (see Table 4).

Table 4: The industries in which firms that received the survey questionnaire were registered.

NACE group	NACE code	Description
B - Mining and Quarrying	6	Extraction of crude petroleum (6.1) and natural gas (6.2)
C - Manufacturing	10-11, 13-17, and 19-32.	All manufacture, production, and processing activities in section C, except manufacture of tobacco products (12), printing and reproduction of recorded media (18), and repair and installation of machinery and equipment (33)
M - Professional, scientific, and technical activities	71, 72 and 74	Architectural and engineering activities, technical testing and analysis (71), scientific research and development (72), and other professional, scientific, and technical activities (74)

Start-up year. The second selection criterion included a temporal delimitation. Since the survey data were to be used for the further selection of green entrepreneurship cases (Article 1 and Article 3), companies older than ten years were excluded from the sample. At the time when the questionnaire was distributed, this included companies established later than 1 January 2004. This was done to improve the validity and reliability of survey responses, but more importantly the validity of subsequent case studies. Coverage of a longer period would have increased the likelihood of receiving imprecise data, for example due to changing ownership structures, replacement of initial personnel, and recollection difficulties. By adding the age criterion, the preliminary sample was reduced from 84,232 companies to 13,866 companies (Table 5).

Organizational form. As a third criterion, a delimitation regarding organisational form was included in the selection process. The main purpose was to exclude firms registered as sole proprietorship. Despite the name, sole proprietorship businesses can have employees, but they have unlimited personal economic and legal responsibilities. Thus, most sole proprietorships include self-employed persons who provide various services in low-risk markets (e.g. accountants, consultants, cleaning, small repair jobs). Start-ups that are scalable and financially risky (e.g. most technology firms) usually register as private limited companies to reduce risk and gain more credibility in the market. The selection step resulted in a rather small reduction from 13,866 to 12,415 enterprises (see Table 5).

Number of employees. Like the third criterion, the fourth selection criterion was carried out to exclude firms that were irrelevant with regards to mapping green business activities, such as dormant firms and holding companies. To exclude these categories, the sampling only included enterprises that employed 5–99 people, which corresponds to division limits used by the Norwegian statistics bureau (Statistics Norway, 2019). A significant share of the private limited companies had less than five employees, which lowered the preliminary population of 12,415 down to 1860 firms (see Table 5).

Contact information. The fifth and final selection criterion was added to ensure adequate contact information. The email addresses of most of the firm were manually obtained by searching online for each firm (1860 firms) to derive contact information

from their website or equivalent (e.g. firms social media profile). Of the 1860 relevant firms, correct email addresses of CEOs and managers of 1154 firms were obtained. This was a very time-consuming task but also highly valuable, since the contact information in the national enterprise register often were missing, outdated or incorrect.

Table 5: The criteria used to select the study sample.

Selection criteria steps	**1**	**2**	**3**	**4**	**5**
Criterion	Industries according to NACE codes (Table 4)	Start-up year later than 1 January 2004	Organizational form as private limited company	Number of employees in the range 5–99	Access to contact information
Number of firms	84,232	13,866	12,415	1860	1154

Table 5 summarises the chronological selection process based on the sequence in which the steps was presented. Of the 1154 firms that received the survey questionnaire, 447 responded (39%). The survey was administered using SurveyXact, software by Ramboll for producing, distributing, and analysing online questionnaires. Further methodological reflections on the survey are presented in Chapter 4, which covers the research design and methods.

Survey results and discussion

Using two-digit NACE codes (see Table 4), the survey consisted of firm-level data from companies representing 25 different industrial segments. However, before the questionnaire was distributed, the 25 NACE sectors were aggregated into 13 industry categories (of related activities) to reduce the number of categories presented to the respondents. For example, NACE code B.06.1 – Extraction of crude petroleum, and code B.06.2 – Extraction of natural gas were combined to form a joint category, 'extraction of crude petroleum and natural gas', as shown in Figure 5. Based on the 13 new categories, the respondents were asked to mark the single category that most accurately described their business area (Figure 5).

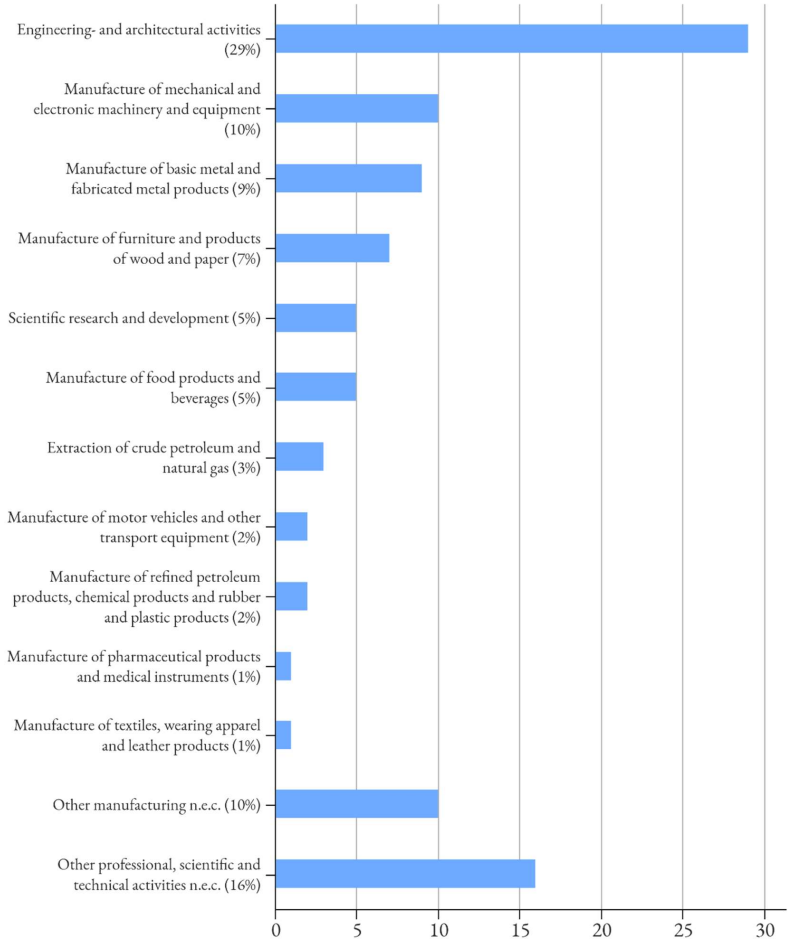

Figure 5: Industrial distribution among the surveyed firms (n = 447).

Figure 5 demonstrates a wide variety of economic activities among the surveyed firms, ranging from oil and gas to food production and medical equipment. Firms engaged in engineering and architectural activities had the highest representation in the survey (29%), followed by manufacturers of mechanical and electronic machinery and equipment (10%), basic metal and fabricated metal producers (9 %), and manufacturers of furniture and other products of wood and paper (7%). Furthermore, many of the firms were engaged in activities that fit poorly with the predefined categories, as demonstrated

by the relatively large share of firms operating in other manufacturing activities and other professional, scientific and technical activities. Combined, the latter two categories comprised 26% of the firms, and represented very diverse activities. For example, the two cases explored in Article 1 were registered in the 'Other professional, scientific, and technical activities' category. It is hard to assess whether the industrial distribution shown in Figure 5 accurately reflects the total firm population, since the survey was based on self-reporting using various joint industrial categories. However, it is likely that the industrial distribution partly reflects the industrial profile of the Norwegian economy (e.g. mechanical manufacture and metals) and partly industries in which environmental improvements are likely to occur (e.g. engineering, scientific and technical activities).

Green the new mainstream?

Initially, it is interesting to note that 57% (i.e. responded 'Agree' or 'Partly agree'; see Figure 6) of the firms reported that they contributed to environmental sustainability by either providing or making use of technologies or services that were less harmful than the dominant market standard (Figure 6). Since the survey relied on self-reporting, the dominant market standard was assessed by the CEOs based on competing firms and technologies present in the market.

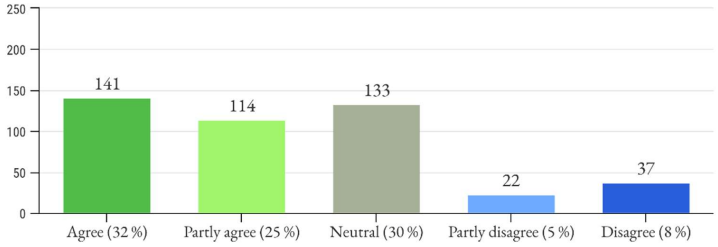

Figure 6: 'Our business contributes to mitigate environmental problems by offering or making use of products and services that are greener than the dominant market standard' (n = 447).

The numbers in Figure 6 indicate that many CEOs and managers believe that their business provides a greener impact than is common in their line of business. There is

obviously a validity issue involved in relying on self-reports as opposed to various quantitative methods such as life-cycle assessment (LCA) or Environmental Product Declaration (EPD). However, regardless of whether 'tangible evidence' supported the responses, the large share of firms that reported they were 'greener' than their competitors clearly demonstrate that CEOs consider environmental performance an important competitive dimension. While some of the survey responses were underpinned by LCAs (e.g. one of the cleantech start-ups explored in Article 1), it is probable that many of the responses reflected an increasing tendency to have some kind of 'green narrative' to showcase. The complementary comment section of the survey questionnaire provided some insights into the reasoning behind some of these responses:

> Our products and services contribute to more efficient drilling operations, which result in less emissions from the rig.
>
> We offer online interpretation services. In this way we reduce the need for travelling.
>
> Environmental technology is implemented in our products, for example low carbon cement.

These quotes reflect how many businesses tend to perceive green as a 'top of the class' phenomenon, relative to the industry of which they are part. This is the case even for 'dirty industries' (e.g. oil and gas); a number of the surveyed firms claimed that their operations made the sector greener than if they were not present in the market. This understanding corresponds to the process approach (see section 3.1.2), as expected due to the survey sampling. Furthermore, 30% ('Neutral') of the responding firms believed that they were neither better nor worse than the market standard, whereas only 13% of the firms ('Disagree' or 'Partly disagree') claimed to be worse than the market standard with respect to environmental performance.

Turnover and green sales

Looking at turnover figures is another way of measuring the 'green part' of the economy (Statistics Canada, 2017). The approach focuses on the demand side rather than business

activities within predefined environmental sectors (see section 3.2.1). Self-reported turnover data from the survey provided some interesting insights. Only 11% of the firms reported having the majority (more than 51%) of their turnover from environmental goods and services. Most firms (48%) did not report any 'green sales', while 31% of the firms reported that less than 20% of their turnover stemmed from environmental goods and services (Figure 7). These turnover figures are not very surprising considering that the environmental goods and service sector (i.e. output firms) was excluded from the firm sample. However, it is noteworthy that that 57% of the firms reported that they provided or utilised products and services that were greener than conventional offerings (Figure 6), yet at the same time hardly reported any 'green sales' (Figure 7). A possible explanation is that many firms deliver goods and services that subsequently contribute to greener 'end-products', even though their own products/services per se fit poorly with the environmental goods and service category. This may indicate that business leaders tend to have a dual conception of green that largely coincides with the output/process distinction emphasised by the OCED (2011).

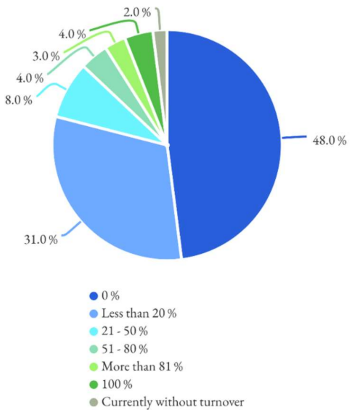

Figure 7: 'How large share of the sales came from environmental goods and services in 2013?' (n = 447).

Many firms tended to report partly green turnover figures. The comment section in the questionnaire revealed that the extent to which sales were perceived as green seemed to be determined by the markets in which they operate or even projects they are involved in:

> We're not a green business, but we do a lot of advisory services related to environmental planning in construction.
>
> The company is involved in a lot of product development and some of the products are environmental technology.
>
> We work on all kinds of construction projects. Some of the projects prioritise environment, but it depends on the client and budget size.

These quotes demonstrate that businesses occasionally may take part in environmental projects that influence on their reported share of green sales. In such cases, a business may even deliver the exact same product or service, yet report it differently due to the environmental orientation of the project on which they have worked (e.g. installation of ventilation system in passive houses instead of in conventional houses). Such cases often appear in relation to discussions on green restructuring. One example includes suppliers that have exclusively provided technical services in the petroleum market (e.g. drilling rigs) which increasingly are turning their attention towards offshore wind projects (Hanson and Normann, 2019). Despite doing what they always have done, some of these suppliers have become commonly mentioned examples of successful green restructuring in Norway (Norsk industri, 2019). A timely question in this regard is whether firm-level restructuring necessitates changes in the internal capabilities of the business (i.e. knowledge, competency, expertise) or simply can be determined by the markets (or projects) they operate in. Often, market orientation and internal capabilities are considered to develop hand in hand, but the above-mentioned examples may indicate that this is not necessarily always the case.

The core activity of the firm

A third defining characteristic of green entrepreneurs that frequently appears in the research literature is the core activity of the business (Isaak, 2002; Schaltegger, 2002). The survey provided data on how CEOs and managers perceived their own firm's core activity (Figure 8). Figure 8 shows that a relatively small share of the firms perceived environmental improvements the core activity of their business.

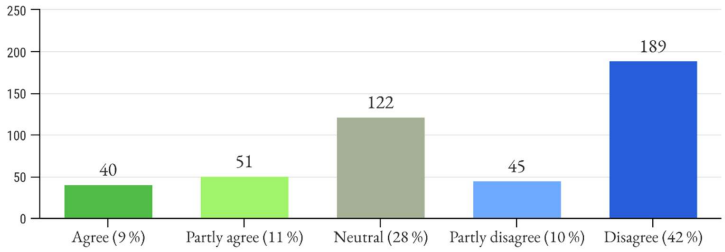

Figure 8: 'The core activity of our business is environmental improvement' (n = 447).

Most of the firms either disagreed or partly disagreed with the statement that environmental improvement was their core activity, while a large proportion of the firms gave a neutral response. These results indicate that relatively few firms identify themselves as a green business, even though they occasionally carry out tasks and operations that are 'green' (see Figure 7). Many of the surveyed firms also had the impression that they were greener than commensurable firms (see Figure 6), even though relatively few CEOs and managers considered environmental improvement their core activity.

The 'green' motive

Motivation is one of the most discussed features in terms of understanding and defining green entrepreneurship (see 3.1.1). It is widely emphasised that green entrepreneurs often have a passionate desire to change the world (Linnanen, 2002). Often, this passionate desire translates into what Isaak (2002) defines as a 'green-green business', a business whose products and services are designed to be green from the start. The questionnaire included two related questions to explore the extent of 'green-green businesses' among the surveyed firms. The first question concerned the environmental orientation in the initial business plan, while the second focused on intentionality in product and service development.

Figure 9 shows that a relatively low proportion of the CEOs either agreed (12%) or partly agreed (14%) with the statement that their firm had a clear environmental orientation in their initial business plan. Most of the firms did not explicitly state that environmental improvements were a key part of their business concept. These numbers (Figure 9) largely coincide with those relating to the firm's core activity (Figure 8).

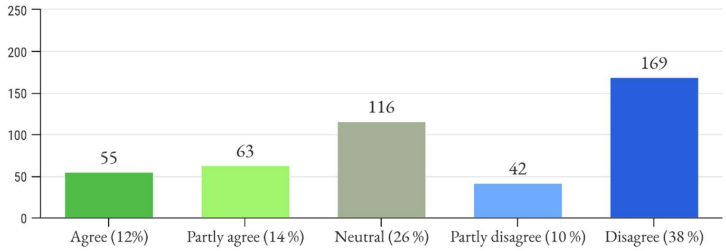

Figure 9: 'The environmental dimension was a key part of the initial business concept that led to the formation of our company' (n = 445[7]).

The clear connection between initial environmental priority and core activity is not surprising, especially considering that the surveyed firms were less than 10 years old at the time when the survey was conducted (see the subsection *Population and sampling*). However, in a long-term perspective, businesses may undergo a transition from conventional to green by gradually moving towards environmental sustainability (Isaak, 2002). Therefore, in the case of older firms it is more likely that their current activities are greener than was the case when they were established, due to increased demand for greener solutions. This leads us to the second question pertaining to intentionality in product and service development. Most of the firms (53%) reported that their business model was based on products or services regarded as non-environmental. Nearly one-fifth of the firms (19%) reported that their products or services had unintended environmental benefits. In line with some of the typologies presented earlier in this thesis, this shows that accidental or unintentional green entrepreneurship probably

[7] The sample size was reduced from 447 firms to 445 firms due to two non-responses. Similarly, the sample size (439 firms) shown in Figure 10 is due to eight non-responses. The total percentages in Figures 9 and 10 are based on their respective n-vales.

represents a certain share of green businesses (see section 3.1.1). The relatively high share of firms (19%) that reported unintended environmental benefits may further indicate that environmental improvement often is a consequence of improvements along other dimensions, for example improved designs or use of materials. This has also been found in earlier studies for which the authors conclude that addressing inefficiency often leads to joint reductions of environmental and economic waste (Hawken et al., 1999; Guenster et al., 2011).

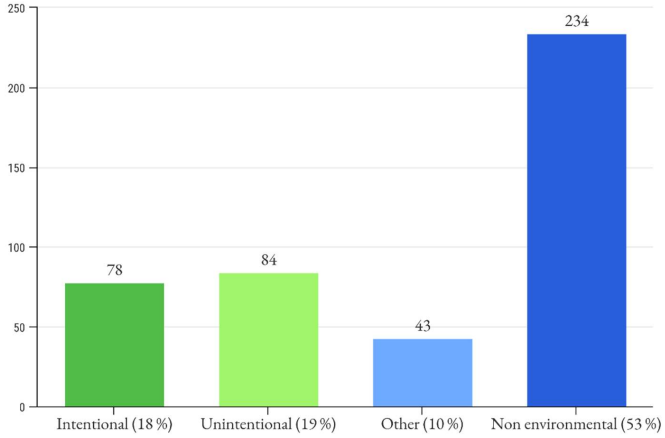

Figure 10: 'Are your firm's products and services intentionally designed to mitigate environmental issues?' (n = 439).

Roughly equal numbers of firms that reported unintentional environmental benefits (19%), also reported that they deliberately incorporated environmental performance into their product/service design (18%). This may reflect the motivation of the entrepreneur, but might also have been intentionally driven by strategic purposes, as noted by one of the respondents:

> The environmental benefits of our technology are not unintended. They are deliberate, but our technology is first and foremost competitive due to other advantages. The environmental benefits are just the 'icing on the cake'.

In such cases, the business will probably appear highly conventional, yet still demonstrate a form of green opportunism, as emphasised in some of the typologies discussed earlier in this thesis (see section 3.1.1).

Summary of the survey

The survey questionnaire (3.1.3) provided empirical material that is not published elsewhere. The survey data constitute an important part of the thesis due to mapping variations of 'green' among newly established firms in relation to state-of-the-art literature on the topic (3.1.1 and 3.1.2). The results of the survey also played a key role in identifying start-ups for further investigations, including the case studies in Article 1 and Article 3. The reported survey connects the theoretical and empirical discussion on green entrepreneurship and related concepts, including green technologies, green businesses, and green industries. By means of empirical data, the survey has demonstrated different ways of measuring green business activities and green entrepreneurship. Moreover, the survey deliberately included firms operating outside the environmental goods and service sector (EGSS) in order to demonstrate how green activities also occur in 'non-environmental' sectors (see 3.2.1). Besides demonstrating how statistical accounts fail to capture the full spectrum of green business activities, the survey also exposed some challenges encountered when theoretically derived concepts were tested and operationalised empirically. For example, more than half of the surveyed firms claimed to provide or utilise products and services that were less environmentally harmful than those provided or utilised by their competitors. Still, few considered themselves a green business when asked about their core activity.

Furthermore, the results of the survey indicate that business leaders often interpret the green dimension in both an absolute and relative sense. The absolute interpretation seems to draw a rather clear boundary between environmental and non-environmental businesses activities. However, where this boundary is drawn is somewhat subjective and does not necessarily coincide with the statistical classifications of environmental and non-environmental activities (see 3.1.2). For example, even though all of the firms operated outside the environmental goods and services sector (due to selection criteria),

20% of the firms still either agreed or partly agreed that environmental improvement was their core activity. In statistical accounting, such as when using the SEEA Central Framework (see section 3.1.2), none of the surveyed firms would be considered part of environmental core sectors, as the latter are restricted industries with an explicit environmental protection (EP) or resource management (RM) purpose (see 3.1.2). By contrast, business leaders often seem to embrace a relative understanding of 'green' based on their comprehension of the 'environmental standard' in the industries and markets in which they operate. Furthermore, the survey results demonstrated another challenge that hardly is emphasised in conceptual discussions of green business activities (see 3.1.1 and 3.1.2). The conceptual discussions tend to label entrepreneurs and businesses as either green or non-green. Based on turnover figures, the survey revealed that many CEOs considered their firm was partially green or at least delivered a green contribution in particular projects in which they were involved. In this case, market demand rather than a clear-cut conception of 'core activity' played a decisive role in the firm's perception of what made them green.

Some authors suggest that a higher degree of convergence in subject-specific terminologies is needed to advance the research field of green entrepreneurship (Schaltegger and Wagner, 2011; Gast et al., 2017). While this is a reasonable argument, the discussion above demonstrates that this probably is easier said than done. Rather than attempting to develop clear-cut definitions, an alternative approach is to acknowledge that green is a highly complex and multifaceted concept that necessitates situational definitions. The latter approach would also allow the research field to advance, given that authors provide accurate, yet situational definitions. In other words, the discussions in the preceding sections suggest that a higher degree of conceptual awareness rather than conceptual convergence is needed. This is not unusual for terms that are criticised for being *floating signifiers*,[8] such as sustainable development (Kögl and Kurze, 2013), which conceptually comprises social, environmental, and economic dimensions that are open to different ascriptions of meaning depending on the context.

[8] Floating signifier or empty signifier is a term used to describe words and concepts that do not have a specific meaning in themselves, but instead function as a vehicle for absorbing meanings that readers want to impose upon them (Oxford Reference, 2020).

The preceding three sections have discussed green entrepreneurship and related terms and concepts from both a theoretical and empirical point of view. Some of the issues that have been discussed are further elaborated upon in Article 1, based on case studies of two cleantech start-ups. A summary of the first article of the thesis *'Green entrepreneurship in rural locations: Motivations, strategies and structures'* is given in the next section to conclude the theoretical and empirical discussion of the micro-level perspective (section 3.1).

3.1.4 Article 1: Summary

Article 1 explore three research questions through in-depth case studies of two clean technology start-ups based in rural locations in Western Norway. In line with the micro-level perspective (see section 1.2), the article takes a closer look at green value-creation initiatives through the eyes of green entrepreneurs. The study starts by exploring the motivations and triggers for the start-ups, which is followed by a thorough discussion of how the entrepreneurial teams sourced strategic partnerships and funding, and how that had been influenced by the 'green value' of their businesses. Lastly, the article establishes a bridge to the meso-level perspective by discussing the role of the rural communities encompassing the start-up processes. The latter represents geographical contexts that, despite 'institutional thinness' (e.g. opposed to the cleantech clusters explored in Article 2), offered something unique to the establishment of the two cleantech start-ups.

First, Article 1 demonstrates how cleantech firms can emerge from rather conventional entrepreneurial endeavours. The study offers an alternative conception of the 'green entrepreneur' that fits rather poorly with dominant understandings in the research literature, in which there is a tendency for 'green entrepreneurs' to be portrayed as individuals motivated by a mix between environmental idealism and economic profit (see section 3.1.1). Instead, a desire to outwit the dominant market standard and at the same time make a living from their hobby were important motives for the green entrepreneurs explored in Article 1. The 'green' part of the entrepreneurship happened

to be integrated in the envisioned technical design, but was neither the main purpose of the business, nor a strong personal motivation for the entrepreneurs. However, in both cases the environmental value of their business represented an advantage that was used strategically in relation to finding partners, recruiting personnel, and obtaining financial capital. Second, the article elaborates on how the entrepreneurs successfully managed to develop advanced cleantech firms from rural locations by creating 'green' task environments. While the research literature tends to treat geographical proximity to innovation resources as a uniform quality for high-tech entrepreneurship, Article 1 draws on the concept of 'task environment' to provide a more nuanced understanding of when, for what, and with whom geographical proximity is considered important in start-up processes. The latter indicates that relational abilities in concert with online information and communication in many stages of the establishment process can compensate for the need for proximity to innovation resources. For certain activities and partnerships, geographical proximity is still required, but is not necessarily decisive in situations where social proximity can operate across space. Lastly, Article 1 demonstrates how rural communities influenced the start-ups and were even valuable in certain stages of the start-up processes.

3.2 Meso-level perspective: cleantech clusters

While the first part of Chapter 3 has dealt with the micro-level perspective in this thesis, the following sections elaborate on the meso-level perspective (see section 1.2). The meso-level perspective focuses on the formation of cleantech clusters. Cleantech clusters are expected to play a key role as incubators for green value creation and through this be a tool for greening the economy (Gray and Caprotti , 2011; Sjøtun and Njøs, 2019).

For decades, economic geography has been preoccupied with the economic performance of regions, including how regions innovate and restructure. In this connection, spatial concepts at subnational scale, such as business clusters and regional innovation systems (RIS), have frequently been the unit of analysis. The spatial dimension is also presumed to play key role in green transitions, but few attempts to explore the role of geography in relation to green industry development have been made to date (Capasso et al., 2019). Exploring cleantech clusters is one way of approaching the relationship between geography and green industry development. Numerous studies have investigated conventional business clusters (Lu et al., 2018), but few contributions have explicitly addressed those that are focused on cleantech development. Studies specifically addressing cleantech clusters are reviewed in section 3.2.4, following a broader introduction to the meso-level topic. The introduction consists of three sections covering the ontological underpinnings of meso-level concepts, including business clusters (3.2.1), the conventional business cluster concept (3.2.2), and theories of how business clusters emerge (3.2.3).

3.2.1 Structure over agency

For decades, research on innovation and industrial restructuring has been inseparably bound with the spatial settings in which firms and industries are embedded (De Groot et al., 2015). Considerable research has been conducted on the relationship between spatial

settings and economic performance, culminating in several theories and concepts, including business clusters (Porter, 1990), regional innovation systems (Cooke et al., 1997) and urban agglomerations (Jacobs, 1969; Florida et al., 2017). Common to all of these concepts is an interest in the physical, financial, and human capital of places and regions, and how this affects the capacity of individuals and firms to innovate and thrive. By looking at the spatial setting in which firms and entrepreneurs operate, geographical perspectives give primacy to the structural conditions encompassing business activities. In this sense, the geographical context is seen as a confined space of certain qualities and capabilities that may restrain or encourage innovation and restructuring (Shearmur, 2011). These geographically embedded qualities and capabilities include both tangible assets (e.g. firm composition, R&D, funding opportunities) and intangible assets[9] (e.g. culture, norms, informal institutions). The spatial concentration of tangible and intangible assets is further coupled with procompetitive mechanisms that are strengthened by geographical proximity (Boschma, 2005), including labour mobility, knowledge spillovers, shared infrastructure, and other spatial externalities.

The ascription of the vitality of business communities to spatial conditions originates in the work of Alfred Marshall (1890) and his studies of industrial agglomerations in England. Marshall was particularly concerned with knowledge spillovers and proximity effects within specialised industries, and how such mechanisms caused firms to agglomerate (Marshall, 1890; 1919). The interest in proximity effects within specialised industry agglomerations were eventually rediscovered by other scholars, including Arrow (1962) and Romer (1986), to form what subsequently became known as MAR spillovers (after Marshall, Arrow and Romer) (Glaeser et al., 1992). MAR spillovers include external economies of scale related to the exchange of knowledge and ideas between co-located firms, which ultimately is believed to encourage innovations and growth. According to this stream of literature, the possibilities for such spillovers to take place is largely determined by the degree of firm specialisation (horizontally and vertically linked firms) and the geographical proximity between them (Porter, 2000).

[9] Intangible assets largely correspond to what often are referred to as 'untraded interdependencies' (Storper, 1995).

These two conditions constitute key premises in business cluster theory popularised by Michael E. Porter in *The Competitive Advantage of Nations* (Porter, 1990). Concurrently with the specialisation paradigm, an opposing explanation of proximity effects between firms emerged. Inspired by Schumpeter's notion of new combinations (Schumpeter, 1939), Jacobs (1969) wrote *The Economy of Cities*, in which she argues that recombinant processes based on knowledge derived from diversified industries drive regional economies forward. Jacobs (1969) argues that the variety of knowledge and resources typically found in cities increases the capacity to continuously generate new products and services. The diversity perspective, commonly referred to as 'Jacob's externalities', remains highly relevant in contemporary research on urban innovation, including studies of how creative industries tend to agglomerate in cities (Mellander and Florida, 2014; Florida et al., 2017).

For many years, specialisation versus diversification represented two contrasting stands within economic geography (van Oort, 2015). This stalemate was further consolidated by ambiguous empirical evidence that both corroborated and disapproved the alleged agglomeration externalities associated with the two stands (De Groot et al., 2015). Following the 'evolutionary turn' in economic geography, Frenken et al. (2007) introduced the concept of related variety as an attempt to reconcile the two opposing views on how regional industry structures impact both innovation capacities and restructuring capacities. The related variety perspective implies that neither diversification nor specialisation per se, but rather a form of 'specialised diversity' provides optimal conditions for innovation and restructuring. According to this perspective, regional industries that are technologically related are more likely to merge resources and knowledge, unleashing processes of innovation and regional branching (Boschma, 2017). In this way, firms may operate in different sectors (representing 'variety') yet build upon similar technological knowledge and know-how (i.e. 'related') to create new industrial trajectories. From a policy perspective, this resonates with contemporary smart specialisation strategies (RIS3) that currently are being widely adopted across Europe to support industry renewal at the regional level (European Commission, 2019). In line with the promises of related variety, smart specialisation strategies aim to develop new specialisation areas based on knowledge and

competencies that are related and already present in the region. This allows regions to branch into new fields, thereby increasing regional competitiveness and resiliency (Neffke et al., 2011; Boschma, 2017).

The three paradigms, specialisation, diversification, and related variety reflect key developments within economic geography regarding how the meso-level (i.e. regional structures and assets) impacts the micro-level (firms/entrepreneurs innovation capacity). Despite their obvious differences, they all give primacy to the external environment in which firms operate (i.e. structures and institutions), rather than exploring the internal workings of the firm (i.e. firm-level agency). In other words, meso-level concepts typically depart from a socio-spatial ontology in which economic actions (and hence aggregated outcomes) are shaped by business structures and the sociocultural context in which they are located (Plummer and Sheppard, 2006). The lack of agent-sensitive perspectives in meso-level theories implies that firms and individuals are treated as 'black boxes', which implicitly are presumed to respond a certain way to regional conditions. Inspired by related research within management and organisation fields (Sydow et al., 2009; Karnøe and Garud, 2012), the structural primacy within economic geography has been criticised for largely omitting the role of agency. For instance, it is emphasised that structural explanations of regional restructuring hardly account for the heterogeneity and complexity among firms, including different strategies, motives, and rationalities (Steen, 2016). In line with the broader structure-agency debate, this critique has lingered for decades, but has lately intensified (Njøs, 2018).

Recently, evolutionary economic geographers have responded to the critique by introducing system agency in their analyses (Njøs, 2018). System agency refers to actors that somehow bring about changes at the structural level, for example by establishing new cluster initiatives (meso-level agency, see Article 2) or advocating for market enabling policies (macro-level agency, see Article 3). In this way, system agency allows for greater emphasis on what actors do, while still retaining a socio-spatial ontology. In other words, agents are considered important units of analysis due to their ability to induce structural changes at the meso-level and macro-level, which in turn

influence micro-level agency. By analysing how actors shape their system (and vice versa), the perspective explicitly incorporates a dialectic and recursive relationship between structure and agency, in line with structuration theory (Giddens, 1984). However, this perception of agency is still considered inadequate by those who call for greater emphasis on firm-sensitive accounts within economic geography (Steen, 2016). Inspired by behavioural thinking (Montello, 2013), a firm-level perspective is more concerned with the internal workings of businesses and entrepreneurs in order to gain a better understanding of how motives, strategies and innovation play out in different socio-spatial contexts (i.e. opening up the black box). This perspective, which is adopted in Article 1, is therefore concerned with firm-level agency (e.g. entrepreneurs) as opposed to system agency, despite both types being methodologically conceptualised as actor-centred analysis (Njøs, 2018). By contrast, Article 2 explores green value-creation initiatives at the meso-level through studies of cleantech clusters. While studies specifically focusing on cleantech clusters have been scarce, there is still a large body of literature on conventional business clusters. Therefore, a brief discussion of conventional cluster theory is provided in the following section to complement the literature review (section 3.2.2). The latter particularly focuses on how business clusters emerge (3.2.3), which constitutes the main research question addressed in Article 2.

3.2.2 Business clusters

While published studies of proximity effects and external economies of scale have been available for more than a century (see 3.2.1), Michael Porter's book, *The Competitive Advantage of Nations* (1990), played a key role in reviving interest in business clusters from a research and policy perspective. Initially, Porter saw clustering of firms as a countrywide phenomenon based on conditions in the national environment (Porter, 1990). In his later work, the cluster concept became more aligned with subnational scales, as demonstrated by his definition of business clusters as a 'geographically proximate group of interconnected companies and associated institutions in a specific field, linked by commonalities and complementarities' (Porter, 2000: 16). Apart from

geographical proximity, the definition also emphasises firms in specific fields. This include businesses that are vertically linked (customers-suppliers) and horizontally linked (in the same part of the value chain), which largely corresponds to the notion of specialised agglomerations (see 3.2.1). Furthermore, Porter's definition of business clusters highlights associated institutions as distinct from the firms. Like geographical proximity, the emphasis on associated institutions (e.g. universities, technology transfer agencies, incubators) became more prevalent in Porter's his later writings (Lindquist, 2009).

Between 1990 and 2000, the cluster concept developed into a theory that aimed at explaining the competitiveness of specialised firms that are located close to each other, typically supported by a broader complementary innovation infrastructure (associated institutions). The cluster concept is clearly related to other meso-level theories (e.g. Marshallian agglomerations and regional innovation systems) but remains quite unique in terms of its systematic focus on explaining the processes and mechanisms that are claimed to increase the competitiveness of clustered firms. The latter is summarised in Porter's diamond model, which comprises four determinants for competitiveness: (1) factor conditions, (2) demand conditions, (3) firm strategy, structure, and rivalry, and (4) related and supporting industries (Porter, 2000). The diamond model, including the four determinants, is briefly explained below.

Factor conditions. Factor conditions include access to and availability of local resources, which comprise natural assets (e.g. oil, solar, climate) and human capital (innovation infrastructure, skilled labour, research capacities within relevant fields).

Demand conditions. Demand conditions include the presence of sophisticated customers that push suppliers (and sub suppliers) to innovate and continually improve the quality of their products and services, thereby creating innovation pressure throughout the entire business cluster, and hence the value chain.

Firm strategy, structure, and rivalry. Due to firms' composition in clusters (i.e. horizontally and vertically connected firms), the structure encourages rivalry between firms, forcing them to continually look for areas of improvement. Fierce local

competition will eventually result in unique capabilities within certain fields, thus increasing the performance gap between clustered firms and outside competitors.

Related and supporting industries. Besides firms that are directly engaged in the value-chain, related and supporting industries constitute a key subsystem of business clusters. Related and supporting industries contribute to a wider innovation infrastructure by providing input from adjacent fields and occasional feedback that is important for specialised clusters to excel.

The four determinants work together to increase the competitiveness of business clusters, as illustrated in Figure 11. In addition to endogenous processes within the clusters, their performance can be influenced by external factors, namely chance and government.

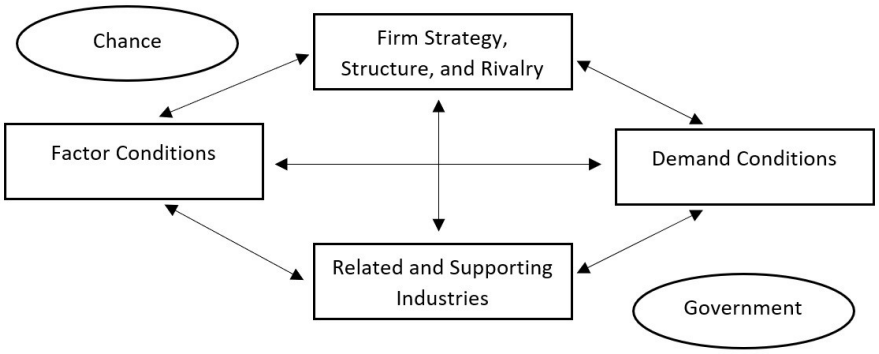

Figure 11: Porter's diamond model (Porter, 2000), reproduced from Tsiligiris (2018).

Chance. The role of chance is acknowledged as an external and partly unforeseen component with the potential to alter the landscape in which firms operate. Geopolitical crises, famines, and environmental disasters are chance events that may lead to increased demand or other advantages among clustered firms. A recent, yet unprecedented, example is the COVID-19 outbreak, which altered the global demand for goods and services overnight.

Government. Government is another external factor that may influence the performance of clusters. Regulation, such as in the form of new environmental demands, can alter the demand conditions (Figure 11) and give rise to new products and services. Government can also play a key role in changing the factor conditions, for example by introducing new educational programmes or by improving infrastructure to increase the communication and mobility of firms.

Following the introduction of the cluster theory, a considerable amount of empirical research has been conducted in efforts to validate, elaborate on, or disapprove the theory (De Groot et al., 2015). Most of the cluster literature focuses on the performance (e.g. innovation, start-ups, economic growth) and mechanisms (e.g. labour mobility, university links, other proximity effects) of business clusters (Hassink, 2016; Lu et al., 2018). In this regard, there is relatively strong evidence suggesting that organising economic activities in clusters improves the competitiveness of local firms (Lu et al., 2018). However, many studies have been criticised for being biased towards successful case locations, indicating that the cumulative empirical evidence relating to cluster performance poorly reflects the diversity of business clusters (Kasabov, 2011). This critique is accompanied by several studies in which the authors question the presumed effects of cluster localisation. For example, Dahl-Fitjar and Rodriguez-Pose (2017) demonstrate how innovative partnerships among clustered firms emerged from deliberate partnership searches that had little to do with merely 'being there'. Moreover, Giuliani (2007) demonstrates how cluster structures per se hardly facilitate learning and innovation, but rather depend on the position and presence of firms in local strategic networks. Contributions such as those by Giuliani (2007), Kasabov (2011), and Dahl-Fitjar and Rodriguez-Pose (2017) demonstrate that there is dissention about the effects of co-location in clusters. However, the uncertainty with regards to cluster effects has not lessened the interest in clusters from a policy perspective. Since the mid-1990s, accommodating for cluster development has been considered one of the most powerful policy instruments in business development issues, at both the regional level and national level (Solvell, 2015). In recent years, cluster initiatives have increasingly been adopted to support a shift towards the green economy (see Article 2 and section 3.2.4).

The above-presented introduction to the business cluster concept (3.2.2) serves to present also the broader theoretical context in which the concept of cleantech clusters has originated. Article 2 deals specifically with the formation and structure of cleantech clusters. This topic has barely been studied in relation to conventional business clusters (Hassink, 2016), let alone in the cleantech cluster literature, which only represents a fraction of the literature (see 3.2.4). The next section reviews relevant literature on cluster formation, followed by a discussion of cleantech clusters.

3.2.3 Cluster formation

A considerable number of studies has scrutinised how clusters perform (see Lu et al., 2018), but few studies have explored how they form (Lorentzen, 2005; Hassink, 2016). The exception includes the emerging literature on cluster life cycles, of which cluster formation constitutes part of the research agenda (Fornahl et al., 2015). Cluster life-cycle perspectives aim at explaining how clusters evolve over time, from inception and through different development stages, and in some cases eventually leading to stagnation and decline (Menzel and Fornahl, 2010). The interest in cluster development over time has been largely inspired by evolutionary thinking within economic geography (Boschma and Frenken, 2011) and offers a rather different perspective to the dominant focus on cluster performance and cluster mechanisms (Lu et al., 2018). The cluster life-cycle literature tends to focus on the role of actors, networks, and institutions, and how these three constituents influence cluster development. The role of these constituents in relation to cleantech cluster development is discussed in more depth in Article 2, based on empirical evidence from Graz, San Diego and Dublin.

While studies of cluster formation per se represent a rather novel contribution in the research literature (Hassink, 2016), they are still related to the wider literature in (evolutionary) economic geography concerned with how regional industries arise and renew (Scott and Storper, 1987; Neffke et al., 2011; Boschma, 2017). Prior to the evolutionary turn in economic geography, Scott and Storper (1987) proclaimed that

emerging industries experienced considerable freedom with respect to location because spatial conditions (e.g. access to knowledge, labour) were novel to the industry and therefore had to be created. Over time, an ecosystem of suppliers, knowledge, capital, and labour will develop in regions and eventually anchor firms to certain places due to localisation factors (Scott and Storper, 1987; Storper and Walker, 1989). Gradually, such development trajectories will lead to the formation of business clusters or regional innovation systems. However, the initial localisation pattern of new industries was, according to Scott and Storper (1987), largely ascribed to chance events, since the spatial preconditions for new industries to emerge was considered evenly distributed across the geographical landscape. With rising interest in evolutionary thinking, the emphasis on chance came under scrutiny (Martin and Sunley, 2006; Boschma and Frenken, 2006). Inspired by the concept of path dependency, the explanatory power given to chance has largely been replaced by giving primacy to locally embedded resources of the past (Frenken et al., 2007). Rather than accepting that new industries are developed by chance from an unbiased point of departure (Scott and Storper, 1987), the evolutionary path-dependency perspective claims that newly emerging industries are a product of inherited regional conditions. This particularly includes spatially embedded knowledge and institutions, which new economic activities tend to build upon (Boschma and Frenken, 2003). In this way, regions reproduce socio-spatial structures, creating industrial trajectories that tend to shape the industrial future of regions (Neffke et al., 2011). On this basis, new industries are more likely to emerge and succeed if they are related to existing economic activities present in the region (cf. related variety, see 3.2.1). Combining industrial activities that are technologically related will encourage processes of *path renewal* and typically lead to regional branching (Neffke et al., 2011; Isaksen, 2015; Boschma, 2017). Processes of regional branching based on related activities are the main goal of smart specialisation strategies that have been adopted in many regions across European since 2011 (European Commission, 2019). However, some regions may experience that regional branching is challenging, due to dominant economic activities with weak potential for cross-industry innovation. In such cases, regions are more likely to specialise through processes of *path extension*, which involves strengthening existing regional industries through

incremental innovations (Isaksen, 2015). A third approach involves creating regional trajectories that are completely unrelated to existing activities (i.e. *path creation*). The latter deviates from the notion of path dependency and usually requires importation of commercially relevant knowledge from elsewhere (Isaksen, 2015). For example, the establishment of university departments or relocation of large corporations may bring in new knowledge bases to promote processes of path creation. Article 2 demonstrates how all of these regional development paths (renewal, extension, and creation) are useful for understanding how the respective case cleantech clusters have emerged. However, these different paths only tell part of the story of how clusters may emerge, as they tend to view development of new economic activities as a somewhat structurally determined process shaped by the industry and knowledge composition of regions. This view hardly accounts for clusters that are formed deliberately in efforts to strengthen new or strategic areas that are relatively peripheral to a region's core activities. This can, for example, be driven by restructuring or rebranding concerns and could play a crucial part in cluster development, as shown in Article 2.

As discussed in this section, understanding how regional industries form (including clusters) requires careful analysis of developments in the past (path dependency), but also how the present interplay between actors, networks and institutions creates breeding grounds for new economic activities to emerge (Menzel and Fornahl, 2010). The latter may also include strategic cluster initiatives or other forms of system agency practised deliberately to steer resources in certain directions. Article 2 explores these issues in more detail, based on empirical evidence from three emerging cleantech clusters, a concept that is discussed further in the next section.

3.2.4 Cleantech clusters

Since 2010, economic geography has increasingly shown interest in the relationship between spatial settings and green transformations (Coenen and Truffer, 2012; Hansen and Coenen, 2015; Capasso et al., 2019). This relationship can be studied in many ways,

for example through research on industrial symbiosis (Jensen et al., 2011), green incubators (Fonseca and Jabbour, 2012), or by exploring the role of geography in sustainability transitions (Hansen and Coenen, 2015). This thesis approaches this research task through case studies of cleantech clusters (Article 2). Like conventional clusters, cleantech clusters refer to agglomerations of firms and the associated proximity effects that can be derived from this type of spatial organisation (section 3.2.2). In contrast to conventional clusters, the cleantech variant comprises firms that provide products and services with a greener impact. By reconciling the competitive promises of clusters with environmentally sound activities, cleantech clusters are considered a win-win strategy (Marra et al., 2017) and a desirable approach to green growth (see section 2.2). Commercial industry developers, local authorities and businesses are increasingly engaging in cleantech cluster initiatives (see Article 2, Supplementary Appendix). These initiatives include both narrowly defined clusters (i.e. geographical concentrations of cleantech firms), such as the cases explored in Article 2, and networks of dispersed cleantech actors that are organised as virtual business clusters (Davies, 2013). Moreover, cleantech clusters vary in their degree of specialisation, from technology oriented (e.g. Norwegian Offshore Wind Cluster), to sector oriented (e.g. Renewable Energy Hamburg) and to more diversified cleantech clusters comprising a variety of green industries (e.g. Green Tech Valley). Despite the tendency to organise cleantech activities in clusters (spatial or virtual), the academic interest in cleantech clusters has so far been rather limited. Some exceptions include the studies by Gray and Caprotti (2011), McCauley and Stephens (2012), Davies (2013), Hatch et al. (2017), Marra et al. (2017), and Sjøtun and Njøs (2019).

The article by Gray and Caprotti (2011) represents one of the first contributions that aims to bridge cluster theory with the cleantech segment. Their study analyses the Copenhagen climate cluster, the Masdar initiative, and virtual cleantech clusters to determine factors that contribute to their success or failure. Adequate government backing, promotion of higher education and making use of existing regional strengths are seen as key success criteria to their development (Gray and Caprotti, 2011). McCauley and Stephens (2012) provide a more in-depth analysis of a green energy cluster in Central Massachusetts, USA. They analyse the energy cluster from a socio-

technical perspective, demonstrating how cleantech clusters may act as intermediaries between niche-level activities and institutions at the regime level. Hence, the cluster is expected to play a key role in diffusing clean technologies and practices within and outside the region (McCauley and Stephens, 2012). Davies (2013) provides a more critical reflection on the practices and potentialities of cleantech clusters and what they offer in terms of inducing transformational change. Hatch et al. (2017) explore the role of Ecotech in promoting green transition. Ecotech is a cleantech cluster in Quebec, Canada, which functions as an intermediary organisation by bringing together multiple actors from the public, private and civic domain. In addition to having the conventional role of promoting innovation and commercialisation in the local industry, Hatch et al. conclude that Ecotech plays a formative role in shaping the position and collective mobilisation of actors in relation to the green transition (Hatch et al., 2017). Marra et al., (2017) provide a more methodological contribution to the cleantech cluster literature. They investigate agglomerations of green businesses in San Francisco, New York and London using network-based analysis of technological innovations. The method is useful for identifying specialisations, as well as technological and market complementarities within local cleantech clusters (Marra et al., 2017). Additionally, the method can be used in the design and implementation of policies and to facilitate closer relationships between cluster firms that are technologically related. Lastly, Sjøtun and Njøs (2019) explore how clusters and cluster policies can achieve directionality and reorient themselves towards a greener economy. By means of empirical investigations of three business clusters in Western Norway, they argue that insights from both evolutionary economic geography (EEG) and transition studies (TSs) are needed to inform cluster theory on how to achieve 'green' directionality in cluster evolution and policy (Sjøtun and Njøs, 2019).

Additionally, two more recently published studies related to the cleantech cluster topic are worth mentioning, namely those by Grillitsch and Hansen (2019) and Sotarauta and Suvinen (2019). Their studies do not focus on cleantech clusters explicitly, but rather more generally on how regions may promote green value creation. Grillitsch and Hansen (2019) explore the opportunities for green industry development in different types of regions. They show how the strategies and paths to a green economy differ

according to the regional setting, including peripheral regions, specialised 'green regions', specialised 'dirty regions', and metropolitan regions (Grillitsch and Hansen, 2019). Different regional preconditions for green industry development is further discussed in Article 2 of the thesis. Sotarauta and Suvinen (2019) take a slightly different approach by exploring how place leadership could promote green growth in regions. Through empirical studies of two regions in Finland, they demonstrate how place leaders promote green institutional paths by encouraging development processes that revolve around collective learning, as well as collective generation and dissemination of knowledge.

My review of the cleantech cluster literature shows that while the topic has received some attention in the last decade it still remains a rather immature research field. Hence, further research is needed to extend our theoretical and empirical knowledge of cleantech clustering. Article 2 combines the novelty of empirically looking into cleantech clusters from a research perspective that even in the context of mainstream cluster literature has been rather unusual, namely how clusters emerges (see section 3.2.3). Moreover, Article 2 elaborates on the structure of the case cleantech clusters, and how they differentiate from Porterian business clusters (3.2.2). A summary of the second article of this thesis, titled *'The formation and structure of cleantech clusters: Insights from San Diego, Dublin and Graz'*, is provided below to conclude the meso-level perspective.

3.2.5 Article 2: Summary

Article 2 addresses two research questions through in-depth case studies of three internationally recognised cleantech clusters, respectively located in San Diego, Graz, and Dublin. First, the article explores key factors that have been involved in the formation of the case clusters. Second, it sheds light on their structure and composition. With respect to structure and composition, the case cleantech clusters are all much more diversified compared with conventional business clusters (3.2.2). Moreover, the

cleantech clusters are not production oriented (i.e. value chain clusters linked by suppliers of specialised inputs) but are rather focused on developing collaborative knowledge and innovation platforms to promote innovation and growth in regional cleantech activities. This is reflected in their comprehensive cluster composition that consists of specialised firms with a clear environmental orientation, as well as more generic innovation system partners involving members from the private, public, academic, and civic sectors.

While the structure and mandate of the case cleantech clusters share many similarities, the processes and triggers involved in their formation have been rather different. First, this relates to the initial motive for establishing regional cleantech clusters. The case cluster in San Diego was launched to identify and seize green market opportunities following new state-wide legislation (Assembly Bill 32), which set clear greenhouse gas emission targets for the state of California. By contrast, the cleantech initiative in Graz emerged in the wake of a broader restructuring and rebranding effort driven by regional and local authorities. In the third case, the Dublin cleantech cluster represents a subnational strategic initiative that was mainly motivated by inadequate attention from central government regarding support for cleantech activities. Second, prior to the establishment of the cleantech clusters, place-specific conditions and local capabilities played a crucial role in forming the content and industrial pivot of the cleantech clusters as they exist today. In San Diego, this included a combination of locational assets, regulatory changes, and scientific knowledge within the life sciences. In the Austrian case, industrial capabilities within traditional industries, in concert with institutional and political changes following the economic crisis of the 1980s within the steel and metal industry of Styria, were highly important in forming the cleantech cluster. In the third case, attraction of foreign hardware and software companies to the Dublin region, and the subsequent intertwining between the ICT industry and cleantech activities played a decisive role. This demonstrates how unique geographical settings may encourage green industry development. Having said this, ‘green’ or ‘clean’ is a rather flexible designation (i.e. process approach, see section 3.1.2) implying that many regions or industries have potential for cleantech cluster development.

The lessons derived from Article 2 inform the relationship between path dependency and place leadership (system agency). The empirical discussion indicates that the development trajectories leading up to the present-day cleantech clusters tended to follow patterns that conformed to path extension (Dublin), path renewal (Graz), and path creation (San Diego) (see Article 2 for further discussion). Although these path development processes played a key role in forming the industrial basis for cleantech clusters to emerge, the actual cluster initiatives are largely a result of deliberate place leadership triggered by various conditions, such as changing markets, restructuring needs, and environmental regulations.

3.3 Macro-level perspective: market structures and demand mechanisms

Certain approaches to a green economy rely heavily on behavioural change among consumers, as discussed in section 2.1. In line with the degrowth approach (see section 2.4), this includes individual actions and choices that strive for carbon neutrality, for example by abstaining from air travel. By contrast, a green growth approach (see section 2.2) to travelling by air would strive for investments and innovations that would enable people to fly as usual but with minimal environmental impact, for example through electrification of airborne traffic fuelled by renewable energy. Thus, green growth tends to address the environmental challenges through a top-down approach based on innovations rather than through consumer behaviour, which represents a bottom-up approach in battling environmental problems. This thesis explores green value-creation initiatives, implicitly endorsing the idea that businesses (in concert with policymakers) rather than consumers should be in the vanguard of solving the environmental crisis. At the individual level, the one obviously does not rule out the other. However, from the perspective of incorporating environmental sustainability in the economic and political system, creating markets that enable green value creation to unfold appears to be more viable approach than relying heavily on environmentally conscious consumers. The latter point is further explained in the next section, which forms the introduction to the macro-level perspective in this thesis.

3.3.1 Letting people decide or deciding for people?

While the environmental insurgence seems to be stronger than ever, there are still big questions marks about the scope, scale, impact, and permanency of entrusting consumers to solve the environmental crisis through degrowth behaviour.

First, the scope of the problem concerns the extent to which degrowth lifestyles will resonate with critical masses of the population or merely comprise small idealistic groups in a society. While making sustainable choices arguably has become a trend in

some parts of the world (see Chapter 2), most people in affluent countries are still consuming far more than what has been measured as sustainable based on the ecological footprint methodology developed by the Global Footprint Network. For example, in Norway, the ecological footprint per capita was 5.5 gha[10] in 2019, whereas the global sustainability limit (i.e. the equilibrium between human demand and available resources) per capita is 1.63 gha (Hofstad and Andersen, 2020). Given the large discrepancy between current consumption and the set sustainability limit in many countries, it is highly unlikely that the goal can be met solely by making environmentally sound choices.

Second, scale deals with the observed spatial differences with respect to environmental awareness. In this connection, Western affluent societies are more likely to be susceptible to a post-growth regime in which environmental sustainability constitutes a key societal objective. However, it is less likely that developing countries will prioritise environmental sustainability over other UN sustainability goals such as no poverty (goal 1), zero hunger (goal 2), good health and well-being (goal 3), and quality education (goal 4). Economic growth is a precondition for achieving these goals. Theoretically, and in line with promises of 'green growth', the required economic growth could potentially be 'green' and hence completely aligned with the UN sustainability agenda. However, it is rather unlikely that this 'win-win' scenario will be achievable in developing countries, given the low level of education, poor infrastructure, political instability, and other structural impediments that often characterise them.

Third, impact concerns the sufficiency and effectiveness of changing consumption patterns in relation to climate change and other environmental challenges. The life cycle of goods and services is often highly complex, and the environmental performance of goods and services is influenced by myriad of factors in the production system concerning materials, energy, transportation, disposal, and recycling. It is claimed that this complexity makes it challenging for consumers to comprehend the environmental

[10] Global hectares (gha) is the standard unit used to measure ecological footprints (Global Footprint Network, 2020). It accounts for a range of consumptions, including energy, water, food, wood, building materials and other resources which are converted into a standardised land area measure (gha).

credentials of goods and services, and hence difficult for people to make choices that alleviate environmental strain (Cohen and Winn, 2007). Often, the complexity and lack of transparency seems to be countered with simplistic environmental narratives about products that tend to be largely incomplete. For example, electrical vehicles are frequently heralded (and perceived) as a sustainable alternative to fossil fuel cars, even though life-cycle assessments (LCAs) have provided inconclusive results (Nordelöf et al., 2014). In a review, Hawkins et al. (2013: 16) conclude that it is '*counterproductive to promote electric vehicles in regions where electricity is produced from oil, coal, and lignite combustion'*. Another example of a simplistic environmental narrative about a product includes the environmental superiority ascribed to paper bags (particularly in marketing) compared with plastic bags. Most life-cycle assessments conclude the opposite, that production of paper bags requires more non-renewable energy, more water, and produces far more greenhouse gas emissions than plastic bag production (Kimmel, 2014). However, if bags end up in natural environments, for example due to poor waste management systems, the contaminants and slow decay rate of plastic bags could eventually become more environmentally harmful than the use of paper bags. The two examples underscore the complexity involved in assessing the environmental impacts of various goods and services. Furthermore, they highlight the risk of ascribing green attributes to goods and services whose environmental impact is highly ambiguous or even context dependent.

Fourth and finally, permanency concerns the intensity and duration of the environmental insurgence. To achieve environmental sustainability through degrowth, a perpetual change in consumption patterns is needed. However, the noticeable propensity for degrowth lifestyles could potentially represent a temporary response to political inertia that eventually will fade away, similar to the 'green wave' we witnessed in the 1970s (Du Pisani, 2006).

For many reasons, including those accounted for above, it seems unlikely and somewhat unrealistic that consumers (directly) through environmentally sound choices will be able to provide a substantial contribution to a shift towards a green economy. However, consumers (indirectly) play a crucial role in driving demand for innovations (e.g. in

products, services, business models) that are environmentally superior to those currently offered in the market. In this sense, consumers are important players in creating market demand that enables green entrepreneurship (3.1) and sustainable cluster initiatives (3.2) to rise and thrive. The following sections elaborate on some key issues that are relevant for understanding how markets can accommodate green value creation. Like section 3.1 (micro-level), and section 3.2 (meso-level), the following sections (3.3.2–3.3.4) overlap with the individual articles of the thesis, but generally provide a broader theoretical foundation than is included in articles.

3.3.2 The immanent conflict between business and the environment?

Environmental economics is an inevitable point of departure in discussions about markets for green innovations. Environmental economics are concerned with the environmental costs (e.g. pollution, resource depletion) caused by economic activities, and how such costs can be internalised in market transactions. In a free market context, environmental costs associated with production and consumption are not accounted for, thus causing negative externalities defined as costs that are suffered by a third party as a consequence of an economic transaction (Economics Online, 2019). With respect to climate change and the natural environment, third parties often encompass the entire international community since many negative externalities (e.g. greenhouse gas emissions) have a transboundary environmental impact that essentially affects everyone. The cost of such environmental damage is borne by society (third party) instead of by the producer (first party) or consumer (second party). Since the society incurs the environmental costs, producers will produce and sell goods at a price which poorly reflects the actual costs (including the social and environmental costs) of producing and consuming the product. This type of market failure will lead to excess production and overconsumption, demonstrating how the current market system fails to ensure sustainability (Dean and McMullen, 2007). To address such market failures, state intervention is needed. For example, governments may impose regulations or tax regimes to compensate for environmental damage caused by economic activities (i.e.

internalisation of negative externalities) (McHenry, 2009). Due to the costs associated with environmental protection, mainstream economics has traditionally regarded economic growth and environmental sustainability as conflicting interests (Carillo-Hermosilla et al., 2009). Often, environmental issues have been addressed through reactive strategies deliberately adopted to meet minimum requirements to uphold licenses to operate (Carillo-Hermosilla et al., 2009; Rusten and Tvedt, 2018). One example of such reactive strategies is the implementation of end-of-pipe solutions designed to reduce factory emissions merely to meet regulatory demand (Carillo-Hermosilla et al., 2009). Another strategy includes firms' relocating activities to countries (or states) with less rigid regulatory regimes. Sometimes, governments even deregulate environmental policy in a deliberate attempt to attract firms and foster economic growth, a tactic often referred to as 'race to the bottom' (Rabe, 2019). International regulations and standards are a way of reducing the possibilities for regional and national governments to create such regulatory sanctuaries for businesses. International standards also provide more predictability in terms of market prospects for green entrepreneurs, as demonstrated by the Clean Robotics case presented in Article 1.

The conventional license-to-operate strategy has recently been challenged by more proactive ideas asserting that environmental protection represents commercial opportunities rather than commercial liabilities (Cohen and Winn, 2007; Porter and Kramer, 2011; Rusten and Tvedt, 2018). The latter aims at integrating environmental performance in the economy by revamping incumbent production systems in efforts to reduce or remove environmental strains throughout the whole value chain (Porter and Kramer, 2011). This upheaval, which can be seen as 'creative destruction of unsustainable businesses and paradigms' (York and Venkataraman, 2010), depends on the capability of markets to accommodate for innovations that continually strive for environmental superiority. Current markets already encompass certain sustainable business opportunities (Cohen and Winn, 2007), but quite often new niches must be created through government interventions (Porter and van der Linde, 1995). This topic is discussed in more detail in the following sections (3.3.3 and 3.3.4).

3.3.3 Current and future markets for a greener economy

The green entrepreneurship literature has predominantly been concerned with whom these enterprising individuals are and why they engage in sustainable business activities (see section 3.1.1). However, a small stream of the literature has synthesised the entrepreneurship literature with environmental economics in efforts to provide a theoretical understanding of how and why green business opportunities arise (Cohen and Winn, 2007; Dean and McMullen, 2007; Galkina and Hultman, 2016; Gast et al., 2017).

On the one hand, environmental economics conclude that environmental degradation results from market failures, for example failure to account for environmental costs, as discussed in the preceding section. On the other hand, the entrepreneurship literature argues that market failure entails business opportunities (York and Venkataraman, 2010). By inference, these two core presumptions suggest that market failures represent a duality of environmental causes (derived from environmental economics) and opportunities (derived from entrepreneurship literatures). In other words, green business opportunities are claimed to be inherent in environmentally relevant market failures (Dean and McMullen, 2007). Accordingly, current markets are believed to encompass a range of sustainable business opportunities waiting to be grasped by enterprising individuals. Some of the most relevant market failures in relation to green business opportunities include inefficient firms, negative externalities, imperfect information, and public goods (Cohen and Winn, 2007; Dean and McMullen, 2007). A more detailed account of how these market failures potentially can lead to sustainable businesses opportunities is provided in the following.

The first form of market failure includes inefficient firms. While neoclassical economic models assume perfect efficiency as a precondition for their analysis, reality shows that this seldom is the case (Cohen and Winn, 2007). Firms in all parts of the production system operate inefficiently and generate considerable amounts of waste, for example the food industry. This implies commercial opportunities for entrepreneurs to address resource use, energy input and waste in various production systems. Addressing

inefficiencies will often lead to joint reductions in environmental and economic waste (Hawken et al., 1999; Guenster et al., 2011). The latter is clearly demonstrated in the Clean Robotics case (see Article 1). Clean Robotics provides hull cleaning for shipowners, which significantly reduces fuel costs, air pollution and the spread of invasive alien species, among other benefits.

Negative externalities include the second type of market failure frequently emphasised in relation to green business opportunities (Dean and McMullen, 2007). As mentioned earlier (section 3.3.2), negative externalities are costs suffered by third parties resulting from economic transactions, for example air pollution. Governments have traditionally been given the responsibility of addressing negative externalities. However, inadequate government intervention creates opportunities for green entrepreneurs to develop product, services and business models designed to reduce negative externalities, for example substitutes for toxic components or remediation activities (Cohen and Winn, 2007). The second cleantech start-up explored in Article 1, Air Generator, arguably contributes to mitigate negative externalities by providing a significantly cleaner technology alternative compared with, for example, coal-fired electricity. However, for Air Generator, simply addressing negative externalities has not been a strong commercial driver by itself (see Article 1).

A third form of market failure that can be acted upon by green entrepreneurs concerns imperfect information. Omniscient economic actors are, like the notion of perfectly efficient firms, a theoretical prerequisite for neoclassical economic models that resonate poorly with the complex reality (Cyert and March, 1963). Rather than being omniscient, producers and consumers differ greatly in their possession of and access to knowledge and information (Dean and McMullen, 2007). From a producer perspective, imperfect information may lead to use of suppliers that are suboptimal with respect to environmental performance. It may also result in inadequate discovery and assessments of green niches due to poor information about preferences and needs in the market. From a consumer perspective, information asymmetries concern buyers' incomplete knowledge and information about products, services, and their production systems, for example in terms of environmental performance, as discussed in section 3.3.1. This may

lead to consumer choices whose environmental impact is highly ambiguous. Green entrepreneurs can seize opportunities that aim to fill such information gaps in the market, thereby providing producers and consumers with the right tools to make more 'informed' decisions. Eco Analysis, explored in Article 3, has specialised in providing this type of information by analysing the environmental impact of products and other economic activities (e.g. LCAs and EPDs). Another example includes firms that offer environmental certification services (Rusten, 2016).

Lastly, common goods are worth mentioning in relation to green entrepreneurial opportunities. Common goods are goods that are non-excludable, but rivalrous. Non-excludability means that the market fails to exclude people from using certain goods in the absence of property rights or effective enforcement, for example clean air (Everard et al., 2013). Rivalrous means that consumption of the good diminishes the quantity or quality of the good available to others (Dean and McMullen, 2007). The combination of weak exclusion mechanisms (e.g. price) and rivalrous consumption (i.e. finite resources) may lead to overconsumption and resource depletion, a situation known widely as 'the tragedy of the commons', after Hardin's article with the same title (Hardin, 1968). Green entrepreneurs may address this problem through innovative business models or technologies that enable stronger exclusion mechanisms for goods that traditionally are perceived as non-excludable (Cohen and Winn, 2007). In this respect, advanced information technologies (e.g. bi-directional sensor systems, digital applications, and the Internet-of-Things) that utilise big data and positioning technologies have arguably widened the scope of potential 'green' business opportunities.

The above discussion demonstrates how current markets are presumed to possess a wide range of potential opportunities for green entrepreneurs to discover. Moreover, green entrepreneurial action arguably will intensify concurrently with increased environmental urgency. However, converting theoretical perceived opportunities (e.g. market failure driven opportunities) to profitable green businesses is not necessarily straightforward, as demonstrated in both Article 1 and Article 3. This ultimately relies on the number and importance of various demand mechanisms for green innovations

(see Article 3). In this respect, government intervention may play a key role in creating such demand mechanisms, either in the form of temporary stepping stones for start-ups (e.g. public procurement of green innovations) or in the form of market enabling regulations of a more permanent nature (e.g. international environmental standards). This topic is discussed in more detail in the next section.

3.3.4 The role of governments in creating demand for greener solutions

Governments play a crucial role in relation to creating demands for greener products and services. Their range of instruments includes a wide variety of measures related to taxation, subsidy schemes, green procurement strategies, and environmental regulations. The latter (environmental regulations) have attracted a particularly high level of interest in relation to green value creation. Already in 1971, James Brian Quinn stated, in his paper entitled 'Next big industry: Environmental improvement', that environmental regulations could boost innovation and create new markets for green products and services. His idea, which subsequently became known as the Porter hypothesis (Porter and van der Linde, 1995), is now a relatively established concept within the research literature. The hypothesis claims that environmental regulations sometimes are needed to alert and motivate economic actors to innovate and exploit new 'green' opportunities (Porter and van der Linde, 1995). The state of California's Global Warming Solutions Act of 2006, which is discussed in Article 2, represents a clear example in this regard. Further examples of how national or international regulations contribute to demands for greener solutions are provided in Article 3.

Exploiting new environmental regulations commercially is not just a 'passive response' to the institutional context governments throw to businesses and entrepreneurs. From a corporate perspective, such exploitation requires strategic attention and is sometimes about anticipating future regulations to position their businesses in the market and gain first-mover advantage (Cleff and Rennings, 2012). In other cases, corporate actors will actively engage with policymakers with a clear purpose of influencing the regulatory

landscape. The latter, commonly referred to as institutional entrepreneurship, may result in regulations and standards that enable new market opportunities or favour certain products, services, or technologies (Maguire et al., 2004). Lastly, the interplay between regulations and market opportunities can be somewhat coincidental, without a deliberate strategy involved. This has been the case for Clean Robotics, which is discussed further in Article 1. It is also worth mentioning that governments themselves increasingly are becoming aware of the green industry potential that lies in policy design and the regulatory regime. In section 3.3.2, I pointed out that governments traditionally have used a 'race to the bottom' tactic in environmental policy to attract firms and stimulate growth. More recently, the exact opposite strategy has emerged, particularly in the USA, involving a 'race to the top' tactic based on innovative environmental policies and regulations (Rabe, 2019). Like the earlier tactic, the purpose is to encourage growth, but in a more environmentally sound direction. In this way, firms in countries and states with forward-looking environmental regulations may get a head start in the race towards a greener economy (Rabe, 2019). Moreover, this could become an important competitive dimension when laggard countries and states, or even international authorities implement new policies and regulations. In some cases, environmental regulations may even be dynamic, depending on the type of technologies that are available in the market. For example, the EU's Industrial Emissions Directive (IED), which states that industrial production processes should make use of base available techniques (BATs) with respect to environmental performance (European Commission, 2010).

Apart from regulations and other 'indirect' sanction-based measures, governments may also create direct demand for greener products and services by taking on the role of customer. Green public procurement (GPP) has increasingly been recognised as a powerful instrument in the shift towards a greener economy (Cheng et al., 2017). By integrating environmental criteria when choosing products and services, public authorities could play a key role in promoting green value creation. Many of the issues discussed above have been highly relevant in creating the demands for the start-up cases explored in Article 3. The third article of this thesis, *'Market conditions for sustainable*

entrepreneurship: A case study of green support services', is summarised in the next section to conclude the macro-level perspective.

3.3.5 Article 3: Summary

Article 3 explores market conditions for environmental goods and services using empirical evidence to analyse different demand mechanisms. Understanding demand mechanisms for greener solutions is key for entrepreneurs, businesses and policymakers involved in sustainable regional and industrial development. The study presented in Article 3 is based on two green businesses that provide services aimed at improving the environmental performance of their clients. The vast numbers of their clients and the close customer dialogue the businesses have during service provision, were important criteria when selecting cases that could provide information about why firms purchase services in efforts to improve their environmental credentials. The study demonstrates how green market demand is created by multiple conditions and mechanisms that jointly work together. This includes profitability, environmental and social responsibility, customers' environmental awareness, CSR strategies, risk-management, regulations, and subsidies. Moreover, the different market drivers seem to vary in importance. The economic gains that the two green service providers create for their customers are one of the identified drivers but are of modest importance compared with some of the other market drivers. In the research literature there is frequent emphasis on the market enabling role of environmental regulations (3.3.4) and support for this is provided Article 3. In both of the studied cases, environmental regulation has played a role in creating market demand. The study further indicates that environmental and social responsibility, as well as 'voluntary' demand for green goods and services, are becoming increasingly important drivers that lead to sustainable business opportunities. Furthermore, some drivers are specific to certain markets and may be both interdependent and geographically distinct, as demonstrated in the study (see Article 3 for further details).

4 Research design and methods

A doctoral thesis is the final product of several years working as a PhD candidate. However, the academic journey may turn out very differently for the candidates. In my case, this thesis comprises research that has been projected and carried out with considerable freedom and flexibility. My research has not been part of any project in which certain conditions have been defined by others (e.g. research problems, theoretical framework, methods). Instead, I had the opportunity to develop a research design from scratch. Throughout this process, my supervisor has been the most prominent academic sparring partner. I have also discussed various academic challenges with other researchers in Sweden, the UK, and other countries, whom I have met via my supervisor's academic networks. In this regard, the core team of the Green Economies Research Network was particularly valuable, as it provided an academic community for the 'green topic', which was often raised during workshops and conferences. Still, the novelty of bringing the green topic into economic geography (especially when I started back in 2013) led to a rather explorative research process involving many independent judgements and decisions regarding research design, analytical approach, and methods. This is discussed in more detail throughout this chapter. Chapter 4 elaborates on the choice of research scope and analytical framework (section 4.1), philosophical stance (section 4.2), and research method (section 4.3). The latter section provides a deeper methodological discussion than is included in the respective articles of this thesis.

4.1 Defining research scope and analytical framework

The research scope of this thesis (see section 1.1) reflects my initial desire to explore green value creation from a holistic perspective, covering green entrepreneurs as agents, the spatial settings in which they operate, and the market conditions they face. Eventually, this research scope was encapsulated in a tripartite understanding of analytical levels, respectively the micro-, meso- and macro level (see section 1.2). I use

the term multilevel approach to describe the analytical framework surrounding my thesis, deliberately to avoid confusion with the more established term multilevel perspective (MLP). The reason for this is that the latter term (MLP) constitutes an analytical framework strongly related to (and inseparable from) transition studies (Geels, 2004). The MLP are used to explore far-reaching technological transitions in a society (including sustainability transitions) by analysing interacting processes at different levels, respectively niches (micro-level), regimes (meso-level) and landscapes (macro-level) (Rip and Kemp, 1998; Geels, 2004; Kemp et al., 2007; Markard et al., 2012). Briefly explained, niches are spaces for technology development that are relatively isolated from normal market selection pressure. Regimes (socio-technical regimes) constitute the composition of rules and forces governing the reception and functioning of technologies, including for example policies, infrastructure, user practices. Lastly, landscapes concern the deep structural trends in societies such as broad political agendas and climate change. The focal point of the multilevel perspective is that radical technological change (e.g. renewable energy transition) is governed by interacting development and processes at all three levels (Geels, 2004). With respect to my own research scope (holistic exploration of green value creation), the MLP, which is designed to explore fundamental changes in technological systems, fits rather poorly. Accordingly, I avoid *the* multilevel perspective as an analytical tool but instead adopts *a* multilevel approach based on disciplines and concepts that tend to be more concerned with (green) innovations of a more incremental nature. As discussed earlier in the synopsis (section 1.2), this framework understands and is used to analyse green value creation as a process that both occurs and depends on progress at multiple levels. This is reflected in the theoretical and empirical orientation of the thesis through studies of green entrepreneurs (micro-level perspective), cleantech clusters (meso-level perspective) and market conditions (macro-level perspective). While these units of analysis were chosen in this thesis, the different levels could very well be operationalised differently, for example through studies of other analytical units (e.g. eco-industrial parks at the meso-level) or with more narrowly defined unit of analysis (e.g. the role of energy policies at the macro-level).

As discussed in the Introduction (section 1.2), the operationalisation of levels in this thesis suggests a cross-disciplinary approach. This can be understood as a form of theoretical triangulation (Denzin, 2017), whereby phenomena are analysed and interpreted through the use of multiple theoretical perspectives. In this thesis, this is done by deriving insights from economic geography, economics (environmental economics) and entrepreneurship research to provide a more holistic understanding of green value creation than singular approaches allow for (see section 1.2). Cross-disciplinary approaches are increasingly encouraged (even demanded in some calls for proposals) in research projects (e.g. the EU's Horizon 2020 and the Research Council of Norway) as they entail the capacity to produce new insights that otherwise would be hard to discover through subject-specific research. This is particularly the case when dealing with complex topics and 'wicked' problems, such as the shift towards a green economy, which depends on economic, political, and cultural change. Carrying out cross-disciplinary research independently has been very intriguing but has also posed some challenges along the way. Considerable time has been spent on reading literature that is relatively peripheral to my own academic discipline (economic geography), but still has represented valuable insights into the understanding of business and the environment. Consequently, much work has been devoted to issues such as how to operationalise the different levels, what literature to include, and where to draw the boundaries of the research project. My experience in this regard is that interdisciplinary and holistic research scopes resonate poorly with subject-specific depth, due to their wide and comprehensive focus. The strategy to overcome this challenge has been to address the respective research fields in the articles and to use the synopsis to elaborate on the overarching contribution of the thesis. In other words, there is not a one-to-one correspondence between the research questions explored in the articles and the research problems put forward in the synopsis (see section 1.1). The latter include broader problems for discussion in relation to the shift towards a green economy, whereas the individual articles address research questions that inform and complement the respective research fields (see section 1.2). For example, the main objective of exploring how green value creation unfolds at different levels in the corporate sector is reflected in the individual articles through questions such as 'What motivates green

entrepreneurship?' (Article 1), 'How does cleantech clusters emerge?' (Article 2), and 'What mechanisms and conditions create demands for greener products and services?' (Article 3). Additionally, the thesis draws on the articles to discuss how each level is influenced by geography and interactions across levels (see section 1.1). A more comprehensive discussion of the research problems addressed in the thesis is presented in Chapter 5. First, further details of the ontology and epistemology surrounding the thesis (section 4.2), as well as the research methods (section 4.3) are provided.

4.2 Between positivism and interpretivism: a critical realist stance

The questions of what is reality (ontology) and how we obtain knowledge about the reality (epistemology) are fundamental to all philosophies of the sciences. This thesis is inspired by critical realism (Bhaskar, 1975; Sayer, 1997), a philosophical stance that has gained increasing popularity within social science research in recent decades (Gorski, 2013). Critical realism is best explained by briefly touching upon positivism and interpretivism, two major contrasting traditions within the philosophies of sciences. These two traditions are particularly relevant in relation to critical realism, as it tends to be perceived as a golden mean positioned somewhere between positivism and interpretivism (Archer et al., 2016).

Positivists assert that there is a single objective reality that can be studied and measured through a set of universal laws or direct empirical observations (i.e. sense experience) (Baily and Eastman, 1994). Accordingly, scientific inquiries are often associated with various quantitative and statistical techniques (derived from natural sciences) believed to provide true knowledge regardless of human interpretations and inferences of social phenomena (Carson et al., 2001). This leads us to the opposing philosophical stance, interpretivism, which in contrast to positivism understands reality as something complex, subjective, and multifaceted (Creswell, 2014). Truths and realities are shaped by the researcher's perception of the social world based on his or her role and background, for example experience, beliefs, prejudices, language, and theoretical

understanding (Carson et al., 2001). The third stance, critical realism, is a synthesis of transcendental realism (Bhaskar, 1975) and critical naturalism (Bhaskar, 1975), which sits between positivism and interpretivism (Archer et al., 2016). Like positivism, critical realism holds that any research phenomenon has an objective reality irrespective of the 'eyes' of the person conducting the research (Sayer, 2000). However, and in contrast to positivistic claims, it is not possible to obtain true knowledge of the reality because the reality is more complex than what simply can be observed (McAvoy and Butler, 2018). Instead, reality is stratified and divided into three domains, the real, the actual and the empirical.

The real domain encompasses mechanisms, structures and relations that exist independent of events, yet are capable of producing them. This leads to the actual domain, which comprises events triggered by generative mechanisms and structures that exist in the real domain. Events occur independent of our experience and knowledge of them, but may also be observable, which brings us to the empirical domain. The latter domain consists of events (actual domain events that have been activated by mechanisms in the real domain) that can be observed and experienced (McAvoy and Butler, 2018). The implication is that empirical observations do not reflect the reality (as positivists argue), but rather a way of approaching the real domain by moving through different layers of reality. In other words, it is not possible to enter the real domain directly. Instead, observations in the empirical domain (which can be accessed) are used to explain (observable) events in the actual domain in order to derive knowledge and theories that approximate to objective realities (i.e. the real domain). For example, the study of how cleantech cluster forms (Article 2) will increase our understanding of this phenomenon by looking at events (i.e. cleantech clustering) activated by casual mechanisms (hence observable) under certain circumstances (e.g. system agency, economic crisis, environmental regulations). From a critical realist point of view, the conclusion in Article 2 will therefore not provide the 'truth' regarding how cleantech clusters emerges because our knowledge will never be fully reconciled with the real domain. However, the stratified ontology indicates that casual mechanisms identified through the study (Article 2) go beyond the observed empirical particularities of each case (the three cleantech clusters studied) because we can approach the real

domain through layers of realities. Thus, critical realism allows social science researchers to uncover causations that can form the basis for theorising (even generalisable theories, see section 4.3.3) and policy recommendations (Fletcher, 2017). This also applies to Article 1 and Article 3, in which the empirical findings provide knowledge of mechanisms and conditions that are transferable to the phenomena more generally.

The interest in critical realism in recent decades probably lies in its ability to capture 'the best' ontological and epistemological insights from traditional stances, responding to the needs of many social science researchers. On the one hand, it accepts that there is an objective reality 'out there', which in certain disciplines (particularly natural sciences) is claimed to be a prerequisite for science and scientific inquiries. Critics of interpretivism will question the purpose of science if truths and realities were to become subjective, relative to the mind of the researcher. Arguably, critical realism provides a response to this critique. On the other hand, critical realism holds that realities (albeit objective) are far more complex than what simply can be observed through the empirical domain. This obviously resonates with many social science disciplines that study complex social phenomena and mechanisms such as cultures, norms, power, and values in different political, institutional, geographical, and temporal contexts. The way critical realism sees reality has also guided the philosophical choice for this thesis given its comprehensive focus (multiple levels) and complex topic (greening the corporate sector). Moreover, this complexity is coupled with understanding how the research phenomena (green entrepreneurship, cleantech clusters and market conditions) are shaped by different geographical and political contexts.

As discussed above, critical realism is about approaching (complex) objective realities through empirical observations and experiences. How 'close' a researcher can get to reality will mainly be determined by the methods and techniques used in their research. Further details of the methods are discussed in the following section.

4.3 Qualitative case study approach

This thesis predominantly employs a qualitative case study approach designed to provide in-depth knowledge of the phenomenon being studied. The case study approach is particularly suited for thorough investigations of certain phenomena because it tends to explore relatively few units, which enables the researcher to observe and discover a myriad of mechanisms and causations using multiple methods (Yin, 2009). For example, Article 2 explores the phenomenon of cleantech clusters based on three units (i.e. cases). Moreover, the research employed different methods, including semi-structured interviews (face-to-face), on-site observations, analysis of earlier empirical studies of the regions, as well as other secondary data sources, including reports, strategy documents and online information (see Article 2). Combined, these methods contribute to build solid cases, which can be used further to inform, complement, and develop theories (see section 4.3.3). An alternative approach would, for example, include the distribution of a survey questionnaire to managers and CEOs of cleantech cluster organisations. The latter would increase the number of units studied but would limit the possibility to obtain profound knowledge through multiple methods and close dialogue with the observation units. Therefore, by using a critical realist terminology (see section 4.2), a case study approach will come much closer to the 'real domain' compared with using a questionnaire, given the nature of the research problems addressed in this thesis.

Since the case study approach enables observations of many (interacting) variables, it is also well suited for exploratory research that aims at gaining familiarity with certain phenomena (Yin, 2009). The latter is partly the case for the topics address in this thesis, as it deals with phenomena (green entrepreneurs, cleantech clusters) that barely have been explored empirically. This does not mean that the thesis only comprises exploratory research, but rather elements of exploration combined with descriptive and explanatory accounts. This multipurpose design is encouraged by the scope of the thesis, which deals with research topics that are both in their infancy and mature at the same time. The explicit focus on 'green' and 'clean' arguably turns relatively mature research topics such as entrepreneurship and business clusters into new phenomena that

need to be explored, described, and explained. This indicates that research on green entrepreneurship and cleantech clusters entails exploratory elements, but that the process of exploration (i.e. gaining familiarity with the research phenomena) departs from a solid basis of 'conventional' theoretical propositions. This is demonstrated in Article 2 and section 3.2, which employ conventional cluster theory to analyse how cleantech clusters emerges, while simultaneously accentuating the unique characteristics of cleantech clusters and how they deviate from Porterian business clusters. A similar discussion is provided in Article 1 and section 3.1, concerning the (supposed) differences between conventional entrepreneurs and green entrepreneurs. This alternation between inductive reasoning based on own empirical observations and deductive reasoning derived from theoretical propositions indicates that the thesis combines theory testing and theory building through an abductive logic (see Dubois & Gadde, 2002).

The empirical evidence provided in all three articles was generated through case study research. However, the thesis also includes a survey (section 3.1.3) that, besides theory and conceptual testing, has played an important part in the case selection process. The survey is fully accounted for in section 3.1.3 but is briefly touched upon in the following section on case selection.

4.3.1 Selection of cases and interviewees

The sampling was done at two levels, respectively case sampling and sampling of the interviewees who provided data to inform the respective cases. In the following, the selection of cases is outlined and then an explanation is given regarding the choice of interviewees.

The cases were identified through a purposive sampling strategy, a method that allows the researcher to lean on personal judgements to ensure cases that are believed to be of particular interest to address the research problems (Palinkas et al., 2015). Purposive sampling does not necessarily provide cases that are representative of the population,

but this is often not the intention either. Sometimes, extreme or deviant cases that represent the exception rather than the rule could be useful (Palinkas et al., 2015). In other cases, heterogeneous sampling is preferred, to demonstrate empirical variability in a population. The cases presented in this thesis were selected with the intention to generate extensive knowledge and information about the studied phenomena by focusing on distinctive qualities and unique characteristics. This corresponds to what often is referred to as a critical case sampling strategy (Etikan, 2016), which alongside extreme case sampling and heterogeneous case sampling is a form of purposive (non-probability) sampling. Critical cases are chosen because the researcher presumes that they are very important or distinctive with respect to learning something about the research phenomenon. This logic guided the selection of both the case firms (Article 1 and Article 3) and the case clusters (Article 2) discussed in this thesis. In Article 1, the cleantech start-ups were chosen because of the technological novelty of their business, their geographical location, and the fact that they both were recently established (see Article 1). The empirical cases in Article 2 were also chosen with the intention to learn as much as possible about cleantech clustering. This was done by selecting three cleantech clusters that had received international recognition and considerable online publicity (see Article 2 for further details). The case clusters were chosen to look for similarities and differences between them, including the unique spatial settings in which they emerged. Lastly, in Article 3, the empirical cases were chosen because they represented businesses that provide services to clients that seek to improve their environmental performance. This was done to obtain information about why firms make green investments and by extension, information about market demands for environmental goods and services (see Article 3). The case firms presented in Article 1 and Article 3 were initially identified as 'green businesses' through the survey (see section 3.1.3) before the above-mentioned criteria were used to select the cases for further empirical investigation. For Article 2, relevant cleantech clusters were initially identified through the Global Cleantech Cluster Association and the International Cleantech Network (see Article 2).

When the cases were selected, a process of choosing relevant interviewees followed. In Article 1 and Article 3, the empirical cases involved green start-ups for which the

interviews concerned various questions related to the entrepreneurial process, their company, and other business-related issues. Accordingly, interviewing the CEOs and founders of those start-ups were the obvious choice. In all cases, the founder (or lead founder) was also the CEO of the company. The latter was partly secured by only including firms that were less than 10 years old in the initial sample (i.e. the survey questionnaire), as this increased the likelihood of the entrepreneur and CEO being the same person.

The selection of informants for the empirical cases in Article 2 followed a rather different approach. The interviews for each case (cleantech cluster) were carried out during a 1–2 week field trip visit to each of the cities, Graz, Dublin, and San Diego. Most of the interviews were scheduled in advance, but some of them were scheduled on-site using snowball sampling based on referrals from the informants. In contrast to the business cases (Article 1 and Article 3), the choice of interviewees for the cleantech cluster cases was less obvious. It was important to contact people who knew the industrial past and present of the regions well, particularly the 'green' industries. It was also necessary to reach out to the respective cleantech cluster organisations. This resulted in a rather wide composition of interviewees, including business representatives, university employees, and representatives of regional development agencies, cluster organisations, and regional authorities. It was relatively easy to get in touch with relevant people and gain admittance to their organisation despite being a foreign student and having to communicate in English. However, there were still elements of convenience sampling involved, meaning that the informant's enthusiasm and willingness to take part in the study was an important factor. The latter was also due to the relatively short time spent at each location, which made it difficult to get in touch solely with key informants. Further details on data collection are provided in the next section.

4.3.2 Data collection and methodological triangulation

The data provided in this thesis are based on multiple methods involving primary data collected by me in person (survey and interviews) and from secondary sources (e.g. reports, media articles). The data collection process can be divided into two main categories, the survey and the qualitative case studies, of which the latter constitutes the main part of the data collection. Initially, a large survey questionnaire was distributed to more than 1150 start-up companies in Norway. The purpose of the survey was twofold: (1) to explore how start-ups assessed the environmental value and performance of their business against the backdrop of the theoretical and conceptual discussion in the research literature, and (2) to identify green entrepreneurship for subsequent case studies. Data from the survey are not directly included in any of the articles, but still provides a broader theoretical and empirical contribution to the topic explored in the thesis, as outlined in section 3.1.3. Before the questionnaire was distributed, it was pretested during interviews with CEOS of five different companies to ensure that the questions were clear and easily understood. The questionnaire, based on Likert scales, was designed to take less than five minutes to complete, and resulted in a response rate of 39%. However, it was also possible for the respondents to elaborate on their fixed responses (i.e. on the Likert scales) by using an optional comment section. The latter turned out to be very valuable, as it brought in a qualitative dimension that was used extensively in the analysis of the survey data (see section 3.1.3).

The second, and main form of data collection related to the qualitative case study methodology, on which all three articles are based. Each case (two cleantech start-ups, two green service providers and three cleantech clusters) is based on methodological triangulation, which implies using more than one kind of method to study a phenomenon (Denzin, 2017; Fusch et al., 2018). Semi-structured interviews with relevant stakeholders (see section 4.3.1) constitutes the main method. In total, 26 face-to-face interviews were conducted, some of which subsequently involved shorter follow-up conversations. Being physically present at business premises and in the case cities also enabled observations, which added another dimension to the data collection. For this thesis, the latter did not constitute a research method in its own right (e.g. such

as participatory observation), but rather a supplement to the interviews, which resulted in business tours, technology demonstrations, and other observations that contributed to actualise and contextualise the respective cases. In addition to the primary data sources (interviews and on-site observations), considerable time was spent on desk research and collection of secondary data. The latter included analysis of reports, strategy documents, online information, media articles, and earlier empirical studies pertaining to the respective cases. A summary of the methods used in relation to the different research activities and articles is provided in Table 6.

Table 6: Research tasks, methods, and data sources.

Research task	Methods	Data sources	Data collection year
(1) Survey: The occurrence of green entrepreneurship in the Norwegian economy	Survey and semi-structured interviews (pretesting)	Business start-ups (447 responses) and five interviews with CEOs (pretesting survey)	2013/2014
(2) Article 1: Green entrepreneurship in rural locations: conditions, motivations, strategies, and performance	Semi-structured interviews, follow-up conversations, desk research	Interviews and follow-up conversations with representatives of two cleantech start-ups (CEO/Founder), and secondary data	2015/2016/2017/2020
(3) Article 2: The formation and structure of cleantech clusters: insights from San Diego, Dublin, and Graz	Semi-structured interviews, desk research	14 interviews with various stakeholders related to the cleantech clusters, and secondary data sources	2015/2016
(4) Article 3: Market conditions for sustainable entrepreneurship: a case study of green support services	Semi-structured interviews, desk research	Five interviews with CEO/founder of two green service start-ups and other relevant stakeholders, and secondary data	2015

4.3.3 Validity, reliability, and generalisability

The quality of research is influenced by the extent to which the data accurately shows what they are intended to measure (internal validity) and the consistency of the results if the research were to be replicated (reliability). Moreover, the relevance of the data, if

applied in other contexts, concerns the external validity of a study, which directly relates to the generalisability of research (Golafshani, 2003). While these concepts tend to be clearly defined, they are still subject to different understandings, depending on the research field, type of study (e.g. qualitative versus quantitative) and epistemological perspective (Stenbacka, 2001). Therefore, in the context of this thesis, the concepts of validity and reliability will be discussed in relation to critical realism (section 4.2) and the qualitative research design (section 4.3) that encompasses my research.

Qualitative research generally seeks to generate knowledge and understandings as opposed to quantitative studies, which mainly are concerned with causal explanations and predictions (Stenbacka, 2001; Golafshani, 2003). Thus, the understanding of validity and reliability, and hence the conception of generalisation is obviously very different from a rigorous positivist view in which the terms initially were applied. In post-positivist qualitative research of complex social phenomena, the 'truth' is sometimes considered relative and context-specific (e.g. interpretivism) or at least difficult to access fully through empirical observations (e.g. critical realism). Accordingly, validity and reliability sit somewhat uncomfortably with qualitative research, whose methods and purpose seldom include rigorous measurements and predictions. This does not mean that validity and reliability are irrelevant in qualitative research. In a qualitative case study design, validity and reliability are often treated as two interwoven concepts that point towards the trustworthiness of research (Golafshani, 2003). This 'trustworthiness', which concerns the credibility of data, methods and interpretations, largely determines the quality of the research. In my thesis, the trustworthiness of the research has largely been ensured through different forms of triangulation, a method that represents a common quality control in qualitative research (Street and Ward, 2012). First, methodological triangulation involving mixed methods and multiple data sources has been used extensively to increase the internal validity (see Table 6). For the articles, this included interviews combined with desk research and in some of the cases, follow-up interviews either to verify data from other sources or to obtain more recent information about the start-up projects. For the survey, the questionnaire was pretested through interviews with CEOs to minimise ambiguities and vague questions. The purpose of the survey was not to fully map out 'green business

activities' in the Norwegian economy, but rather to provide an empirical response to the theoretical and conceptual discussion on green business practices, and to identify business for later case studies (see section 3.1.3). Hence, the survey sample did not necessarily have to reflect a representative population of start-up firms in Norway. That was neither the intention since the survey amongst other things deliberately omitted certain industries (e.g. NACE codes). The survey was more of a qualitative task that contributed to explain how CEOs assess their start-up in relation to various green criteria, and why they perceive 'green' in the way that they do.

While methodological triangulation contributed to increase the trustworthiness of the data, theoretical triangulation helped to improve the credibility of the interpretations and conclusions. The holistic nature of the thesis called for an eclectic approach based on concepts, theories, and insights derived from various disciplines (see Table 1). This cross-disciplinary approach represents a form of theoretical triangulation that has guided the data analysis and entailed a rather rigorous interpretation that combines theory testing and theory building through abduction (see section 4.1). The thesis includes theory testing through analysis of my own empirical evidence in relation to theoretical propositions (deductive reasoning), but also theory building based on inductive reasoning, for which my own empirical evidence is used to inform and complement contemporary theories. The latter leads us to a discussion of the external validity (generalisability) of the thesis.

From a critical realist perspective, it is possible to generalise through the identification of generative mechanisms (Easton, 2010). The latter can be identified by forming a hypothesis based on empirically observed regularities and then testing the hypothesis against further empirical evidence (Couper, 2015). That being the case, the explanations and conclusions put forward in this thesis require further empirical investigations to be generalisable in a nomothetic sense that involves causal determinism. However, this does not imply that the qualitative case design of the thesis lacks external validity. Case studies and other qualitative methods offer a form of analytic generalisation, in which new knowledge and insights can be derived from case studies to inform and complement existing theories (Polit and Beck, 2010). This typically include variables and

mechanisms that probably operate beyond the particular case or empirical context in which the study was conducted. For example, the findings from the case study of the two cleantech start-ups suggest that contemporary conceptualisations of green entrepreneurship should be broadened. However, the study cannot be used to make any generalisations about whom green entrepreneurs are based on two deviant cases. This demonstrates how certain elements can be generalised analytically to inform theory without generalising the empirical evidence per se. This resonates with the abductive logic of the thesis, where the purpose is to provide new theoretical insights rather than reaching theoretical and conceptual saturation through inductive reasoning of empirical evidence. In this way, case studies, including the studies in this thesis, can generate knowledge and understanding that are valid in other settings, and hence improve the external validity of the research.

5 Concluding discussion and future research

A shift towards a greener economy is inevitable, given the urgency of climate change and other pressing environmental challenges. This thesis takes a closer look at how green value is created at different levels in the corporate sector, and how green value-creation initiatives are shaped by geography and interactions between the micro-, meso-, and macro-levels. This concluding discussion elaborates on the overarching research questions of the thesis (section 1.1) by drawing on findings and insights from the individual articles.

RQ1: How is green value creation unfolding in the corporate sector at the micro-meso-, and macro-level?

This thesis stratifies the corporate sector into three analytical levels with the aim of providing a holistic account of constituents involved in green value creation, namely actors, systems, and structures. These constituents are operationalised through studies of green entrepreneurs (micro-level agents), cleantech clusters (meso-level systems), and market conditions for environmental goods and services (macro-level structures).

Green entrepreneurs are considered to play a pivotal role in steering the economy in a greener direction. Hitherto, the literature on green entrepreneurship has predominantly been concerned with the motives and triggers that give rise to green entrepreneurship and how the interplay between motives and triggers produces different types of green entrepreneurs (see section 3.3). This thesis moves beyond this narrow focus by covering a broader spectrum of the start-up process, wherein motivation is one of several aspects that are discussed. Apart from motivation, the micro-level study (Article 1) explores how green entrepreneurs work on technological development, the formation of strategic partnerships, source funding, and approach markets. The study shows how the entrepreneurial teams created 'green' task environments composed of actors that have played crucial roles throughout different stages of the start-up process, for example in

relation to technological development or funding. From an analytical perspective, the study does not differentiate between 'green' and 'conventional' task environments in terms of what they represent. However, conceptually, 'green' is used as a prefix since the study indicates that the green value created by the start-ups had a clear impact on the composition and formation of the task environments. The latter relates to how the 'green label' of their business played a role in attracting partners, recruiting personnel, and obtaining financial capital, either unintentionally or through deliberate sourcing by the entrepreneurial teams. In some cases, the green value was a dominant factor in attracting human and financial capital to the projects, but most often it was considered an added value. With respect to motivation, the study revealed that the green entrepreneurs were highly 'conventional' in the sense that they were driven by what has been found to be common entrepreneurial motives in general rather than a concern for the environment. This deviates from many of the green entrepreneurial ideal types in which a sustainability motive tends to be prominent (see section 3.1.1). Hence, the study findings suggest a broader conception of green entrepreneurship that, in addition to personal motives, also considers the green value delivered by a business based on the technology they offer or the market in which they operate. There are still many unanswered questions in relation to what 'being green' means for a start-up company, and some of the indications put forward in the study (i.e. Article 1) require further research (see section 5.1).

At the meso-level, the thesis takes a closer look at cleantech clusters. Economic geography has recently begun to discuss the link between spatial context and green industry development (see section 3.2.4). In this relation, cleantech clusters are identified as a promising concept that requires further research. Through case studies of three internationally recognised cleantech clusters, the thesis explores conditions and triggers involved in their formation, as well as their structural characteristics. Initially, the cleantech clusters appear rather different from conventional business clusters (i.e. Porterian clusters). The latter tend to include agglomerations of vertically and horizontally connected firms that are part of the same field, whereas the case cleantech clusters are much more diverse with respect to industry composition and actor heterogeneity. In all three cases, the cleantech clusters are cross-industry initiatives that

cover a wide variety of stakeholders from the private and public sectors, as well as academia, non-governmental organisations, and interest groups. Their main task is to integrate and coordinate regional resources in various knowledge, innovation, and collaboration initiatives. Thus, the case cleantech clusters represent regional priority areas that transcend the conception of a conventional business cluster. This is not to say that the cleantech clusters have emerged purely for strategic reasons. Drawing on established knowledge within evolutionary economic geography, the study further shows how the cleantech cluster are built upon regional capabilities within industries that already conform to the 'cleantech sector', including biotechnology and renewable energy, often in conjunction with advanced digital technologies. Thus, the cleantech cluster initiatives are mainly focused on accelerating the 'green part' of existing regional industries rather than promoting entirely new economic activities. This is in accordance with theories asserting that the industrial knowledge, expertise, and institutions of the past tend to define the present and future economic trajectory of regions (see section 3.2.2). However, the study also demonstrates how deliberate place-leadership has played a key role in the formation of the cleantech clusters. The latter dimension is often left out in analyses of how regional economies develop, which tend to focus on structural and institutional conditions for path dependency rather than exploring what actors do and why they do it. In this relation, the study finds that place-leadership is motivated and triggered by restructuring needs, regional rebranding efforts, environmental regulations, and inadequate attention from central government regarding support of cleantech activities. This calls for more attention to actor-centred perspectives that can complement structural analysis in future research on regional industry development, including cluster formation.

Lastly, the macro-level perspective of the thesis explores market conditions for environmental goods and services. This is obviously a very important part of understanding how and under what circumstances green value creation transpires. To date, the green entrepreneurship literature has dealt with this issue from a rather theoretical point of view by arguing that environmentally relevant market failures entail business opportunities for green entrepreneurs to seize (see section 3.3.3). The macro-

level study provides an empirical response to this question by asking why firms chose to purchase services to improve their environmental credentials. The study reveals that market demand for greener products and services is created by several conditions and mechanisms that often work together. First, the study shows that often there is a direct economic driver involved. Many green products and services seek to reduce environmental waste by addressing inefficient use of energy, material, and other resources. Often, this also reduces 'economic waste', resulting in cost savings (see section 3.3.2). The study finds that this is part of the motivation when green products and services are purchased in the busines-to-business (B2B) market. Apart from demand by clients who seek to improve product and operational efficiency (and by extension their profit), the study shows that green investments can be driven by a desire to demonstrate environmental responsibility in the market, regardless of any direct economic gains (e.g. cost savings). Often, this is a strategic decision that proactively seeks to promote the environmental credentials of their business. In other cases, a certain environmental standard is demanded by customers (e.g. environmental criteria in supplier screening), which means that enterprises could be 'forced' to make green investments to cover a larger market. This leads us to a third type of demand created by government intervention, which also is found to be an important market driver in the study. The latter includes both regulations that coerce businesses to adopt greener products and services to meet current demands, but also subsidies that largely contribute to trigger green investments by lowering the cost borne by the customer. Sometimes, market-enabling regulations and standards operate at the international level but is more commonly imposed by national authorities or even regionally in federal states. This leads us to the second research question (RQ2) of the thesis, concerning the role of geography in green value creation processes.

RQ2: How does geography impact the processes of, and conditions for green value creation at the different levels?

The thesis addresses the role of geography by incorporating the spatial context as an overarching dimension that is discussed in relation to each analytical level. In this respect, the first contribution (Article 1) discusses the value of the rural communities encompassing the cleantech start-ups. The micro-level study does not address how the rural communities accommodate green industry development in general (i.e. system perspective), but rather how the two cleantech start-ups have been initiated and shaped by their rural settings. The study finds that the rural communities have offered a unique and tacit knowledge base that, combined with resources sourced from elsewhere, has led to their successful development. In this relation, the 'institutional thinness' of the respective communities has encouraged the entrepreneurial teams to form geographically dispersed task environments characterised by relatively few local actors. This has made the cleantech start-ups very interesting cases with respect to elaborating on the link between high-tech entrepreneurship and geographical proximity. In this regard, the study indicates that the need for geographical proximity depends on entrepreneurial stage, the tasks and activities that are carried out, and not least the type and quality of the relationships involved. In certain cases, geographical proximity is considered very important, but not necessarily decisive in situations where other forms of proximity could operate across space. This calls for a more nuanced understanding of when, for what, and with whom geographical proximity (and other forms of proximity) is important in high-tech entrepreneurship.

The meso-level study of the thesis, represented by Article 2, demonstrates how the regional level is likely to play a key role in driving the economy towards sustainability. The study concludes that regionally embedded structures and institutions connected to existing industries are a key reason why the cleantech clusters have emerged in the respective cities. Furthermore, the study identifies some key triggers for cleantech clustering that are independent of industry structure, but still highly conditioned by the specific geographical contexts. In one of the cases (Graz), the cleantech cluster

represented an opportunity to redefine the region's image from 'heavy industry' to a sustainable and forward-looking region. In another case (Dublin), cleantech clustering was partly trigged by lack of attention to green business development in national policy and strategies, whereas the third cleantech cluster (San Diego) came as a direct response of state-wide environmental legislation to focus on potential business opportunities following enactment. Although these conditions and triggers are very specific to the respective cases (and regions), they illustrate more broadly how different spatial contexts impact green value creation initiatives at the meso-level.

Lastly, the macro-level study provides some interesting reflections on how market demand for green products and services varies across the geographical landscape. First, the study demonstrates how different regulatory landscapes and public priorities across countries (and states) has a direct impact on green demand. The study exemplifies this by discussing the role of national subsidy programmes, the introduction of energy labels, and demand related to environmental assessments (e.g. LCAs and EDPs), all of which are found to play a role in creating green market demand. Similar findings are shown in the micro-level study, where banning of conventional hull-cleaning practices led to increased demand in certain European ports. Besides direct government intervention, the study further indicates that other structural and economic conditions have had an impact on the market conditions. For example, in contrast to many other European countries, the Norwegian energy market is dominated by cheap and green electricity (see Article 3). This is presumed to impede focus on energy efficiency and the development of new renewable energy technologies. This could be compensated for through active state involvement (e.g. subsidy programmes) and political willingness to support potential export technologies and industries that are compatible with a green economic transformation. This illustrates how different spatial settings both can encourage and impede the arrival of green products and services. However, the study is limited by its focus on the business-to-business (B2B) market, which in many respects is rather different from the business-to-consumer (B2C) market. Hence, the geography concerning demand for greener consumer goods, including social acceptance, and

consumer trust related to products and industries, should be addressed separately (see section 5.1).

RQ3: How do the different levels interact in green value creation initiatives?

RQ3 analyses interactions across the micro-, meso-, and macro-levels. In many ways, these interactions represent the link between the three individual contributions of the thesis. Cross-level interactions appear when green value-creation initiatives observed at one level are contingent upon changes and mechanisms at other levels. The empirical evidence demonstrates that this occurs regularly, but until now these cross-level interactions have not been explicitly addressed in the thesis.

Cross-level interactions are particularly evident in the study of cleantech clusters. The study shows how different conditions and triggers at each level are part of the explanation of how these cleantech clusters emerged and why they are located where they are. First, macro-level structures linked to national and state authorities taking an active or passive role in relation to green industry development have contributed to the formation of the cleantech clusters at the meso-level. In one of the cases this was trigged by ambitious renewable energy goals, while political inertia, or more precisely what was perceived by local stakeholders as an inadequate response by central authorities to issues regarding green industry development, was relevant in another case. However, the formation of the cleantech clusters is not solely down to these macro-level triggers. Industry structures and regional strengths help to explain why the cleantech clusters were formed in and around the case cities and not elsewhere in the countries or states, which after all are subject to the same macro-level influences. The latter demonstrates the importance of the meso-level in analyses of cleantech clustering and more broadly the geography of green industry development. Still, given the industrial width of the cleantech segment, many regions have the industrial capabilities needed to branch out green commercial activities and organise them in clusters. In this respect, there is also a clear element of micro-level agency involved, driven by strategic motives and a desire

to make the region 'stand out' in what probably will become a myriad of 'green' and 'clean' clusters or even regions in the near future. The latter corresponds to the notion of 'system agency', which has received increasing attention within economic geography in recent years (see section 3.2.1).

The thesis further demonstrates how cross-level interactions are important for green value creation that unfolds at the micro-level. The micro-level study shows how the cleantech start-ups are shaped by the spatial setting as well as the regulatory landscape. With respect to spatial context (i.e. meso-level), the study indicates that the 'institutional thinness' of the rural communities has had a clear impact on the composition and geographical reach of the task environments that were formed to bring their solutions to the market. Despite relying extensively on external knowledge sources, the unique and tacit knowledge embedded in the rural communities, respectively associated with being at sea or in the air, still played a crucial role in forming the business concepts. However, the fact that this unique knowledge contributed to the establishment of 'green' businesses is rather incidental and highly determined by the specific technological solutions. In other words, there are no indications that the two rural communities discussed in the study are more likely to foster green value creation initiatives than other places and regions, unlike what might be expected from the cleantech clusters. Moreover, the macro-level has played a role in the successful development of the two businesses. In this relation, the study finds that public grant schemes targeting green innovation have been very important financial sources to the projects, in addition to regulations, which have had an impact on the market conditions (either domestically or abroad). The latter is sometimes very evident and easy to observe, for example in cases where there is a direct link between environmental regulations imposed at the macro-level and entrepreneurial response at the micro-level. In other cases, these cross-level interactions may be more subtle. This is exemplified in both Article 1 and Article 3, in which government regulation are considered to play a contributive role rather than a decisive role in creating green demand, implying that the market was not entirely dependent upon intervention.

Based on the empirical evidence presented above, this concluding discussion highlights many instances where the macro-level has influenced processes and conditions for green value creation at the meso-level and micro-level. The discussion further exemplifies how the meso-level has impacted the micro-level and vice versa. However, the individual studies contain few concrete examples of where the macro-level has been influenced by the micro-level and meso-level. However, it is reasonable to say that the latter also is part of the dynamic regarding how multiple levels interact in green value creation. This is implicitly shown in the meso-level study, in which advocating for policies was found to be part of the cluster organisations strategy for promoting the adoption of greener products and services. Based on earlier research, we also know that micro-agents have been found to engage with the macro-level in deliberate efforts to create or shape an ecosystem around their business, for example by lobbying for environmental regulations (see section 3.1.1).

Bringing in multiple analytical levels in the study of green value creation has contributed to the identification of theoretical implications and areas for future research. This is discussed further in the next and final section of this synopsis.

5.1 Theoretical implications and future research

My aim in this thesis is to widen the theoretical and conceptual understanding of actors, systems, and structures involved in green value creation. This has been achieved by taking a multilevel approach that explores and analyses green entrepreneurs (micro-level perspective), cleantech clusters (meso-level perspective) and market conditions for green products and services (macro-level perspective), both separately and in junction. Methodologically, the thesis predominantly relies on a qualitative case study design aimed to inform and complement theories and concepts through abductive reasoning. The latter involves a rigorous alternation between theoretical propositions and my own empirical evidence, with the purpose of confirming (i.e. theory testing) and expanding (i.e. theory building) contemporary theories and concepts.

The first implication concerns the concept of green entrepreneurs and the green entrepreneurship literature. In the research literature, the 'green entrepreneur' is largely portrayed as something distinct and different from conventional entrepreneurs. Often, typology studies have associated green entrepreneurs with idealistic motives driven by concern for the environment, or the complete opposite, namely profit-seeking opportunists that successfully have seized a green market opportunity. While these entrepreneurial types obviously exist, this biased focus on motivation has led to a rather narrow and stereotypical conception of what and whom green entrepreneurs are. This thesis demonstrates that it can be very hard to distinguish 'green' from 'conventional' entrepreneurs in terms of motivation. On this basis, the thesis suggests a broader conceptualisation of green entrepreneurs who also consider the green value delivered by their business or the market in which they operate. Moving beyond the conceptual discussion, the thesis further indicates that the 'green value' created by these start-ups is important in relation to attracting human and financial resources to the start-up projects. This calls for further research on what the 'green value' means for a start-up company and how this shapes strategic networks, funding opportunities, and relationships with public stakeholders. Another dimension that is discussed in relation to the cleantech start-ups is the geographical context. In this connection, the thesis indicates that the importance of geographical proximity to innovation resources is highly dependent on where they are in the start-up process, what tasks and activities are carried out, and not least the type and quality of the relationships they have with different actors. On this basis, future research should aim at providing a more nuanced understanding of when, for what, and with whom proximity (geographical, but also social, cognitive, and other types) is important in high-technology start-up processes. This would also allow for greater emphasis on agency and actor heterogeneity in studies of the geography of innovation and entrepreneurship. This leads us to another key implication of the thesis, which addresses the theoretical understanding on how economic activities develop within regional contexts.

Evolutionary economic geography is built on an understanding that regional economic development can be explained by the structures and institutions of the past and present. The literature highlights the path-dependent nature of how regional economies evolve

and renew. From an aggregate perspective, this is found to be very prominent in explaining how and why certain economic activities emerge in specific regions. In this respect, this thesis is not an exception. However, the thesis also demonstrates how other factors could play a role in the spatial distribution of economic activities, including mechanisms and conditions at the macro-level combined with place leadership at the micro-level. This is especially relevant in the context of green industry development, in which influences from both the macro-level and micro-level arguably will aim at steering regions in greener directions. A timely question in this respect is the extent to which green strategic priorities could offset the 'predetermined' industrial trajectories of regions. This calls for more attention to the micro-level and macro-level in regional analyses of industry development, which predominantly has been occupied with aggregate structures and institutions at the meso-level. With respect to the cleantech clusters specifically, the thesis has, in line with cluster theory, implicitly 'presumed' that these spatial agglomerations contribute to green value creation by fostering innovation and entrepreneurship within the cleantech segment. However, whether value creation is green or not is ultimately determined by the environmental impact of economic activities. Therefore, this thesis suggests that future studies should investigate the environmental performance of cleantech clusters to assess the green contribution they deliver. This is particularly relevant, as the thesis points out that the 'cleantech label' does not necessarily represent more than a regional branding strategy.

The thesis also provides insights into demand mechanisms that encourage the arrival of greener products and services. In this relation, the thesis empirically demonstrates how green business opportunities are inherent in environmentally relevant market failures. However, the thesis also shows that these opportunities may exist regardless of demand. In other words, simply responding to environmentally relevant market failures does not necessarily imply success in the market. For example, a green business opportunity that addresses firm inefficiency (i.e. a form of environmentally relevant market failure) does not equate to demand. Unlike neoclassical assumptions, many firms are unaware of excessive resource use in, for example, products, operations, and buildings, as well as potential solutions available in the market to address this inefficiency. Moreover, choosing greener alternatives may involve initial costs and risks associated with novel

technologies and unknown suppliers. In this respect, bounded rationality will often guide decision-making and choices, even if there is a potential cost-effective green technology available in the market. Thus, green entrepreneurs are often reliant on multiple market drivers jointly working together. This is demonstrated in the thesis, which shows how cost-effectiveness (and hence responding to market failure) does not necessarily constitute a sufficient market driver per se. Future research on this topic should aim for a better understanding of the link between environmentally relevant market failure and business opportunities, for example by comparing situations where simply responding to market failure suffices with situations where regulations or other market drivers are needed to create green demand. Moreover, the thesis brings the spatial dimension into the discussion about green market demand by analysing how different regulatory landscapes and economic conditions are expected to play a key role in the geography of green value creation. In relation to this, it would be interesting to explore variations across countries (or even states and regions) in the consumer market for green products and services, which are not covered in this thesis.

Lastly, it is important to briefly mention the temporal context. Since I started working on this thesis in 2013, the attention to green value creation has changed dramatically. This implies that some of the empirical evidence collected in the early stages of my research probably would reflect a rather different situation if they were collected in 2020. In this connection, it would be interesting to repeat the survey to compare the data before and after what arguably has been a very important period regarding the corporate sectors view on business and the environment.

6 References

Anderson, A. R. (1998). Cultivating the Garden of Eden: environmental entrepreneuring. *Journal of Organizational Change Management 11*(2), 135-144.

Archer, M., Decoteau, C., Gorski, P., Little, D., Porpora, D., Rutzou, T., Smith, C., Steinmetz, G., & Vandenberghe, F. (2016). *What is critical realism?* Newsletter for American Sociology Section. Accessed March 2020: http://www.asatheory.org/current-newsletter-online/what-is-critical-realism

Arrow, K. (1962). Economic welfare and the allocation of resources for invention. *National Bureau of Economic Research*. Princeton University Press.

Bailey, J. R., & Eastman, W. N. (1994). Positivism and the Promise of the Social Sciences. *Theory & Psychology 4* (4), 505-524.

Barney, J. (1991). Firm resources and sustained competitive advantage. *Journal of Management 17* (1), 99-120.

Bauhardt, C. (2014). Solutions to the crisis? The Green New Deal, Degrowth, and the Solidarity Economy: Alternatives to the capitalist growth economy from an ecofeminist economics perspective. *Ecological Economics 102*, 60-68.

Bennet, J. S. (1991). *Ecopreneuring: The Complete Guide to Small Business Opportunities from the Environmental Revolution*. New York, John Wiley and Sons.

Bergquist, A. K., & Söderholm, K. (2011). Green Innovation Systems in Swedish Industry, 1960-1989. *The Business History Review 85* (4), 677-698.

Bergset, L., & Fichter, K. (2015). Green start-ups – a new typology for sustainable entrepreneurship and innovation research. *Journal of Innovation Management 3* (3), 118-144.

Berle, G. (1991). *The Green Entrepreneur: Business Opportunities that Can Save the Earth and Make You Money.* Blue Rudge Summit, Liberty Hall Press.

Beveridge, R., & Guy, S. (2005). The rise of the eco-preneur and the messy world of environmental innovation. *Local Environment 10* (6), 665-676.

Bhaskar, R. (1975). *A Realist Theory of Science*. Leeds, Leeds Books.

Bina, O. (2013). The Green Economy and Sustainable Development: Un Uneasy Balance? *Environment and Planning C: Politics and Space 31* (6).

Blue, J. (1990). *Ecopreneuring: Managing for Results*. London, Scott Foresman.

Boschma, R., & Frenken, K. (2003). Evolutionary economics and industry location. *Jahrbuch für Regionalwissenschaft 23*, 183-200.

Boschma, R. (2005). Proximity and Innovation: A Critical Assessment. *Regional Studies 39* (1), 61-74.

Boschma, R., & Frenken, K. (2006). Why is economic geography not an evolutionary science? Towards an evolutionary economic geography. *Journal of Economic Geography 6* (3), 273-302.

Boschma, R., & Frenken, K. (2011). The emerging empirics of evolutionary economic geography. *Journal of Economic Geography 11* (2), 295–307.

Boschma, R. (2017). Relatedness as driver of regional diversification: a research agenda. *Regional Studies 51* (3), 351-364.

Brossmann, J., & Islar, M. (2020). Living degrowth? Investigating degrowth practices through performative methods. *Sustainability Science 15,* 917-930.

Brundtland, G. (1987). *Report of the World Commission on Environment and Development: Our Common Future.* United Nations General Assembly.

Carson, R. (1962). *Silent Spring.* Boston, Houghton Mifflin.

Carson, D., Gilmore, A., Perry, C., & Grønhaug, K. (2001). *Qualitative Marketing Research.* London, SAGE Publications.

Capasso, M., Hansen, T., Heiberg, J., Klitkou, A., & Steen, M. (2019). Green growth – A synthesis of scientific findings. *Technological Forecasting and Social Change 146*, 390-402.

Carrillo-Hermosilla, J., del Río González, P. & Könnölä, T. (2009). *Eco-Innovation: When Sustainability and Competitiveness Shake Hands.* London, Palgrave Macmillan.

Chapple, K., Kroll, C., Lester, T. W., & Montero, S. (2011). Innovation in the Green Economy: An Extension of the Regional Innovation System Model? *Economic Development Quarterly 25* (5).

Cheng, W., Appolloni, A., D'Amato, A., & Zhu, Q. (2017). Green Public Procurement, Missing Concepts and Future Trends – A Critical Review. *Journal of Cleaner Production 176.*

Cleff, T. and Rennings, K. (2012). Are there any first-mover advantages for pioneering firms? *European Journal of Innovation Management 15* (4), 491-513.

Coenen, L., & Truffer, B. (2012). Places and Spaces of Sustainability Transitions: Geographical Contributions to an Emerging Research and Policy Field. *European Planning Studies 20* (3), 367-374.

Cohen, B. & Winn, M. I. (2007). Market imperfections, opportunity and sustainable entrepreneurship. *Journal of Business Venturing 22*, 29-49.

Cooke, P., Gómez Uranga, M., & Etxebarria, G. (1997). Regional Innovation Systems: Intuitional and Organisational Dimensions. *Research Policy 26* (4-5), 475-491.

Cooke, P. (2010). Regional innovation systems: development opportunities for the 'green turn'. *Technology Analysis & Strategic Management 22* (7), 831-844.

Couper, P. (2015). *A Student's Introduction to Geographical Thought: Theories, Philosophies, Methodologies*. London, SAGE Publications.

Creswell, J. W. (2014). *Research Design: Qualitative, Quantitative, and Mixed Methods Approaches.* London: SAGE Publications.

Cyert, R. M., & March, J. G. (1963). *A Behavioural Theory of the Firm*. University of Illinois at Urbana-Champaign's Academy for Entrepreneurial Leadership Historical Research Reference in Entrepreneurship.

Dahl Fitjar, R., & Rodríguez-Pose, A. (2017). Nothing is in the Air. *Growth and Change 48* (1), 22-39.

Davies, A. R. (2013). Cleantech clusters: Transformational assemblages for a just, green economy or just business as usual? *Global Environmental Change 23*, 1285-1295.

Dean, T. J. and McMullen, J. S. (2007). Toward a theory of sustainable entrepreneurship: Reducing environmental degradation through entrepreneurial action. *Journal of Business Venturing 22*, 50-76.

de Groot, H. L. F., Poot, J., & Smit, M. J. (2015). Which agglomeration externalities matter most and why? *Journal of Economic Surveys 30* (4), 756-782.

del Río González, P. (2005). Analyzing the Factors of Influencing Clean Technology Adoption: A Study of the Spanish Pulp and Paper Industry. *Business Strategy and the Environment 14*, 20–37.

Denzin, N. K. (2017). *Sociological Methods: A Sourcebook.* New York, Routledge.

Douthwaite, R. (2011). Degrowth and the supply of money in an energy-scarce world. *Ecological Economics 84.*

Du Pisani, J. A. (2006). Sustainable development – historical roots of the concept. *Environmental Sciences 3* (2), 83-96.

Dubois, A., & Gadde, L. E. (2002). Systematic combining: an abductive approach to case research. *Journal of Business Research 55* (7), 553-560.

Easton, G. *(*2010*).* Critical realism in case study research*. Industrial Marketing Management 39* (1)*,* 118–128*.*

Economics Online (2019). *Negative externalities.* Accessed November 2019: https://www.economicsonline.co.uk/Market_failures/Externalities.html

Ehrlich, P. R. (1968). *The Population Bomb*. New York, Ballantine Books.

Elkington, J. (1994). Enter the triple bottom line. In A, Henriques, & J. Richardson (eds.). *The Triple Bottom Line, Does it All Add Up?* (pp. 1-16). London, Earthscan.

Escobar, A. (2015). Degrowth, postdevelopment, and transitions: a preliminary conversation. *Sustainability Science 10*, 451-462.

Etikan, I. (2016). Comparisons of Convenience Sampling and Purposive Sampling. *American Journal of Theoretical and Applied Statistics 5* (1), 1-4.

European Commission (2010). *Industrial Emissions Directive.* Accessed January 2020: https://ec.europa.eu/environment/industry/stationary/ied/legislation.htm

European Commission (2019). *Smart Specialisation Platform. What is Smart Specialisation?* Accessed December 2019: https://s3platform.jrc.ec.europa.eu/what-is-smart-specialisation-

European Commission (2020). *Green growth and circular economy*. Accessed March 2020: https://ec.europa.eu/environment/green-growth/index_en.htm

European Commission (2020). *A European Green Deal.* Accessed June 2020: https://ec.europa.eu/info/strategy/priorities-2019-2024/european-green-deal_en

Eurostat (2008). NACE Rev. 2: Statistical classification of economic activities in the European Community. *Eurostat Methodologies and Working Papers.*

Eurostat (2009). The environmental goods and services sector: A data collection handbook (2009 ed.) *Eurostat Methodologies and Working Papers.*

Eurostat (2016). *Environmental goods and services sector accounts*. Handbook (2016 ed.).

Everard, M., Pontin, B., Appleby, T., Staddon, C., Hayes, E. T., Barnes, J. H., & Longhurst, J.W.S. (2013). Air as common good. *Environmental Science & Policy 33*, 354-368.

Ferguson, P. (2015). The green economy agenda: business as usual or transformational discourse? *Environmental Politics 24* (1), 17-37.

Fletcher, A. J. (2017). Applying critical realism in qualitative research: methodology meets method. *International Journal of Social Research Methodology 20* (2), 181-194.

Fletcher, R., & Rammelt, C. (2017). Decoupling: A Key Fantasy of the Post-2015 Sustainable Development Agenda. *Globalizations 14* (3), 450-467.

Florida, R., Adler, P., & Mellander, C. (2017). The city as innovation machine. *Regional Studies 51* (1), 86-96.

Fonseca, S. A., & Jabbour, C. J. C. (2012). Assessment of business incubators' green performance: A framework and its application to Brazilian cases. *Technovation 32*, 122-132.

Fornahl, D., Hassink, R., & Menzel, M. (2015). Broadening our knowledge on cluster evolution. *European Planning Studies 23* (10), 1921-1931.

Foster, J. B. (2011). Capitalism and Degrowth: An Impossibility Theorem. *Monthly Review.*

Frenken, K., van Oort, F., & Verburg, T. (2007). Related variety, unrelated variety and regional economic growth. *Regional Studies 41* (5), 685-697.

Fusch, P., Fusch, G. E., & Ness, L. R. (2018). Denzin's Paradigm Shift: Revisiting Triangulation in Qualitative Research. *Journal of Social Change 10* (1), 19-32.

Galkina, T., & Hultman, M. (2016). Ecopreneurship – Assessing the Field and Outlining the Research Potential. *Small Enterprise Research 23*, 58–72.

Gari, L. (2002) Arabic treatises on environmental pollution up to the end of the thirteenth century. *Environment and History 8* (4), 475-488.

Gast, J., Gundolf, K., & Cesinger, B. (2017). Doing Business in a Green Way: A Systematic Review of the Ecological Sustainability Entrepreneurship Literature and Future Research Directions. *Journal of Cleaner Production 147*, 44–56.

Geels, F. W. (2004). From sectoral systems of innovation to socio-technical systems. Insights about dynamics and change from sociology and institutional theory. *Research Policy 33*, 897-920.

Georgeson, L., & Maslin, M. (2019). Estimating the scale of the US green economy within the global context. *Palgrave Commun 5* (121).

Giddens, A. (1984). *The Constitution of Society: Outline of the Theory of Structuration.* Los Angeles, University of California Press.

Giuliani, E. (2007). The selective nature of knowledge networks in clusters: evidence from the wine industry. *Journal of Economic Geography 7* (2), 139–168.

Glaeser, E. L., Kallal, H. D., Scheinkman, J. A., & Shleifer, A. (1992). Growth in Cities. *Journal of Political Economy 100* (6).

Global Footprint Network (2020). *Ecological Footprint*. Accessed May 2020: https://www.footprintnetwork.org/our-work/ecological-footprint/

Golafshani, N. (2003). Understanding Reliability and Validity in Qualitative Research. *The Qualitative Report 8* (4), 597-606.

Gorski, P. S. (2013). What is Critical Realism? And Why Should You Care? *Contemporary Sociology 42* (5), 658-670.

Grand View Research (2019). *Vegan Food Market Size: Share and Trends Analysis Report, 2019-2025*. Accessed January 2020: https://www.grandviewresearch.com/industry-analysis/vegan-food-market

Gray, M., & Caprotti, F. (2011). Cleantech clusters and the promotion of the low carbon transition: Criteria for success and evidence from Copenhagen, Masdar and online platforms. *Carbon Management 2* (5), 529-538.

Grey, F. (2018). Corporate lobbying for environmental protection. *Journal of Environmental Economics and Management 90*, 23-40.

Grillitsch, M., & Hansen, T. (2019). Green industry development in different types of regions. *European Planning Studies 27* (11), 2163-2183.

Guenster, N., Bauer, R., Derwall, J., & Koedijk, K. (2011). The Economic Value of Corporate Eco-Efficiency. *European Financial Management 17* (4), 679-704.

Haarstad, H., & Rusten, G. (2018). Grønn omstilling og norske veivalg: Introduksjon. In H. Haarstad, & G. Rusten (eds.) *Grønn omstilling: norske veivalg* (pp. 11-25). Oslo, Universitetsforlaget.

Hajer, M. (1995). *The Politics of Environmental Discourse: Ecological Modernization and the Policy Process.* New York, Oxford University Press.

Hansen, T., & Coenen, L. (2015). The geography of sustainability transitions: Review, synthesis and reflections on an emergent research field. *Environmental Innovation and Societal Transitions 17*, 92-109.

Hanson, J., & Normann, H. (2019). Conditions for growth in the Norwegian offshore wind industry. *CenSES Report.*

Hardin, G. (1968). The Tragedy of the Commons. *Science 162* (3859), 1243-1248.

Hassink, R. (2016). Cluster decline and political lock-ins. In F. Belussi, & J. L. Hervas Oliver (eds.). *Unfolding Cluster Evolution* (pp. 191-203). London, Routledge.

Hatch, C., Tremblay, D., & Cazabon-Sansfaçon, L. (2017). The Role of Social Actors in Advancing a Green Transition: The case of Québec's Cleantech Cluster. *Journal of Innovation Economics & Management 24* (3), 63-87.

Hawken, P., Lovins, A., & Lovins, L. H. (1999). *Natural Capitalism: Creating the Next Industrial Revolution.* Boston, Little, Brown.

Hawkins, T. R., Singh, B., Majeau-Bettez, G., & Hammer Strømman, A. (2013). Comparative Environmental Life Cycle Assessment of Conventional and Electric Vehicles. *Journal of Industrial Ecology 17* (1), 53-64.

Hickel, J. (2019). Degrowth. a theory of radical abundance. *Real-world Economics Review 87*, 54-68.

Hickel, J., & Kallis, G. (2019). Is Green Growth Possible? *New Political Economy 25* (4), 469-486.

Hofstad, K., & Andersen G., (2020). Økologisk fotavtrykk. Store norske leksikon. Accessed May 2020: https://snl.no/%C3%B8kologisk_fotavtrykk

IPCC (2014). *Climate Change 2014: Synthesis Report. Contributions of Working Groups 1, 2, 3 to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change*. IPCC, Geneva, Switzerland.

Isaak, R. (2002). The Making of the Ecopreneur. *Greener Management International 38*, 81–91.

Isaksen, A. (2015). Industrial Development in Thin Regions: Trapped in Path Extension? *Journal of Economic Geography 15*, 585–600.

Jacobs, J. (1969). The economy of cities. *Vintage International* 584, Random House.

Jacobs, M. (2012). Green Growth: Economic Theory and Political Discourse. *Centre for Climate Change Economics and Policy* Working Paper No. 108.

Jänicke, M. (2020). Ecological Modernization – a Paradise of Feasibility but no General Solution. In L. Mez., L. Okamura., & H. Weidner (eds.). *The Ecological Modernization Capacity of Japan and Germany. Energiepolitik und Klimaschutz - Energy Policy and Climate Protection.* Wiesbaden, Springer.

Jensen, P. D., Basson, L., Hellawell, E. E., Bailey, M. R., & Leach, M. (2011). Quantifying 'geographic proximity': Experiences from the United Kingdom's National Industrial Symbiosis Programme. *Resources, Conservation and Recycling 55* (7), 703-712.

Kallis, G. (2011). In defence of degrowth. *Ecological Economics 70* (5), 873-880.

Kallis, G., & March, H. (2015). Imaginaries of Hope: The Utopianism of Degrowth. *Annals of the Associate of American Geographers 105* (2), 360-368.

Karnøe, P., & Garud, R. (2012). Path Creation: Co-creation of Heterogeneous Resources in the Emergence of the Danish Wind Turbine Cluster. *European Planning Studies 20* (5), 733-752.

Karrierebarometeret (2019). *Attraktive bransjer, arbeidsgivere og traineeprogram*. Accessed February 2020: https://studenttorget.no/UserFiles/content/Karrierebarometeret%202019_lister%20og%20trender.pdf

Kasabov, E. (2011). Towards a Theory of Peripheral, Early-stage Clusters. *Regional Studies 45* (6), 827-842.

Kemp, R., Loorbach, D., Rotmans, J. (2007). Transition management as a model for managing processes of co-evolution towards sustainable development. *International Journal of Sustainable Development and World Ecology* 14, 1-15.

Keogh, P. D., & Polonsky, M. J. (1998). Environmental commitment: a basis for environmental entrepreneurship? *Journal of Organizational Change Management 11* (1), 38-49.

Kimmel, R. M. (2014). Life Cycle Assessment of Grocery Bags in Common Use in the United States. *Environmental Studies 6*.

Kögl, I., & Kurze, K. (2013). Sustainable development: A floating signifier in the EU's energy policy discourse. In P. M. Barnes, & T. C. Hoerber (eds.). *Sustainable Development and Governance in Europe* (pp. 61-75). New York, Routledge.

Kumar, S. (2018). Understanding Different Issues of Unit of Analysis in a Business Research. *Journal of General Management Research 5* (2), 70-82.

Larson, A. L. (2000). Sustainable innovation through an entrepreneurship lens. *Business Strategy and the Environment 9* (5), 304-317.

Leadbeater, C. (1997). *The rise of the social entrepreneur.* London, Demos.

Lindqvist, G. (2009). *Disentangling Clusters: Agglomeration and Proximity Effects*. Doctoral thesis. Stockholm School of Economics.

Linnanen, L. (2002). An Insider's Experiences with Environmental Entrepreneurship. *Greener Management International 38*.

Linster, M., & Yang, C. (2018). China's Progress Towards Green Growth: an international perspective. *OECD Green Growth Papers*. Paris, OECD Publishing.

Liodakis, G. (2018). Capita, Economic Growth, and Socio-Ecological Crisis: A Critique of De-Growth. *International Critical Thought 8* (1), 46-65.

Lorentzen, M. (2005). Why do clusters change? *European Urban and Regional Studies 12* (3), 203–208.

Lu, R., Reve, T., Huang, J., Jian, Z., & Chen, M. (2018). A literature review of cluster theory: Are relations among clusters important? *Journal of Economic Surveys 32* (4), 1201-1220.

Maguire, S., Hardy, C., & Lawrence, T. B. (2004). Institutional Entrepreneurship in Emerging Fields: HIV/AIDS Treatment Advocacy in Canada. *The Academy of Management Journal 47* (5), 657-679.

Markard, J., Raven, R., & Truffer, B. (2012). Sustainability transitions: An emerging field of research and its prospects. *Research Policy 41*, 955-967.

Marra, A., Antonelli, P. & Pozzi, C. (2017). Emerging clean-tech specializations and clusters – A network analysis on technological innovation at the metropolitan level. *Renewable and Sustainable Energy Reviews 67*, 1037-1046.

Marshall, A. 1(890). *Principles of Economics*. London, MacMillan and Co. Limited.

Marshall, A. (1919). *Industry and trade: A study of industrial technique and business organization*. London, Macmillan.

Martin, R., & Sunley, P. (2006). Path dependence and regional economic evolution. *Journal of Economic Geography 6* (4), 395–437.

McAvoy, J., & Butler, T. (2018). A critical realist method for applied business research. *Journal of Critical Realism 17*, 1-16.

McCauley, S. M., & Stephens, J. C. (2012). Green energy clusters and socio-technical transitions: analysis of a sustainable energy cluster for regional economic development in Central Massachusetts, USA. *Sustainability Science 7*, 213-225.

McHenry, M. (2009). Policy options when giving negative externalities market value: Clean energy policymaking and restructuring the Western Australian energy sector. *Energy Policy 37* (4), 1423-1431.

Meadows, D. H. (1972). *The Limits to Growth: A report for the Club of Rome's project on the predicament of mankind*. New York, Universe Books.

Mellander, C., & Florida, R. (2014). The Rise of Skills: Human Capital, the Creative Class, and Regional Development. In M. Fischer, & P. Nijkamp (eds.). *Handbook of Regional Science* (pp. 317-329). Berlin, Springer.

Menzel, M., & Fornahl, D. (2010). Cluster life cycles – dimensions and rationales of cluster evolution. *Industrial and Corporate Change 19* (1), 205–238.

Montello, D. R. (2013). Behavioral and Cognitive Geography: Introduction and Overview. In D. R. Montello (ed.). *Handbook of Behavioral and Cognitive Geography*. Edward Elgar Publishing.

Neffke, F., Henning, M., Boschma, R. (2011). How do regions diversify over time? Industry relatedness and the development of new growth paths in regions. *Economic Geography 87* (3), 237-265.

Nikolaou, I. E., Tasopoulou, K., & Tsagarakis, K. (2018). A Typology of Green Entrepreneurs Based on Institutional and Resource-based Views. *The Journal of Entrepreneurship 27* (1).

Njøs, R. (2018). *The role of multilevel dynamics and agency in regional industry renewal*. Doctoral thesis, University of Bergen.

Nordelöf, A., Messagie, M., Tillman, A. M., Ljunggren Söderman, M., & Van Mierlo, J. (2014). Environmental impacts of hybrid, plug-in hybrid, and battery electric vehicles – what can we learn from life cycle assessment? *International Journal of Life Cycle Assessment 19*, 1866-1890.

Norsk industri (2019). Aibel vinner stor havvind-kontrakt. Accessed September 2020: https://www.norskindustri.no/bransjer/olje-og-gass/aktuelt/aibel-vinner-stor-havvind-kontrakt/

Næss, A. (1973). The shallow and the deep, long-range ecology movement. A Summary. *Inquiry 16* (1-4), 95-100.

OECD (2011). Towards Green Growth. *OECD Green Growth Studies*.

OECD (2011). *Entrepreneurship at a Glance*. Paris: OECD Publishing.

OECD (2020. *Green growth and sustainable development*. Accessed February 2020: https://www.oecd.org/greengrowth/

O'Neill, K. J., & Gibbs, D. (2016). Rethinking green entrepreneurship – Fluid narratives of the green economy. *Environment and Planning A 46*, 1088-1107.

Osborn, F. (1948). *Our Plundered Planet*. Boston, Little, Brown.

Oxford Reference (2020). *Floating signifier.* Access June 2020: https://www.oxfordreference.com/view/10.1093/oi/authority.20110803095824238

Pàdranos, L. I. (2013). Toward a euro-Mediterranean socio-environmental perspective: The case for a Spanish ecocriticism. *Ecozon 4* (2), 30–48.

Palinkas, L. A., Horwitz, S. M., Green, C. A., Wisdom, J. P., Duan, N., & Hoagwood, K. (2015). Purposeful Sampling for Qualitative Data Collection and Analysis in Mixed Method Implementation Research. *Administration and Policy in Mental Health and Mental Health Services Research 42*, 533-544.

Parrique, T., Barth, J., Briens, F., & Spangenberg, J. H. (2019). *Decoupling Debunked. Evidence and arguments against green growth as a sole strategy for sustainability*. A study edited by the European Environment Bureau EBB.

Pastakia, A. (1998). Grassroots Ecopreneurs: Change Agents for a Sustainable Society. *Journal of Organizational Change Management 11*, 157–173.

Pernick, R., & Wilder, C. (2007). *The Clean Tech Revolution: The Next Big Growth and Investment Opportunity*. Harper Business.

Platt, H. L. (2005). *Shock Cities: The Environmental Transformation and Reform of Manchester and Chicago.* Chicago, The University of Chicago Press.

Plummer, P., & Sheppard, E. (2006). Geography matters: Agency, structures and dynamics at the intersection of economics and geography. *Journal of Economic Geography 6* (5), 619-637.

Polit, D. F., & Beck, C. T. (2010). Generalization in quantitative and qualitative research: Myths and strategies. *International Journal of Nursing Studies 47*, 1451-1458.

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

Porter, M. E., van der Linde, C. (1995). Toward a new conception of the environment-competitiveness relationship. *The Journal of Economic Perspectives 9*, 97-118.

Porter, M. E. (2000). Location, competition, and economic development: Local clusters in a global economy. *Economic Development Quarterly 14* (1), 15-34.

Porter, M. E., & Kramer, M. R. (2006). Strategy and society: The link between competitive advantage and corporate social responsibility. *Harvard Business Review 84* (12), 78–92.

Porter, M. E., & Kramer, M. R. (2011). Creating Shared Value. How to reinvent capitalism – and unleash a wave of innovation and growth. *Harvard Business Review* January-February 2011 Issue.

Quinn, B. J. (1971). Next big industry: environmental improvement. *Harvard Business Review 49* (5), 120-131.

Rabe, B. G. (2019). Racing to the Top, the Bottom, or the Middle of the Pack? The Evolving State Government Role in Environmental Protection. In J. V. Norman, & M. E. Kraft (eds.).

Environmental Policy: New Directions for the Twenty-First Century (10th ed., pp. 37-66). Thousand Oaks, SAGE Publications.

Rip, A., & Kemp, R. (1998). Technological change. In S. Rayner, & E. L. Malone (eds*.). Human choice and climate change* (pp. 327-399). Columbus, Battelle Press.

Romer, P. M. (1986). Increasing returns and long-run growth. *The Journal of Political Economy 94* (5), 1002-1037.

Rusten, G. (2016). The Structure, Strategy and Geography of Green Certification Services. In A. Jones, P. Ström, B. Hermelin, & G. Rusten (eds.). *Services and the Green Economy* (pp. 51-75). London, Palgrave Macmillan.

Rusten, G., & Tvedt, H. L. (2018). Hvordan kan næringslivet bidra til en grønn omstilling? In H. Haarstad, & G. Rusten (eds.) *Grønn omstilling: norske veivalg* (pp. 79-95). Oslo, Universitetsforlaget.

Santini, C. (2017). Ecopreneurship and Ecopreneurs: Limits, Trends and Characteristics. *Sustainability 9* (492).

Sayer, A. (1997). Critical Realism and the Limits to Critical Social Science. Journal *for the Theory of Social Behaviour 27* (4), 473-488.

Sayer, A. (2000). *Realism and Social Science*. London, SAGE Publications.

Schaltegger, S. (2002). A Framework of Ecopreneurship: Leading Bioneers and Environmental Managers to Ecopreneurship. *Greener Management International 38*, 45–58.

Schaltegger, S., & Wagner, M. (2011). Sustainable Entrepreneurship and Sustainability Innovation: Categories and Interactions. *Business Strategy and the Environment 20*, 222–237.

Schneider, F., Kallis, G., & Martinez-Alier, J. (2010). Crisis or opportunity? Economic degrowth for social equity and ecological sustainability. Introduction to this special issue. *Journal of Cleaner Production 18* (6).

Schumpeter, J. (1939). *Business Cycles.* New York, McGraw Hill.

Scott, A. J., & Storper, M. (1987). High technology industry and regional development: a theoretical critique and reconstruction. *International Social Science Journal 39*, 215-232.

Shearmur, R. (2011). Innovation, Regions and Proximity: From Neo-regionalism to Spatial Analysis. *Regional Studies 45*, 1225–1243.

Sjøtun, S. (2018). A ferry making waves: A demonstration project 'doing' institional work in a greening maritime industry. *Norsk Geografisk Tidsskrift – Norwegian Journal of Geography 73* (1), 16-28.

Sjøtun, S., & Njøs, R. (2019). Green reorientation of clusters and the role of policy: the normative and the neutral route. *European Planning Studies 27* (12), 2411-2430.

Solvell, Ö. (2015). The competitive advantage of nations 25 years – opening up new perspectives on competitiveness. *Competitiveness Review 25* (5), 471-481.

Sotarauta, M., & Suvinen, N. (2019). Place leadership and the challenge of transformation: policy platforms and innovation ecosystems in promotion of green growth. *European Planning Studies 27* (9), 1748-1767.

Statistics Canada (2017). *Environmental and Clean Technology Products Economic Account, 2007-2016.* Accessed July 2020: https://www150.statcan.gc.ca/n1/en/daily-quotidien/171213/dq171213g-eng.pdf?st=oLJ0Nhj7

Steen, M. (2016). Reconsidering path creation in economic geography: aspects of agency, temporality and methods. *European Planning Studies 24* (9), 1605-1622.

Stenbacka, C. (2001). Qualitative research requires quality concepts of its own. *Management Decision 39* (7), 551-555.

Storper, M., & Walker, R. (1989). *The capitalist imperative, territory, technology, and industrial growth*. New York, Basil Blackwell.

Street, C. T., & Ward, K. W. (2012). Improving validity and reliability in longitudinal case study timelines. *European Journal of Information Systems 12* (2), 160-175.

Sydow, J., Schreyögg, G., & Koch, J. (2009). Organizational Path Dependency: Opening the Black Box. *Academy of Management Review 34*, 689–709.

Sylvan (Routley), R. (1973). Is There a Need for a New, an Environmental, Ethics? *Proceedings of the 15th World Congress of Philosophy* 205-201. Varna, Bulgaria, Sofia Press.

Swedberg, R. (2018). How to use Max Weber's ideal type in sociological analysis. *Journal of Classical Sociology 18* (3), 181-196.

Thornton, P. H., & Ocasio, W. (1999). Institutional logics and the historical contingency of power in organizations: Executive succession in the higher education publishing industry, 1958-1990. *American Journal of Sociology 105* (3), 801-843.

Tokic, D. (2012). The economic and financial dimensions of degrowth. *Ecological Economics 84*, 49-56.

Tsiligiris, V. (2018). An adapted Porter Diamond Model for the evaluation of translational education host countries. *International Journal of Educational Management 32* (2), 210-226.

UN General Assembly (1972). *Report of the United Nations Conference on the Human Environment*. Stockholm, 5-16 June 1972.

United Nations (2020). *UN Sustainable Development Goals*. Accessed August 2020: https://sdgs.un.org/goals

UNFCCC (2020). *Berlin Climate Change Conference – March 1995*. Accessed March 2020: https://unfccc.int/process-and-meetings/conferences/past-conferences/berlin-climate-change-conference-march-1995

Van de Ven, H. (1993). The development of an infrastructure for entrepreneurship. *Journal of Business Venturing 8* (3), 211-230.

van den Bergh, J. C. J. M., & Kallis, G. (2012). Growth, A-Growth or Degrowth to Stay within Planetary Boundaries? *Journal of Economic Issues 46* (4), 909-920.

van den Bergh, J. C. J. M. (2017). A third option for climate policy within potential limits to growth. *Nature Climate Change 7*, 107-112.

van Oort, F. (2015). Unity in variety? Agglomeration economics beyond the specialization-diversity controversy. In C. Karlsson, M. Andersson, & T. Norman (eds.). *Handbook of Research Methods and Applications in Economic Geography* (pp. 259-271*)*. Cheltenham, Edward Elgar Publishing.

Vogt, W. (1948). *Road to Survival.* New York, W. Sloane Associates.

Volkmann, C., Fichter, K., Klofsten, M., & Audretsch, D. B. (2019). Sustainable entrepreneurial ecosystems: an emerging field of research. *Small Business Economics*.

Walley, L. E. E., & Taylor, D. W. (2002). Opportunists, Champions, Mevericks…? A Typology of Green Entrepreneurs. *Greener Management International 38*.

Weber, M. (1904). Objectivity in Social Science and Social Policy. In M. Weber, E. Shils, & Finch, H. A. (eds.). *The Methodology of the Social Sciences* (pp. 49-112). New York, Free Press.

Willums, J. O. (1990). The Greening of Enterprise. Business Leaders Speak Out. *ICC Publication 487*.

Wright, C., & Nyberg, D. (2014). Creative self-destruction: corporate responses to climate change as political myths. *Environmental Politics 23* (2), 205-223.

Yin, R. K. (2009). *Case study research: Design and methods* (4th ed.). Thousand Oaks, SAGE Publications.

York, G. J. and Venkataraman, S. (2010). The entrepreneur-environment nexus: Uncertainty, innovation, and allocation. *Journal of Business Venturing 25* (5), 449-463.

Graphic design: Communication Division, UiB / Print: Skipnes Kommunikasjon AS

uib.no

ISBN: 9788230864364 (print)
9788230860458 (PDF)