

THESIS FOR THE DEGREE OF DOCTOR OF PHILOSOPHY

Sustainability intrapreneurship:
The role of employees in early-stage sustainability transitions of large technical systems

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Abstract

Large technical systems, such as energy grids, transport networks and freshwater and sewage systems, are socio-technical systems designed to last for many decades. Typically, they operate under strong regulation and are dominated by incumbent actors who are frequently portrayed as reluctant to commit to novel ideas and experiments. Therefore, large technical systems are often characterised by path dependence, and newcomers, such as entrepreneurs or actors from adjacent sectors, have limited room to initiate path-breaking innovations. Not just ‘anyone’ can design and build a large technical system, such as an electricity grid.

Still, recent empirical findings show that path-breaking innovation also emerges within large technical systems, and there has been a growing scholarly interest in understanding this phenomenon. However, this research has remained at the organisational level, overlooking the internal complexity of organisations, including the individuals within them. As a result, there is a gap where an intrapreneurial perspective could provide new insights.

Relying on three separate studies containing several empirical cases, primarily from the Swedish energy and traffic safety sectors, the thesis applies a qualitative approach to examine the locus of agency in path-breaking innovations in large technical systems. A role-based typology of sustainability intrapreneurs is proposed, distinguishing between the agenda setter, the demonstrator and the networking educator, each role contributing differently to the development and scaling of path-breaking innovation. Findings show that some incumbent employees act as sustainability intrapreneurs and play these roles, at their own discretion, to mobilise resources, challenge dominant technologies and visualise alternative futures for colleagues and others.

Theoretically, the thesis integrates insights from the entrepreneurship literature into the sustainability transitions literature, allowing the development of a novel analytical lens focusing on incumbent employees. This incumbent firm-internal bottom-up agency has previously not been represented in the conceptualisation of incumbents in sustainability transitions.

Furthermore, the proposed concept of sustainability intrapreneurship is a new form of intrapreneurship, focusing explicitly on improving the socio-technical system rather than merely the employer’s organisational benefits. By capturing sustainability intrapreneurship as both a theoretical concept and an empirical phenomenon, this thesis contributes to understanding how agency for early-stage sustainability transitions emerges, evolves and materialises within large technical systems.

Keywords: sustainability intrapreneurship; sustainability transitions; large technical systems; incumbents; employees; workplace behaviour.

List of appended papers

This thesis is based on the work contained in the following papers, referred to by Roman numerals in the text:

- I Fernqvist, N., & Lundqvist, M. (2021). Entrepreneurial Sustainability Engagement of Insiders Initiating Energy System Transition. *Sustainability*, 13(2), 734.
- II Fernqvist, N., Broberg, S., Torén, J., & Svensson, I. L. (2023). District heating as a flexibility service: Challenges in sector coupling for increased solar and wind power production in Sweden. *Energy Policy*, 172, 113332.
- III Fernqvist, N., & Lundqvist, M.. Sustainability intrapreneurs: Agents of path-breaking innovation initiatives in large technical systems. *Unpublished*.
- IV Fernqvist, N. (2025). Activation of values and anchoring of beliefs: How contextually embedded individuals are inspired by an institutional entrepreneur. *Scandinavian Journal of Management*, 101448.

Acknowledgements

So, this is the part that everybody who picks up this book will read... Well, in that case, I should begin by telling you that the vast majority of you will not find your name here. I'm sorry. But if I were to thank everyone who has been important to me over the years I have spent working on this thesis, this section would be so long that none of you would bother reading it anyway. Rest assured, you have been, and most importantly, you still are very important to me.

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So, what have I learnt? Well, a thesis journey and everything that comes with it give you so much that it is difficult to convey, even in a book. But if I had to choose just one thing to pass on to you, it would be to stay away from transdisciplinary research.

Niklas Fernqvist

Göteborg, Juni 2026

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1 Introduction

The inspiration for the thesis came from an initiative that seemed to be driven by one of Sweden's three largest electricity grid operators. In 2016, this Distribution System Operator (DSO) turned a small village in southern Sweden into a fully self-sufficient energy community. By taking advantage of local solar and wind production, adding a smart IT system, a 'just-in-case' renewable (HVO) diesel generator and a battery for storage, the village became the first Swedish community with an electric microgrid, able to produce and store its own energy. At first glance, the DSO's involvement in this initiative was puzzling since the widespread development of self-sufficient and grid-independent energy communities would threaten their core business. This made me curious about how and why this idea had come up in the first place. When investigating this question, I soon got caught up in a fascinating story about two employees and their strong personal drive to develop sustainable, self-sufficient energy systems.

In short, what I found was two DSO employees who, at their own discretion and without permission, used 'slack time' to seize an opportunity to act on their personal beliefs about a sustainable and resilient energy system. They secured external funding and identified a suitable site within the DSO's electricity grid – not just once, but twice. They engaged in dialogues with local residents and utilised external funding to hire a public relations officer, successfully turning local resistance into acceptance. Thus, what may look like a DSO initiative of path-breaking innovation was really the work of two of its employees. This made me realise that individuals can significantly influence what we may perceive as 'firm behaviour'.

Hence, by adopting an individual-level perspective, the thesis explores how employees of established firms and other organisations (labelled incumbents), acting as sustainability intrapreneurs, can contribute to the formation and diffusion of path-breaking innovation in early-stage sustainability transitions. Path-breaking innovation differs from path-dependent innovation, which is characterised by incremental improvements and 'innovation-as-usual-mentality'. Path-breaking innovation, instead, entails creation through meaningful navigation of constituted events that break with existing technologies, norms and institutions (Garud & Karnøe, 2001; Van Looy et al., 2001). This can be done, for example, by requiring different standards, changed user practices, industry structures or decision-making processes (Smith & Raven, 2012). I will return to the importance of path-breaking for sustainability transitions in the next section. First, however, I will briefly demonstrate that the established sustainability transitions literature has difficulty explaining the origins of path-breaking innovation, specifically in the context of energy systems.

In the sustainability transitions literature, incumbents are frequently portrayed as being reluctant to commit to novel ideas and experiments (Geels, 2002; Geels & Raven, 2006; Meadowcroft, 2009). However, since about the same time that the small village in the example above became a

fully self-sufficient energy community, sustainability transitions scholars have paid increasing attention to incumbents' efforts to adapt to transitions and actively shape them. It has been demonstrated that incumbents, as organisations, are in practice far more heterogeneous, nuanced and complex than commonly assumed in the transition literature and theory, and they can play different roles and enact critical strategies and actions in accelerating or slowing down transitions (Berggren et al., 2015; Karltorp & Sandén, 2012; Kungl, 2015; Steen & Weaver, 2017; Turnheim & Sovacool, 2020). For example, it is argued that incumbents can engage in various roles and activities aimed at developing radical innovations, niche alternatives or exploring and adopting emerging alternatives during regime change. They can also actively contest any form of regime change by staying inert and focusing on incremental fixes (see Table 1 for a review). This is not an 'either-or' situation, and incumbents can sometimes seek dual strategies of preservation and niche development simultaneously and change modes of behaviour over time (Berggren et al., 2015; Dutt, 2022; Geels et al., 2016; Hoes et al., 2016; Lindberg et al., 2019; McMeekin et al., 2019; Smink et al., 2015; Tolonen, 2024; Vormedal et al., 2023).

In the sustainability transitions literature, the focal point of agency has primarily remained at the organisational level. Incumbents are assumed to act as a single body with a unified agency. Firms are, obviously, complex bodies, and in some aspects, the behaviour of an organisation is, in a limited but important sense, reducible to the behaviour of the individuals who are members of that organisation (Nelson & Winter, 1982). Hence, organisations can be understood as a collective of individuals with diverse interests, including pro-social and environmental concerns (Hansen & Steen, 2015). Along these lines, scholars have called for greater use of multidisciplinary insights to embrace a more pluralistic and ultimately, complementary approach regarding actor perspectives (Kaufman et al., 2021; Upham, Bögel, & Dütschke, 2019).

Recently, in the sustainability transitions literature, the interest in the individual level has been increasing. Studies have started to highlight the importance of individual-level agency in relation to incumbents in sustainability transitions. It is argued that managers in incumbent organisations can play a crucial role in shaping the development of sustainability transitions (Goggins & Rau, 2021; Hoes et al., 2016). For example, it is suggested that managers' personal beliefs and incentives (Kenner & Heede, 2021; Kump, 2023; Loder et al., 2024) and their abilities to enable strategies, new practices (Leitch et al., 2019; Lenfle & Söderlund, 2022; Moncreiff et al., 2024; Sackey & Akotia, 2017; Wang et al., 2022), or include entrepreneurial staff members (Papadonikolaki et al., 2023), are important aspects of incumbent firm behaviour. Even though these studies adopt a firm-internal approach and are partly linked to personal sensemaking (Halttunen et al., 2022), they still employ a top-down perspective in which management is seen as having the agency to influence what actions are taken in relation to sustainability transitions. Only a very limited number of studies in the sustainability transitions literature look beyond management and delve deeper into the organisation. These studies primarily underscore the importance of R&D teams and dedicated business units. Particularly, the ability to negotiate with

various parties, identify standard technologies and components and drive innovation and strategic renewal (Berggren et al., 2015; Schönwälder & Weber, 2023).

However, in the initial example above, there was no top-level management decision to transform the village into a fully self-sufficient energy community. Nor did the two employees simply do what was expected of them in their professional roles. Furthermore, I did not find any firm-level strategies aimed at actively developing or exploring self-sufficient energy communities. Instead, this initiative was fully undertaken by two employees who, at their own discretion, acted on personal beliefs about the future and had to find and seize opportunities within and outside the organisation. Such bottom-up agency is not represented in the conceptualisation of incumbents in sustainability transitions. Thus, there is a gap in the sustainability transitions literature regarding the role of employees who, without the professional expectation of developing innovation and business, are motivated to take actions to initiate and develop path-breaking innovation for sustainability transitions.

As a reader, you may now wonder: what exactly is the problem here? After all, aren't there entrepreneurs and niche initiatives already offering alternatives to the incumbent actors within the regime (to borrow lingo from sustainability transitions theory)? Let us return to the example introduced at the beginning of this introduction, where two incumbent employees, at their discretion, initiated Sweden's first community electric microgrid. It is interesting to note that this event took place within the context of a large technical system (Hughes, 1987). Large technical systems, such as those in the energy distribution and transportation sectors, are systems including critical infrastructures that are essential to society. They are strongly path-dependent, as the infrastructure is typically capital-intensive and often designed to last for many decades. Incumbent actors own or have oligopolies over technical infrastructures, they operate under strong regulation and are usually owned and administered by public actors (Markard, 2011). Therefore, newcomers, such as entrepreneurs or actors from adjacent sectors, would have limited room to initiate breakthrough innovations in these sectors (Markard & Truffer, 2006). Not just 'anyone' can, or is allowed to, design and build an electricity grid and start to compete with the incumbent energy industry, especially not on a large scale (Andersen & Markard, 2020). The same can be said about large but localised infrastructural systems, such as district heating, drinking and sewage water infrastructures (Markard & Truffer, 2006; Turnheim & Geels, 2019). However, intrapreneurs, i.e., employees with entrepreneurial skills, would, on the other hand, have access to the infrastructure and the possibility to act bottom-up and from within the incumbent organisation (Burgelman, 1983; Pinchot III, 1985). Let me, therefore, briefly introduce the intrapreneurship perspective and elaborate on its possibilities for understanding the example introduced at the beginning of this introduction.

In its original form, intrapreneurship focuses on creating new business opportunities or strategic organisational renewal for a single firm (Corbett et al., 2013; Lang & Baltes, 2019). It is a

bottom-up, firm-internal process seeking to renew established organisations or increase their competitive advantage (Corbett et al., 2013; Hernández-Perlines et al., 2022). Path-breaking innovation, however, represents a dramatic departure from the dominant development trajectory in a particular field, for example, by challenging established technologies, practices or business models (Smith & Raven, 2012; Walrave et al., 2018). Thus, path-breaking innovation extends beyond creating value for the single firm and seeks to improve the sector at large.

Intrapreneurship, with its single-firm focus, is therefore not a perfect fit for describing the actions of the two incumbent employees who started a fully self-sufficient energy community in their employers' electricity grid and name. Nevertheless, with some adjustments to sustainability transitions, the intrapreneurial perspective, with its inherent individual-level analysis, can provide a fruitful theoretical framework for understanding incumbent employees who engage in path-breaking innovation for sustainability transitions of large technical systems. I will return to the intrapreneurial perspective and the necessary adjustments to sustainability intrapreneurship in the next section.

Against this background, the purpose of this thesis is to investigate how and why incumbent employees who act as sustainability intrapreneurs become key actors in path-breaking innovation in early-stage sustainability transitions of large technical systems. I use the term 'early-stage' to refer to potential or emerging transitions that have not yet resulted in any visibly changed behaviours or new dominant technology designs (Rotmans et al., 2001). In the energy sector, for example, initiatives such as the village case in Paper I illustrate the potential in fundamentally rethinking energy distribution. Although energy distribution systems, such as the electricity grid and district heating networks, have been in place for decades, they currently show few signs of transformative change in either technical configurations or business models. Three research questions have therefore guided my work:

RQ1: In what ways do sustainability intrapreneurs initiate, develop and realise path-breaking innovation in early-stage sustainability transitions of large technical systems?

RQ2: How do psychological factors, such as personal values and beliefs, shape sustainability intrapreneurship and new workplace behaviour in relation to early-stage sustainability transitions?

RQ3: How can sustainability intrapreneurship influence the development of sustainability transitions?

The thesis is situated within the sustainability transitions literature, a field that largely focuses on long-term, multidimensional processes of socio-technical systems change (Köhler et al., 2019; Markard et al., 2012). By introducing sustainability intrapreneurship as the locus of prime movers in a context where actors such as frontrunners, grassroots and entrepreneurs have limited

room to initiate path-breaking innovation, the thesis contributes with a bottom-up perspective on the origin of path-breaking innovation in large technical systems. As such, the thesis offers a distinct yet multi-disciplinary agency perspective, demonstrating theoretical and practical relevance primarily in understanding, supporting and governing the early stages of sustainability transitions, particularly in large technical systems.

The sustainability intrapreneurship framework is derived from the entrepreneurship literature and has been developed in one of the papers included in the thesis. It is a framework that extends intrapreneurship as a value-driven workplace behaviour, aiming to drive path-breaking innovations for sustainability transitions. The reason for taking an entrepreneurial perspective in the thesis is that, as illustrated earlier in this introduction, when I investigated the origins of the initiative to transform a village into a fully self-sufficient energy community, I found that the two employees approached the task in a very entrepreneurial way (Shane & Venkataraman, 2000). I will elaborate on this observation in a later section, before introducing the framework for sustainability intrapreneurship.

The introduced framework for sustainability intrapreneurship will be used to connect the attached papers into a more coherent body of knowledge to address the thesis's purpose. Combined with the exploration of personal values that precede sustainability intrapreneurial behaviour, the thesis will provide an individual-level understanding of how and why incumbent employees act as sustainability intrapreneurs. As such, the thesis will not only contribute to the sustainability transitions literature but also offer new perspectives on the entrepreneurship literature, particularly by expanding the understanding of intrapreneurs' personal motivation and perspectives on path-breaking value creation.

The thesis combines a number of case studies from the energy sector to explore the emergence of path-breaking innovation in an early-stage sustainability context. To contrast this with path-breaking innovation that we know has had an impact, I have also added a case study on the introduction of Vision Zero, a road-safety policy developed and implemented in Sweden in late 1990. I elaborate on the case selection in Section 4.2.1. In the next section, I will review the literature on incumbent employees as key actors in path-breaking innovation in early-stage sustainability transitions and, from a theoretical perspective, explore whether psychological factors can explain their workplace behaviour.

2 Theoretical framework

The following literature review will focus on what is known about incumbent employees in relation to early-stage sustainability transitions. I will explore parts of the social psychology literature to examine whether psychological factors, such as personal values, beliefs and norms, can be used to better understand workplace behaviour and if this can explain why some incumbent employees choose to act as sustainability intrapreneurs. The section concludes with a review of the intrapreneurship literature.

2.1 Sustainability transitions, the role of path-breaking innovation and individuals

Sustainability transitions are open-ended, complex and dynamic processes, encompassing environmental, social and economic dimensions that evolve over decades (Markard et al., 2012). To help us understand these complex processes, a multidisciplinary sustainability transitions literature has emerged, providing insights into factors that influence the adoption of new practices and technologies, as well as the barriers and opportunities that can enable or delay sustainability transitions (Köhler et al., 2019). The central aim of this literature is to conceptualise and explain how radical changes across different parts of society, such as geographic areas or sectors, occur in ways that also fulfil societal functions (Köhler et al., 2019). The sustainability transitions literature has its roots in theories of evolutionary economics, with additional insights from complex systems theory and the history of technology (Markard et al., 2012). Sectors are often referred to as ‘socio-technical systems’, which include multiple actors (e.g., individuals, firms, collective actors), institutions (e.g., societal and technical norms, regulations, standards of good practice), material artefacts (e.g., technology and infrastructures) and knowledge (Geels, 2004; Weber, 2003).

Briefly, this field has four main theoretical frameworks: transition management (Loorbach, 2010; Rotmans et al., 2001), strategic niche management (Geels & Raven, 2006; Kemp et al., 1998), the multi-level perspective on socio-technical transitions (Geels, 2002, 2005) and technological innovation systems (Bergek et al., 2008; Hekkert et al., 2007; Jacobsson & Johnson, 2000). These frameworks take a systems perspective to capture co-evolutionary complexity and key phenomena such as path dependency, emergence and non-linear dynamics. The innovation systems frameworks focus on the structures that create change, while frameworks using the multi-level perspective focus on the structures that are changing. Naturally, these perspectives complement each other. Primarily, studies in the sustainability transitions literature derive data from detailed case studies, often spanning several decades, in order to gain a deeper understanding of the complex, long-term changes that occur within specific sectors.

Illustrating sustainability transitions is a balancing act between simplifying a complex reality and teasing out simplified patterns. Interpreted as a relatively linear, evolving process, sustainability transitions can be divided into four development phases: pre-development, take-off, acceleration and stabilisation (Rotmans et al., 2001). In the sustainability transitions literature, it is often recognised that in the pre-developing phase, path-breaking innovation (Garud & Karnøe, 2001; Van Looy et al., 2001) that embodies a highly novel socio-technical configuration is important for creating networks, reducing the uncertainty of new technologies and applications, and opening up new social spaces and politics for governing towards the future (e.g., Bergek et al., 2008; Berkhout et al., 2010; Castán Broto & Bulkeley, 2013; Farla et al., 2012; Geels, 2005; Hekkert et al., 2007; Hellsmark et al., 2016; Kemp et al., 1998; Seyfang & Smith, 2007). Path-breaking innovations are typically found in all socio-technical systems undergoing transition (Hildén et al., 2017; Sengers et al., 2019), including large technical systems (Turnheim & Geels, 2019).

As noted in the introduction, individuals can play key roles in path-breaking, specifically in the early stages of sustainability transitions (Dütschke et al., 2024; Perlaviciute et al., 2021; Upham, Bögel, & Dütschke, 2019). In the sustainability transitions literature, individuals with expert knowledge are brought forward, for example, as ‘frontrunners’ in transition arenas (Rotmans & Loorbach, 2009) or as ‘system builders’ in emerging technological innovation systems (e.g., Hellsmark & Jacobsson, 2009; Wittmayer & Schöpke, 2014). Furthermore, end-users are sometimes highlighted as key actors in social movements, civil society and social networks, exerting pressure on policymakers and firms to adopt more sustainable practices (Hargreaves et al., 2013; Seyfang & Haxeltine, 2012; Seyfang & Smith, 2007). In some cases, psychological factors such as personal values, beliefs and norms are emphasised as important antecedents for individuals’ engagement and acceptance in early-stage sustainability transitions (e.g., Bögel & Upham, 2018; Kump, 2023; Perlaviciute et al., 2021; Upham, Bögel, & Dütschke, 2019; Upham et al., 2021). Next, I will review this literature in detail, and I will start by examining how personal values, beliefs and norms can shape the workplace behaviour of employees.

2.1.1 Personal drivers of behavioural change in sustainability transitions

The antecedents of individuals’ behaviour are complex and will not be fully addressed in the thesis. However, for matter on the current purpose, I will review some of the theories from social psychology, which state that value-driven behaviour, such as engaging in path-breaking actions for early-stage sustainability transitions, is grounded deep within a person’s cognitive sphere, more specifically, in personal values (De Groot & Steg, 2008; Schwartz, 2006, 2012; Steg et al., 2013; Verplanken & Holland, 2002). Drawing on the value-belief-norm theory (Stern et al., 1999), psychological factors can provide a strong explanatory account of individuals’ value-driven behaviours, including in the workplace (De Groot & Steg, 2008; Schwartz, 2006, 2012; Verplanken & Holland, 2002). For readers who normally don’t read social psychology literature, I would like to highlight that the context of a specific behaviour can be of importance. For

example, whether a person sorts out their waste can differ between home and the workplace. In this thesis, I focus on how individual values, beliefs and norms may affect individuals' behaviour at the workplace.

Acknowledging the importance of individual-level factors is not new to the sustainability transitions literature. It has previously been applied in, for example, the understanding of consumption patterns and acceptance of more sustainable technologies (Bögel & Upham, 2018; Fernqvist & Hansla, 2021; Perlaviciute et al., 2021; Upham, Bögel, & Dütschke, 2019; Upham et al., 2021). Nevertheless, the individual-level perspectives are often marginalised in high-level sociotechnical transition concepts (Upham, Bögel, & Dütschke, 2019). A better understanding of what motivates people to change their behaviour, also at the workplace, in the early stages of sustainability transitions, can thus add to a more multi-disciplinary actor perspective in the sustainability transitions field (Perlaviciute et al., 2021; Upham, Bögel, & Johansen, 2019).

In the following section, I will review some of the established individual-level perspectives in the sustainability transitions literature and explore how individuals and their personal characteristics are brought forward. It will be demonstrated that individuals primarily appear as part of a community, as small-business owners or actors in professional roles (e.g., managers and policymakers), rather than employees of established companies. Thereafter, I will examine the emerging body of literature on incumbents' behaviour in relation to path-breaking, to see if there is any mention of employees, e.g., whether they are identified and associated with path-breaking activities, if there are specific professional roles or behaviours brought forward, and if psychological factors are described.

2.1.2 Grassroots, frontrunners and system builders

In the multi-level (Geels, 2002, 2005) and strategic niche management (Geels & Raven, 2006; Kemp et al., 1998) perspectives, experiments of new technologies and practices are often referred to as bottom-up driven processes, typically small-scale and explorative, and there is usually an emphasis on uncertainty (e.g., (Geels, 2005; Kemp et al., 1998)). Path-breaking innovations are primarily associated with niche actors, such as visionary entrepreneurs, start-ups or grassroots movements (Kemp et al., 1998; Smith & Raven, 2012). The multi-level and strategic niche management perspectives apply a Schumpeterian notion of entrepreneurship in which a significant motivator for entrepreneurs is to build a new organisation with the goal of gaining financial rewards (Schumpeter, 2010). Thus, entrepreneurs and start-ups are usually portrayed as visionary firms or individuals with capabilities such as visioning and networking (e.g., Garud & Karnøe, 2003; Hörisch, 2015). I will revisit the entrepreneurial perspective, particularly intrapreneurship, in more detail in Section 2.2.

Grassroots-driven experiments are understood as social innovations that aim to empower local communities (Berkhout et al., 2010; Seyfang & Smith, 2007) and test sustainability and climate

solutions in real-life urban settings (Castán Broto & Bulkeley, 2013). These types of initiatives highlight, for example, individuals' abilities to generate alternative systems of provision, foster social learning and construct a common identity among varied actor groups (Becker et al., 2021; Martiskainen, 2017; Ramos-Mejía & Balanzo, 2018). Thus, actors such as civil society, non-government organisations and intermediary organisations are central to this literature (Hargreaves et al., 2013; Seyfang & Haxeltine, 2012). Psychological factors among individuals involved in these initiatives play a crucial role in their success and sustainability (Martin & Upham, 2016). For example, it is important that they have the ability to influence decision-making processes and foster a sense of ownership and empowerment throughout the community (de Haan et al., 2018).

In the transition management literature, frontrunners are brought forward as important visionary individuals with the ability to 'think outside the box' (Loorbach, 2010; Rotmans et al., 2001). Frontrunners are often recruited among experts, such as consultants and academic scholars. This means that although frontrunners can be incumbent employees (one can, for example, argue that an academic university scholar is employed by an incumbent actor, i.e., the university), they are not necessarily recruited from the incumbent organisations at the centre of the large technical system (such as the local electricity distribution system operator). Individuals recruited as frontrunners are often described as pioneers who can generate transformative structures, contribute to the formation of attractive visions and explore alternative solutions through their specialised knowledge and creative capabilities (Rotmans & Loorbach, 2009).

Another concept that brings forward the role of individuals is 'system builders' (Hughes, 1987). System builders are portrayed as experts or researchers with specialised knowledge and research capabilities who have made considerable contributions to the development of a specific technological innovation system (Hellsmark & Jacobsson, 2009; Wittmayer & Schäpke, 2014), for example, by creating system resources (Musiolik et al., 2020) or as intermediaries engaged in the critical interface between incumbent regime actors and society (Blomkvist et al., 2023). Like frontrunners, incumbent employees are not excluded from being system builders. The primary characteristics of a system builder are their ability to influence (Hellsmark & Jacobsson, 2009) and construct unity from diversity, as well as coherence from chaos (Hughes, 1987). This construction often involves the destruction of alternative systems. However, much of the literature adopts a broader actor perspective on system builders, considering them as firms (Jacobsson & Bergek, 2004), intermediary organisations (Kivimaa, 2014) and formal networks (Hellsmark, 2010). To my knowledge, the literature has not particularly problematised psychological factors or the role of system builders stemming from an incumbent firm.

2.1.3 Incumbent employees and path-breaking innovation

In the literature of incumbents' behaviour in sustainability transitions, a few studies apply an individual-level analysis or highlight individuals as a potential intra-organisational starting point

for path-breaking innovation (for a review, see Table 2). The studies that do undertake individual-level analysis underscore the importance of managers' actions (Galeano Galvan et al., 2020), their decision-making capabilities in enabling strategies, new practices and actions (Leitch et al., 2019; Lenfle & Söderlund, 2022; Loder et al., 2024; Papadonikolaki et al., 2023; Sackey & Akotia, 2017; Wang et al., 2022) and their ability to identify and include entrepreneurial staff members in developing path-breaking innovation (Moncreiff et al., 2024). It is argued that decision-makers can use their personal values (Halttunen et al., 2022; Kump, 2023) or beliefs about the importance of increased firm performance (Kenner & Heede, 2021) in their interpretation of extrinsic factors, such as policy, rules, standard procedures and landscape pressure, to influence their employer's behaviour in experiments for sustainability transitions. While these studies primarily apply a firm-internal top-down logic in which management makes strategic decisions to initiate sustainability experiments, Berggren et al. (2015) introduce a firm-internal bottom-up perspective by underscoring the importance of R&D teams and their ability to negotiate with various parties to find standard technology and components (Berggren et al., 2015).

Following the firm-internal bottom-up line of thinking, some scholars bring forward firm-internal entrepreneurship as a potential force for initiating path-breaking innovation (Duygan et al., 2021; Schönwälder & Weber, 2023). In detail, Schönwälder and Weber (2023) show that incumbent firms that are attentive to corporate entrepreneurship through dedicated business units and entrepreneurial culture report more innovation initiatives. Duygan et al. (2021) focus on the recursive interplay between actors and institutions, i.e., employees' work practices and the various endowments that enable these practices. Both these studies aim to provide a more accurate view of embedded agency, i.e., the ability of employees within an institutional field to think and act in new ways despite being subject to regulative, normative and cognitive influences. However, both studies rely on data collected from experts and top management rather than interview data from employees. Thus, the studies fail to tell us what entrepreneurial culture entails, what employees are doing in relation to path-breaking innovations, and why they are doing it.

In sum, studies examining incumbents and path-breaking innovation for sustainability transitions indicate that managers and appointed key individuals can influence how such actions evolve during early-stage sustainability transitions. Psychological factors can influence these individuals' understanding and interpretation of extrinsic factors, which, in turn, impact their workplace behaviour in relation to early-stage sustainability transitions. It is argued that there is a promising avenue for future research into the actual practices of path-breaking innovation (Sengers et al., 2019). Hence, this thesis delves deeper into the origin of path-breaking innovation in early-stage sustainability transitions of large technical systems and applies management studies perspectives to explore the role of entrepreneurial individuals embedded within incumbents. Therefore, in the next section, I will review the literature on intrapreneurship

and elaborate on its relevance to bottom-up practices for path-breaking innovation in early-stage sustainability transitions of large technical systems.

2.2 Intrapreneurship

The intrapreneurship literature is primarily situated within management and organisational development studies (Corbett et al., 2013; Sharma & Chrisman, 2007). Like entrepreneurship, intrapreneurship is a bottom-up process, but the main difference is that it occurs within an established organisation. In other words, intrapreneurship is rooted in a cooperative perspective on exploring opportunities to create goods and services, with a primary focus on a single organisation. Therefore, there is a need for an adjusted intrapreneurship perspective that aligns with the purpose of this thesis and can be used to explore the roles of incumbent employees in utilising dominant large-scale technical infrastructures for path-breaking innovation. Before I introduce a framework for *sustainability intrapreneurship* (Section 3.1), I will review some intrapreneurship perspectives and examine what is known about social benefits and business advantages, where intrapreneurs are found within the organisation, how they involve colleagues and others, and whether psychological or other individual-level factors are discussed.

Acting in an entrepreneurial way, whether it is within or outside an established organisation, is an individually chosen course of action to achieve personal intentions (Packard, 2017; Sarasvathy, 2001; Welter et al., 2017). Individuals who engage in an entrepreneurial way are often characterised by passion, emotional energy and drive. They possess a spirit that endures over time and often involves a significant investment of time and energy (Cardon et al., 2009). ‘Entrepreneurial’ can thus be understood as a personal characteristic expressed through attitude and specific behaviours (Krueger & Carsrud, 1993).

Focusing on the literature about entrepreneurial engagement among individuals within an organisational context, this body of work is pioneered by concepts such as corporate entrepreneurship (Burgelman, 1983) and intrapreneurship (Pinchot III, 1985) and includes concepts such as internal corporate entrepreneurship, corporate venturing and strategic renewal, to mention a few (for a review of this, see Sharma & Chrisman, 2007). For simplicity, I will refer to entrepreneurial engagement among individuals within an organisational context as intrapreneurship.

Intrapreneurship happens when members of a company identify and exploit opportunities for their company (Hernández-Perlines et al., 2022). The intrapreneurship literature is generally rooted in a Schumpeterian view, where entrepreneurial actions, such as venture creation and risk-taking, are understood as being geared towards market or economic outcomes (Welter et al., 2017). Intrapreneurs are often associated with managers, experts or strategists who have

leadership characteristics and abilities to engage others to create new business opportunities and strategic organisational renewal (Corbett et al., 2013; Lang & Baltes, 2019). They are ‘dreamers who do’ and take hands-on responsibility for creating innovation of any kind within an organisation (Pinchot III, 1985). Personal traits among intrapreneurs are typically innovativeness, proactiveness, risk-taking, opportunity recognition or exploitation and internal and external networking (Martiarena, 2013; Neessen et al., 2019). Intrapreneurship is, however, primarily an intra-organisational perspective without connection to complex social problems or social benefits.

The notion that intrapreneurs are primarily found among managers, experts or strategists is challenged by scholars who argue that entrepreneurship is a matter of learnable skills and, thus, something that potentially can be found among all employees (e.g., Hemingway, 2013; Lackeus et al., 2020). Along this line of thinking, activities considered ‘entrepreneurial’ are also somewhat broader (Sharma & Chrisman, 2007). This implies that actions undertaken outside an existing organisation can also be considered intrapreneurial. Over the last few decades, scholars have thus begun to pay attention to employees who engage in entrepreneurial ways to address social problems. Two concepts have begun to emerge: *corporate social entrepreneur* (Hemingway, 2005, 2013) and *social intrapreneur* (Elkington, 2009; Grayson et al., 2011). Neither of these two concepts is yet well studied (McGaw & Malinsky, 2020), and my interpretation of this literature is that these concepts are often used interchangeably and that they are difficult to clearly separate. To simplify, I will thus cluster them both as *social intrapreneurship*.

The literature on social intrapreneurs is scattered, and academic investigations are few. The social intrapreneur has nevertheless been conceptualised as an employee who can reimagine the employer's potential and link business growth to the creation of social value (Belinfanti, 2015; Elkington, 2009; Hemingway, 2013; Mair & Martí, 2006). As such, social intrapreneurs leverage existing organisational capabilities to deliver social and business value (Brenneke & Spitzeck, 2010). Within profit-maximising organisations, this can, however, be challenging, given that many internal and external stakeholders may perceive social and business values as mutually exclusive rather than mutually reinforcing (Belinfanti, 2015; Tracey & Stott, 2017).

Still, no intrapreneur is an ‘employee activist’ (e.g., Skoglund & Böhm, 2020; Wright et al., 2012; Yaco & Hardy, 2013) in the sense that they would engage in ‘confrontational actions’. Intrapreneurs do not primarily oppose something or adopt a specifically ‘anti’ stance. Instead, they are *entrepreneurial* in that they can engage others to identify and exploit opportunities to create value. Furthermore, just like entrepreneurs, intrapreneurs are often driven by personal values, or what ‘feels right’ (Hemingway, 2005). In other words, if someone is doing what they are told, they are not intrapreneurs. This is also one of the key differences from corporate social

responsibility (CSR), which is based on a top-down, strategy-initiated approach to enhance society and the environment rather than degrade them (Carroll & Brown, 2018).

In sum, the current intrapreneurship literature lacks the ability to fully explain and appreciate incumbent employees who, at their own discretion, initiate, develop and realise path-breaking innovation for sustainability transitions, i.e., initiatives that extend beyond the immediate advantages for the firm and instead focus on developing a sustainable sector. Such initiatives do not necessarily exclude benefits for the firm, but they can still have far-reaching consequences for the employer and will not always follow the obvious business case trajectory. In the following section, I therefore introduce a framework for *sustainability intrapreneurship* that foregrounds incumbent employees who act in entrepreneurial ways to initiate, develop and realise path-breaking innovations in early-stage sustainability transitions of large technical systems. The sustainability intrapreneurship framework offers a novel perspective on the origins of path-breaking innovation in large technical systems, addressing a gap in the sustainability transitions literature as well as where established intrapreneurship perspectives fall short.

3 Analytical framework

The analytical framework applied in this thesis is developed in Paper III. It is a framework for studying and understanding sustainability intrapreneurship, and I apply it in the thesis to connect the attached papers into a more coherent body of knowledge. Exploring the origins of path-breaking innovation in early-stage sustainability transitions of large technical systems, without relying on received wisdom, has led me on a bumpy journey of discovery through concepts and theories that have often guided me closely, but never entirely. This becomes evident in my attached papers, where I use terms such as 'insiders', 'institutional entrepreneurs', and 'engaged individuals'. In Paper III, however, my supervisor and I have developed a framework for sustainability intrapreneurship that is distinct from other forms of intrapreneurship. The framework suggests a 'role-based' typology derived from entrepreneurial employees within established district heating firms that develop and advance path-breaking innovation. The roles are derived from themes of activities identified among individuals who act as sustainability intrapreneurs in the Swedish district heating sector. Guided by the purpose of this thesis, I will apply this framework to all the appended cases and synthesise the role of incumbent employees in initiating path-breaking innovation in early-stage sustainability transitions of large technical systems (in Section 5). First, however, I will present the concept of sustainability intrapreneurship.

3.1 Sustainability intrapreneurship

Sustainability intrapreneurship aligns with Krueger and Carsrud's (1993) understanding of 'entrepreneurial' as an individual's attitude and specific behaviours. I use 'intra', as in intrapreneurship, although it is framed in the literature within a single organisation's context. However, it signals a contextual and organisational embeddedness. 'Entrepreneurship', on the other hand, is associated with actions oriented towards developing external collaborations and venture creation (Shane & Venkataraman, 2000). However, it also has a strong connotation of freedom. Nevertheless, both the intrapreneurial and the entrepreneurial approaches include a chosen course of everyday actions toward subjective ends (Welter et al., 2017). Such subjective ends may include the society, culture or ecology, sometimes even with minor or no emphasis on profitability (Bjerke, 2007), such as in social entrepreneurship (Mair & Martí, 2006).

Like intrapreneurship, sustainability intrapreneurship is a firm-internal bottom-up 'entrepreneurial' process that emerges without the company's permission. In other words, those who do what they are told to do or accidentally produce sustainability value are not sustainability intrapreneurs. In line with Hemingway (2013) and Lackeus et al., (2020), 'entrepreneurial' is thought of as a learnable skill that can be found among all employees. Sustainability intrapreneurship, however, arises from within politically powerful actors who control technological oligopolies in large technical systems. Sustainability intrapreneurs are thus

contextually and organisationally embedded within politically influential organisations that control large technical infrastructures and operate in heavily regulated sectors. Hence, an expert employed as a researcher by a university is not considered a sustainability intrapreneur in this context.

Incumbent employees who, at their own discretion, engage in path-breaking innovation for sustainability transitions display a unique form of intrapreneurship. For example, they do not compare with traditional intrapreneurs who primarily seek new business opportunities and strategic organisational renewal (Corbett et al., 2013; Lang & Baltes, 2019). Nor do they fully compare with institutional entrepreneurs, who are associated with mobilising resources to transform or create institutions that favour specific interests (Leca et al., 2008), or intrapreneurs who tend to focus on firm benefits in combination with social aspects such as community, health, poverty and climate (Darcis et al., 2023). Instead, incumbent employees who, at their own discretion, engage in path-breaking work are typically those who identify strongly with their profession and see an opportunity, or perhaps perceive a responsibility, to make a difference in the sector in which they operate. As such, they are driven by personal values, or their inner moral compass, and devote a lot of effort into getting ‘everyone onboard’ on their transformative journey. A journey of changing a sector, rather than realising a specific opportunity for their employer.

Following theories of value-driven behaviours from social psychology (e.g., Schwartz, 2012; Stern et al., 1999; Verplanken & Holland, 2002), it is reasonable to assume that employees (at all levels) who use their discretion to behave in an entrepreneurial manner to address social, environmental and/or economic challenges in society are motivated by emotions or personal values. However, engagement in initiating, developing, and realising path-breaking innovation for sustainability transitions of large technical systems can stem from various personal values and motivations, and it is unclear how psychological factors shape sustainability intrapreneurs’ workplace behaviour in relation to path-breaking innovation. Still, acting as a sustainability intrapreneur requires entrepreneurial characteristics, including, for example, passion, emotional energy, drive and spirit that endure over time (Neessen et al., 2019).

Recognising that newcomers have limited ability to initiate breakthrough innovation capable of transforming a sector, and that no single actor can change a sector alone, sustainability intrapreneurs leverage existing organisational capabilities and utilise dominant large-scale technical infrastructures to drive path-breaking innovation that supports socio-technical transitions. Hence, sustainability intrapreneurship is oriented towards developing external collaboration. This implies that actions undertaken outside an existing organisation can also be considered as sustainability intrapreneurship if the initiative addresses key aspects of the sector and its established technologies.

Like successful entrepreneurship is a collaborative process, a central aspect of sustainability intrapreneurship is (emergent) entrepreneurial teams. Sustainability intrapreneurs are thus skilled at crafting and voicing visions of imagined futures that other actors (both internal and external to the organisation) are inclined to endorse. For example, they do this by deliberately framing their vision to resonate with existing interests, values and familiar structures (Dorado, 2013; Garud et al., 2014; Hemingway, 2005). Sustainability intrapreneurship can thus, together with others, catalyse socio-technical transitions in ways similar to how entrepreneurs discover and pursue sustainable development opportunities (e.g., Alvord et al., 2004; Avelino et al., 2015; Klein Woolthuis, 2010; Patzelt & Shepherd, 2011). In other words, sustainability intrapreneurs can be characterised as visionary team workers.

In sum, sustainability intrapreneurship offers a unique perspective on entrepreneurial incumbent employees who, at their discretion, initiate, develop and realise path-breaking innovation for sustainability transitions of large technical systems. Characteristically, sustainability intrapreneurship is a value-driven bottom-up process that emerges without permission. In other words, it is a self-chosen course of everyday entrepreneurial actions, guided by personal values or a perceived responsibility to make a difference in the sector in which he or she operates. Such engagement can stem from various personal values, beliefs and norms, and may manifest in different kinds of actions. Next, I will thus introduce a ‘role-based’ typology to examine how sustainability intrapreneurs support path-breaking innovation for sustainability transitions in a set of case studies. The thesis thus contributes to our understanding of how intrapreneurial actions, embedded within incumbent firms in large technical systems, can lead to positive social and environmental outcomes, and how policy and practice can accelerate change by empowering sustainability intrapreneurs.

3.1.1 A role-based typology of sustainability intrapreneurship

The role-based typology is derived from an inductive study of activities that sustainability intrapreneurs have chosen to engage in to promote path-breaking innovation initiatives in the district heating sector. The identified roles are *the agenda setter*, *the demonstrator* and *the networking educator*. This ‘role-based typology’ partly resonates with established theoretical concepts, and I will thus define key characteristics of each role and trace their similarities and differences relative to these concepts. Nevertheless, these roles can help explain the different ways sustainability intrapreneurs can support the initiation, development and realisation of path-breaking innovation for sustainability transitions of large technical systems.

3.1.1.1 *Agenda setter*

The agenda setter is a role in which sustainability intrapreneurs invite themselves, or become invited, as experts to arenas outside their organisation. Typically, they are visionary individuals with strong leadership skills. An agenda setter draws on skills such as establishing formal and

informal partnerships with internal and external stakeholders, allocating resources and crafting and voicing visions of imagined futures that others are inclined to endorse. Acting as an agenda setter is not an activity that is expected in their professional role. Rather, it is a result of a personal decision. The professional role merely legitimises the involvement as an agenda-setter. The agenda setter endorses sustainability missions or regional development plans primarily in situations where the general competence about technological infrastructures is low. Still, the agenda setters do not seek mandates from other actors in the sector. Instead, it is a role that they have chosen to take on themselves for the benefit of the socio-technical system at large.

Hence, the agenda setter is driven by personal values in all professional situations and acts accordingly both within and outside the organisation. This behaviour is similar to how entrepreneurs act when they apply a ‘360 degrees entrepreneurial effectuation strategy’ (Sarasvathy, 2001), strategies that have also been highlighted in relation to frontrunners (Loorbach, 2010; Rotmans et al., 2001) and intrapreneurs (Hemingway, 2005). However, in the former, there is no relation to intrapreneurial dynamics, whereas in the latter, the focus is on firm benefits rather than on the benefits of socio-technical systems.

3.1.1.2 Demonstrator

The demonstrator role involves a heterogeneous range of activities within an organisation for developing path-breaking innovation. Activities are typically bottom-up development of innovation, addressing sustainability issues rather than firm-specific challenges. In other words, sustainability intrapreneurs who take on the demonstrator role are ‘doers’ with the personal skills to collaborate and move seamlessly between different tactics and stakeholders within the organisation. Thus, demonstrators typically frame their vision in ways that resonate with existing interests. The development process often involves attracting external resources, such as finance and knowledge, and the demonstrators do this by leveraging their personal networks. In essence, the demonstrator role promotes the development of projects, such as technology and service development, introducing new market strategies, reducing costs and launching alternative businesses within the home organisation.

Hence, the demonstrator role includes a wide range of activities, including attracting external resources such as finance and specialised knowledge, to enable experimentation within a large technical system infrastructure. The importance of such activities has been previously highlighted in relation to bottom-up processes for technology development, testing and demonstration (e.g., Burgelman, 1983; Hellsmark & Jacobsson, 2009; Mair & Martí, 2006; Musiolik et al., 2020; Tracey & Stott, 2017). However, previous literature has not problematised either the intra-organisational perspective or the connection to complex sustainability challenges. Thus, a perspective on sustainability intrapreneurs acting as demonstrators offers a fresh viewpoint on understanding the emergence of path-breaking innovation for sustainability transitions of large technical systems.

3.1.1.3 Networking educator

The networking educator is a role that involves activities aimed at empowering colleagues in their professional roles, enhancing vision-based engagement, developing path-breaking innovation, leadership and communication. The role involves connecting individuals from various actors in the sector and colleagues within the organisation to train change-makers, mobilise engagement and coordinate initiatives in line with a vision of change. In other words, a sustainability intrapreneur who is acting as networking educator wants to get ‘everyone on board’. The networking educator thus contributes to awareness-raising, knowledge-sharing and capacity-building activities that professionalise colleagues. It is a role that contributes to developing engagement and entrepreneurial capabilities among colleagues and others, rather than focusing only on developing business opportunities or organisational renewals. This role is thus key in mobilising collective actions of change.

Hence, the networking educator role is closely related to a social network theory concept, sometimes referred to as ‘the network broker’ (Burt, 1995), which addresses structural holes between groups of actors. However, the networking educator is not a third-party mediator bridging gaps between established actors or networks. Instead, it is a networking-oriented visionary employee, acting bottom-up to empower colleagues in the sector towards imagined futures. Like intrapreneurs, sustainability intrapreneurs acting as networking educators can stimulate motivation, alter decision-making logics and develop innovative thinking among a large number of participants (Dorado & Ventresca, 2013; McGaw & Malinsky, 2020).

4 Method and methodology

In this section, I will briefly outline the characteristics of the research process that preceded this thesis and the epistemological and theoretical perspectives, i.e., the type of knowledge I claim based on the appended papers. I will also introduce some of the main issues in qualitative research, the cases I have studied, how I came to study them and how they relate to each other and to the purpose of the thesis.

4.1 Research process

This thesis was conducted as an Industrial PhD programme. I have been employed by RISE – Research Institutes of Sweden, a state-owned research institute. However, the graduate education and supervision have been offered by Chalmers University of Technology.

The research projects and the papers produced within them, which are included in this thesis, were carried out at RISE and funded through competitive research grants. I have applied for and conducted some of these research projects independently, while others have been carried out in collaboration with colleagues at RISE. Since not all the projects I have worked on in my professional role at RISE fall within the scope of my thesis project, I have pursued my Industrial PhD studies on a part-time basis. This has brought both challenges and opportunities. For example, securing funding for multiple research projects that align in ways that support the thesis has been challenging. Research funding, whether we like it or not, is subject to trends. Sometimes in ways that may appear random to those of us without access to all the relevant information. Typically, calls open once or twice per year, and the period between submitting an application and receiving a decision can take several months. Applying for research funding, therefore, becomes a process of juggling several project ideas simultaneously and tailoring each one to the specifics of a given call, including project size, scope, wording and requirements for any consortia. Not to forget the importance of ensuring that a research project can be carried out if funding is granted.

During my time as a graduate student, I have been involved in a wide variety of projects, ranging from self-sufficient energy villages to life-cycle information studies in large industries, industrial symbiosis, policy studies of electric vehicle subsidies and ocean and coastal management studies, to mention a few. Therefore, from time to time, it has been challenging to find time for academic coursework and thesis writing. However, one of the key opportunities has been the applied nature of the projects I have been involved in. This has given me close access to practical and empirical phenomena related to established organisations and path-breaking innovation for sustainability transitions. These phenomena have genuinely interested me, and my motivation throughout this thesis work has been to better understand and facilitate path-breaking innovation for sustainability transitions. Still, by working with a number of diverse projects, as well as colleagues with varying areas of expertise, I have gained perspective on my own research and on

the role of individuals in path-breaking innovation. For example, some projects have had other focuses, forcing me to adapt and balance my questions with my colleagues' research interests. This has, of course, given me an understanding of the importance of other perspectives, but it has also taught me that my perspective is relevant to researchers with different areas of focus and backgrounds.

I have chosen to include four papers that use single- or multiple-case study designs in the thesis. The studies have either been conducted as stand-alone research projects, such as the case study of system coupling between the electricity grid and district heating systems flexibility services, or as part of a larger research project, such as the case study of Vision Zero, which was one of several innovation journeys (Van de Ven et al., 2008) studied at the Swedish Transport Administration. Thus, the selection of case studies in the thesis is frankly the result of circumstances rather than a mindful strategy set out at the start of my PhD journey. Nevertheless, I have had research projects to choose from, and the appended case studies provide an informative patchwork useful for highlighting key aspects of incumbent employees in relation to path-breaking innovation in large technical systems. I will return to the case studies and how they relate to each other in more detail below. First, however, I will introduce this thesis's epistemological and theoretical approach.

4.2 Research approach

The research in this thesis is strongly influenced by interpretivist phenomenological scientific philosophy (Giorgi, 1997). This may sound complicated, but in short, it means that I view (most) social events as emerging from intentional actions and interactions at the individual level. The thesis is, thus, positioned on the subjective side of Burrell and Morgans' well-known scale of sociological paradigms perspectives (Burrell & Morgan, 1979) and emphasises the role of individuals' subjective meaning and experiences. In this perspective, we can understand the material world by measuring it in various ways. However, the mental understanding of the social world is subjective and derived from either experiences or imagination. This means that concepts, such as norms, beliefs and business opportunities that do not strictly belong to the material reality are formed in the eye of the beholder. Humans learn and understand reality through their interaction with it, and individuals can put pieces of understanding together in rational ways to form a coherent idea about reality (Packard, 2017).

Unlike quantitative research approaches that usually focus on measuring variables, the study of mental models and subjective experiences is often done in a qualitative manner. For example, inductively deriving conclusions from people's experiences, using open-ended research questions (Maxwell, 2012). Such an inductive research approach allows us to discover participants' underlying meanings and perspectives, from which we can learn how others understand the world around them (Cunliffe, 2011; Willig, 2008). By understanding what

employees value highly in life and how they examine, maintain or alter their perspectives, we can get a valuable and nuanced understanding of how individuals' actions and interactions emerge into social events and economic structures at the workplace (de Vries et al., 2021). Hence, the research approach in the thesis is to zoom in on employees' behaviour to inform the understanding of the origin of path-breaking innovation in early-stage sustainability transitions of large technical systems.

4.2.1 Empirical approach/overall study design

Case studies allow for detailed and comprehensive exploration of a particular phenomenon in a particular setting, i.e., a case. Case studies are suitable when there is a lack of previous literature and prior empirical evidence (Eisenhardt, 1989; Flyvbjerg, 2001, 2006), but where there is access to rich and complex data (Eisenhardt, 1989; Flick, 2014). It is considered a suitable research strategy for understanding the dynamics present within a specific setting (Eisenhardt, 1989). It is a research approach that has the potential to come very close to real-life situations and test views directly in relation to a phenomenon as it unfolds in practice (Flyvbjerg, 2006).

Using a case study approach has been a natural choice in my research process. Working at RISE has placed me close to practice in the formation of path-breaking innovation for sustainability transitions across various sectors. I also have numerous colleagues at RISE with diverse expertise, hands-on experience and extensive networks. Because of this, I have been able to obtain accurate and up-to-date information about ongoing initiatives exploring path-breaking innovation, as well as initiatives developed and proposed in research and innovation grant applications.

In the thesis, I rely on three different studies, two from the energy sector and one from the traffic safety sector. The selection of studies is made to fit the categorisation of large technical systems, compare different cases and discuss similarities and differences in employees' roles in forming path-breaking innovation for sustainability between sectors. The nature of the selected cases in these studies also highlights the early mobilisation process in which visionary employees get others to endorse their ideas.

In short, the 'energy studies' are set in an energy system context and related to the decentralisation of the electricity grid through localised energy systems and coupling between the electricity grid and district heating systems. Both the decentralisation and the coupling path are subject to energy system transition through technologies, practices and institutions (Di Silvestre et al., 2018; Lund et al., 2010). The study of path-breaking innovation for decentralisation was the first research grant application I wrote on my own. It was also the first research project I was the principal investigator of. The proposal was written with my PhD project in mind, and the focus was on exploring agency in path-breaking innovation for sustainability transition in the Swedish energy industry – or 'who is doing what and why', as I

used as a catchy line in the summary of the grant application. The project was funded by the Swedish Energy Agency, and it allowed me to explore two cases in the Swedish energy system: the development of a local energy system and the development of an energy system demonstrator in a city district. This study not only resulted in Paper I, but it also enabled me to obtain my Licentiate.

The second energy study was developed together with three colleagues who are energy system scholars at RISE. The application was financed by the Swedish Energy Agency, and I was the principal investigator. The focus of this study was to explore the reasons behind a known but still underdeveloped potential in utilising district heating infrastructures for flexibility services to the electricity grid. The idea was that because this pathway was in pre-development, socio-technical experiments would have large catalytic potential on the energy system (Rotmans et al., 2001). However, when the study was conducted in 2020, we found surprisingly few initiatives, with the result that we could not carry out a comparative case study analysis as originally planned. Instead, we had to examine the use of district heating as a flexibility service in Sweden as a whole (Paper II). One year later, I skunk worked a follow-up study specifically focusing on the incumbent employees who had a key role in initiating and developing the emerging initiatives identified in 2020. This work resulted in Paper III, which, for various reasons, was not submitted to a journal until the summer of 2025. Interestingly, in March 2025, 20 energy distribution firms launched a three-year project to explore the possibilities of coupling the electricity grid and district heating systems. One could say that the study we made in 2020 was five years ahead of its time.

The third study is a sub-project within a larger research project on innovation and transformative capacities in innovation journeys (Van de Ven et al., 2008). The project was financed by the Swedish Transportation Administration, and I did this work together with Fredric Norefjäll, a colleague at RISE. In the sub-project, which is included in the thesis, I investigated the motivational factors among individuals involved in the early development and implementation of Vision Zero, a radical road safety policy. Although Vision Zero was developed and initiated more than two decades ago, it is an interesting case to study in relation to its instant acceptance and rapid implementation of new technologies, practices and institutions. Today, zero casualties in traffic is a reasonable expectation. However, in 1997, when the Swedish Vision Zero Road Safety Policy was introduced, it was considered a radical policy proposal which was only possible to adopt after drastic changes in the dominant road safety institutions with regard to road safety problem formulation, views on responsibilities and attitudes toward and among road users (Becker et al., 2021; Rosencrantz et al., 2007). Compared to emerging sustainability transitions, such as the coupling pathway in the energy sector, the Vision Zero case study adds an additional perspective to this thesis, as it has proven to be a successful endeavour widely recognised internationally. The Vision Zero case study also highlights how a small group of individuals managed to engage colleagues and others and mobilise support for their vision.

In sum, the studies included in this thesis explore different aspects of incumbent employees' motivations and intrapreneurial practices in path-breaking innovation. They provide an individual-level perspective, enabling the thesis to move from a firm-level understanding to a more nuanced view of employee behaviour in path-breaking innovation in early-stage sustainability transitions of large technical systems.

4.2.2 The studies

Case study research can take many forms and can include both qualitative and quantitative data (Maxwell, 2012). In my case, most of the data collection has been made by qualitative methods such as interviews, study visits and desk-top research, meaning that the collected data is descriptive and primarily based on spoken and written accounts. Next, each study will be presented in detail and summarised in Table 3.

4.2.2.1 *Study I*

This study investigates the origin of path-breaking innovation for sustainability-driven energy systems, who the individuals are that initiate such innovation, what motives they may have and how they accomplish the achievement. The research examines two Swedish cases, pioneering initiatives that challenge conventional energy distribution models through decentralised and collaborative energy systems: the Energy district and the Village. The Energy district, which is located on a university campus, integrates electricity, district heating and cooling into a local energy market and uses AI-driven optimisation to balance energy consumption and production. The Village is a small rural community that operates a self-sufficient, renewable-based microgrid with islanding capabilities, allowing residents to produce and trade energy independently of the national grid (also introduced at the very start of this thesis).

Data collection was carried out using a combination of methods, including desktop research (e.g., websites, policy documents, funding applications and academic reports), semi-structured interviews (23 interviews were conducted between 2017 and 2019 using a snowball sampling technique) and the construction of narrative case studies. Interviews explored personal motivations, decision-making processes and socio-technical effects of these initiatives, while documentary analysis provided historical context and ideas about the future. The data was analysed by a problem-driven abductive methodological approach, iterating between empirical findings and theoretical perspectives. A timeline of key events was constructed for each case, supplemented by overlapping narratives from key actors to trace how entrepreneurial employees leveraged personal beliefs, networks and socio-technical knowledge about the energy system into practice. A thematic analysis was applied to interview data to identify recurring patterns in motivations, engagement strategies and perceived barriers.

The findings indicate that path-breaking innovation for sustainable energy systems can be initiated by employees from within incumbent organisations who, without management mandates, act beyond the expectations of their professional roles. These insiders, as we call them in the paper, have leveraged organisational resources, cultivated interdisciplinary teamwork and mobilised external funding to experiment with alternative energy models. Although neither initiative could directly demonstrate any tangible impact on the energy sector during the study period, the attention they attracted within the sector and in public media influenced views of the future energy system, generated new knowledge and fostered widespread public and policymaker engagement. By highlighting the importance of entrepreneurial teamwork, purpose-driven engagement and voiced visions, the study offers a novel individual-level perspective on the role of the initiators and their ability to inspire others in the emergence of path-breaking innovation for sustainability transitions of large technical systems.

The study is presented in Paper I, which offers insights for policymakers and organisations aiming to foster similar bottom-up innovations. The paper was published in a special issue of *Sustainability* 2021. The manuscript was drafted and written together with my supervisor, Mats Lundqvist. Both of us contributed equally to writing the paper. I had the main responsibility for study design and data collection.

4.2.2.2 Study II

The study examines the potential of using district heating systems as flexibility services to support Sweden's electricity grid, given the increasing integration of solar and wind power. With Sweden aiming for 100% renewable electricity production by 2040, the energy system faces challenges in balancing intermittent power generation. In this context, scholars argue that power-to-heat is an attractive alternative to provide flexibility services for the electric grid. The study thus investigates whether Swedish district heating companies and electricity distribution system operators utilise, or plan to utilise, district heating systems for this purpose. If not, it explores the barriers preventing such integration and the conditions required for its realisation.

The study adopts a qualitative approach, using a 'grounded' methodology to develop insights from empirical data rather than relying on predefined theoretical assumptions. Data was collected through semi-structured interviews with 14 professionals affiliated with district heating companies, electricity distribution system operators, national agencies, industry organisations and research institutions. The selection of interviewees was guided by a registry of key energy actors in Sweden, complemented by a snowballing technique to identify additional relevant individuals. The interviews explored participants' perspectives on energy production, storage technologies and flexibility initiatives. Thematic analysis was applied to the interview transcripts, categorising findings into four main themes: technologies for coupling district heating systems with the electricity grid, market and business models, regulatory and operational challenges and beliefs about future trends.

The findings indicate that while Sweden has well-established district heating systems with significant thermal storage capacity, initiatives to use these systems for electricity grid flexibility remain rare. Thus, the case in this study turned out to be a) the Swedish district heating system in general (Paper II) and b) individuals who had been working on ideas related to this context (Paper III).

Although there are many existing power-to-heat technologies, such as heat pumps and electric boilers, in Swedish district heating systems, their potential is largely underutilised as flexibility services in Sweden due to economic and regulatory barriers. The study identifies key obstacles, including limited financial incentives, strict legislation and a lack of coordination between district heating operators and electricity market actors. Most district heating companies focus primarily on optimising their own operations rather than considering broader energy system benefits. Additionally, fixed taxes and Sweden's electricity pricing model, which sets prices at a national level rather than reflecting local grid conditions, do not effectively incentivise district heating companies to engage in flexibility services.

Despite these challenges, some localised initiatives demonstrate potential solutions. For example, certain distribution system operators have experimented with remote-controlled heat pumps and peak-hour electricity pricing to encourage demand-side flexibility. Interestingly, these initiatives are characterised as bottom-up innovation, often led by small groups of engaged individuals rather than being systematically introduced into Sweden's energy system by policy actors. The findings emphasise that while technical solutions exist, institutional and economic factors play a key role in whether district heating systems can effectively contribute to Sweden's renewable energy transition.

Study II is presented in two papers, Paper II and Paper III. Paper II was drafted and written together with three energy system colleagues at RISE, Sara Broberg, Johan Torén and Inger-Lise Svensson. All co-authors contributed to the study design and data collection. I did most of the data analysis and made a significant contribution to writing the manuscript and the revision work. The paper was published in 2023 in *Energy Policy*.

Paper III was more of a consequence of opportunities partly identified when writing Paper II. Using spare time after the research study was finalised, I narrowed the data collection to energy incumbent employees, collected additional data and wrote the first version of the manuscript. The manuscript was then refined together with my main supervisor, Mats Lundqvist. The current version is the result of a major revision in response to comments from two anonymous reviewers and a rejection decision from *Environmental Innovation and Societal Transitions*.

4.2.2.3 *Study III*

The study examines how individuals become motivated to alter their workplace behaviour and contribute to socio-technical change. The case used in this study is the early development of Sweden's Vision Zero road safety policy. Vision Zero was introduced in 1997 and marked a radical change in road safety policy, technology and practice. It shifted road safety responsibility from road users to road designers and policymakers. The study explores how entrepreneurial employees who take action to create new social norms and organisational structures mobilise others to endorse their vision of change.

The research in this study follows an exploratory abductive approach, characterised by a systematic collection of 'facts', which is followed by an attempt to identify and apply frameworks that can explain patterns in the collected facts. Data was collected using a combination of qualitative methods, such as document analysis and semi-structured interviews. Initially, various reports and documents were collected to construct a chronological narrative of Vision Zero's early phases. Key individuals involved in its development and implementation were identified and invited for interviews, using a snowballing technique to locate additional participants. A total of 14 interviews were conducted with policymakers, researchers, strategists, and other stakeholders, who shared their experiences of engaging with Vision Zero. These interviews were transcribed and analysed using thematic analysis, identifying recurring patterns in how individuals justified their involvement and how their personal values, beliefs and norms influenced their decisions. The analysis categorised individuals' motivations into pro-social and self-oriented value dimensions, revealing the diverse ways in which people were inspired to participate in institutional change.

The study highlights the psychological factors that influence incumbent employers' willingness to break with existing expectations, norms and regulations despite their contextual embeddedness. Drawing on theories from social psychology, particularly the value-belief-norm theory, the study argues that activating personal values and anchoring beliefs play a crucial role when individuals engage in new value-driven workplace behaviours. Thus, the ideators behind Vision Zero played a crucial role in the mobilising process by crafting compelling visions of the future, framing road safety in ways that aligned with different stakeholders' values and providing the necessary structures for anchoring new beliefs.

The findings in this study show that policy directives do not solely drive socio-technical change; they are also shaped by deeply rooted psychological factors and social processes. To successfully inspire others to mobilise for change, entrepreneurial employees must activate different personal values and provide avenues for individuals to anchor their new behaviours in a broader social and organisational context. By understanding the interplay between personal values, beliefs and norms, organisations and policymakers can design more effective strategies to encourage collective action and socio-technical change.

The study of how individuals become motivated to alter their workplace behaviour and contribute to socio-technical change is presented in Paper IV. I fully designed and carried out this paper and am the sole author of this manuscript. The paper was published in March 2026 in the *Scandinavian Journal of Management*.

Table 3: Summary of cases and data collection methods for each study, as well as the number of data points and method of analysis for each case.

Study (included in Paper no)	Study design	Case description	Data collection method	Number of datapoints and method of analysis
The Village (Paper I)	Case study (one local experiment)	Development of a local energy system experiment functioning as a microgrid with islanding capability	Semi-structured interviews, snowball sampling, desktop research of websites, policy documents, funding applications and various types of reports and academic literature.	5 respondents; interpretive case analysis focusing on the phenomenon.
Energy district (Paper I)	Case study (one system demonstrator)	Development of a city district scale demonstrator for energy systems integration, including the development of a local energy market.	Semi-structured interviews, snowball sampling, desktop research of websites, policy documents, funding applications and various types of reports and academic literature.	8 respondents; interpretive case analysis focusing on the phenomenon.
National investigation of district heating as a flexibility service in Sweden (Paper II)	Case study	Exploring DSO's utilisation of district heating as flexibility services for the electricity grid.	Semi-structured interviews, snowball sampling, desktop research of websites, funding applications and various types of reports and academic literature.	13 respondents; collected data was analysed using thematic analysis.
Follow-up of the previous study (Paper III)	Multiple case studies	Ten path-breaking initiatives in the district heating sector.	Semi-structured interviews, snowball sampling and desktop research of websites.	13 respondents; interpretive case analysis focusing on the phenomenon.
Vison Zero (Paper IV)	Case study	The development and early implementation of Vision Zero.	Semi-structured interviews, snowball sampling, desktop research of websites, policy documents, funding applications and various types of reports and academic literature.	14 responders and written documentation; collected data was deciphered using an exploitative abductive approach.

4.2.3 Methodological reflection and limitations

The studies above can be characterised as critical case studies (Flyvbjerg, 2001, 2011), meaning that all cases have ‘strategic importance in relation to the general problem’ (Flyvbjerg, 2011, p. 307). In other words, it is a selection of cases that provide information which permits logical deductions of the type, ‘If this is (not) valid for this case, then it applies to all (no) cases.’ (ibid). There are no universally applicable methodological principles for identifying critical cases. Instead, identifying critical cases involves searching for either the ‘most likely’ or ‘least likely’ cases (Flyvbjerg, 2011). My position at RISE has indeed provided unique access to socio-technical experimentation with strategic importance in relation to the phenomenon addressed in this thesis. At the same time, being exposed to these cases has sparked my curiosity about the role of incumbent employees. The selection of critical cases as a methodological approach is, therefore, a result of my personal interests and professional context at RISE, which has been woven together into the thesis.

The inductive case selection approach I have applied in this thesis has led me to a set of cases that are highly likely to strongly support the role of incumbent employees in path-breaking innovation for sustainability transitions. One could argue that this approach would introduce a strong bias in favour of my assumption, namely, that incumbent employees are key actors in the origin of path-breaking innovation in large technical systems, despite limited research supporting this claim. However, when focusing on the very early phases of path-breaking innovation in large technical systems, it is difficult to overlook the role of individuals. In fact, their presence is so pronounced that it is surprising how little scholarly attention they have received. With the risk of overreliance, I argue that inductive case selection is a suitable research approach for a detailed and comprehensive exploration of this particular phenomenon in this specific setting.

All the cases in this thesis are considered ‘successful’ in the sense that the ideators have effectively communicated their vision, making their ideas known to others and capturing my attention. Thus, they have already achieved some impact on their surroundings. Still, except for Vision Zero, only time will tell whether the energy cases will succeed in creating new pathways for the future energy system. In addition, it is reasonable to assume that, beyond the cases I have worked on at RISE, there are examples of incumbent employees who have run out of steam and been less successful at initiating path-breaking innovation, regardless of their entrepreneurial mindset. These ‘unsuccessful’ ventures remain unexplored.

Another reflection regarding the study of critical cases is their relevance for and transferability to other contexts (Yardley, 2000). The cases in this thesis are drawn from large technical systems, and their relevance to other socio-technical systems can, therefore, be questioned. For example, in the food industry, where small entrepreneurial firms play a key role in introducing path-breaking innovation (Thomson et al., 2025), incumbent employees may take on different roles in relation to path-breaking. In other words, different socio-technical systems have varying

preconditions for path-breaking innovation. Selecting case studies solely from large technical systems can, therefore, be seen as a limitation compared to selecting cases from various types of socio-technical systems. However, a study comparing the roles of incumbent employees in path-breaking innovation across different systems would, from the outset, need to be grounded in more robust research supporting this claim – a gap this thesis fills.

My final methodological reflection concerns case studies in general and, more specifically, interview data. Historical accounts provided by individuals can be problematic. Researchers in various fields have offered convincing evidence of the unreliability of individuals' witness accounts, even after just a few days. Using interview data about past events can thus include a significant amount of recall biases and errors. For example, interviewees may forget to mention others who have made important contributions, and those omitted from descriptions risk being overlooked by the researcher. Furthermore, there is a risk that some interviewees are more inclined to exaggerate or downplay their own contributions in relation to others, which can lead to a misleading understanding of the course of events. To mitigate these risks, I have worked on constructing overlapping case narratives (De Fina & Georgakopoulou, 2019). These narratives 'grow' as more people contribute to the story of how and why a path-breaking innovation has emerged. Overlapping case narratives are useful not only for gaining a clear understanding of an evolving event, but they are also useful during interviews for 'recall checks' to ensure that essential parts of the interviewee's story were not missing and that 'events' were placed in chronological order (Kvale et al., 2009). In addition, overlapping case narratives allow for incorporating multiple perspectives to balance individuals' contributions in the process.

In sum, the critical case selection and the sensitivity to the individual level add a novel perspective on incumbent employees' motivations and practices in path-breaking innovation in large technical systems. Although there are methodological shortcomings in this approach, it opens new avenues for future research and a more dynamic understanding of the locus of prime movement for path-breaking. In the next section, I will apply the analytical framework of sustainability intrapreneurship to the appended cases and explore the use of an individual-level perspective to a more dynamic understanding of the emergence of path-breaking innovation for sustainability transitions of large technical systems.

5 Findings

This section synthesises the appended case studies by applying the sustainability intrapreneurship framework introduced in Section 3.1. Instead of presenting separate findings from each paper, which use overlapping concepts such as 'insiders', 'institutional entrepreneurs' and 'engaged individuals', applying a single framework to all the cases will provide a more coherent and integrated analysis across the appended cases. In the subsequent section, the results will be summarised and discussed in relation to the thesis research questions. Thereafter, the conclusions section will present the learnings regarding how sustainability intrapreneurs initiate, develop and realise path-breaking innovation for sustainability transitions of large technical systems, how psychological factors shape workplace behaviour and how collective path-breaking actions for sustainability transitions can be mobilised.

5.1 Synthesising empirical cases through the sustainability intrapreneurship framework

Key characteristics of sustainability intrapreneurship include its nature as a value-driven bottom-up process that emerges without permission. Hence, it is an entrepreneurial and firm-internal process that primarily emerges outside management and that can be found among all employees. Sustainability intrapreneurs who engage in path-breaking innovation, at their own discretion, within large technical systems are motivated to do so by their emotions or personal values. Furthermore, to be successful, sustainability intrapreneurs need to be skilled socially and able to craft and voice visions of imagined futures that others are inclined to endorse, for example, by deliberately framing their vision to resonate with existing interests, values and familiar structures.

Sustainability intrapreneurship can support path-breaking in different ways. Using a role-based typology, different 'styles' of sustainability intrapreneurship can be categorised into three roles: the agenda setter, the demonstrator and the networking educator. These roles describe how sustainability intrapreneurs can support the initiation, development and realisation of path-breaking innovation for sustainability transitions of large technical systems. First, however, I will examine how the key characteristics of sustainability intrapreneurs manifest in the appended cases.

5.1.1 Key characteristics of sustainability intrapreneurs

Reviewing the appended cases, the findings show that the Village and the Energy district initiatives (presented in Paper I) emerged from firm-internal, bottom-up processes driven by a small number of incumbent employees acting on personal beliefs. In none of these cases was management actively taking part in forming or supporting the initiative. The same can be said

about the case of Vision Zero (Paper IV), although in this case, top management initially severely criticised the initiative. The multiple case studies presented in Paper III show similar patterns and key characteristics, although these initiatives were still in the making.

Focusing on the details of the Village experiment (Paper I), the original idea of a localised energy system took shape in a meeting between an operational manager at a large Electricity Distribution Operator and a customer who owned a wildlife camp in a remote village in northern Sweden. They met because the village often suffered power outages due to the substandard electricity grid, which was causing problems for the wildlife camp owner. Although traditional improvements to the electricity grid solved the problem for the wildlife camp, the operational manager discussed his idea about a localised energy system with a trusted friend and long-time colleague working as a strategist at the same company. Soon after, the strategist seized an opportunity to secure external funding, allowing them to develop their thoughts as ‘strategic future work’ without being questioned by other colleagues. Eventually, they managed to anchor their ideas in a small community in southern Sweden and to initiate the country's first localised energy system. Similar events were played out in the formation of the Energy district initiative (Paper I). In this case, a small group of old friends who worked for different employers met regularly in informal meetings to discuss different aspects of more sustainable future energy systems, such as flexibility issues and smart grids. They also seized an opportunity and managed to secure funding through a call from the European Commission, allowing them to initiate a path-breaking innovation on smart neighbourhood energy management. Hence, in both cases, a small team of incumbent employees acted as sustainability intrapreneurs and seized an opportunity to initiate path-breaking innovation, aligned with their personal interests. Furthermore, they utilised their insider knowledge about the infrastructure to craft visions of imagined future energy systems that others endorsed. The Strategist in the Village experiment illustrates this nicely when he says: ‘I think we all had an idea about changing the energy system and making contributions to a sustainable society. Some of us are perhaps more interested in technical challenges, while others are more towards sustainability and contributing to society. But [environmental] sustainability was probably the main driver for all of us.’

Vision Zero (Paper IV) and the path-breaking initiatives in the district heating sector (Papers II & III) present complementary aspects of sustainability intrapreneurship, and the organisational-internal bottom-up process of initiating, developing and realising path-breaking innovation for sustainability transitions of large technical systems. In these cases, sustainability intrapreneurs have managed to use different strategies to successively build support for their vision among colleagues and others. In the case of Vision Zero, for example, the ideator formed a team of colleagues within the organisation who strategically developed and diffused evidence-based data and value-based information to actively engage others within and outside the organisation to change their workplace behaviour in favour of Vision Zero. ‘The system perspective that was brought [into traffic safety] really did pave the way for me, and it also made it possible for others

to join in,’ says one of the experts and researchers in road safety. The Vision Zero case further highlights the importance of framing a vision or information in ways that resonate with existing interests, values, and familiar structures. People change workplace behaviour when information is aligned with current interests, values and established decision-making routines.

In the path-breaking initiatives in the district heating sector (Papers II and III), sustainability intrapreneurs, instead, formed teams with individuals outside the organisation. In these cases, sustainability intrapreneurs provided their insider technical knowledge to support and initiate path-breaking innovation, for example, with a focus on system coupling for more sustainable usage of established energy systems. ‘I know quite a lot about both electricity and district heating, which allows me to have a broad perspective,’ says a business area manager (B) at a regional energy distribution operator who invited himself to the municipality’s annual energy planning process.

In all these case studies, incumbent employees have played key roles in forming path-breaking innovation by acting as sustainability intrapreneurs. Guided by personal beliefs, they have formed small entrepreneurial teams and encouraged others to change their workplace behaviour by framing their communication so that it resonates with existing interests, values and familiar structures. Results show that sustainability intrapreneurs are primarily found outside top management, for example, among experts, engineers, strategists, business or operational managers. In only one case does a local energy distribution operator's CEO, at his discretion, take the initiative to develop and implement path-breaking sustainability innovations (Paper III).

A commonality among the sustainability intrapreneurs identified in these cases is their ability to seize windows of opportunity to attract external funding or to use their insider knowledge and access to key infrastructures to collaborate with outsiders and co-create path-breaking innovation within large technical systems. The results from these case studies show that sustainability intrapreneurs tend to work with people they know rather than proceeding through organisational hierarchies and structures. They act at their own discretion and in ways that align with their personal beliefs about professional role responsibilities, which transcend the employer and include a moral obligation to the sustainable development of the socio-technical system at large. A business developer at a local energy distribution operator illustrates this nicely by saying ‘We cannot wait until the regional electricity grid is strengthened. It will take decades. Imagine all the potential job opportunities we will miss [...] From a strict district heating system perspective, this heat-storage was not necessary, but it is necessary for our society.’

5.1.2 Role-based sustainability intrapreneurship

In the role-based typology, different ‘styles’ of sustainability intrapreneurship can be categorised into three roles: the agenda setter, the demonstrator and the networking educator (see Section 3.1.1). These roles were originally developed in Paper III based on incumbent employees’

motives, motivations and strategies for developing and advancing path-breaking initiatives in the district heating sector. In Paper III, four out of the thirteen interviewees are categorised as *agenda setters*, five as *demonstrators* and four as *networking educators*. Next, I will provide a brief recap of Paper III and outline how the different roles are presented in the manuscript. Subsequently, I will apply this typology as a lens to the other cases and explore its fit in other socio-technical contexts. A summary of role manifestation will be presented in Table 4.

5.1.2.1 District heating

The district heating study comprises a number of initiatives that reveal three distinct but complementary ways in which incumbent employees, acting as sustainability intrapreneurs, contribute to path-breaking innovation in the district heating sector.

Starting with the initiative for regional development, a business area manager (A) at a local energy distribution company was frustrated with the municipal energy plans, perceiving them as neither realistic nor forward-looking. By taking on an *agenda setter* role, the business area manager invited himself into the planning process, positioning district heating as an essential part of sustainable energy development. By drawing on professional legitimacy and energy system expertise, the business area manager was repeatedly invited back to planning discussions. Here, the business area manager voiced visions that extended beyond firm-specific concerns, framing district heating as a vital component for preventing grid congestion and supporting long-term urban growth. Although the business area manager (A) was not formally assigned to engage in the municipality's energy planning process, he showed proactiveness and the ability to craft visions for imagined futures. Similarly, in another region, a development engineer (A) and part-time politician exemplifies the *agenda setter* role by using her political influence and energy expertise to shape regional sustainability missions, placing district heating as a central flexibility resource in the regional energy mix.

The demonstrator role is nicely illustrated by a development engineer (B) and a business developer. The former engaged, at his own discretion, in the development of a low-temperature district heating grid as part of a 'net-zero city district' initiative, while the business developer engaged in experimenting with new business models enabled by transforming an underground facility into a large-scale heat storage solution, opening up a new possibility for moving electricity use for heat production in time. Both the development engineer and the business developer leveraged external funding and collaborated with multiple stakeholders, using their knowledge of infrastructure and system integration to move innovation from concept to practice. Their entrepreneurial spirit is shown in their ability to attract partners and resources while experimenting with innovative solutions that reach far beyond the traditional boundaries of their firms.

A different set of activities illustrates *the networking educator* role. One example is the creation of a national network for professionals, made by the development engineer (D), where individuals from geographically bound district heating companies could share materials, test ideas and collaborate on common challenges. Another example is the annual intrapreneurship training programme to prepare individuals in the sector for upcoming paradigm shifts in the energy sector. An initiative launched by an expert, a former vice CEO and chairperson of a national energy organisation. Although neither of these efforts directly introduced new technologies, both played a crucial role in building collective capacity, empowering employees across the sector and cultivating a culture of collaboration. These activities demonstrate how networking educators mobilise others, sustain engagement and create the conditions for sustainability transitions of large technical systems.

In sum, the district heating cases demonstrate how sustainability intrapreneurs can enact entrepreneurial capabilities, such as persistence, creativity and a willingness to cross organisational and sectoral boundaries. Agenda setters, such as the development engineer (A) and the business area manager (C), expand the conversation beyond their firms. Sustainability intrapreneurs acting as demonstrators, such as the business area developer (A) and the development engineer (A), test and validate new solutions, while networking educators, like the development engineer (D) and the expert, prepare colleagues and peers for collective transformation. Through the interplay of these roles, early-stage transitions in the district heating sector gain momentum and legitimacy.

5.1.2.2 The Village experiment

In the Village case, the operational manager and the strategist initiated a bottom-up development of a local energy system, an innovation primarily developed to address sustainable electricity grid challenges rather than firm-specific challenges. Both the operational manager and the strategist leveraged personal networks and were involved in attracting external resources, such as finance, workforce and competencies. They also utilised personal infrastructural-specific knowledge to identify a suitable location for their experiment. However, when they pitched their idea to the community, the citizens did not accept it. Showing an entrepreneurial spirit, the operational manager and the strategist searched for another location. The second time, they applied their learning from the latest failure and approached the citizens in the new location in another way. This time, the pitching of a local energy system is successful, and the citizens are positive about experimenting with the energy system in their community.

Although other individuals were important for realising the Village case, such as the house owner and the project leader, only the operational manager and the strategist qualify as sustainability intrapreneurs. The house owner is not an employee, and the project leader was recruited to run the project and was therefore acting in line with professional role expectations. Nonetheless, widespread enthusiasm and personal beliefs about transforming the energy system

as a means to create a sustainable future society are essential. Still, the sustainability intrapreneurs played a key role in making this momentum.

In sum, the operational manager and the strategist demonstrate entrepreneurial characteristics, such as passion and an enduring emotional drive. They also display entrepreneurial skills, such as collaborating and shifting between different tactics to frame their vision in ways that resonate with existing interests. Combined with investing time and energy in technology development, the operational manager and the strategist take on the role of *demonstrator*.

5.1.2.3 The Energy district

The Energy district case is the result of a team effort by individuals embedded in the energy sector, although from slightly different perspectives. For example, the director of renewable electricity and the R&D strategist both worked for the local energy company. The technology manager was involved in energy issues, but from a property owner's perspective. The project coordinator, the area manager for energy and the initial project leader, however, worked for intermediaries, i.e., organisations that can support and facilitate day-to-day actions in the making of the initiative (Kivimaa et al., 2019). The energy market researcher worked for a research institute and, by definition, was not considered a sustainability intrapreneur, even though he contributed key competencies in forming the Energy district. The same can be said about the programmer who was brought into the initiative to solve a specific technical issue. The energy market researcher and the programmer will thus not be considered in this analysis.

Exploring the roles of sustainability intrapreneurs in the Energy district case, the director of renewable electricity and the R&D strategist were active in forming the initiative and ensuring that it addressed energy systems issues rather than electricity system-specific challenges. They saw large potential in coordinating district heating and electricity from an energy-system-at-large perspective. However, even though district heating and electricity distribution operators are often part of the same local energy provider, they are distinct firms that operate in different markets and fall under different legislative frameworks. This makes collaboration and integration between the two types of energy complicated. Still, the director of renewable electricity and the R&D strategist took an energy system perspective rather than an electricity system perspective on future challenges related to increased variable electricity production and consumption, even though this was controversial within their own organisation. In this initiative, they specifically explored information sharing and market issues, hence taking on the role of *demonstrators* in relation to their home organisation.

The technology manager participated in the Energy district initiative from a property owner's perspective. One might question how 'entrepreneurial' it is for an employee of a property owner to engage in efforts to reduce energy usage in buildings. However, the Energy district could only be realised through collaboration between actors from the district heating, electricity distribution,

and property sectors. Thus, the initiative addressed issues that went beyond merely reducing energy usage in buildings and extended beyond what might typically be expected of a technology manager in this professional role. The technology manager, therefore, took on the role of *agenda setter* within the informal group of individuals and in discussions about future energy systems. As the results from the Energy district proved successful, the technology manager later became involved in a similar initiative in northern Sweden. Although this initiative is not covered in the study, the technology manager reports that the results from the original initiative were widely communicated within his organisation. It is, therefore, reasonable to assume that he adopted a *demonstrator* role in the northern initiative and worked with energy system actors to promote technological and service development, introduce new market strategies, reduce costs, or launch alternative business models.

The project coordinator, the area manager for energy and the initial project leader played slightly different roles. The project coordinator, for example, acted as a *networking educator* when he initiated the informal meetings to discuss various aspects of potential future energy systems. At the time, he was working as an R&D strategist at a municipality-owned energy company, and most of the people who were brought together knew each other beforehand. Although they worked for different organisations, they were interested in energy flexibility issues and smart grids. The project coordinator himself was curious about what a localised energy system would look like and if an established energy company could play a role in such a system. After changing jobs and starting at the Science Park, the project coordinator had even more freedom to ‘get some friends together and discuss this’, as he says. Hence, he has played a key role in strengthening the network's awareness, knowledge sharing and capacity building.

The area manager for energy and the initial project leader played key roles in identifying and taking the lead in formulating the Energy district initiative and writing the funding application. According to the area manager, a key success factor was that all the individuals involved had been discussing these issues for some time and had established mutual trust. Still, the area manager and the initial project leader took on the role of *networking educators*, actively engaging individuals from various organisations and sectors, aligning the initiative with previous discussions within the network, and involving experts to strengthen the application and ensure the Energy district initiative was both innovative and distinctive

5.1.2.4 Vision Zero

In the case of Vision Zero, the director of traffic safety is widely recognised in documents and by interviewees as the ideator, hence the sustainability intrapreneur. When introduced, Vision Zero was a radical shift in the ethical perspective of road safety that challenged the dominant paradigm. It was an idea that went completely against the prevailing road safety and planning standards and was instantly met with doubt, ‘It’s your career, not mine,’ said the director general to the director of traffic safety the first time the idea was voiced. Still, by different means, the

director of traffic safety successfully engaged individuals both within and beyond the organisation, mobilising a collective effort of change that diffused throughout the organisational field and ultimately transformed the standards for road safety and planning, turning Vision Zero into institutional practice (Lawrence et al., 2009; Lawrence & Suddaby, 2006).

To achieve this, one of the first things the director of traffic safety did was to engage a team of close colleagues and road safety experts in preparatory work including, for example, the development of recommendations for road safety targeted to road providers instead of road users, new ethical standpoints, a new science-based approach to road safety efforts and theoretical models of the human body's biomechanical tolerances to kinetic energy. Convincing colleagues was, however, not an easy task. There were strong protests when the vision of zero road traffic fatalities was brought to life. Common objections were 'This is a utopia', 'It is not realistic' and 'This cannot be accomplished.' 'The first time the director of traffic safety said "zero" to me, I smiled and thought to myself, "Sure, that sounds good, but it isn't possible",' says planner (A). However, having voiced support for the idea from the minister of communication, the director of traffic safety and the small team of experts could carry on their work and eventually, together with planner (A), implement one of their first major experiments, the 2+1 roads [i.e., using two road lanes in one direction and one lane in the opposite direction, with the two-lane section alternating between directions every few kilometres]. 'Nearly everyone, including all emergency services personnel, was against this idea,' says one of the team members, working as an expert and researcher in road safety. And he continues: 'However, an ambition of zero fatalities was difficult to argue against. And as it turned out, the 2+1 road was an absolutely fantastic innovation.'

Struggling against significant internal and external resistance based on an unwillingness to change priorities and approach things in new ways, the director of traffic safety utilised his personal skills to frame Vision Zero in a way that resonated with diverse interests and personal beliefs. With support from his team of experts and an entrepreneurial effectuation strategy, i.e., leveraging available means rather than setting a specific end goal in advance (Sarasvathy, 2001), the director of traffic safety and the planner (A) took on the role of *demonstrator*.

In the work of realising Vision Zero, there are also other individuals who have acted as sustainability intrapreneurs. Planner (B), for example, got inspired by the concept and started to experiment with introducing roundabout intersections instead of traffic light-controlled intersections. At the time, this was a radical traffic design and planner (B) pursued as a *demonstrator*. The expert and researcher in road safety and the strategist (A) took on the role of *agenda setters* when they summoned different actors, including the media, to present research findings and initiate discussions on traffic norms and safety culture. It is stated in Paper IV that this was done with 'support from the minister and the new director general.' However, it is unclear if this was official or perceived support.

Table 4: Role manifestation

Case	Agenda Setter	Demonstrator	Networking Educator
District heating	Business area manager (A)	Development engineer (B)	Specialist
	Development engineer (A)	Business developer	Marketing manager
	Business area manager (B)	Business area manager (C)	Development engineer (D)
	CEO, district heating and cooling	Development engineer (C) Engineer, district heating and cooling	Expert
Village		Operational manager Strategist	
Energy District	Technology manager	Director of renewable electricity R&D strategist	Project coordinator Area manager Project leader
Vision Zero	Director of traffic safety, Expert and researcher Strategist	Director of traffic safety, Planner (A) Planner (B)	

6 Discussion

The purpose of this thesis was to investigate how and why incumbent employees acting as sustainability intrapreneurs become key actors in path-breaking innovation in early-stage sustainability transitions of large technical systems. Three research questions have guided this work, and I will subsequently address each question individually in relation to the main findings presented in this thesis.

RQ1: In what ways do sustainability intrapreneurs initiate, develop and realise path-breaking innovation in early-stage sustainability transitions of large technical systems?

The appended case studies have provided rich illustrations of bottom-up and organisation-internal processes that have arisen without management endorsement and, at least in these cases, were strongly associated with the emergence of path-breaking innovation in early-stage sustainability transitions. While the traditional notion of intrapreneurs has a strong focus on developing business opportunities or organisational renewal (Corbett et al., 2013; Lang & Baltes, 2019; Neessen et al., 2019; Pinchot III, 1985; Sharma & Chrisman, 2007), the results in this thesis show that sustainability intrapreneurs are instead characterised by a strong sense of personal responsibility and commitment to drive sustainability transitions of socio-technical systems. In other words, sustainability intrapreneurs take a systems approach and seek benefits for the sector over benefits for their employer. Although the individuals in this thesis may not identify as sustainability intrapreneurs, the findings show that they are typically innovative, proactive and demonstrate strong networking skills. Furthermore, they take calculated risks, search for and recognise opportunities. Thus, they exhibit personal characteristics and workplace behaviours that, in some respects, align with descriptions of intrapreneurial employees (Hernández-Perlines et al., 2022; Neessen et al., 2019). For example, results from Vision Zero and the Energy village illustrate that individuals who engaged in sustainability intrapreneurship typically worked through informal networks, under trust and without permission, at least in the early phases. They acted outside their direct area of accountability and were not just fulfilling professional expectations. Hence, sustainability intrapreneurship emerges as a distinct form of intrapreneurial behaviour that has not previously been described in either the intrapreneurship or sustainability transitions literature. Originating in strong sustainability engagement, sustainability intrapreneurs are employees who connect deep insider technical knowledge of large technical systems to complex social problems.

As introduced in Section 3, the concept of sustainability intrapreneurship has similarities to how others have described intrapreneurship. For example, as a bottom-up process that can be associated with employees at all levels within an organisation who, at their own discretion, identify and exploit opportunities to realise socially oriented personal values (e.g., Alt & Geradts, 2019; Grayson et al., 2011; Hemingway, 2013). The primary difference between sustainability intrapreneurship and other forms of intrapreneurship lies in the scope of their

impact. For example, social intrapreneurs, who engage with social challenges, simultaneously focus on providing value to the firm. Hence, social intrapreneurs have a strong focus on contributing to their employer's objectives (Alt & Geradts, 2019). The sustainability intrapreneur, on the other hand, engages in actions to initiate, develop and promote path-breaking innovation to realise socio-technical sustainability transitions, i.e., focusing beyond the immediate advantages for their employer. In Paper I, for example, the sustainability intrapreneurs identified in both the Village and the Energy district case were focused on creating a decentralised energy system, even though there was no obvious role for their employer. Only in the Village case, and after a while, were the business aspects addressed by the sustainability intrapreneurs, although this issue was never resolved during the course of the study. Nevertheless, sustainability intrapreneurs are not blind to the importance of business relevance. In the district heating cases, the business developer and the development engineer (B) frame their ideas within their home organisation by qualifying district heating as a sustainable business case for the energy system at large. In Vision Zero, the strategist emphasises the importance of not wasting public funds as one of the arguments for his work. Still, none of the sustainability intrapreneurs studied in this thesis developed path-breaking innovation primarily to contribute to their employer's objectives.

The sustainability intrapreneurship framework and the cases included in the thesis offer a new understanding that can serve as a starting point for future research addressing calls for the actual practices of path-breaking innovation in early-stage sustainability transitions (e.g., Sengers et al., 2019; Upham, Bögel, & Dütschke, 2019). First, sustainability intrapreneurship fits within the broader technical systems context, where actors such as grassroots groups and entrepreneurs have limited room to initiate path-breaking innovation. Second, it is a concept that complements transition management literature, where experts and researchers with specialised knowledge and creative capabilities are recruited as frontrunners into transition arenas for experimentation and generation of transformative solutions (Loorbach, 2010; Rotmans et al., 2001). Although incumbent employees are not excluded from being frontrunners, sustainability intrapreneurship is not necessarily localised in an external transition arena, and faced with the associated challenges of introducing path-breaking actions in their home organisation (see more about these challenges in Rex et al., 2019). Furthermore, once incumbent employees are recruited into a transition arena with the expectation to develop transformative solutions, they do not qualify as intrapreneurs. Third, sustainability intrapreneurship complements the concept of systems builders (Hughes, 1987). Once again, incumbent employees are not excluded from this concept. However, much of this literature adopts a broader actor perspective and includes, for example, firms (Jacobsson & Bergek, 2004), intermediary organisations (Kivimaa, 2014) and formal networks (Hellsmark, 2010) as system builders. A summary of the similarities and differences between sustainability intrapreneurs and other change-oriented theoretical roles related to established organisations is presented in Table 5.

Incumbent employees engaging in sustainability intrapreneurship may not identify as sustainability intrapreneurs. Nonetheless, this thesis shows that they can still be identified and studied. The findings suggest that sustainability intrapreneurs can take on three characteristic roles: *the agenda setter*, *the demonstrator* and *the networking educator* to initiate, develop and realise path-breaking innovation for sustainability transitions of large technical systems. Although these roles originate from an inductive study of sustainability intrapreneurs in the Swedish district heating sector (Paper III), they proved useful also in other contexts. The roles could therefore be used to connect the papers attached to this thesis into a more coherent body of knowledge. I will now examine the key characteristics of each role and trace their similarities and differences across the appended cases.

The agenda setter has a key role in forming shared agendas and strategies among different stakeholders within a sector. The agenda setter's work is primarily related to communicating an imagined future, internal and external to the organisation. The technology manager in the energy district and the director of traffic safety in Vision Zero are good illustrations of this. The technology manager and the director of traffic safety primarily encompassed a socio-technical systems perspective in their visionary work, which means that their imaginary futures were only possible to realise with broad collaborations across multiple actors. They both demonstrated personal skills that included the ability to formulate and articulate visions of imaginary futures that garner support from both internal and external stakeholders. Furthermore, they were also able to leverage their personal networks to attract attention, summon representatives and secure commitment among internal and external stakeholders.

The demonstrator role is probably the most self-explanatory category in this taxonomy of roles. In comparison to the agenda setter, who is involved in forming stakeholder commitment, the demonstrator acts in situations where external stakeholders have strong commitment and high system-specific competence. The demonstrator thus finds or creates contexts to develop path-breaking innovation. The demonstrator role is nicely illustrated by the development engineer (B), who, at his own discretion, leveraged external funding to explore the benefits of a low-temperature district heating grid as part of a net-zero city district initiative. Characteristically, the development engineer (B) attracted external resources to experiment with innovative solutions that extend far beyond his employer and without clear business benefits.

The networking educator connects individuals from stakeholders who are otherwise weakly or not connected at all. Although the networking educator role is less common than the others in this thesis's findings, the role's potential scope of impact may place it as one of the more important roles in the early stages of (innovation) systems formation (see, e.g., Musiolik et al., 2012). The networking educator, for example, holds strategic importance for informal education, as they foster a common understanding of strategic goals and build trust among network members. An illustrative example is found in Paper III. The Swedish district heating sector comprises a large number of relatively small and geographically defined organisations.

Employees in the district heating sector who engage in path-breaking work may thus feel lonely and unsupported by their home organisation. Such feelings can easily hamper individuals' engagement (Hemingway, 2005). Sustainability intrapreneurs who act as networking educators focus on developing the skills of innovation, leadership and communication among colleagues and others, thereby empowering them to engage in sustainability intrapreneurship efforts. A key difference between the agenda setter and the networking educator is that the latter acts in contexts where everyone already shares a vision or an understanding of the future system. Hence, the networking educator does not need to garner support for an imagined future.

In sum, in all these roles, sustainability intrapreneurs act from the bottom up to initiate, develop and realise path-breaking innovation for sustainability transitions of large technical systems. To do so, they use their personal and professional networks and utilise resources associated with their professional role, but not necessarily with the company's permission. Notably, these roles may partially overlap, and the description is not to be understood as a rigid framework. For example, both the agenda setter and the networking educator promote awareness and build capacity. Nevertheless, the way in which this is done in practice differs. Furthermore, in this thesis, sustainability intrapreneurs are primarily found outside top management, for example, among experts, engineers, strategists, business area or operational managers. However, there are also examples of sustainability intrapreneurs among managers, such as the CEO of a small energy company in Paper III. Sustainability intrapreneurship can thus potentially be found among all employees. This resonates with some of the intrapreneurship literature, which states that employees at all levels can act in an entrepreneurial manner (e.g., Hemingway, 2013; Lackeus et al., 2020). However, it is a perspective that challenges the notion that it is the management of incumbent organisations that is the locus of agency in path-breaking innovation for sustainability transitions (c.f., Galeano Galvan et al., 2020; Leitch et al., 2019; Lenfle & Söderlund, 2022; Loder et al., 2024; Moncreiff et al., 2024; Papadonikolaki et al., 2023; Sackey & Akotia, 2017; Wang et al., 2022). As such, the concept of sustainability intrapreneurship contributes to the sustainability transitions literature, offering a novel and more nuanced understanding of how path-breaking innovation emerges within large technical systems. Next, I will explore the reasons for sustainability intrapreneurs to do so.

RQ2: How do psychological factors, such as personal values and beliefs, shape sustainability intrapreneurship and new workplace behaviour in relation to early-stage sustainability transitions?

Applying the framework for sustainability intrapreneurship to the appended case studies has revealed that incumbent employees can alter their workplace behaviour, much as intrapreneurs can link business growth to social value creation (Belinfanti, 2015; Elkington, 2009; Hemingway, 2013; Mair & Martí, 2006). However, with the main difference that sustainability

intrapreneurs have a clear focus on *path-breaking innovation*, i.e., improving a socio-technical system. All the appended cases exemplify initiatives to improve systems in one way or another, and the sustainability intrapreneurs show strong pro-social and environmental values. This echoes some of the characteristics of system builders (Hughes, 1987), who create system resources or make substantial contributions to the development of a technological innovation system (Blomkvist et al., 2023; Hellsmark & Jacobsson, 2009; Musiolik et al., 2020; Wittmayer & Schöpke, 2014). However, what may make a socio-technical system more sustainable is not automatically ‘good’ for all actors in the system, from an organisational perspective. In contrast to intrapreneurs, sustainability intrapreneurs may thus initiate path-breaking innovation that can have far-reaching consequences for their employer. The case of the Village is an illustrative example of this, as a widespread development of self-sufficient and grid-independent energy communities would challenge the DSO’s core business.

The appended cases demonstrate that sustainability intrapreneurs are individuals who are motivated to engage in new workplace behaviours because of personal values, beliefs and norms, particularly related to pro-social and environmental values. It is also shown that successful sustainability intrapreneurs are skilled at creating cues to activate personal values and anchor beliefs to garner support for their initiatives (Paper IV). These results not only add to the understanding of how intrapreneurs find support for their initiatives (Alt & Geradts, 2019), but also to what motivates people to change their workplace behaviour. As such, this thesis contributes to calls about a more multidisciplinary actor perspective in the sustainability transitions field (e.g., Perlaviciute et al., 2021; Upham, Bögel, & Johansen, 2019). The strategist in the Village case exemplifies this nicely when he says, ‘Some of us are perhaps more interested in technical challenges, while others are more towards sustainability and contributing to society. But [environmental] sustainability was probably the main driver for all of us’. Another example, stressing the pro-social value dimension, is provided by planner (B), who says: ‘The focus on human lives in Vision Zero was important to me. Traffic safety is a collective responsibility shared by all members of society. I think we can create safer roads and communities for everyone, especially if we work together’.

The thesis has drawn on theories from social psychology, particularly the value-belief-norm theory (Stern et al., 1999). Psychological factors, such as personal values and beliefs, are thus expected to have a strong explanatory account for individuals’ value-driven behaviours, also at the workplace (De Groot & Steg, 2008; Schwartz, 2006, 2012; Verplanken & Holland, 2002). In the study of Vision Zero, it is shown that new value-driven workplace behaviour originates from activated personal values and the anchoring of personal beliefs, thereby expanding the original value-belief-norm theory. In short, when an individual is exposed to an idea or an imagined future that activates his or her personal values, it triggers a positive response, i.e., recognising that ‘this is good!’ Next, the individual wants to engage and searches for arguments in favour of this new behaviour. For example, in strategies, policy documents or by talking to colleagues to

find out whether this new behaviour is acceptable and morally right – in other words, posing the question ‘is this right?’ If the individual can anchor the new workplace behaviour, i.e., reach the conclusion that an action is acceptable, he or she starts to act in ways that benefit personal values aligned with the idea or the presented future. The importance of activating personal values and anchoring beliefs can also be seen in other cases. For example, in the Energy district, a group of individuals shared beliefs about future energy systems, although with an overlap between pro-social and self-oriented values, but without conflict of interests. Anchored in their employer’s strategies, they placed an externally funded project on a university campus grid, which, because of the grid’s exemption from the national concession requirement, enabled them to experiment without adhering to the prevailing grid regulations. Another example is the business developer in Paper III, who explored the use of a large-scale underground heat storage facility for the local energy system, anchored, it appears, in the employer’s ambition to be part of the energy transition and be an attractive employer.

Without overlooking the strong social and situational factors that influence large technical systems (Hughes, 1987), this thesis provides detailed accounts of sustainability intrapreneurs as key agents in the emergence of path-breaking innovations. Both pro-social and environmental personal values, personal beliefs about opportunities and feelings of responsibilities play a crucial role in incumbent employees’ adoption of new workplace behaviours and their role as sustainability intrapreneurs. The importance of activation of personal values and anchoring of beliefs, brought forward in Paper IV, not only contributes to a better understanding of how agency is diffused among contextually embedded individuals (Lawrence et al., 2009; Lawrence & Suddaby, 2006). It may also offer novel insights into key factors that determine successful intrapreneurship in general (Camelo-Ordaz et al., 2012).

RQ3: How can sustainability intrapreneurship influence the development of sustainability transitions?

As I approach the end of this thesis, it is time to discuss the possibilities for sustainability intrapreneurs to influence socio-technical systems. After all, socio-technical transitions unfold over considerable time spans and involve a broad range of actors and social groups in coordinated actions (Köhler et al., 2019). I have now worked with an individual-level perspective on socio-technical transitions for some years, and I have had many discussions with others about my work. Interestingly, when I hear these stories, I have noticed that many can share experiences about working with individuals who have played crucial roles in inspiring transformative change. It seems to me that quite a few have had personal experience with sustainability intrapreneurs, even if they don’t refer to them as such.

Sustainability intrapreneurs, like other types of intrapreneurs, are innovative, proactive, risk-taking and they are networkers who can recognise and exploit opportunities. Moreover, they can,

like other types of intrapreneurs, see possibilities in new logics within organisations, such as in Vision Zero, and introduce bottom-up, pro-social and environment-inspired innovations in for-profit organisations, as seen in the energy district and village cases. However, the case studies show that sustainability intrapreneurs show little interest in creating new business opportunities or strategic organisational renewal.

The sustainability intrapreneurs identified in the cases in this thesis introduced path-breaking innovation, such as connecting known technologies to enable localised energy systems within the existing electricity grid or utilising established technologies for peak shaving or to balance electricity use and production between district heating systems and the electricity grid. Path-breaking innovation initiatives were also introduced through utilising an energy perspective in district planning, energy policy approaches to new industrial establishments and new marketplace solutions, and through the communication of attractive futures. Only in some cases were new technologies used to drive change, such as the ultra-low temperature district heating system. However, such technology would introduce a fundamentally new way of delivering heat, affecting the whole heat distribution system, including the current business model.

Sustainability intrapreneurs demonstrate strong social and communicative skills, and they can frame a vision or idea in ways that resonate with existing interests, values and structures. By doing so, they attract others' attention, and individuals start to engage in path-breaking innovation. Over time, changes in practice will diffuse throughout the organisational field (Lawrence et al., 2009; Lawrence & Suddaby, 2006). The case of Vision Zero, with its long time series, serves as an illustrative example of this. Today, Vision Zero is taken for granted in traffic safety planning. However, in 1997, when the road safety policy was introduced, it was a radical policy proposal which was met with scepticism and substantial resistance. Comparing a snapshot of the Swedish traffic system from the early 2000s with one from today would yield two different images. For example, today, roundabouts are primarily used instead of traffic-light-controlled intersections, and most highways are constructed with central barriers. In city centres, the speed limit is reduced to 30 km/h. Cars and cyclists are mixed, and crosswalks are removed, allowing pedestrians to cross the street at any point. This was not the case 25 years ago. However, it is not only the traffic system design that has changed, but actors also have new responsibilities and road vehicle designs have evolved. All this, obviously, is not the making of a few sustainability intrapreneurs. Instead, it is the making of an increasing number of individuals taking practical action to do what they feel is right, and, over time, turning a visionary, path-breaking policy innovation into practice.

A sustainability intrapreneur can certainly inspire others to take action through talking and doing. However, inspiration does not automatically translate into sustainability intrapreneurial behaviour. There is a distinction between those who engage in intrapreneurship and those who adopt new workplace behaviours after being inspired by an intrapreneur. Even though this

distinction may not be easily defined. Intrapreneurial behaviour is characterised by sustained passion, emotional energy and drive (Neessen et al., 2019). Consequently, not everyone who feels inspired will themselves become intrapreneurs. However, individuals who are inspired by a sustainability intrapreneur can still act out of personal choice. Their new workplace behaviour emerges from evaluating available alternatives within their specific context. Therefore, when individuals commit to new value-driven actions, they may do so because they have witnessed what a sustainability intrapreneur in their field has accomplished, felt inspired and perceive these actions as morally important. In other words, at their discretion, they choose to use their professional role to garner support for a more sustainable and attractive future. One such example is Planner (B), in the Vision Zero case, who started to use roundabouts in the traffic system design after seeing data on the correlation between speed and injuries, with the argument that ‘when I saw the data, I remember thinking “This is the way!” [...] Everyone within the transport system has a responsibility to reduce or remove risks for the users.’

Although supporting a sustainability intrapreneur’s idea and adopting new workplace behaviours can require considerable effort, especially when the idea is new and lacks widespread support, the more examples there are, the easier it becomes for others to follow. The early ideas may nevertheless be perceived as legitimate because the intrapreneur is acting from within the established organisation. An illustrative example of this is the attention the sustainability intrapreneurs and their visions received from other actors in the field, in both the Village and the Energy district initiatives. Hence, the sustainability intrapreneur’s internal position provides him or her with a social identity in the field, and the sustainability intrapreneur’s actions may thus be interpreted by others as objectively valid, or an assumption that the intrapreneur knows what he or she is doing. In the Vision Zero case, there are many examples of this, showing how individuals were inspired and, at their discretion, chose to support the vision, engage in new workplace behaviours and thereby influence colleagues and others to adopt new approaches in traffic system design.

Psychological factors, such as personal values and beliefs, can frame, characterise and aid understanding of which roles individuals can play in transition processes (Kaufman et al., 2021; Upham, Bögel, & Dütschke, 2019; Upham et al., 2025). Viewing sustainability intrapreneurship as a chosen and reflective behaviour to drive change (Kaufman et al., 2021), the agenda setter, the demonstrator and the networking educator can help explain some of the dynamics by which bottom-up agency influences the development of early-stage sustainability transitions of large technical systems. First, sustainability intrapreneurs and the path-breaking they advocate can serve as inspiring role models or landmark projects (Turnheim & Geels, 2019). As such, they can prompt activation of personal values, provide interpretations of potential ways to realise organisational sustainability strategies, or justify radical approaches to address societal challenges among colleagues in the field. Second, the more examples there are, or the more available anchoring of beliefs there is, the more individuals will be inspired to pay attention to new solutions that contribute to the overall socio-technical transition. Although sustainability

intrapreneurs can have a powerful impact on the development of policy, technology and workplace behaviour, as shown in Vision Zero, it is reasonable to assume that as the cumulative influence increases, the impact of each additional source is reduced (Latané, 1981). In other words, if the first sustainability intrapreneur has a significant impact, adding a second initiative will increase the overall impact. However, the second will have less impact than the first, and the third even less, and so on. Still, by enacting different roles, sustainability intrapreneurs initiate a process in which they influence others, who in turn influence more people, resulting in an increasing growth of new everyday workplace behaviours among colleagues and others (Kaufman et al., 2021), and, eventually, institutional work (Lawrence et al., 2009; Lawrence & Suddaby, 2006). The relationships between the roles and path-breaking innovation can thus bridge between micro and macro perspectives, a relationship that sustainability transitions literature has only recently begun to examine and still struggles with (Upham, Bögel, & Dütschke, 2019). Aided, for example, by social norms, available technologies and supportive policies, this process of influence may be the very essence of path-breaking in the early stages of socio-technical transitions.

7 Conclusions

This thesis aims to explore how and why incumbent employees, acting as sustainability intrapreneurs, initiate, develop and realise path-breaking innovation in early-stage sustainability transitions of large technical systems. The role of incumbent employees in this context is a largely underexamined phenomenon within the field of sustainability transitions. Data from several cases show that sustainability intrapreneurs are key actors in the formation of path-breaking innovation and the emergence of new workplace behaviour in large technical systems.

Three roles characterise sustainability intrapreneurs: the agenda setter articulates transformative visions and mobilises support from internal and external stakeholders; the demonstrator brings about path-breaking innovation by aligning system-specific competencies and resources; and the networking educator fosters informal learning and relational capacity among fragmented actors. Together, these roles demonstrate how sustainability intrapreneurs can navigate both intra- and extra-organisational landscapes to initiate path-breaking innovation and instigate early-stage sustainability transitions of large technical systems.

Although the individuals in the appended case studies may not identify as sustainability intrapreneurs, the thesis shows that they can still be identified and studied. It is shown that sustainability intrapreneurs are guided by trust and personal values and beliefs, particularly those related to pro-social and environmental values. Sustainability intrapreneurs demonstrate unique behavioural patterns that differ from traditional intrapreneurship perspectives, most notably in their focus on improving socio-technical systems over organisational benefits. This incumbent firm-internal bottom-up agency has previously not been represented in the intrapreneurship literature, nor in the conceptualisation of incumbents in sustainability transitions literature. Thus, sustainability intrapreneurship fills a gap in the current literature by conceptualising the role of employees who, without the professional expectation of developing innovation and business, are motivated to take actions to initiate and develop path-breaking innovation for sustainability transitions. By enacting different roles, these employees initiate a process in which they influence others, who in turn influence more people, resulting in a growth of new everyday workplace behaviours among colleagues and others. By introducing an individual-level perspective of employees' workplace behaviour, the thesis challenges a dominant assumption in sustainability transitions literature, namely that incumbents' behaviour is predominantly driven by firm-internal top-down mandates or external policy pressure.

7.1 Implications

The findings carry several important implications for both theory and practice. First, without overlooking the strong social and situational factors that influence socio-technical systems, the thesis presents compelling arguments for greater attention to individual-level agency in studying path-breaking innovation in large technical systems. In doing so, applying an adjusted

intrapreneurial perspective, where the firm's benefits are secondary to developing a socio-technical system at large, shows promise.

Second, the findings in this thesis imply a need to revisit dominant assumptions about the origins of innovation and change. Encouraging reflexivity, flexibility and moral engagement across hierarchical levels may not only empower individuals focused on innovation but also stimulate actions that improve resilience and responsiveness to complex sustainability challenges. Applying a sustainability intrapreneurship perspective is thus not only relevant for better understanding the origins of path-breaking innovation in large technical systems, but also for the formation of directionality and mission-oriented innovation policy (Edler & Boon, 2018; Mazzucato, 2018). For example, by recognising that sustainability intrapreneurs operate in an organisational grey zone, often at personal risk, and, therefore, actively create physical and cultural spaces where bottom-up initiatives can be incubated and prosper without immediate instrumental demands.

While the thesis makes significant efforts to conceptualise and empirically investigate sustainability intrapreneurship, several avenues for future research remain open. First, the transferability of the findings to other socio-technical systems warrants deeper examination. This thesis has focused on large technical systems, specifically the energy and transport sectors, which are characterised by capital-intensive large infrastructures, regulatory complexity and entrenched incumbency. It would be fruitful to explore whether sustainability intrapreneurs exist and play similar roles in more fragmented or less regulated sectors, such as in the food industry or consumer technologies.

Second, although this thesis highlights the importance of informal networks and personal motivation for sustainability intrapreneurship, more attention could be given to understanding how sustainability intrapreneurship as a practice is learned and developed, and what enabling or constraining conditions there are in, for example, organisational or cultural contexts. What inter-organisational structures, leadership styles or cultural elements facilitate, develop or hinder sustainability intrapreneurship? How do middle managers or external intermediaries interact with and support employees who are sowing sustainability intrapreneurial skills? What are the negative consequences of sustainability intrapreneurship, and for the sustainability intrapreneur? Is sustainability intrapreneurship a phenomenon strongly associated with Swedish organisational culture, allowing employees to engage in such efforts at their discretion without risking reprisals, or can similar sustainability intrapreneurial roles be identified in other parts of the world?

Third, the current work focuses on successful or at least visible path-breaking initiatives. Most likely, many sustainability intrapreneurial efforts would fail before they materialise as full path-breaking innovations, possibly due to exhaustion, lack of peer support or institutional resistance. Investigating such 'failed' initiatives presents an interesting avenue for future research to better understand the full spectrum of sustainability intrapreneurship and the intrapreneurial challenges incumbent employees face. Finally, there is room to explore the dynamics by which

sustainability intrapreneurship may scale or diffuse, for example, by examining the individual-level details of how new workplace behaviour, emerging in different parts of an organisation and among different organisational actors, connects and aggregates into new norms or institutional arrangements. Addressing these research questions would deepen the understanding of how incumbent employees' agency can translate into long-term systemic change.

References

- Alt, E., & Geradts, T. (2019). *Social intrapreneurship: Unique challenges and opportunities for future research*. 2019(1), 16643.
- Altunay, M., Bergek, A., & Palm, A. (2021). Solar business model adoption by energy incumbents: The importance of strategic fit. *Environmental Innovation and Societal Transitions*, 40, 501–520. Scopus. <https://doi.org/10.1016/j.eist.2021.10.013>
- Alvord, S. H., Brown, L. D., & Letts, C. W. (2004). Social entrepreneurship and societal transformation: An exploratory study. *The Journal of Applied Behavioral Science*, 40(3), 260–282.
- Ampe, K., Paredis, E., Asveld, L., Osseweijer, P., & Block, T. (2021). Incumbents' enabling role in niche-innovation: Power dynamics in a wastewater project. *Environmental Innovation and Societal Transitions*, 39, 73–85. Scopus. <https://doi.org/10.1016/j.eist.2021.03.004>
- Andersen, A. D., & Gulbrandsen, M. (2020). The innovation and industry dynamics of technology phase-out in sustainability transitions: Insights from diversifying petroleum technology suppliers in Norway. *Energy Research and Social Science*, 64. Scopus. <https://doi.org/10.1016/j.erss.2020.101447>
- Andersen, A. D., & Markard, J. (2020). Multi-technology interaction in socio-technical transitions: How recent dynamics in HVDC technology can inform transition theories. *Technological Forecasting and Social Change*, 151. Scopus. <https://doi.org/10.1016/j.techfore.2019.119802>
- Andersen, A. D., Markard, J., Bauknecht, D., & Korpås, M. (2023). Architectural change in accelerating transitions: Actor preferences, system architectures, and flexibility technologies in the German energy transition. *Energy Research and Social Science*, 97. Scopus. <https://doi.org/10.1016/j.erss.2023.102945>
- Avelino, F., Dumitru, A., Longhurst, N., Wittmayer, J., Hielscher, S., Weaver, P., Cipolla, C., Afonso, R., Kunze, I., & Dorland, J. (2015). Transitions towards new economies. *A Transformative Social Innovation Perspective [Working Paper N° 3]*.
- Becker, S., Bögel, P., & Upham, P. (2021). The role of social identity in institutional work for sociotechnical transitions: The case of transport infrastructure in Berlin. *Technological Forecasting and Social Change*, 162. <https://doi.org/10.1016/j.techfore.2020.120385>
- Beers, P. J., & van Mierlo, B. (2017). Reflexivity and Learning in System Innovation Processes. *Sociologia Ruralis*, 57(3), 415–436. Scopus. <https://doi.org/10.1111/soru.12179>
- Belinfanti, T. C. (2015). Contemplating the gap-filling role of social intrapreneurship. *Or. L. Rev.*, 94, 67.
- Bergek, A., Jacobsson, S., Carlsson, B., Lindmark, S., & Rickne, A. (2008). Analyzing the functional dynamics of technological innovation systems: A scheme of analysis. *Research Policy*, 37(3), 407–429. <https://doi.org/10.1016/j.respol.2007.12.003>
- Berggren, C., Magnusson, T., & Sushandoyo, D. (2015). Transition pathways revisited: Established firms as multi-level actors in the heavy vehicle industry. *Research Policy*, 44(5), 1017–1028. <https://doi.org/10.1016/j.respol.2014.11.009>
- Berkhout, F., Verbong, G., Wieczorek, A. J., Raven, R., Lebel, L., & Bai, X. (2010). Sustainability experiments in Asia: Innovations shaping alternative development pathways? *Environmental Science & Policy*, 13(4), 261–271.

- Bertelsen, N., Paardekooper, S., & Mathiesen, B. V. (2021). Implementing large-scale heating infrastructures: Experiences from successful planning of district heating and natural gas grids in Denmark, the United Kingdom, and the Netherlands. *Energy Efficiency*, 14(7), 64.
- Bjerkan, K. Y., Ryghaug, M., & Skjølsvold, T. M. (2021). Actors in energy transitions. Transformative potentials at the intersection between Norwegian port and transport systems. *Energy Research and Social Science*, 72. Scopus. <https://doi.org/10.1016/j.erss.2020.101868>
- Bjerke, B. (2007). *Understanding entrepreneurship*. Elgar.
- Blomkvist, P., Karpouzoglou, T., Nilsson, D., & Wallin, J. (2023). Entrepreneurship and alignment work in the Swedish water and sanitation sector. *Technology in Society*, 74, 102280.
- Bögel, P. M., & Upham, P. (2018). Role of psychology in sociotechnical transitions studies: Review in relation to consumption and technology acceptance. *Environmental Innovation and Societal Transitions*, 28, 122–136. <https://doi.org/10.1016/j.eist.2018.01.002>
- Bor, S., O'Shea, G., & Hakala, H. (2024). Scaling sustainable technologies by creating innovation demand-pull: Strategic actions by food producers. *Technological Forecasting and Social Change*, 198. Scopus. <https://doi.org/10.1016/j.techfore.2023.122941>
- Borghei, B. B., & Magnusson, T. (2018). Niche aggregation through cumulative learning: A study of multiple electric bus projects. *Environmental Innovation and Societal Transitions*, 28, 108–121. Scopus. <https://doi.org/10.1016/j.eist.2018.01.004>
- Borghei, B., & Magnusson, T. (2016). Niche experiments with alternative powertrain technologies: The case of electric city-buses in Europe. *International Journal of Automotive Technology and Management*, 16(3), 274–300. Scopus. <https://doi.org/10.1504/IJATM.2016.080787>
- Brenneke, M., & Spitzack, H. (2010). Social intrapreneurs: Bottom-up social innovation. *International Review of Entrepreneurship*, 8(2), 157–176.
- Bulah, B. M., Tziva, M., Bidmon, C., & Hekkert, M. P. (2023). Incumbent entry modes and entry timing in sustainable niches: The plant-based protein transition in the United States, Netherlands, and United Kingdom. *Environmental Innovation and Societal Transitions*, 48. Scopus. <https://doi.org/10.1016/j.eist.2023.100735>
- Burgelman, R. A. (1983). CORPORATE ENTREPRENEURSHIP AND STRATEGIC MANAGEMENT: INSIGHTS FROM A PROCESS STUDY. *Management Science*, 29, 1349–1364. <https://doi.org/10.1287/mnsc.29.12.1349>
- Burrell, G., & Morgan, G. (1979). *Sociological Paradigms and Organizational Analysis, Elements of the Sociology of Corporate Life* (Heinemann Educational Books Ltd., 1979). Chambers, R. J., *Accounting, Evaluation and Economic Behavior* (Scholars Book Company, 1966). Chandler, A. D., and.
- Burt, R. S. (1995). *Structural holes: The social structure of competition*. Harvard university press.
- Camelo-Ordaz, C., Fernández-Alles, M., Ruiz-Navarro, J., & Sousa-Ginel, E. (2012). The intrapreneur and innovation in creative firms. *International Small Business Journal*, 30(5), 513–535.
- Cardon, M. S., Wincent, J., Singh, J., & Drnovsek, M. (2009). The nature and experience of entrepreneurial passion. *Academy of Management Review*, 34(3), 511–532. <https://doi.org/10.5465/AMR.2009.40633190>

- Carroll, A. B., & Brown, J. A. (2018). Corporate social responsibility: A review of current concepts, research, and issues. In *Corporate social responsibility*. Emerald Publishing Limited.
- Castán Broto, V., & Bulkeley, H. (2013). A survey of urban climate change experiments in 100 cities. *Global Environmental Change*, 23(1), 92–102. <https://doi.org/10.1016/j.gloenvcha.2012.07.005>
- Chizaryfard, A., & Karakaya, E. (2022). The value chain dilemma of navigating sustainability transitions: A case study of an upstream incumbent company. *Environmental Innovation and Societal Transitions*, 45, 114–131. Scopus. <https://doi.org/10.1016/j.eist.2022.10.002>
- Christley, E., Karakaya, E., & Urban, F. (2024). Analysing transitions in-the-making: A case study of aviation in Sweden. *Environmental Innovation and Societal Transitions*, 50. Scopus. <https://doi.org/10.1016/j.eist.2023.100790>
- Corbett, A., Covin, J. G., O'Connor, G. C., & Tucci, C. L. (2013). Corporate Entrepreneurship: State-of-the-Art Research and a Future Research Agenda. *Journal of Product Innovation Management*, 30(5), 812–820. <https://doi.org/10.1111/jpim.12031>
- Cunliffe, A. L. (2011). Crafting qualitative research: Morgan and smircich 30 years on. *Organizational Research Methods*, 14(4), 647–673. <https://doi.org/10.1177/1094428110373658>
- Damman, S., & Steen, M. (2021). A socio-technical perspective on the scope for ports to enable energy transition. *Transportation Research Part D: Transport and Environment*, 91. Scopus. <https://doi.org/10.1016/j.trd.2020.102691>
- Darcis, A., Hahn, R., & Alt, E. (2023). Putting entrepreneurship in corporate change agency: A typology of social intrapreneurs. *Business Ethics, the Environment & Responsibility*.
- De Fina, A., & Georgakopoulou, A. (2019). *The handbook of narrative analysis*. John Wiley & Sons.
- De Groot, J. I. M., & Steg, L. (2008). Value orientations to explain beliefs related to environmental significant behavior: How to measure egoistic, altruistic, and biospheric value orientations. *Environment and Behavior*, 40(3), 330–354.
- de Haan, E., Meier, S., Haartsen, T., & Strijker, D. (2018). Defining ‘Success’ of local citizens’ initiatives in maintaining public services in rural areas: A professional’s perspective. *Sociologia Ruralis*, 58(2), 312–330.
- De Herde, V., Baret, P. V., & Maréchal, K. (2020). Coexistence of Cooperative Models as Structural Answer to Lock-Ins in Diversification Pathways: The Case of the Walloon Dairy Sector. *Frontiers in Sustainable Food Systems*, 4. Scopus. <https://doi.org/10.3389/fsufs.2020.584542>
- de Vries, G., Biely, K., & Chappin, E. (2021). Psychology: The missing link in transitions research. *Environmental Innovation and Societal Transitions*, 41, 42–44.
- Di Silvestre, M. L., Favuzza, S., Sanseverino, E. R., & Zizzo, G. (2018). How Decarbonization, Digitalization and Decentralization are changing key power infrastructures. *Renewable and Sustainable Energy Reviews*, 93, 483–498.
- Dorado, S. (2013). Small groups as context for institutional entrepreneurship: An exploration of the emergence of commercial microfinance in Bolivia. *Organization Studies*, 34(4), 533–557.
- Dorado, S., & Ventresca, M. J. (2013). Crescive entrepreneurship in complex social problems: Institutional conditions for entrepreneurial engagement. *Journal of Business Venturing*, 28, 69–82. <https://doi.org/10.1016/j.jbusvent.2012.02.002>

- Dütschke, E., Upham, P. J., & Scherrer, A. (2024). *Behaviour and the individual in sustainability transitions*.
- Dutt, D. (2022). Weak states, fast transitions? Exploring the role of actors, governance capacity, and tensions in Indian energy politics. *Energy Research and Social Science*, 94. Scopus. <https://doi.org/10.1016/j.erss.2022.102876>
- Duygan, M., Kachi, A., Oliveira, T. D., & Rinscheid, A. (2021). Introducing the Endowment-Practice-Institutions (EPI) framework for studying agency in the institutional contestation of socio-technical regimes. *Journal of Cleaner Production*, 296. Scopus. <https://doi.org/10.1016/j.jclepro.2021.126396>
- Edler, J., & Boon, W. P. (2018). 'The next generation of innovation policy: Directionality and the role of demand-oriented instruments'—Introduction to the special section. *Science and Public Policy*, 45(4), 433–434.
- Eisenhardt, K. M. (1989). EISENHARDT, K. M. Building theories from case study research. *Academy of Management Review*, 14(4), 532–550. <https://doi.org/10.5465/AMR.1989.4308385>
- Elkington, J. (2009). The social intrapreneur: A field guide for corporate change-makers. *SustainAbility.Com (Available at https://www.allianz.com/content/dam/onemarketing/azcom/allianz_com/migration/media/current/en/press/news/studies/downloads/the-social-intrapreneur_2008.pdf)*.
- Engwall, M., Kaulio, M., Karakaya, E., Miterev, M., & Berlin, D. (2021). Experimental networks for business model innovation: A way for incumbents to navigate sustainability transitions? *Technovation*, 108. Scopus. <https://doi.org/10.1016/j.technovation.2021.102330>
- Ertelt, S.-M., & Kask, J. (2024). Home field advantage: Examining incumbency reorientation dynamics in low-carbon transitions. *Environmental Innovation and Societal Transitions*, 50. Scopus. <https://doi.org/10.1016/j.eist.2023.100802>
- Farla, J., Markard, J., Raven, R., & Coenen, L. (2012). Sustainability transitions in the making: A closer look at actors, strategies and resources. *Technological Forecasting and Social Change*, 79(6), 991–998. <https://doi.org/10.1016/j.techfore.2012.02.001>
- Fernqvist, N., & Hansla, A. (2021). It's all about the functionality: Psychological determinants of acceptance of energy efficient water taps in freshwater abundant urban areas. *Energy and Climate Change*, 2, 100053.
- Flick, U. (2014). *An Introduction to Qualitative Research*.
- Flyvbjerg, B. (2001). *Making Social Science Matter: Why social inquiry fails and how it can succeed again*. Cambridge University Press. <https://doi.org/10.1017/cbo9780511810503.011>
- Flyvbjerg, B. (2006). Five misunderstandings about case-study research. *Qualitative Inquiry*, 12(2), 219–245. <https://doi.org/10.1177/1077800405284363>
- Flyvbjerg, B. (2011). Case study. *The Sage Handbook of Qualitative Research*, 4, 301–316.
- Galeano Galvan, M., Cuppen, E., & Taanman, M. (2020). Exploring incumbents' agency: Institutional work by grid operators in decentralized energy innovations. *Environmental Innovation and Societal Transitions*, 37, 79–92. Scopus. <https://doi.org/10.1016/j.eist.2020.07.008>
- Garud, R., & Karnøe, P. (2001). *Path dependence and creation* (Vol. 2012). Lawrence Erlbaum Associates, Inc.

- Garud, R., & Karnøe, P. (2003). Bricolage vs. Breakthrough: Distributed and embedded agency in technology entrepreneurship. *Research Policy*, 32(2), 277–300.
[https://doi.org/10.1016/S0048-7333\(02\)00100-2](https://doi.org/10.1016/S0048-7333(02)00100-2)
- Garud, R., Schildt, H. A., & Lant, T. K. (2014). Entrepreneurial Storytelling, Future Expectations, and the Paradox of Legitimacy. *Organization Science*.
<https://doi.org/10.1287/orsc.2014.0915>
- Geels, F. W. (2002). Technological transitions as evolutionary reconfiguration processes: A multi-level perspective and a case-study. *Research Policy*, 31(8–9), 1257–1274.
[https://doi.org/10.1016/S0048-7333\(02\)00062-8](https://doi.org/10.1016/S0048-7333(02)00062-8)
- 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*.
<https://doi.org/10.1016/j.respol.2004.01.015>
- Geels, F. W. (2005). Processes and patterns in transitions and system innovations: Refining the co-evolutionary multi-level perspective. *Technological Forecasting and Social Change*, 72(6 SPEC. ISS.), 681–696. <https://doi.org/10.1016/j.techfore.2004.08.014>
- Geels, F. W., Kern, F., Fuchs, G., Hinderer, N., Kungl, G., Mylan, J., Neukirch, M., & Wassermann, S. (2016). The enactment of socio-technical transition pathways: A reformulated typology and a comparative multi-level analysis of the German and UK low-carbon electricity transitions (1990–2014). *Research Policy*, 45(4), 896–913.
<https://doi.org/10.1016/j.respol.2016.01.015>
- Geels, F. W., & Raven, R. (2006). Non-linearity and expectations in niche-development trajectories: Ups and downs in Dutch biogas development (1973–2003). *Technology Analysis & Strategic Management*, 18(3–4), 375–392.
- Giorgi, A. (1997). The theory, practice, and evaluation of the phenomenological method as a qualitative research procedure. *Journal of Phenomenological Psychology*, 28(2), 235–260. <https://doi.org/10.1163/156916297X00103>
- Goggins, G., & Rau, H. (2021). Alteration spaces: Charting the sustainability potential of large organizations. *Environmental Innovation and Societal Transitions*, 40, 435–449. Scopus.
<https://doi.org/10.1016/j.eist.2021.09.006>
- Grayson, D., McLaren, M., & Spitzeck, H. (2011). Social intrapreneurs—An extra force for sustainability. *A Doughty Centre for Corporate Responsibility Occasional Paper*, 1–48.
- Halttunen, K., Slade, R., & Staffell, I. (2022). “We don’t want to be the bad guys”: Oil industry’s sensemaking of the sustainability transition paradox. *Energy Research and Social Science*, 92. Scopus. <https://doi.org/10.1016/j.erss.2022.102800>
- Hansen, G. H., & Steen, M. (2015). Offshore oil and gas firms’ involvement in offshore wind: Technological frames and undercurrents. *Environmental Innovation and Societal Transitions*, 17, 1–14.
- Hargreaves, T., Hielscher, S., Seyfang, G., & Smith, A. (2013). Grassroots innovations in community energy: The role of intermediaries in niche development. *Global Environmental Change*, 23(5), 868–880.
- Havinga, H. C., van der Loos, H. Z. A., & Steen, M. (2024). Collaboration or competition? Interactions between floating and fixed-bottom offshore wind in Norway. *Environmental Innovation and Societal Transitions*, 52. Scopus.
<https://doi.org/10.1016/j.eist.2024.100872>
- Hekkert, M. P., Suurs, R. A. A., Negro, S. O., Kuhlmann, S., & Smits, R. E. H. M. H. M. (2007). Functions of innovation systems: A new approach for analysing technological

- change. *Technological Forecasting and Social Change*, 74(4), 413–432.
<https://doi.org/10.1016/j.techfore.2006.03.002>
- Hellsmark, H. (2010). *Unfolding of the formative phase of gasified biomass in the European Union: The role of system builders in realising the potential of second-generation transportation fuels from biomass*. Chalmers University of Technology.
- Hellsmark, H., Frishammar, J., Söderholm, P., & Ylinenpää, H. (2016). The role of pilot and demonstration plants in technology development and innovation policy. *Research Policy*, 45(9), 1743–1761. <https://doi.org/10.1016/j.respol.2016.05.005>
- Hellsmark, H., & Jacobsson, S. (2009). Opportunities for and limits to academics as system builders—The case of realizing the potential of gasified biomass in Austria. *Energy Policy*, 37(12), 5597–5611.
- Hemingway, C. A. (2005). Personal values as a catalyst for corporate social entrepreneurship. *Journal of Business Ethics*, 60(3), 233–249.
- Hemingway, C. A. (2013). *Corporate social entrepreneurship: Integrity within*. Cambridge University Press.
- Hernández-Perlines, F., Ariza-Montes, A., & Blanco-González-Tejero, C. (2022). Intrapreneurship research: A comprehensive literature review. *Journal of Business Research*, 153, 428–444.
- Hildén, M., Jordan, A., & Huitema, D. (2017). Special issue on experimentation for climate change solutions editorial: The search for climate change and sustainability solutions—The promise and the pitfalls of experimentation. *Journal of Cleaner Production*, 169, 1–7. <https://doi.org/10.1016/j.jclepro.2017.09.019>
- Hoes, A.-C., Beers, P. J., & van Mierlo, B. (2016). Communicating tensions among incumbents about system innovation in the Dutch dairy sector. *Environmental Innovation and Societal Transitions*, 21, 113–122. Scopus. <https://doi.org/10.1016/j.eist.2016.04.005>
- Hojckova, K., Ahlborg, H., Morrison, G. M., & Sandén, B. (2020). Entrepreneurial use of context for technological system creation and expansion: The case of blockchain-based peer-to-peer electricity trading. *Research Policy*, 49(8), 104046. <https://doi.org/10.1016/j.respol.2020.104046>
- Hörisch, J. (2015). The Role of Sustainable Entrepreneurship in Sustainability Transitions: A Conceptual Synthesis against the Background of the Multi-Level Perspective. *Administrative Sciences*, 5(4), 286–300. <https://doi.org/10.3390/admsci5040286>
- Hughes, T. (1987). *The Evolution of Large Technological Systems In: Bijker, W., Hughes, T. y Pinch, T.(Ed.) The Social Construction of Technological Systems. New Directions in the Sociology and History of Technology*.
- Jacobsson, S., & Bergek, A. (2004). Transforming the energy sector: The evolution of technological systems in renewable energy technology. *Industrial and Corporate Change*, 13(5), 815–849.
- Jacobsson, S., & Johnson, A. (2000). The diffusion of renewable energy technology: An analytical framework and key issues for research. *Energy Policy*, 28(9), 625–640. [https://doi.org/10.1016/S0301-4215\(00\)00041-0](https://doi.org/10.1016/S0301-4215(00)00041-0)
- Karltorp, K., Lu, S. S., & Perez Vico, E. (2024). Three incumbents restructuring the Swedish energy and steel regimes: The case of Hybrit. *Industry and Innovation*, 31(8), 1058–1092. Scopus. <https://doi.org/10.1080/13662716.2024.2376317>

- Karltorp, K., & Sandén, B. A. (2012). Explaining regime destabilisation in the pulp and paper industry. *Environmental Innovation and Societal Transitions*.
<https://doi.org/10.1016/j.eist.2011.12.001>
- Kaufman, S., Saeri, A., Raven, R., Malekpour, S., & Smith, L. (2021). Behaviour in sustainability transitions: A mixed methods literature review. *Environmental Innovation and Societal Transitions*, 40, 586–608.
- Kemp, R. R., Schot, J., & Hoogma, R. (1998). Regime shifts to sustainability through processes of niche formation: The approach of strategic niche management. *Technology Analysis & Strategic Management*, 10(2), 175–198. <https://doi.org/10.1080/09537329808524310>
- Kenner, D., & Heede, R. (2021). White knights, or horsemen of the apocalypse? Prospects for Big Oil to align emissions with a 1.5 °C pathway. *Energy Research and Social Science*, 79. Scopus. <https://doi.org/10.1016/j.erss.2021.102049>
- Khodke, A., Watabe, A., & Mehdi, N. (2021). Implementation of accelerated policy-driven sustainability transitions: Case of bharat stage 4 to 6 leapfrogs in india. *Sustainability (Switzerland)*, 13(8). Scopus. <https://doi.org/10.3390/su13084339>
- Kivimaa, P. (2014). Government-affiliated intermediary organisations as actors in system-level transitions. *Research Policy*, 43(8), 1370–1380.
- Kivimaa, P., Boon, W., Hyysalo, S., & Klerkx, L. (2019). Towards a typology of intermediaries in sustainability transitions: A systematic review and a research agenda. *Research Policy*, 48, 1062–1075. <https://doi.org/10.1016/j.respol.2018.10.006>
- Klein Woolthuis, R. J. A. (2010). Sustainable entrepreneurship in the Dutch construction industry. *Sustainability*, 2(2), 505–523.
- Köhler, J., Geels, F. W., Kern, F., Markard, J., Wieczorek, A., Alkemade, F., Avelino, F., Bergek, A., Boons, F., Fünfschilling, L., Hess, D., Holtz, G., Hyysalo, S., Jenkins, K., Kivimaa, P., Martiskainen, M., McMeekin, A., Mühlemeier, M. S., Nykvist, B., ... Wells, P. (2019). An agenda for sustainability transitions research: State of the art and future directions. *Environmental Innovation and Societal Transitions*.
<https://doi.org/10.1016/j.eist.2019.01.004>
- Kriechbaum, M., Terler, N., Stürmer, B., & Stern, T. (2023). (Re)framing technology: The evolution from biogas to biomethane in Austria. *Environmental Innovation and Societal Transitions*, 47. Scopus. <https://doi.org/10.1016/j.eist.2023.100724>
- Krueger, N. F., & Carsrud, A. L. (1993). Entrepreneurial intentions: Applying the theory of planned behaviour. *Entrepreneurship & Regional Development*, 5(4), 315–330.
- Kump, B. (2023). Lewin's field theory as a lens for understanding incumbent actors' agency in sustainability transitions. *Environmental Innovation and Societal Transitions*, 46. Scopus. <https://doi.org/10.1016/j.eist.2022.11.008>
- Kungl, G. (2015). Stewards or sticklers for change? Incumbent energy providers and the politics of the German energy transition. *Energy Research & Social Science*, 8, 13–23.
- Kvale, Steinar., Brinkmann, Svend., & Torhell, S.-E. (2009). *Den kvalitative forskningsintervjun*. Studentlitteratur.
- Lackeus, M., Lundqvist, M., Middleton, K. W., & Inden, J. (2020). *The entrepreneurial employee in public and private sector: What, Why, How*. Joint Research Centre (Seville site).
- Lang, C., & Baltes, G. H. (2019). Entrepreneurial employees: A review and future research agenda. *2019 IEEE International Conference on Engineering, Technology and Innovation (ICE/ITMC)*, 1–11.
- Latané, B. (1981). The psychology of social impact. *American Psychologist*, 36(4), 343.

- Lawrence, T. B., & Suddaby, R. (2006). 1.6 institutions and institutional work. *The Sage Handbook of Organization Studies*, 215–254.
- Lawrence, T. B., Suddaby, R., & Leca, B. (2009). *Institutional work: Actors and agency in institutional studies of organizations*. Cambridge university press.
- Leca, B., Battilana, J., & Boxenbaum, E. (2008). *Agency and institutions: A review of institutional entrepreneurship*. Citeseer.
- Leitch, A., Haley, B., & Hastings-Simon, S. (2019). Can the oil and gas sector enable geothermal technologies? Socio-technical opportunities and complementarity failures in Alberta, Canada. *Energy Policy*, 125, 384–395. Scopus. <https://doi.org/10.1016/j.enpol.2018.10.046>
- Lenfle, S., & Söderlund, J. (2022). Project-oriented agency and regeneration in socio-technical transition: Insights from the case of numerical weather prediction (1978–2015). *Research Policy*, 51(3). Scopus. <https://doi.org/10.1016/j.respol.2021.104455>
- Lindberg, M. B., & Kammermann, L. (2021). Advocacy coalitions in the acceleration phase of the European energy transition. *Environmental Innovation and Societal Transitions*, 40, 262–282. Scopus. <https://doi.org/10.1016/j.eist.2021.07.006>
- Lindberg, M. B., Markard, J., & Andersen, A. D. (2019). Policies, actors and sustainability transition pathways: A study of the EU's energy policy mix. *Research Policy*, 48(10). Scopus. <https://doi.org/10.1016/j.respol.2018.09.003>
- Loder, J., Rinscheid, A., & Wüstenhagen, R. (2024). Why do (some) German car manufacturers go electric? The role of dynamic capabilities and cognitive frames. *Business Strategy and the Environment*, 33(2), 1129–1143. Scopus. <https://doi.org/10.1002/bse.3538>
- Löhr, M., Markard, J., & Ohlendorf, N. (2024). (Un)usual advocacy coalitions in a multi-system setting: The case of hydrogen in Germany. *Policy Sciences*, 57(3), 567–597. Scopus. <https://doi.org/10.1007/s11077-024-09536-7>
- Loorbach, D. (2010). Transition Management for Sustainable Development: A Prescriptive, Complexity-Based Governance Framework. *Governance*, 23(1), 161–183. <https://doi.org/10.1111/j.1468-0491.2009.01471.x>
- Lund, H., Möller, B., Mathiesen, B. V., & Dyrelund, A. (2010). The role of district heating in future renewable energy systems. *Energy*, 35(3), 1381–1390.
- Madsen, S., Miörner, J., & Hansen, T. (2022). Axes of contestation in sustainability transitions. *Environmental Innovation and Societal Transitions*, 45, 246–269. Scopus. <https://doi.org/10.1016/j.eist.2022.11.001>
- Mair, J., & Martí, I. (2006). Social entrepreneurship research: A source of explanation, prediction, and delight. *Journal of World Business*. <https://doi.org/10.1016/j.jwb.2005.09.002>
- Mäkitie, T., Andersen, A. D., Hanson, J., Normann, H. E., & Thune, T. M. (2018). Established sectors expediting clean technology industries? The Norwegian oil and gas sector's influence on offshore wind power. *Journal of Cleaner Production*, 177, 813–823. Scopus. <https://doi.org/10.1016/j.jclepro.2017.12.209>
- Markard, J. (2011). Transformation of infrastructures: Sector characteristics and implications for fundamental change. *Journal of Infrastructure Systems*, 17(3), 107–117.
- Markard, J., Raven, R., & Truffer, B. (2012). Sustainability transitions: An emerging field of research and its prospects. *Research Policy*, 41(6), 955–967. <https://doi.org/10.1016/j.respol.2012.02.013>

- Markard, J., & Truffer, B. (2006). Innovation processes in large technical systems: Market liberalization as a driver for radical change? *Research Policy*, 35(5), 609–625.
- Martiarena, A. (2013). What's so entrepreneurial about intrapreneurs? *Small Business Economics*, 40, 27–39.
- Martin, C. J., & Upham, P. (2016). Grassroots social innovation and the mobilisation of values in collaborative consumption: A conceptual model. *Journal of Cleaner Production*, 134, 204–213.
- Martiskainen, M. (2017). The role of community leadership in the development of grassroots innovations. *Environmental Innovation and Societal Transitions*, 22, 78–89. <https://doi.org/10.1016/j.eist.2016.05.002>
- Maxwell, J. A. (2012). *Qualitative research design: An interactive approach* (Vol. 41). Sage publications.
- Mazzucato, M. (2018). Mission-oriented innovation policies: Challenges and opportunities. *Industrial and Corporate Change*, 27(5), 803–815. <https://doi.org/10.1093/icc/dty034>
- McGaw, N., & Malinsky, E. (2020). Unlocking the potential of corporate social intrapreneurship: A call to scholars. *Available at SSRN 3577762*.
- McMeekin, A., Geels, F. W., & Hodson, M. (2019). Mapping the winds of whole system reconfiguration: Analysing low-carbon transformations across production, distribution and consumption in the UK electricity system (1990–2016). *Research Policy*, 48(5), 1216–1231. Scopus. <https://doi.org/10.1016/j.respol.2018.12.007>
- Meadowcroft, J. (2009). What about the politics? Sustainable development, transition management, and long term energy transitions. *Policy Sciences*, 42, 323–340.
- Moncreiff, H., Bolton, R., & Winskel, M. (2024). Unpacking the strategy of an energy incumbent: A case study of a Dutch oil and gas company in transition. *Energy Research and Social Science*, 111. Scopus. <https://doi.org/10.1016/j.erss.2024.103490>
- Morgunova, M. (2021). The role of the socio-technical regime in the sustainable energy transition: A case of the Eurasian Arctic. *Extractive Industries and Society*, 8(3). Scopus. <https://doi.org/10.1016/j.exis.2021.100939>
- Morgunova, M., & Shaton, K. (2022). The role of incumbents in energy transitions: Investigating the perceptions and strategies of the oil and gas industry. *Energy Research and Social Science*, 89. Scopus. <https://doi.org/10.1016/j.erss.2022.102573>
- Mori, A. (2021). How do incumbent companies' heterogeneous responses affect sustainability transitions? Insights from China's major incumbent power generators. *Environmental Innovation and Societal Transitions*, 39, 55–72. Scopus. <https://doi.org/10.1016/j.eist.2021.02.003>
- Musiolik, J., Markard, J., & Hekkert, M. (2012). Networks and network resources in technological innovation systems: Towards a conceptual framework for system building. *Technological Forecasting and Social Change*, 79(6), 1032–1048.
- Musiolik, J., Markard, J., Hekkert, M., & Furrer, B. (2020). Creating innovation systems: How resource constellations affect the strategies of system builders. *Technological Forecasting and Social Change*, 153, 119209.
- Neessen, P. C., Caniëls, M. C., Vos, B., & De Jong, J. P. (2019). The intrapreneurial employee: Toward an integrated model of intrapreneurship and research agenda. *International Entrepreneurship and Management Journal*, 15, 545–571.
- Nelson, R. R., & Winter, S. G. (1982). An evolutionary theory of economic change. In *The President and Fellows of Harvard College of Harvard College*.

- Normann, H. E. (2019). Conditions for the deliberate destabilisation of established industries: Lessons from U.S. tobacco control policy and the closure of Dutch coal mines. *Environmental Innovation and Societal Transitions*, 33, 102–114. Scopus. <https://doi.org/10.1016/j.eist.2019.03.007>
- Novalia, W., Rogers, B. C., & Bos, J. J. (2021). Incumbency and political compromises: Opportunity or threat to sustainability transitions? *Environmental Innovation and Societal Transitions*, 40, 680–698. Scopus. <https://doi.org/10.1016/j.eist.2021.05.002>
- Nykamp, H. (2017). A transition to green buildings in Norway. *Environmental Innovation and Societal Transitions*, 24, 83–93. Scopus. <https://doi.org/10.1016/j.eist.2016.10.006>
- Onufrey, K., & Bergek, A. (2021). Transformation in a mature industry: The role of business and innovation strategies. *Technovation*, 105. Scopus. <https://doi.org/10.1016/j.technovation.2020.102190>
- Packard, M. D. (2017). Where did interpretivism go in the theory of entrepreneurship? *Journal of Business Venturing*, 32, 536–549. <https://doi.org/10.1016/j.jbusvent.2017.05.004>
- Papadonikolaki, D. E., Morgan, D. B., & Papachristos, D. G. (2023). Megaprojects as niches of sociotechnical transitions: The case of digitalization in UK construction. *Environmental Innovation and Societal Transitions*, 48. Scopus. <https://doi.org/10.1016/j.eist.2023.100728>
- Patzelt, H., & Shepherd, D. A. (2011). Recognizing Opportunities for Sustainable Development. *Entrepreneurship Theory and Practice*, 35(4), 631–652. <https://doi.org/10.1111/j.1540-6520.2010.00386.x>
- Perlaviciute, G., Steg, L., & Sovacool, B. K. (2021). A perspective on the human dimensions of a transition to net-zero energy systems. *Energy and Climate Change*, 100042.
- Pinchot III, G. (1985). Intrapreneuring: Why you don't have to leave the corporation to become an entrepreneur. *University of Illinois at Urbana-Champaign's Academy for Entrepreneurial Leadership Historical Research Reference in Entrepreneurship*.
- Ramanauskaitė, J. (2021). The role of incumbent actors in sustainability transitions: A case of Lithuania. *Sustainability (Switzerland)*, 13(22). Scopus. <https://doi.org/10.3390/su132212877>
- Ramos-Mejía, M., & Balanzo, A. (2018). What it takes to lead sustainability transitions from the bottom-up: Strategic interactions of grassroots ecopreneurs. *Sustainability (Switzerland)*, 10(7). <https://doi.org/10.3390/su10072294>
- Rex, E., Fernqvist, N., & Ryding, S.-O. (2019). Recommendation and context: The missing links for increased life cycle impact in large industries. *International Journal of Life Cycle Assessment*. <https://doi.org/10.1007/s11367-019-01675-x>
- Richter, I., & Smith Stegen, K. (2022). A choreography of delay: The response of German auto incumbents to environmental policy. *Environmental Innovation and Societal Transitions*, 45, 1–13. Scopus. <https://doi.org/10.1016/j.eist.2022.08.002>
- Rosencrantz, H., Edvardsson, K., & Hansson, S. O. (2007). Vision Zero—Is it irrational? *Transportation Research Part A: Policy and Practice*, 41(6), 559–567. <https://doi.org/10.1016/j.tra.2006.11.002>
- Rotmans, J., Kemp, R., & Van Asselt, M. (2001). More evolution than revolution: Transition management in public policy. *Foresight*, 3(1), 15–31. <https://doi.org/10.1108/14636680110803003>
- Rotmans, J., & Loorbach, D. (2009). Complexity and transition management. *Journal of Industrial Ecology*, 13(2), 184–196. <https://doi.org/10.1111/j.1530-9290.2009.00116.x>

- Ruggiero, S., Kangas, H.-L., Annala, S., & Lazarevic, D. (2021). Business model innovation in demand response firms: Beyond the niche-regime dichotomy. *Environmental Innovation and Societal Transitions*, 39, 1–17. Scopus. <https://doi.org/10.1016/j.eist.2021.02.002>
- Sackey, E., & Akotia, J. (2017). Spanning the multilevel boundaries of construction organisations: Towards the delivery of BIM-compliant projects. *Construction Innovation*, 17(3), 273–293.
- Sarasvathy, S. D. (2001). Causation and effectuation: Toward a theoretical shift from economic inevitability to entrepreneurial contingency. *Academy of Management Review*. <https://doi.org/10.5465/AMR.2001.4378020>
- Schönwälder, J., & Weber, A. (2023). Maturity levels of sustainable corporate entrepreneurship: The role of collaboration between a firm's corporate venture and corporate sustainability departments. *Business Strategy and the Environment*, 32(2), 976–990. Scopus. <https://doi.org/10.1002/bse.3085>
- Schumpeter, J. A. (2010). The theory of economic development: An inquiry into profits, capital, credit, interest, and the business cycle (1912/1934). In *Transaction Publishers.—1982.—January* (Vol. 1).
- Schwartz, S. H. (2006). *Basic human values: An overview*.
- Schwartz, S. H. (2012). An Overview of the Schwartz Theory of Basic Values. *Online Readings in Psychology and Culture*, 2(1), Article 11 (1-20). <https://doi.org/10.9707/2307-0919.1116>
- Sengers, F., Wieczorek, A. J., & Raven, R. (2019). Experimenting for sustainability transitions: A systematic literature review. *Technological Forecasting and Social Change*, 153–164. <https://doi.org/10.1016/j.techfore.2016.08.031>
- Seyfang, G., & Haxeltine, A. (2012). Growing grassroots innovations: Exploring the role of community-based initiatives in governing sustainable energy transitions. *Environment and Planning C: Government and Policy*, 30(3), 381–400. <https://doi.org/10.1068/c10222>
- Seyfang, G., & Smith, A. (2007). Grassroots innovations for sustainable development: Towards a new research and policy agenda. *Environmental Politics*. <https://doi.org/10.1080/09644010701419121>
- Shane, S., & Venkataraman, S. (2000). The Promise of Entrepreneurship as a Field of Research. *Academy of Management Review*, 25(1), 217–226. <https://doi.org/10.2307/259271>
- Sharma, P., & Chrisman, S. J. J. (2007). Toward a reconciliation of the definitional issues in the field of corporate entrepreneurship. In *Entrepreneurship* (pp. 83–103). Springer.
- Skeete, J.-P. (2018). Level 5 autonomy: The new face of disruption in road transport. *Technological Forecasting and Social Change*, 134, 22–34. Scopus. <https://doi.org/10.1016/j.techfore.2018.05.003>
- Skeete, J.-P. (2019). Concentration of power: A UK case study examining the dominance of incumbent automakers and suppliers in automotive sociotechnical transitions. *Global Transitions*, 1, 93–103. Scopus. <https://doi.org/10.1016/j.glt.2019.06.001>
- Skoglund, A., & Böhm, S. (2020). Prefigurative partaking: Employees' environmental activism in an energy utility. *Organization Studies*, 41(9), 1257–1283.
- Smink, M. M., Hekkert, M. P., & Negro, S. O. (2015). Keeping sustainable innovation on a leash? Exploring incumbents' institutional strategies. *Business Strategy and the Environment*, 24(2), 86–101. <https://doi.org/10.1002/bse.1808>

- Smith, A., & Raven, R. (2012). What is protective space? Reconsidering niches in transitions to sustainability. *Research Policy*, 41, 1025–1036.
<https://doi.org/10.1016/j.respol.2011.12.012>
- Stalmokaitė, I., & Hassler, B. (2020). Dynamic capabilities and strategic reorientation towards decarbonisation in Baltic Sea shipping. *Environmental Innovation and Societal Transitions*, 37, 187–202. Scopus. <https://doi.org/10.1016/j.eist.2020.09.002>
- Stalmokaitė, I., Larsson Segerlind, T., & Yliskylä-Peuralahti, J. (2023). Revival of wind-powered shipping: Comparing the early-stage innovation process of an incumbent and a newcomer firm. *Business Strategy and the Environment*, 32(2), 958–975. Scopus.
<https://doi.org/10.1002/bse.3084>
- Stalmokaite, I., & Yliskylä-Peuralahti, J. (2019). Sustainability transitions in Baltic Sea shipping: Exploring the responses of firms to regulatory changes. *Sustainability (Switzerland)*, 11(7). Scopus. <https://doi.org/10.3390/su11071916>
- Steen, M., & Weaver, T. (2017). Incumbents' diversification and cross-sectorial energy industry dynamics. *Research Policy*, 46(6), 1071–1086.
<https://doi.org/10.1016/j.respol.2017.04.001>
- Steg, L., Van Den Berg, A. E., & De Groot, J. I. M. (2013). *Environmental psychology: An introduction*. (L. Steg, Ed.). BPS Blackwell.
- Stern, P. C., Dietz, T., Abel, T. D., Guagnano, G. A., & Kalof, L. (1999). A Value-Belief-Norm Theory of Support for Social Movements: The Case of Environmentalism. *Research in Human Ecology*, 6(2), 81–97. <https://doi.org/10.2307/2083693>
- Thomson, L., Andersson, J., & Fernqvist, N. (2025). Business model innovation in food system transitions: An exploratory case study of fermentation firms. *Environmental Innovation and Societal Transitions*, 57, 101027.
- Tolonen, E. (2024). Keeping up with the decarbonization: Conceptualizing and investigating incumbents' responses to transition pressures in the post-Paris world. *Journal of Cleaner Production*, 476. Scopus. <https://doi.org/10.1016/j.jclepro.2024.143520>
- Tracey, P., & Stott, N. (2017). Social innovation: A window on alternative ways of organizing and innovating. *Innovation*, 19(1), 51–60.
- Trencher, G., Truong, N., Temocin, P., & Duygan, M. (2021). Top-down sustainability transitions in action: How do incumbent actors drive electric mobility diffusion in China, Japan, and California? *Energy Research and Social Science*, 79. Scopus.
<https://doi.org/10.1016/j.erss.2021.102184>
- Turnheim, B., & Geels, F. W. (2019). Incumbent actors, guided search paths, and landmark projects in infra-system transitions: Re-thinking Strategic Niche Management with a case study of French tramway diffusion (1971–2016). *Research Policy*, 48(6), 1412–1428.
- Turnheim, B., & Sovacool, B. K. (2020). Forever stuck in old ways? Pluralising incumbencies in sustainability transitions. *Environmental Innovation and Societal Transitions*, 35, 180–184. <https://doi.org/10.1016/j.eist.2019.10.012>
- Upham, P., Bögel, P., & Dütschke, E. (2019). Thinking about individual actor-level perspectives in sociotechnical transitions: A comment on the transitions research agenda. *Environmental Innovation and Societal Transitions*, 31, 1–32.
<https://doi.org/10.1016/j.eist.2019.10.005>
- Upham, P., Bögel, P., & Johansen, K. (2019). *Energy Transitions and Social Psychology: A Sociotechnical Perspective*. Routledge.

- Upham, P., Bögel, P., Klapper, R. G., & Kašperová, E. (2021). Theorising individual agency within sociotechnical sustainability transitions frames: A social psychological review. In *Research Handbook of Sustainability Agency* (pp. 29–45). Edward Elgar Publishing.
- Upham, P., Kaufman, S., Bögel, P. M., & Raven, R. (2025). Behaviours and practices in socio-technical systems and sustainability transitions: Editorial to the virtual special issue. *Journal of Cleaner Production*, 511, 145674.
- Van de Ven, A. H., Polley, D. E., Garud, R., & Venkataraman, S. (2008). *The innovation journey*.
- Van Looy, B., Debackere, K., & Bouwen, R. (2001). Innovation as a process spanning community boundaries: Setting the stage. In *Path Dependence and Creation* (Vol. 2012, p. 329). Psychology Press.
- Verplanken, B., & Holland, R. W. (2002). Motivated decision making: Effects of activation and self-centrality of values on choices and behavior. *Journal of Personality and Social Psychology*, 82(3), 434–447. <https://doi.org/10.1037//0022-3514.82.3.434>
- Vormedal, I., Bjander, J., Larsen, M. L., & Lindberg, M. B. (2023). Technological Change and the Politics of Decarbonization: A Re-making of Vested Interests? *Environmental Innovation and Societal Transitions*, 47. Scopus. <https://doi.org/10.1016/j.eist.2023.100725>
- Walrave, B., Talmar, M., Podoyntsina, K. S., Romme, A. G. L., & Verbong, G. P. (2018). A multi-level perspective on innovation ecosystems for path-breaking innovation. *Technological Forecasting and Social Change*, 136, 103–113.
- Wang, Y., Skeete, J.-P., & Owusu, G. (2022). Understanding the implications of artificial intelligence on field service operations: A case study of BT. *Production Planning and Control*, 33(16), 1591–1607. Scopus. <https://doi.org/10.1080/09537287.2021.1882694>
- Weber, K. M. (2003). Transforming large socio-technical systems towards sustainability: On the role of users and future visions for the uptake of city logistics and combined heat and power generation. *Innovation: The European Journal of Social Science Research*, 16(2), 155–175.
- Weigelt, C., Lu, S., & Verhaal, J. C. (2021). Blinded by the sun: The role of prosumers as niche actors in incumbent firms' adoption of solar power during sustainability transitions. *Research Policy*, 50(9). Scopus. <https://doi.org/10.1016/j.respol.2021.104253>
- Welter, F., Baker, T., Audretsch, D. B., & Gartner, W. B. (2017). Everyday Entrepreneurship—A Call for Entrepreneurship Research to Embrace Entrepreneurial Diversity. *Entrepreneurship: Theory and Practice*, 41(3), 311–321. <https://doi.org/10.1111/etap.12258>
- Werner, V., Flaig, A., Magnusson, T., & Ottosson, M. (2022). Using dynamic capabilities to shape markets for alternative technologies: A comparative case study of automotive incumbents. *Environmental Innovation and Societal Transitions*, 42, 12–26. Scopus. <https://doi.org/10.1016/j.eist.2021.10.031>
- Willig, C. (2008). Introducing qualitative research in psychology. *Introducing Qualitative Research in Psychology*. <https://doi.org/10.4135/9780857029034>
- Wittmayer, J. M., & Schäpke, N. (2014). Action, research and participation: Roles of researchers in sustainability transitions. *Sustainability Science*, 9, 483–496.
- Wright, C., Nyberg, D., & Grant, D. (2012). “Hippies on the third floor”: Climate change, narrative identity and the micro-politics of corporate environmentalism. *Organization Studies*, 33(11), 1451–1475.

- Yaco, S., & Hardy, B. B. (2013). Historians, archivists, and social activism: Benefits and costs. *Archival Science*, 13, 253–272.
- Yardley, L. (2000). Dilemmas in qualitative health research. *Psychology and Health*.
<https://doi.org/10.1080/08870440008400302>

Tables

Table 1: The various ways incumbents, as organisations, can support or hinder socio-technical transitions.

Incumbents' roles in transitions	
Aims	Studies
Develop radical innovation or niche alternatives	(Andersen & Markard, 2020); (B. Borghei & Magnusson, 2016); (Damman & Steen, 2021); (Lenfle & Söderlund, 2022); (Onufrey & Bergek, 2021); (Ramanauskaitė, 2021); (Schönwälder & Weber, 2023); (Skeete, 2019); (Tolonen, 2024); (Turnheim & Geels, 2019); (Vormedal et al., 2023)
Explore and adopt alternative innovations	(Altunay et al., 2021); (Ampe et al., 2021); (Andersen et al., 2023); (Bulah et al., 2023); (Chizaryfard & Karakaya, 2022); (Christley et al., 2024); (De Herde et al., 2020); (Dutt, 2022); (Engwall et al., 2021); (Geels et al., 2016); (Hansen & Steen, 2015); (Havinga et al., 2024); (Hoes et al., 2016); (Khodke et al., 2021); (Lindberg et al., 2019); (Loder et al., 2024); (McMeekin et al., 2019); (Moncreiff et al., 2024); (Nykamp, 2017); (Richter & Smith Stegen, 2022); (Stalmokaite & Hassler, 2020); (Stalmokaite & Yliskylä-Peuralahti, 2019); (Stalmokaite et al., 2023)
Contestation; stay inert; focus on incremental fix	(Dutt, 2022); (Geels et al., 2016); (Haltunen et al., 2022); (Hoes et al., 2016); (Kenner & Heede, 2021); (Lindberg et al., 2019); (Mäkitie et al., 2018); (McMeekin et al., 2019); (Morgunova & Shaton, 2022); (Morgunova, 2021); (Novalia et al., 2021); (Richter & Smith Stegen, 2022); (Tolonen, 2024); (Vormedal et al., 2023)
Incumbents' strategies, practices and actions	
Strategies, practices and actions	Studies
New partnerships, new role	(Bertelsen et al., 2021); (Bjerkan et al., 2021); (Bor et al., 2024); (Damman & Steen, 2021); (De Herde et al., 2020); (Ertelt & Kask, 2024); (Hansen & Steen, 2015); (Havinga et al., 2024); (Hojkova et al., 2020); (Karltorp et al., 2024); (Lindberg & Kammermann, 2021); (Löhr et al., 2024); (Normann, 2019); (Nykamp, 2017); (Ramanauskaitė, 2021); (Ruggiero et al., 2021); (Skeete, 2018); (Skeete, 2019); (Steen & Weaver, 2017); (Tolonen, 2024); (Turnheim & Geels, 2019); (Wang et al., 2022); (Weigelt et al., 2021); (Werner et al., 2022);
Advocacy and policy influence	(Bor et al., 2024); (Bulah et al., 2023); (Christley et al., 2024); (De Herde et al., 2020); (Duygan et al., 2021); (Ertelt & Kask, 2024); (Galeano Galvan et al., 2020); (Hojkova et al., 2020); (Kriechbaum et al., 2023); (Lindberg & Kammermann, 2021); (Löhr et al., 2024); (Madsen et al., 2022); (McMeekin et al., 2019); (Moncreiff et al., 2024); (Morgunova & Shaton, 2022); (Papadonikolaki et al., 2023); (Ramanauskaitė, 2021); (Skeete, 2019); (Trencher et al., 2021); (Werner et al., 2022)
New knowledge, practices and capabilities	(Andersen & Gulbrandsen, 2020); (Andersen et al., 2023); (B. B. Borghei & Magnusson, 2018); (Beers & van Mierlo, 2017); (Engwall et al., 2021); (Galeano Galvan et al., 2020); (Goggins & Rau, 2021); (Hoes et al., 2016); (Karltorp et al., 2024); (Kump, 2023); (Leitch et al., 2019); (Moncreiff et al., 2024); (Mori, 2021); (Papadonikolaki et al., 2023); (Sackey & Akotia, 2017); (Schönwälder & Weber, 2023); (Skeete, 2018); (Stalmokaite et al., 2023); (Steen & Weaver, 2017); (Trencher et al., 2021)
Business model innovation and market (trans)formation	(Altunay et al., 2021); (Andersen & Gulbrandsen, 2020); (Andersen & Markard, 2020); (Chizaryfard & Karakaya, 2022); (Engwall et al., 2021); (Onufrey & Bergek, 2021); (Ruggiero et al., 2021); (Bjerkan et al., 2021); (Skeete, 2019); (Vormedal et al., 2023)

Table 2: Articles studying incumbent organisations actively participating in path-breaking activities, selected from a total of 147 articles citing Berggren et al., 2015, found in Scopus, 2024-11-05 (*the table continues over multiple pages*).

Study	Sector	Country/region	Keywords	Incumbents' actions	Individuals mentioned
(Altunay et al., 2021)	Energy; solar power	Sweden	Business strategy; Horizontal alignment; Institutional environment; Solar PV; Task environment; Vertical alignment	Strategic responses and niche innovation adoption: resource allocation; engagement in disruptive business models; takes on new roles	No
(Ampe et al., 2021)	Waste water management	Belgium	Circular economy; Incumbents; Niche-innovation; Power dynamics; Sustainability transitions; Wastewater	Exploring niche innovation, power and adaptation	No
(Andersen & Gulbrandsen, 2020)	Energy; oil	Norway	Combinatory innovation; Petroleum technology; Sustainability transition; Technological innovation system; Technology phase-out	New organisation of innovation, production and market properties, creation of new knowledge and opportunities	No
(Andersen & Markard, 2020)	Energy; electricity system	Europe	Acceleration; Energy transition; High voltage direct current technology; Multi-sector transitions; Multi-technology interaction; Step-changes in mature technology	Develop niche innovation and new value chains	No
(Andersen et al., 2023)	Energy; electricity system	Germany	Acceleration; Germany; Incumbent reorientation; Sustainability transitions; System architecture	Experimentation (as a strategic response). Reorientation (in routines, capabilities and resources)	No
(B. B. Borghei & Magnusson, 2018)	Transportation; public transport; electric buses	International	Actors; FCEs; Field configuring events; MLP; Multilevel perspective; Niche-regime interactions; SNM; Strategic niche management; Translation	Niche aggregation: knowledge sharing and organisational internal knowledge accumulation	No

(B. Borghei & Magnusson, 2016)	Transportation; public transport; electric buses	Europe	Aggregation; Knowledge flows; Learning; Organization; Strategic niche management	Exploring niche innovation, stretch and transform, radical innovation.	No
(Beers & van Mierlo, 2017)	Food	Netherlands		Diversified strategies, learning and reflexivity towards niche development (paving the way, easy ride, roadblock)	No
(Bertelsen et al., 2021)	Energy; district heating	Denmark; United Kingdom; Netherlands	District heating; Energy infrastructures; Energy planning; Gas grids; Socio-technical transitions	Societal problem-solving, keeper of technology development	No
(Bjerkkan et al., 2021)	Energy; transportation; ports	Norway	Actors; Energy; Port; Roles; Sustainability; Transition	Collaboration arenas; enabler of innovation; legitimatior; producer and consumer	No
(Bor et al., 2024)	Food	Finland	Cross-system interaction; Food packaging; Innovation demand-pull; Scaling; Strategic action; Sustainability transition	Diversified strategies: signposting, demanding, incubating, orchestrating, integrating	No
(Bulah et al., 2023)	Food; plat-based protein	United States; United Kingdom; Netherlands	Entry mode; Entry timing; Incumbent; Plant-based protein; Sustainable product innovation	Exploring niche innovation, proactive participants in transitions, seek niche for market triggers, influencing norms, and adopting.	No
(Chizaryfard & Karakaya, 2022)	Transportation; automotive; electric vehicle	Sweden	Centre of gravity; Incumbent strategies; Industry value chain; Organisational adaptation; Transition; Upstream	Strategic response: analyse, adopt, diversify and explore new opportunities (defender, analyser and prospector)	No
(Christley et al., 2024)	Transportation; aviation	Sweden	Actors; Aviation; Narratives; Sustainability transitions; Temporality	Narrative of transition journeys: substitutions and technical innovation.	No
(Damman & Steen, 2021)	Energy; transportation	Norway	Energy transition; Governance; Infrastructure; Ports; Transport	Developing radical niche innovation; local network management and facilitate spatial planning (landlord, operator, regulator, community manager)	No

(De Herde et al., 2020)	Food; agriculture; dairy	Belgium	Coexistence; Dairy cooperatives; Lock-ins; Pathways of diversification; Structures of collective agency; Value chains	Diversified strategies, explore pathways to scale niche innovation, externalise initiatives, new partnerships and cooperative models, advocacy, influencing norms	No
(Dutt, 2022)	Energy; policy	India	CNG buses; E-rickshaw; Global South; India; Politics; Sustainability Transitions Agency; Coal; Destabilization; Institutional work; Socio-technical regimes; Transitions	Diversified strategies: niche adoption, advocacy; inert, incremental change, defensive, Developing narratives and influence shared understanding and values (theorising, mythologising, enabling work, and creative accumulation).	No
(Duygan et al., 2021)	Energy; coal	Japan		Developing narratives and influence shared understanding and values (theorising, mythologising, enabling work, and creative accumulation).	Yes (institutional entrepreneurs)
(Engwall et al., 2021)	Transportation; heavy manufacturing	Sweden	Business model innovation; Emerging technology; Exploration; Industrial network; Interorganizational collaboration; Project; Sustainability; Systemic change	Exploring niche innovation: experimental networks, new partnership, signalling, mobilising and developing knowledge, redirecting and securing resources, advocating	No
(Ertelt & Kask, 2024)	Transportation; freight	Sweden	Incumbency; Low-carbon transition; Multi-system interactions; Regime change; System reconfigurations	Strategic responses: coalitions, competition, contestations (collaboration, development of norms and shared beliefs	No
(Galeano Galvan et al., 2020)	Energy; electricity system	Netherlands	Decentralised energy innovations; Embedded agency; Energy transition; Grid operators; Incumbents; Institutional work	Advocacy; educating actors; framing; forming networks; mobilising resources; changing boundaries; deterring alternatives	Yes (acknowledge institutional work as individuals' purposive actions)
(Geels et al., 2016)	Energy; electricity system	Germany; United Kingdom	Enactment; Low-carbon electricity transition; Multi-level perspective; Transition pathways typology	Contestation; reorientation; niche innovation; shifts between transition pathways	No
(Goggins & Rau, 2021)	Food	Ireland	Alteration spaces; Food consumption; Incumbents; Organizations; Sustainability; Transitions	Spaces for individuals to alter and shape firm internal routines and practices	Yes (as practices of individuals within the organisation)

(Haltunen et al., 2022)	Energy; oil and gas	International	Business; Discourse; Energy transition; Incumbents; Oil industry	Strategic and defensive responses to manage the paradox of change mitigation imperative and the traditional business models of oil companies.	Yes (sensemaking of workplace behaviour).
(Hansen & Steen, 2015)	Energy; oil and gas; wind power	Norway	Actors and motivation; Niche-regime relationship; Offshore oil and gas; Offshore wind power; Qualitative research	Exploring niche technology, crossover business, framing and reframing of roles, technologies, concepts, situations	No
(Havinga et al., 2024)	Energy; wind power	Norway	Diversification; Floating and fixed-bottom offshore wind; Interaction; Resistance; Socio-technical transitions	Proactive diversification, Diversified strategies: niche adoption; collaboration with niche actors; capitalise on existing knowledge and research base; inert, resistance	No
(Hoes et al., 2016)	Food; agriculture; dairy	Netherlands	Agriculture; Communication; Incumbent; Innovation; Sustainability; Tension	Explore niche innovation: addressing concerns by questioning before responding.	Yes (staff members that allow tension to be revealed and dealt with)
(Hojckova et al., 2020)	Energy; electricity system	Australia; United States	Blockchain; Energy transition; Entrepreneurship; Innovation context; Peer-to-peer electricity trading; Resistance to innovation	Collaboration with system builders (newcomer); use institutional power to create flexibility in regulations	No
(Karlthorp et al., 2024)	Heavy manufacturing; iron and steel	Sweden	Iron and steel industry; Multi-system transition; Radical innovation; Regime destabilisation; Sustainability transition	New partnership, signalling, mobilising and developing knowledge, redirecting and securing resources, advocating	No
(Kenner & Heede, 2021)	Energy; oil and gas	International	Carbon inequality; Climate change; Corporate compensation; Energy industry; Energy transitions; Fossil fuels production: Oil and gas companies; Paris agreement; Social license	Contestation, inertia, incremental change, avoidance, defence	Yes (as personal incentives to sell oil and gas at the top management)

(Khodke et al., 2021)	Transportation; vehicles	India	Accelerated policy-driven sustainability transitions; Asian sustainability transitions; Cleaner vehicle technology; Urban air pollution	Strategic responses: adoption of strategic innovation.	No
(Kriebbaum et al., 2023)	Energy, biogas technology	Austria	Energy policy; Frames and framing; Narrative analysis; Q method; Socio-technical transitions; Technological expectations	Shaping discursive dynamics in the niche; framing new technologies	No
(Kump, 2023)	Waste management; food	Switzerland	Agency; Incumbents; Lewin's field theory; Mainstream actors; Sustainability transitions	Behaviour, conflicts between psychological and social driving forces (individual, group and organisation)	Yes (via Lewin field theory; in management)
(Leitch et al., 2019)	Energy; oil and gas	Canada	Context; Geothermal; Oil sands; Related variety; Sustainability transitions; Technological innovation system	Utilise knowledge and technology overlap for opportunity development, knowledge transfer to mitigate risks, pilot projects, R&D, shifts between transition pathways	Yes (individuals with deep knowledge)
(Lenfle & Söderlund, 2022)	Weather forecasting	France	Data assimilation; Multi-level perspective; Project-oriented agency; Regeneration; Reverse salient; Socio-technical transition; Weather forecasting	Developing niche innovation: Knowledge production, dissemination/framing; goal agreement; building team	Yes (as individuals with deep knowledge)
(Lindberg & Kammermann, 2021)	Energy	Europe	Advocacy coalition framework; Clean energy package; Coalitions; Energy policy; EU; Sustainability transition	Advocacy coalitions; creating legitimacy; build support for transition	No
(Lindberg et al., 2019)	Energy; policy	Europe	Actor preferences; Energy policy; European Union; Policy mix; Sustainability transitions; Transition pathways	Diversified strategies: niche adoption; inert, incremental change, defensive	No

(Loder et al., 2024)	Transportation; automotive	Germany	Automotive industry; Climate change; Cognitive frames; Corporate strategy; Dynamic capabilities; Electric vehicles	Strategic response: Cognitive frames affect firms' dynamic capabilities (status quo or new strategic direction). Stakeholders' propensity to follow and previous experiences can enable transformative change. Advocacy, establishing innovative (unusual) alliances	Yes (in relation to leadership: Executives' perception of risk and opportunity frame firms' capabilities to shape transitions) No
(Löhr et al., 2024)	Energy; hydrogen	Germany	Advocacy coalition framework; Energy transition; Hydrogen; Multi-system interaction; Nascent policy subsystem; Politics of transitions		No
(Madsen et al., 2022)	Waste management	Denmark		Institutional work; advocacy, educating, networking, forming new norms	No
(Mäkitie et al., 2018)	Energy; oil and gas; wind power	Norway	Inter-industry relationships; Oil and gas industry; Sectors; Sustainability transition; Technological innovation system	Contestation, inertia, incremental change, avoidance, low commitment	No
(McMeekin et al., 2019)	Energy; electricity system	United Kingdom	Architectural innovation; Electricity system; Low carbon transition; Multi-level perspective; Whole system reconfiguration	Adding, adaption, niche experiments, advocacy; Contestation, avoidance, defence	No
(Moncreiff et al., 2024)	Energy; oil and gas	Netherlands	Incumbents; Low-carbon niches; Oil and gas; Sustainability transitions	Forming transition team (with a remained focus on oil and gas), advocating and lobbying for a societal licence to operate; Forming energy transition team for reorientation; niche innovation; shifts between transition pathways	Yes (using top-down strategies, but also as emerging niche innovation initiatives)
(Morgunova & Shaton, 2022)	Energy; oil and gas	International	Arctic; Large socio-technical systems; Multi-level perspective; Natural gas; Oil; Sustainable energy transition	Contestation, inertia, incremental change, avoidance, defence	No
(Morgunova, 2021)	Energy; oil and gas	Eurasian Arctic	Climate change; Industry perspective; Natural gas; Oil; Sustainable energy transition	Contestation, inertia, incremental change, avoidance, defence	No

(Mori, 2021)	Energy; power production	China	China; Experimentalist governance; Heterogeneous responses; Incumbents; Power generators; Sustainability transition	Adjusted responses: reorient, innovate, diversify; stay inert	No
(Normann, 2019)	Food; tobacco; energy; coal	United States; Netherlands	Coal; Destabilisation; Phase-out; Policy networks; Sustainability transitions; Tobacco control policy	Strategic responses: new partnerships and changed networks	No
(Novalia et al., 2021)	Water management	Indonesia	Tobacco control policy incumbent actors; Institutional contradiction; Institutional pluralism; Socio-technical regimes; System transformations	Strategic response; short term fix, contestation, finding complementarities. Lack of knowledge for radical niche innovation	No
(Nykamp, 2017)	Construction	Norway	CoPS; Green building; Project based industry; Transformation; Transition pathway	Exploring niche technology; Building alliances	No
(Onufrey & Bergek, 2021)	Heavy manufacturing; pulp and paper	Sweden	Ambidexterity; Business strategy; Competitive position; Innovation strategy; Pulp and paper industry; Resource-based view	Strategic responses and differentiation: cost reduction, increased efficiency, follower; unique products, extended customer values, niche development	No
(Papadonikolaki et al., 2023)	Construction; digitalisation	United Kingdom	Aggregation; Digital; Infrastructure; Megaprojects; Sociotechnical transitions	Boundary spanning; knowledge transfer (personal mobility), influencing norms	Yes (as leadership)
(Ramanauskaitė, 2021)	Incumbency	Lithuania	Case of Lithuania; Incumbents; Sustainability; Sustainability transitions; Transitioning economy	Strategic responses; advocacy, motivating stakeholders, taking initiatives, lead and support change	No
(Richter & Smith Stegen, 2022)	Transportation; automotive	Germany	Automobile industry; Environmental policy; Germany; Incumbency; Sustainability transformation	Strategic response: delay, inert, resistance, adapt	No
(Ruggiero et al., 2021)	Energy; demand response	Finland	Business model; Demand-side management; Multi-technology interaction; Sectoral reconfiguration; Sustainability transition	Forming innovative partnership, building (technology) competence	No

(Sackey & Akotia, 2017)	Construction; digitalisation	United Kingdom	BIM-compliant project; Building information modelling; Construction organization; Construction technology; Multilevel perspective; Organisational boundary	Multilevel boundary spanning; create space for negotiation and handling of conflicting interests	Yes (as project management)
(Schönwälder & Weber, 2023)	Incumbency	Germany; International	Corporate sustainability; Corporate venture; Cross-functional collaboration; Maturity model; Sustainable corporate entrepreneurship	Exploring niche innovation, cross-functional (internal) collaboration between cooperate ventures and sustainability managers; foster sustainable cooperate entrepreneurship	Yes (as management's cooperate entrepreneurship abilities)
(Skeete, 2018)	Transportation; automotive; autonomous vehicles	United Kingdom	Automotive industry; Creative accumulation; Low-carbon innovation; Power; Sociotechnical transitions; State accumulation projects	Exploring niche innovation, forming alliances, new collaborations, developing knowledge	No
(Skeete, 2019)	Transportation; automotive	United Kingdom	Automotive industry; Autonomous vehicles; Intelligent Transport Systems; Private ownership; Sustainable mobility; Transport policy	Developing niche innovation, coordinate networks, strategic and new partnerships, influencing policy and market formation	No
(Stalmokaite & Hassler, 2020)	Transportation; shipping	Baltic Sea region	Decarbonisation; Dynamic capabilities; Incumbents; Innovation strategies; Maritime transport; Reorientation	Dynamic capabilities (sensing, seizing, transforming): reactive strategies (passive, reactive, active, proactive innovation)	No
(Stalmokaite & Yliskylä-Peuralahti, 2019)	Transportation; shipping	Baltic Sea region	Baltic Sea shipping; Environmental innovations; Incumbent companies; Multi-level perspective; Sulphur and nitrogen emission regulation; Sustainability transitions	Strategic responses: adoption of strategic incremental and radical innovation	No
(Stalmokaite et al., 2023)	Transportation; wind powered shipping	France; Sweden	Dynamic capabilities; Incumbents; Innovation process; Multi-level	Dynamic capabilities: Exploring radical niche innovation, knowledge development (scanning, R&D), collaboration	No

(Steen & Weaver, 2017)	Energy; oil and gas; hydropower	Norway	perspective; Newcomers; Shipping		
(Tolonen, 2024)	Transportation; aviation	Europe	Diversification; Incumbent; Multi-level perspective; Selection pressure; Strategy; Sustainability transition	Exploring niche technology; Building alliances; Innovation capacity (but lack of stable institutional environment) Strategic responses: standard responses (improvements, optimisations, communication); inconsistent responses (voluntary compensations); unconventional responses (radical changes to core business)	No
(Trencher et al., 2021)	Transportation; automotive; electric vehicle; hydrogen-powered vehicles	China, Japan and California	Acceleration strategies; Electric vehicles; Incumbent; State; Sustainability transitions; Top-down	Strategic response; Add strategies, collaboration with state, advocacy	No
(Turnheim & Geels, 2019)	Transportation; public transport	France	Incumbent actors; Landmark projects; Local infrastructure systems; Public transport; Radical innovation; Socio-technical transitions; Strategic niche management; Tramways; Transitions governance	Developing niche innovation; collaboration, visioning, landmark projects	No
(Vornedal et al., 2023)	Energy; power production	Europe	Climate policy; Incumbents; Political Mobilization; Technological change	Adjusted responses: reorient, niche innovation, diversify, advocate market transformation; contestation, stay inert	No
(Wang et al., 2022)	Communication; digitalisation	United Kingdom	Artificial intelligence; Case study; Critical success factors; Machine learning; Service operations	Collaboration; Gaining critical stakeholder support for niche innovation; innovation portfolio	Yes (as senior executive support)
(Weigelt et al., 2021)	Energy; solar power	United States	Incumbent response; Niche actors and competition; Prosumers; Solar power;	Diversified strategies: niche adoption; collaboration with niche actors; respond to disruption	No

(Werner et al., 2022)	Transportation; automotive	Sweden	Strategic niche management; Sustainability transitions	Alternative technologies; Automotive; Dynamic capabilities; Incumbents; Market-shaping; Value creation	Exploring niche innovation, diversify, reconfiguration of networks, advocacy, influencing norms	No
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Note: Exploring niche innovation includes mobilising resources, discovering value potentials and experimenting. Like the concept of creative accumulation, exploring niche innovation highlights the significance of accelerated development, technological exploration and the integration of new competencies

Contestation

Table 5: Characteristics of change-oriented theoretical roles related to established organisations.

Theoretical concepts and main references	Organisational position	Primary focus	Motivation	Scope of impact	Permission/Autonomy
Sustainability intrapreneurs (developed in the thesis)	Any employee	Socio-technical sustainability transitions	Strong personal values, utilising professional role to act for sustainability transitions	Beyond the firm, (inter)sector-level transformations	Informal, bottom-up; operating under trust and without permission
Intrapreneurs (e.g., Corbett et al., 2013; Hemingway, 2013; Lang & Baltes, 2019; Mair & Martí, 2006; McGaw & Malinsky, 2020; Neessen et al., 2019; Pinchot III, 1985; Sharma & Chrisman, 2007)	Typically, managers, experts or strategists	Business growth, innovation, strategic renewal. Can also create social value alongside business outcomes	Market/economic opportunity. Engagement can be based in personal values.	Organisational or business model level.	Informal, bottom-up; operating under trust and without permission
Frontrunners (e.g., Loorbach, 2010; Rotmans et al., 2001; Rotmans & Loorbach, 2009)	Often consultants, researchers or experts; employees are not excluded	Visionary change of policy or technology	Visionary futures, path-breaking innovation, finding unity in diversity	Broad, often policy-level or inter-organisational	Invited to lead or shape arenas
System builders (e.g., Hellsmark, 2010; Hellsmark & Jacobsson, 2009; Hughes, 1987; Wittmayer & Schäpke, 2014)	Experts or researchers with specialised knowledge; employees are not excluded.	Creating system resources, e.g., test and demo facilities; guiding system development	Finding unity in diversity, guiding the development of a system	(Inter)sector-level test and demo solutions	Self-imposed intermediaries, acting through formal networks