Pushing innovation from below

The role of accelerator programs in the German energy transition

Charlotte Elsa Jost

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Supervisor: Elina Andersson, LUCSUS, Lund University
Abstract

In order to fight climate change and meet the Paris Agreement to keep the global temperature rise below 2 °C above pre-industrial levels, there is an urgent need to change the dominant way of producing and consuming energy worldwide. However, governing an energy transition is a complex and challenging task, as different actors and interests clash on different levels. In this study, I have a closer look at the governance of the ongoing German energy transition, which has so far mainly been pushed by new market entrants while incumbent firms have been locked into the rigidity of the sector.

More specifically, I explore the role of accelerator programs in facilitating the growth of start-ups in the area of sustainable electricity production and supply and analyse external conditions that influence their successful expansion. Accelerators run timely limited programs designed to support new market entrants and push innovation ‘from below’. I use the German Climate KIC Accelerator as a case study while drawing and critically reflecting on the theory of Strategic Niche Management (SNM) within the Multi-Level Perspective (MLP) framework. I apply a qualitative research approach based on semi-structured interviews, supplemented by secondary sources.

My empirical findings reveal that the studied accelerator can act to a certain extent as valuable ‘niche manager’ by providing monetary support, pushing strategy development and experimentation, imparting knowledge and offering networking opportunities. Yet, slow customer acceptance, poor financing opportunities, existing power imbalances between actors of the energy market and changing regulations still pose barriers to the expansion of sustainable energy start-ups in Germany.

My practical recommendation for the studied accelerator is to make those barriers better visible and to act more as an intermediary actor between the start-ups and policy makers. The accelerator can use its aggregation function to ‘collect’ the experiences and interests of the start-ups and transfer them to a higher level. In line with the practical implications, my main proposal for adjusting the SNM theory within the MLP framework is to place a niche more central within its wider setting as well as to include more business related elements into processes on the niche level. Future research is needed to further study power dynamics and niche-regime interactions within energy transitions.

Keywords: sustainability science, energy transition governance, accelerator program, niche manager, strategic niche management, multi-level analysis

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1 Introduction

“Sustainable energy is opportunity [a necessity] – it transforms lives, economies and the planet.”
(adapted from United Nations, n.d.a)

Even though I do not disagree with the original wording of the statement as part of the 7th Sustainable Development Goal (SDG) on Affordable and Clean Energy, I nevertheless think that we have to go a step further and claim a global energy transition to be ‘necessary’ to “meet the needs of the present without compromising the ability of future generations to meet their own needs” (Brundtland, 1987, para. 27). Firstly, there is no way to deny the fact that fossil resources are finite. Secondly, without a global energy transition greenhouse gas (GHG) emissions will increase even further and the main goal of the Paris Agreement, namely to keep the temperature rise below 2 °C above pre-industrial levels, will not be achieved (International Energy Agency, 2016). Yet, the question remains on how to manage the Herculean task of radically changing an unsustainable energy system to a more sustainable one?

As stated in the 7th SDG, “countries can accelerate the transition to an affordable, reliable, and sustainable energy system by investing in renewable energy resources, prioritizing energy efficient practices, and adopting clean energy technologies and infrastructure” (United Nations, n.d.b, p. 2). Being born in the ‘90s in Germany, I spent most of my life in a country that is globally seen as managing its energy transition in an exemplary way (e.g. Kunzig, 2015). The country’s nuclear phase-out and a rapid expansion of renewables constituted a good take-off for the German ‘Energiewende’, which officially started in 2011. However, it is clearly too early to call this a ‘success story’, as we Germans still heavily depend on conventional energy sources and our government continuously subsidises the coal industry (European Commission, 2017). Interestingly, even though the ‘Energiewende’ was initiated through a top-down decision, its implementation has been pushed from below. It has given rise to new market entrants offering innovative solutions to energy-related problems (Fichter & Weiß, 2016), while the incumbent firms have been locked into their prevailing industry structure (Kungl & Geels, 2017). As innovation is considered to be one of the crucial factors for a successful transition towards a fossil-free energy sector (International Renewable Energy Agency, 2017) and speed of change is considered to be another (Federal Ministry for the Environment, Nature Conservation, Building and Nuclear Safety, 2017), it is reasonable to look at the phenomenon of accelerator programs1, which aim to speed up innovation.

1 The term accelerator program will in the following be used as an umbrella term for all kind of programs or facilities, which support the probability of survival of new businesses in the described way, including incubator programs or science parks.
Since their first appearance in the 1980s in Europe, accelerators have been growing in number (Bank, Fichter & Klofsten, 2017), aiming to facilitate a successful market entry, fast growth and long-term survival of early-stage start-ups (Schwartz, 2013). Those programs push innovation in diverse sectors by supporting new market entrants for up to two years, typically providing physical and financial resources, networking opportunities and coaching sessions (Aernoudt, 2004; Carayannis & Von Zedtwitz, 2005). Therefore, accelerator programs could positively contribute to the growth of energy innovations, which eventually contribute to a successful sustainable energy transition.

1.1 Aim and research questions

In this thesis, I critically explore the current as well as the potential role of accelerator programs as facilitators for sustainable energy transitions. I draw on system theory and take a closer look on the first stage of a sustainability transition (‘niche level’) as well as on its contextual setting (‘regime level’) (Geels, Elzen & Green, 2004). The focus is put on the dynamic and on-going German energy transition, as it offers a promising example to learn from both practically and theoretically. Therefore, to explore the role of accelerator programs in energy transitions, I conduct a case study of the Climate KIC Accelerator, which operates inter-connectedly in three German cities to support the development of climate start-ups, mainly in the areas energy, mobility and food. The focus of this study is put on new businesses operating within the field of sustainable electricity production and supply, as those support a fundamental change in the energy system, eventually replacing fossil fuel (Geels et al., 2004). Innovations include both hard- and software solutions dealing inter alia with decentralised electricity production systems, storage technologies or platforms to invest into respective projects at home or abroad. Consequently, new businesses dealing with energy management and efficiency devices are set aside for this study, as those do not necessarily strive for a radical system change, but are rather meant to optimise the existing one (Geels et al., 2004).

I am addressing two research questions (RQ), which are logically built upon each other: I first explore niche dynamics (RQ 1) and then regime dynamics (RQ 2) within the case and finally conduct a combined analysis of both, leading to practical implications and a theoretical generalisation.

RQ 1: How does the chosen accelerator program facilitate the growth of start-ups in the field of sustainable electricity production and supply?

RQ 2: Which conditions outside of the accelerator program eventually influence the success of start-ups in that field?
My ambition is to give practical recommendations for the underlying case. More specifically, the practical aim of this thesis is to detect ways to improve the operations of the accelerator as a niche manager to better support its start-ups and eventually push the energy transition. I am aware that both the structure of accelerator programs and the regional contexts differ between energy transitions in diverse countries, making direct generalisation of my results difficult. However, using a deductive research approach, I make use of my case study findings to reflect on and inform the theory of Strategic Niche Management (SNM), aiming for theoretical generalisation (Ritchie & Lewis, 2003). More precisely, the theoretical aim of this thesis is to find out if the underlying theory should be revised, and if yes, in which ways.

1.2 Contributions to Sustainability Science
Sustainability scientists study interactions between natural and social systems, whereby scientific work goes hand in hand with complex real life issues and practical applications (Kates et al., 2001). As stated by Kates (2011), two of the main questions for research within this young and evolving academic field are the following: “What shapes the long-term trends and transitions that provide the major directions for this century?” (p. 19450) and “how can society most effectively guide or manage human environment systems toward a sustainability transition?” (p. 19450). With my thesis, I contribute to those research streams by looking into the role of accelerator programs as niche managers within the German energy transition. At the same time, I help to close the current research gap around “intermediary organisations as part of sustainability transitions” (Kivimaa, 2014, p. 1370). By using the theory of SNM as well as the more holistic Multi-Level Perspective (MLP) framework for sustainability transitions, I make sure to keep a practical focus while applying system thinking. I want to come forward with real-life proposals on energy transition governance as well as create new scientific knowledge by reflecting on the theory.
2 Theoretical frame

2.1 System innovation

A transition from one system to a drastically different one, as in this case from a fossil fuel-based to a fossil-free energy system, can be defined as a ‘system innovation’. This long process is characterised by its far-reaching change on different levels including a broad set of actors on both the demand and supply side (Geels et al., 2004). Technological innovations, as for example the application of renewable energies, can initiate a system innovation, yet its success is eventually dependent on social factors, such as user preferences or policies in place (Geels, 2004). A diverse set of literature addresses separate components of such a ‘socio-technical transition’, whereby the disciplines range from innovation studies over evolutionary economics to cultural or technology studies. In this sustainability science thesis, I make use of the interdisciplinary and holistic MLP framework to outline the sustainability transition as a whole, while putting a focus on its micro level dynamics by applying the theory of SNM.

2.2 Multi-Level Perspective (MLP)

The MLP is an “analytical and heuristic concept to understand the complex dynamics of socio-technical change” (Geels, 2005, p. 33), comprising a macro-level (‘landscape’), meso-level (‘regime’) and micro-level (‘niche’) as well as the interaction between those.

![MLP framework](image)

**Figure 1.** MLP framework. A socio-technical transition typically starts on a niche level, then intrudes the regime level before finally influencing the landscape level. The arrows indicate changes (Geels, 2011)
As visualised in Figure 1, on the overarching landscape level, profound structural trends occur, such as political or economic crises, cultural values, environmental concerns or the development of a certain infrastructure (Geels, 2004). Socio-technical transitions aim at influencing the landscape-level eventually, however rigid structures and rules make it hard for regime actors, “such as firms and industries, policy makers and politicians, consumers, civil society, engineers and researchers” (Geels, 2011, p. 24) to have a long-term impact on the landscape level (Geels, 2004). The regime level is characterised by the prevalent way of how a socio-technical system is organised, as for example it depicts how the energy provision is handled within a certain country. It consists of the following six dimensions, which are strongly interlinked and therefore provide stability to the dominant structure: Scientific knowledge, policies and regulations, markets and user preferences, technologies, cultural value as well as the industry structure (Geels, 2011). Even though the dynamics on the regime level are considered to be less rigid than the ones on the landscape level, the structure is still rather stable and gives space only to incremental innovations (Geels, 2002). On the contrary, radical innovations, which aim to challenge the prevailing socio-technical system, arise on the micro level, where so called niches “provide the seeds for change” (Geels, 2004, p. 37). However, the momentum has to be right for a radical innovation to successfully leave the niche level and intrude the regime level as a new entrant (Geels, 2004; Kemp, Schot & Hoogma, 1998). There needs to be a ‘window of opportunity’ resulting either from tensions within the regime or pressure from the wider landscape (Geels, 2002). Those are for example changing user preferences on the regime or environmental concerns or crises on the landscape level. Yet, especially sustainable technologies have difficulties in growing into and finally changing the prevailing regime, which is a problem addressed by the approach of SNM (Caniëls & Romijn, 2008).

2.3 Strategic Niche Management (SNM)

The theory of SNM provides a detailed view on how niche dynamics ideally should be managed in order to successfully support the development of sustainable technologies. Hereby, a niche is typically divided into a so called technological niche and a market niche (Kemp, Rip & Schot, 2001). A technological niche is an artificially protected space in which an innovation can be tested and developed further without being exposed to incumbent technologies (Raven, 2012). Protection is typically given through subsidies, tax-reliefs (Caniëls & Romijn, 2008), research and development programs or the reduction of institutional constraints (Kemp et al., 2001). Niche-experiments should be conducted in real-life settings in order to present the innovation (Schot & Geels, 2008), trigger interaction and exchange between different actors and finally enable learning processes about the technology within its social scope (Geels & Raven, 2006). As soon as the innovation is ready to be up-
scaled, the protection should gradually be withdrawn while the market niche is entered, which in practice is one of the most critical steps in entering the regime level (Caniëls & Romijn, 2008). Following Schot and Geels (2008), a successful niche creation can be understood as a “transformation of a technological niche into a market niche and eventually a regime shift” (p. 540). The theory of SNM describes three internal niche processes to be crucial for a successful niche development: Expressing expectations and a vision, establishing social networks and experiencing learning processes. The following Table 1 gives a more detailed description of each of those internal niche processes and explains how they should be performed to best support a successful niche development.

**Table 1. Necessary internal niche processes for a successful niche development following SNM (Own illustration, 2018)**

<table>
<thead>
<tr>
<th>Internal niche process</th>
<th>Description</th>
<th>Hypothesis for successful niche development</th>
</tr>
</thead>
<tbody>
<tr>
<td>Formulating and adapting expectations/vision</td>
<td>Needed to gain attention and to legitimate protection and support (Hoogma, Kemp, Schot &amp; Truffer, 2002; Kemp et al., 1998)</td>
<td>Should be shared by different niche actors (Hoogma et al., 2002; Kemp et al., 1998), be specific enough to provide guidance (Hoogma et al., 2002; Kemp et al., 1998; Van der Laak, Raven &amp; Verbong, 2007) and have a high quality through continuous reflection and adaption (Kemp et al., 1998; Van der Laak et al., 2007)</td>
</tr>
<tr>
<td>Building social networks</td>
<td>Important to create a customer base (Hoogma et al., 2002), to encourage interaction between relevant stakeholders (Hoogma et al., 2002; Kemp et al., 1998) and to provide resources (Hoogma et al., 2002)</td>
<td>Should be broad (inclusion of a diverse set of internal and external stakeholder) (Hoogma et al., 2002; Van der Laak et al., 2007) and deep (high commitment of members of the network) (Hoogma et al., 2002)</td>
</tr>
<tr>
<td>Experiencing learning processes</td>
<td>New knowledge is needed in the following areas to improve the outcome of the innovation: Technological aspects, market and user preferences, cultural meaning, infrastructure, industry dynamics, regulations and political factors, societal and environmental impacts (Hoogma et al., 2002; Kemp et al., 1998)</td>
<td>Should not only include first-order learning (presentation of facts and data) but also second-order learning (reflection on facts, data and final adjustment in all areas) (Hoogma et al., 2002; Kemp et al., 1998)</td>
</tr>
</tbody>
</table>
Some SNM scholars have expanded the theory by focusing on the interaction between those three processes, encompassing an exchange between local projects and the global level, which is shown in Figure 2. Those terms are not to be confused with geographical locations, but should be understood as an accumulation of innovative projects (local level) and its wider community (global level). The focus has clearly been shifting from single niche experiments to a plurality of co-existing local projects, where learning processes and the building of networks finally lead to the confirmation or the adjustment of shared rules on the global level (Geels & Raven, 2006). The idea is to accumulate “generic lessons and cognitive rules” (Geels & Raven, 2006, p. 378) from experiences on the local level, which are then transferred to the global level, for example through “standardisation, [...] writing of handbooks [or the] formulation of best practices” (Geels & Deuten, 2006, p. 267).

![Local-global interaction within niche formation.](image_url)

**Figure 2.** Local-global interaction within niche formation. Experiences on a project level (niches) are collected and transferred to a wider community (Geels & Raven, 2006)

Last but not least remains the question of ‘who is actually managing such a strategic niche creation?’ Who is acting as “intermediary[y] working between actors – producers and users, entrepreneurs and adopters, idea generators and funders” (Kivimaa, 2014, p. 1370)? Surprisingly little focus is put on that question within the theory of SNM, which mainly states that niche managers can be the state, local authorities, NGOs, citizen groups, private companies or individuals (Kemp et al., 1998). However, most literature on SNM in energy transitions allocates this position to policy makers (e.g. Caniëls & Romijn, 2008; Park, 2011; Quitzau, Hoffmann & Elle, 2012) or the civil society (e.g. Ruggiero, Martiskainen & Onkila, 2018; Seyfang & Haxeltine, 2012). The latter is especially prevalent in studies about community energy systems as grassroot movements. Yet, as recently pointed out in a study by Bush et. al (2017), “the influence of intermediaries within socio-technical transitions and strategic niche management is still an under-researched area” (p. 137). In
order to contribute to the underdeveloped managerial perspective of SNM (Raven, 2012), I explore the chosen accelerator program as case of a possible niche manager.

2.4 Alternative theories
As this thesis follows a rather deductive way of reasoning, it is indispensable to consider alternative theories to the one of SNM within the wider MLP framework (Hyde, 2000; Løkke & Sørensen, 2014). Within literature, two alternative theories on transition governance stick out: The theory on Technological Innovation Systems (TIS) and the theory on Transition Management (TM), which both follow the same evolutionary approach as SNM and MLP, yet they uphold different elements which can help to eventually reflect and revise the chosen theoretical foundation of this study.

Contrary to the niche-focused SNM approach, the TIS approach is located between the niche and the regime level, “focus[ing] on mesoscopic dynamics [in the] sector or technological field [and not on] microscopic dynamics in niches and experiments” (Suurs & Hekkert, 2012, p. 154). It contains the following seven system functions, which are needed to support the development of an innovation: 1.) Entrepreneurial activities develop innovations, 2.) knowledge is created through studies or pilots, 3.) knowledge is diffused through exchange between actors, 4.) the search is guided by clear expectations or targets, 5.) the market formation is pushed by stimulating the demand side, 6.) resources are mobilised and 7.) support from advocacy coalitions, such as lobbying activities, are present (Suurs & Hekkert, 2012). Covering a lot of elements, TIS still misses a detailed description of niche internal processes, however those are central to the purpose of my study, which speaks in favour for applying the niche-focused SNM approach.

The TM approach highlights the value of vision creation and adaptation (Rotmans, Kemp, & Van Asselt, 2001) and differentiates between a strategic, tactical, operational and reflexive level. Acting on a strategic level means both debating about the system’s culture and defining a long-term vision, tactical activities aim to achieve specific goals within the existing regime, the operational level comprises the development of innovations through transition experiments and reflexive activities are meant to provide continuous monitoring and evaluation of policies and changes in society (Loorbach, 2010). Even though these elements are too broad to be applied to my niche-focused study, the different levels still illustrate the need to apply a system-wide perspective in transition governance. Consequently, by using SNM within its wider MLP framework I make sure to not analyse niche dynamics in isolation, but put them into their wider socio-technical setting.
3 Context and case study

3.1 Overview of the German energy transition

In order to answer the research questions, it is vital to understand the unique history of the German energy transition and the role of new entrants and incumbent firms in the energy sector. To do so, one has to jump back around 40 years to the transition’s deepest roots. As shown in Figure 3, the first vision of an energy transition was formulated by the political left already around 1980 (Strunz, 2014) and three years later, in 1983, the Green Party entered the parliament for the first time and started a debate about environmental concerns on the political level (Morris & Pehnt, 2016). Then, in 1991, the Feed-in-Act was introduced by the Conservative-Liberal coalition, marking the first policy in support of the expansion of renewable energies (Morris & Pehnt, 2016). With the liberalisation of the European electricity market in 1998, the German electricity market was opened for competition and prices were no longer regulated by the state, but through market mechanisms (Kungl & Geels, 2017). Even though the market opening aimed to break up the monopolistic structure of regional power suppliers, allowing new actors in the sector, the opposite happened. The former nine biggest electricity utilities feared the competition and merged into four powerful ones (Feudel, 2013), eventually making it very difficult for newcomers to enter the market. The so called ‘Big Four’, consisting of RWE, E.ON, Vattenfall and EnBW made strategic use of their market power, finally holding a strong oligopoly (Kungl & Geels, 2017).

![Figure 3. German energy transition from 1980 until today. The official ‘Energiewende’ started in 2011, however is built up on previous happenings in the sector. Own illustration, 2018](image)

Two years later, in 2000, the coalition of Social Democrats and the Greens replaced the 1991 Feed-in-Act with the German Renewable Energy Act (EEG), aiming to double the share of renewable electricity until 2010 (Bundesministerium für Wirtschaft und Energie, 2018a). Grid operators had to favour renewable energies and a long-term remuneration rate for electricity production from renewables helped new entrants to access the market (Lauber & Jacobsson, 2016). It became
profitable for private citizens, farmers or landowners to invest into renewables, which led to a considerable expansion of decentralised renewable energy production (Feudel, 2013). At the same time, a nuclear phase-out was decided, which was anchored in law in 2002 (Feudel, 2013). In 2004, an EEG amendment further stimulated the development of renewables through new market entrants and set the clear goal to increase the share of renewables in the electricity supply to 12.5% in 2010 and at least 20% in 2020 (§1 EEG, 2004). According to opinion polls, the majority of the German population was in favour for a changing energy sector (Bundesministerium für Umwelt, Naturschutz und Reaktorsicherheit, 2006, 2008), yet the ‘Big Four’ showed resistance and concentrated their research and development activities towards efficiency improvements in fossil fuel power plants and carbon capture and storage technologies (Kungl & Geels, 2017).

In 2009, the EGG was further amended and the goal for electricity generation from renewable energies was adjusted to at least 30% until 2020 (§1 EEG, 2008). Yet, since then, the Conservative-Liberal coalition contrarily planned to slow down investments for renewable energy technologies due to cost aspects (Lauber & Jacobsson, 2016). In 2010, heavy lobbying from the ‘Big Four’ succeeded and resulted in a drastic turn of the nuclear phase-out, which was finally revised and nuclear plants were given a further lifetime expansion (Kungl & Geels, 2017). Then, in 2011, the disastrous nuclear catastrophe in Fukushima happened, which led to a serious turning point in the German energy politics, reverting back to a full nuclear phase-out (Morris & Pehnt, 2016). With the decision to close down all nuclear power plants by 2022, the ‘Deutsche Energiewende’ (German energy transition) officially took off in 2011 and since then aims at restructuring the German energy sector in order to reduce GHG emissions, phase-out nuclear power, assure competitiveness and secure the country’s energy supply (Federal Ministry for Economic Affairs and Energy, 2015). The new energy transition policy is built up on two pillars, namely the extension of renewable energies in electricity consumption, heat consumption and the transport sector as well as the reduction of primary energy consumption through energy efficiency measurements (Federal Ministry for Economic Affairs and Energy, 2015). The targeted share of renewables in the electricity supply was raised to at least 35% until 2020 and at least 80% until 2050 (§1 EEG, 2012). This development in favour of renewable energies meant difficult years for the incumbent firms, which were not prepared for such a reorganisation of the energy structure (Kungl & Geels, 2017). The ‘Big Four’ and the coalition started to question and work against the structure of the EEG, which eventually led to its amendment in 2014, favouring the incumbent utilities (Lauber & Jacobsson, 2016). Finally, in 2017, the latest amendment of the EEG came into place and replaced the guaranteed remuneration rates for renewable electricity production with market defined prices determined in auctions (Bundesministerium für Wirtschaft und Energie, 2018b). This change is expected to further favour
the incumbents and slow down the development of renewables (Bundesverband Erneuerbare Energie e.V., 2016; Morris & Pehnt, 2016).

3.2 Innovation in the energy sector

Throughout the history of the German energy transition innovation has always been present. Changes have been made in how energy is produced, consumed or how market structures are defined. Equally does the Climate Action Plan 2050 of Germany stress the need and support for research and innovation processes for the country to become largely GHG-neutral until 2050, whereby the GHG intense energy sector holds an especially high potential for GHG savings (Federal Ministry for the Environment, Nature Conservation, Building and Nuclear Safety, 2016). Technically, innovation can either occur within the existing structure or result from newcomers, yet the expansion of the German renewable energy sector has been driven by the latter. New entrants were the ones pushing for a radical change while the incumbents were locked into and defending their status quo (Kungl & Geels, 2017). In fact, between the years 2006 and 2014, 190.000 ‘green’ businesses were founded in Germany, finally making up the second biggest sector for new business formations after the commerce sector (Fichter & Weiβ, 2016). Out of those, two thirds were located in the field of renewable energies and energy efficiency (Fichter & Weiβ, 2016). Even though this indicates that innovation enters the energy sector ‘from below’, those numbers have to be watched with caution. Firstly, the number of new ‘green’ businesses entering the market is stagnating since 2014 (Trautwein, Fichter & Bergset, 2018) and secondly, one must not forget the high rate of failure for any kind of start-up within the first years on the market (Freeman, Carroll & Hannan, 1983). A high risk of failure is positively related to the time needed to develop an innovation (Negro, Alkemade & Hekkert, 2012), which makes system changing energy technologies especially risky, as their diffusion requires time-intense changes in numerous areas. As speed is a crucial factor for start-ups to be successful, which in the following is to be understood as growing and expanding within the market, accelerator programs address that issue by pushing the development and growth of new businesses, aiming to reduce their risk of failure (Grimaldi & Grandi, 2005; Schwartz, 2013). Those programs can be attached to a university, arise as publically funded innovation centres as well as comprise a company owned or privately set up supporting program (Grimaldi & Grandi, 2005). Typical elements are the provision of physical resources, such as office spaces or computer networks, financial resources, coaching and knowledge-sharing within the fields of operations, management and legal issues, networking opportunities and an easier access to the market (Aernoudt, 2004; Carayannis & Von Zedtwitz, 2005). Stressing their wide outreach, I claim that accelerators further act as intermediaries, which do not only provide different kinds of resources, but also create a platform
to connect different actors (Kivimaa, 2014; Van Lente, Hekkert, Smits & Van Waveren, 2003). Yet, “intermediary organisations as part of sustainability transitions, particularly in the energy regime, have been little studied” (Kivimaa, 2014, p. 1370). Hence, this study addresses this research gap in the context of the German energy transition by analysing a sustainability focused accelerator as a case study: The German Climate KIC Accelerator.

3.3 Case study: German Climate KIC Accelerator

The German Climate KIC Accelerator aims to facilitate the development of sustainable innovations, mainly in the areas energy, mobility and food, making it a valuable case with regard to the context of the German energy transition. As its program is considered to be one of the most successful ones (Bank et al., 2017), it can serve as a good practice case to learn from, still bearing in mind that different local contexts have to be considered when applying new knowledge to another setting (Klofsten, Heydebreck & Jones-Evans, 2010). The main elements of the Climate KIC Accelerator make it a “critical case” (Yin, 2003, p. 40) to finally reflect on the niche internal processes proposed by the theory of SNM. This means that main elements of SNM which I described previously – experiments, protection, focus on a vision, networking opportunities, learning processes – are present in the description of the accelerator program. It promises to “fast-track your cleantech business” by enabling benefits ranging from financial support over coaching and customer exposure to international networking opportunities (Climate KIC Deutschland, 2018). The following Figure 4 represents those five core elements visually.

![Figure 4. Main elements of the German Climate KIC Accelerator, which are in line with the theory of SNM (Climate KIC Deutschland 2018)](image)

The German Climate KIC Accelerator has existed since 2010 and has since then supported numerous start-ups in Berlin, Frankfurt and Munich. While the program has changed slightly during the years, the main elements have remained the same. At present, the program comprises a three stage
process, whereby each stage lasts six months and is tailored towards a certain level of development. The first stage focuses on business model development, the second on the creation of first customer contacts and the last one prepares the start-ups for upcoming investment rounds (Climate KIC Deutschland, 2018).

The whole program is funded by the European Union (EU), more specifically by the budget of Horizon 2020, which is a seven year long EU program that fosters the development and market breakthrough of new sustainable ideas, in which “small and medium enterprises [should] receive special attention” (European Union, 2014, p. 10). The German Climate KIC Accelerator is part of the European-wide innovation initiative called Climate KIC, which is a ‘Knowledge and Innovation Community’ aiming to connect research, technology and businesses (EIT, 2018) to finally “mak[e] Europe the leader in the global transition to a zero-carbon economy” (EIT-Climate KIC, 2018a). However, even though the German Climate KIC Accelerator is part of this overall network, it operates free from content specifications.
4 Methodology

4.1 Generation of new scientific knowledge

In order to create new knowledge about the governance of energy transitions ‘from below’, I decided to conduct a qualitative study, which is “particularly well suited to exploring issues that hold some complexity and […] that occur over time” (Ritchie & Lewis, 2003, p. 5). That clearly holds true for energy transitions in general, as they are multi-layered and long-term oriented (Loorbach & Verbong, 2012). Specifically, I focus on a single case study as it allows me to “investigate [the] contemporary phenomenon [of accelerator programs] within its real-life context” (Yin, 2003, p. 13). By conducting semi-structured interviews with a diverse set of actors, I managed to collect a broad range of empirical data to answer my research questions. The chosen approach allowed me to get insights into individual experiences as well as helped me to gain a grounded understanding of the main dynamics in the energy sector. As context matters, I further included relevant documents to deepen my understanding of the German energy transition.

The theory of SNM within the wider MLP framework provided a structure to guide my research. However, it was never meant to be acknowledged as ‘the truth’. Instead, I applied a deductive way of coding while staying open for new themes to arise in order to finally revise and improve the theory. The following notion of Bhaskar, summarized by Fletcher (2017), expresses the logic behind my research very well: “Initial theories must be treated as just that: initial theories. The initial theory facilitates a deeper analysis that can support, elaborate, or deny that theory to help build a new and more accurate explanation of reality” (p. 184).

4.2 Data collection

To collect relevant data, I used the approach of triangulation, hence combined different methods to verify the findings of the study through more than one data source (Ritchie & Lewis, 2003). Academic literature, semi-structured interviews, documents and website and video contents were used to address the research questions in a dynamic and iterative process of collecting, analysing and comparing data.

4.2.1 Literature search

Literature searches on Scopus, LUB Search and Google Scholar accompanied my whole research process to continuously enhance my understanding, deepen my knowledge and support arguments by reading up on theoretical concepts, energy transition governance, the German ‘Energiewende’ as well as on past studies in this field. I started my literature collection with the highly cited book
System Innovation and the Transition to Sustainability: theory, evidence and policy by Elzen, Geels and Green (2004), accompanied by online searches using relevant keywords such as ‘technological innovation system’, ‘strategic niche management’ or ‘German energy transition’. After compiling a first set of literature, the snowball search approach led me to further relevant literature in the field.

4.2.2 Semi-structured interviews

In total, my primary data consists of five semi-structured interviews with founders of Climate KIC start-ups, two leading managerial staff of the program as well as four following expert interviews, which Table 2 gives an overview about. Eight interviews were conducted in the form of a video or phone call, two interview partners answered the questions via e-mail and one was a face-to-face meeting (see Appendix A). Following Bryman (2012), I used semi-structured interviews to assure that specific topics were covered in the interview, while at the same time they allow flexibility in structuring the order of questions as well as in providing space to pick up new issues raised by the interviewees (see interview guides in Appendix B).

Using a deductive research approach, the interview guide for all interviews except the expert interviews were informed by the theories of SNM and the wider MLP framework. As this thesis puts a focus on sustainable innovations on the production and supply side of the electricity system, I contacted the 16 start-ups in that field, which have been part of the German Climate KIC Accelerator. Out of those 16, two are not operating anymore and were not interested in an interview, nine did not answer or were not interested in an interview and five finally agreed on giving insights into their experiences with the program and knowledge about the German energy sector. Their operations range from hardware solutions for in-pipe hydro power recovery, over a software solution to organise a decentral energy supply to an investment platform for solar projects in developing countries. Those five interviews were complemented by two interviews with leading staff of the accelerator, which answered my questions regarding the program’s structure and operations as well as gave insights into their overall impressions about start-ups entering the wider energy sector. After those first seven interviews, the most dominant dynamics on both the niche and regime level were stated repeatedly, hence a saturation point was achieved and I decided to find new interview partners that could provide further insights into my initial findings. Consequently, I conducted an interview with a former Climate KIC start-up operating in the field of energy management and efficiency, followed by an interview with a venture capitalist, with a specialist for energy-related policies as well as with the facilitator of the politically active Eco Innovation Alliance².

² The Eco Innovation Alliance represents the interests of more than 60 ‘green’ young companies on the political level.
Every interview partner was informed about the aim of my thesis before the interview and each of them gave their consent to being recorded before I started with the questions. I further invited them to ask me any remaining questions before starting with the interview and clarified if their answers should be anonymised. I conducted all of the interviews in German and finally transcribed and translated the relevant sections of the recordings into English myself.

Table 2. Categorised interview partners and respective abbreviations (Own illustration, 2018)

<table>
<thead>
<tr>
<th>Category</th>
<th>Abbreviation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Managerial staff German Climate KIC Accelerator</td>
<td>M1, M2</td>
</tr>
<tr>
<td>Former Climate KIC start-ups</td>
<td>S1, S2, S3, S4, S5</td>
</tr>
<tr>
<td>Expert (energy management)</td>
<td>E1</td>
</tr>
<tr>
<td>Expert (venture capitalism)</td>
<td>E2</td>
</tr>
<tr>
<td>Expert (energy-related policies)</td>
<td>E3</td>
</tr>
<tr>
<td>Expert (political interaction)</td>
<td>E4</td>
</tr>
</tbody>
</table>

4.2.3 Documents

Following Bowen (2009), I drew on documents as secondary sources in order to give context, supplement the interviews, track change and development as well as verify findings from several sources. Especially for theory-guided analyses, social research experts recommend to include secondary data to enhance the quality of the findings (Kohlbacher, 2006). Thus, next to public documents (Ritchie & Lewis, 2003), I included websites as well as the transcript of a publically accessible video as valuable forms of documentary (Gibson & Brown, 2009). More precisely, the Climate KIC Accelerator website and their promotion video were used to gather detailed information about their outlined program elements (RQ1). Further, an official letter authored by the Eco Innovation Alliance (2018) addressing the German government during their coalition talks in 2018 contains valuable data about external conditions on the regime level (RQ2), as it comprises proposals for political measures aiming to reduce certain barriers for start-ups within the energy, heat and mobility sector. In reference to that, I additionally made use of an internal document, in which the Eco Innovation Alliance compares those proposals with the actual outcome of the coalition talks. A detailed overview of all documents can be found in Appendix C.
4.3 Data analysis

For the data analysis, I made primarily use of a deductive, also referred to as directed, coding process (Hsieh & Shannon, 2005), which was guided by the theory of SNM and the MLP framework. Prior to examining the data, I created a coding system of five main and 13 sub-categories for RQ 1 (Appendix D) and one main and six sub-categories for RQ 2 (Appendix E) as well as added a coding guideline consisting of descriptions, coding rules and anchor-examples, as demonstrated in the following Figure 5 (Mayring, 2014).

![Figure 5. Exemplary screenshot of the coding guideline (Own illustration informed by Mayring, 2014)](image)

Within the coding process, those apriori codes were complemented by empirical codes, which means I included new categories or added sub-categories which did not fit into the pre-defined ones (Hsieh & Shannon, 2005). This interplay between a deductive and inductive analysis is seen to be necessary to eventually reflect on and at best modify an existing theory or model (Bhattacherjee, 2012). Making use of the data analysis software MAXQDA, I started the coding process by going through the interview data and further analysed the Climate KIC homepage content, the transcribed promotion video and the official letter by the Eco Innovation Alliance by using the same pre-defined codes as for the interview data (Bowen, 2009), leaving equally room for new codes to be developed (Appendix F).

4.4 Potential limitations

Firstly, as different interview modes were used to gather primary data (mail, phone, video and face-to-face), one could claim that the quality of answers might differ (Novick, 2008). However, the favourable flexibility in scheduling the dates, the geographical distribution of the interview partners (Oltmann, 2016) as well as differing preferences of the interviewees regarding the mode of interview legitimise this mixed approach. Further, I do not consider social cues, such as voice, intonation or the body language (Opdenakker, 2006) to be important for the purpose of my study, which is why I did not include those into the transcripts. Secondly, I am aware that especially the credibility and representativeness of documents have to be handled with caution in order to not be misled by a
certain point of view or the uniqueness of a document (Bryman, 2012). Thirdly, a directed content analysis always holds the risk of finding rather supportive than non-supportive evidence for the underlying theory, as “researchers approach the data with an informed but strong bias” (Hsieh & Shannon, 2005, p. 1283), which I considered during the whole coding process. Last but not least, the qualitative nature of this case study and the limited amount of interviews make direct transference of my findings to other cases or contexts difficult, still, this thesis aims at theoretical generalisation of the findings (Ritchie & Lewis, 2003). This means that the ‘fit’ between a case study and an existing theory is examined, which finally helps to revise and expand the underlying theoretical understanding (Ritchie & Lewis, 2003).
5 Results and Analysis

The following results and analysis chapter presents the key findings from my empirical investigation, which are supplemented by and compared to relevant secondary literature. My research questions are answered by explaining the specific niche dynamics of the chosen case study, followed by the regime dynamics in the German energy sector. However, as the structure of this study is strongly informed by the MLP framework, consisting of a micro- (niche), meso- (regime) and macro- (landscape) level, I shortly picture the overall landscape dynamics for this case prior to going deeper into the main focus of this study. The subsequent Figure 6 highlights the MLP-elements, which are relevant for this case study and indicates where their analysis is placed within this chapter.

![Figure 6. MLP contextualising accelerators in the German energy transition. The elements marked in red are central to my analysis (Own illustration based on Geels, 2011)](image)

5.1 Landscape dynamics

Landscape dynamics typically describe exogenous trends, as for example crises, which can put pressure on existing regimes (Geels, 2004). In Germany, the disastrous Fukushima nuclear accident in 2011 has been interpreted as such – a critical event – which finally triggered a regime shift (Strunz, 2014). More precisely, the German government decided on the country’s nuclear phase-out until 2022 and further announced a fundamental change in the German energy sector, also known as the German ‘Energiewende’ (Federal Ministry for Economic Affairs and Energy, 2015). This top-down decision has since then been supported by the majority of the German population (Agentur für Erneuerbare Energien e.V., 2017) and pressured the existing energy regime (Kungl & Geels, 2017). The resulting tensions within the traditional energy sector on the regime level finally created a
‘window of opportunity’ (Geels, 2002) for radical innovations to enter the system (E3). The global problem of climate change pushed this development even further, as it put and still puts pressure on the energy sector in every country (Geels, 2004). As stated in the Climate Action Plan 2050 “effective climate action is inconceivable without a sustainable energy policy” (Federal Ministry for the Environment, Nature Conservation, Building and Nuclear Safety, 2016, p. 34). Consequently, all these dynamics on the wider landscape level were in favour of radical innovations to be developed on the niche level. However, as discussed later on, there are still obstacles to overcome on the intermediate regime level.

5.2 Niche dynamics: Main program elements

In the following, I explore the Climate KIC Accelerator as a possible ‘niche manager’, outlining niche dynamics and the program’s main elements while showing in which way they are benefitting the start-ups. Each component is presented separately in order to assure a clear structure, however connections between them are explained and the theory of SNM is referred to when relevant for the upcoming discussion chapter. At the end of the chapter, Figure 7 gives an overview of the main findings.

5.2.1 Strategy development

One of the first things to notice about the accelerator program is its focus on fighting climate change, meaning that there is an overall vision that all start-ups are expected to share from the beginning. The whole Climate KIC initiative “works on transformative, systemic innovation […] to trigger a shift in the system […]” which “encompasses not just the technical and material, but regulation, governance structures, values and mindsets” (EIT Climate-KIC, 2018b). Even though there is this underlying shared, yet not specific wide-reaching climate-vision, which all start-ups follow from the beginning, the accelerator program itself does not put a focus on the formulation and development of expectations or visions per se. As pointed out by a managerial staff member, start-ups do have to formulate specific goals for certain timespans. However, those should “absolutely not be visionary”, but instead refer to measurable achievements, such as the number of conducted customer interviews within phase one (M1). Other interviewees further state that there was no time during the program to work on developing a clear vision statement (S1) and that the focus was rather put on writing a business plan than developing the vision (S2). This shows that there has to be made a clear division between a vision and a strategy, which in my case are managed by different niche actors. While the vision to fight climate change is formulated on the wider KIC level, the German Climate KIC Accelerator does not practically address that element, but puts a focus on strategy
development instead. The accelerator program promises to “help early-stage start-ups refine and develop their specific USP and business model” (Climate KIC Deutschland, 2018), which is confirmed through my interviews, in which the formulation, evaluation and adjustment of a clear business strategy or business plan are raised explicitly (S1; S2; S4). Adjustments are mainly based on market experiences, both within (S1; S2) and after the program (S3; S5). Consequently, the market plays an important role in managing a niche, which expands the theory of SNM and brings us to the next element of the accelerator program: Monetary support and early market entrance.

5.2.2 Monetary support and early market entrance

Within this accelerator program, all participating start-ups receive monetary support from the accelerator, which is highlighted and strongly appreciated by all of the interviewed start-ups (S1; S2; S3; S4; S5). Each start-up can receive up to 95.000 € (Climate KIC Deutschland, 2018), which for example helps to finance the founders’ salaries to work on the project full-time (Climate KIC, 2016). The financial aid provides some kind of protection from incumbents (Raven, 2012) in the sense of reducing the risk to be outcompeted by them immediately. Yet, this shows that the development of innovations is happening in the ‘real world’, where start-ups begin to operate and are exposed to competitors. As stated by a managerial staff member of the program, start-ups should be founded the latest after being six months in the program (M1). This early market-, thus regime-entry contradicts the theory of SNM, which stresses the importance of first operating and developing the product in a market-isolated technological niche (Raven, 2012), while a market niche should not be entered before the innovation is ready to be up-scaled (Caniëls & Romijn, 2008). The gradual withdrawal of protection is seen as a critical step to enter the regime level (Caniëls & Romijn, 2008). However, the Climate KIC Accelerator does not connect protection and support with the timing of the market entry, which is pictured clearly in the following comment: “Leaving the accelerator was no turning point. It is not as if you operate there in a bubble and then all of the sudden stand on the cold market place by yourself” (S3). Closely connected to this early market exposure are test- and feedback-rounds, which are described in the next section.

5.2.3 Customer-centred experimentation

The Climate KIC Accelerator puts a focus on experimentation, which means a prototype is finalised within the first phase of the program and then presented to externals in order to receive early feedback on it (Climate KIC Deutschland, 2018; M1; S2; S3; S4). The interviews reveal that the key stakeholders to get feedback from are potential customers, which is valued as important by all interviewed start-ups (S1; S2; S3; S4; S5). Even though not all of them mention the specific role of the
accelerator in this feedback-process, the following quotes show how the program has explicitly
helped two of them to focus on testing, presenting and adjusting their product or service: “So you
have to somehow test something every day and then draw conclusions from that so that you can
make changes. And those are the skills we so to speak acquired in the accelerator” (S4), “Climate KIC
‘forces’ each team in a positive sense to get out into the world, to present itself and to sell their
product. [...] From the beginning, you have to get out, test, present, [...]” (S3). An expert interviewee
further points out the importance of early experimentation and presentation to increase the chance
to obtain financing after leaving an accelerator program (E2).

To sum it up, niche-experiments are possible through interaction mainly between the start-ups and
their actual or possible customers on the market. In line with SNM, learning processes about the
technology within its social scope take place and help to develop the innovation further (Geels &
Raven, 2006). This demonstrates the close connection between experiments and learning
opportunities, which is another crucial element within the Climate KIC Accelerator.

5.2.4 Knowledge creation
The studied accelerator program supports two types of learning processes: Firstly, as described
above, it promotes test- and feedback-rounds with customers, which help start-ups to learn about
user preferences and adjust the innovation accordingly (Climate KIC Deutschland, 2018; M1; S2; S3;
S4). Following the categorisation of SNM, this represents a second-order learning process, which
comprises critical reflections and adjustments instead of a mere collection of fact-based knowledge
(Hoogma et al., 2002). Secondly, the accelerator’s group trainings and individual coaching sessions
clearly focus on creating operational knowledge, mainly within the areas of sales, marketing,
communication and legal issues (M1; M2). All interviewed start-ups have benefitted from trainings or
advice in at least one of those areas and state that they have been very helpful (S1; S2; S3; S4; S5).
This kind of fact-based knowledge creation represents a first-order learning process (Hoogma et al.,
2002), which in this case, is not targeted towards the energy sector, but is rather applicable for all
kind of start-ups, which are missing general business skills. Summing it up from the theoretical
standpoint of SNM, the studied accelerator program covers some kind of first- and second order
learning processes, however not within a wide range of topics. For example, even though climate
topics are explicitly stated as one workshop content on the program’s homepage (Climate KIC
Deutschland, 2018), none of the interviewed start-ups nor managerial staff talks about this in any
way.
Finally, the issue of ‘whom to learn from?’ is worth mentioning, as it is not covered in SNM but has repeatedly occurred in the interviews. While customers give feedback and therefore create knowledge about the market or user preferences and skilled coaches and mentors mediate operational knowledge, there is still a third group of actors, which has helped the interviewed start-ups to gain knowledge in diverse areas: Other start-ups. A peer-to-peer learning approach is stressed within the program description (Climate KIC, 2016; Climate KIC Deutschland, 2018) and is also highly appreciated by the interviewees (S1; S3; S4; S5). Exchanging experiences with other founders is considered to be helpful to learn new things and push the company’s successful development, whereby one interview partner explicitly expresses the advantage to have been connected to other start-ups focusing on the energy sector (S3). Even though the level of support for this peer-to-peer learning approach seems to differ between the locations Berlin, Frankfurt and Munich, it still holds true that workshops with former founders (M1), common networking events for start-ups from different locations (Climate KIC Deutschland, 2018) as well as office spaces in Berlin and Munich generally provide a platform for start-ups to connect among each other, learn from each other and actively build a network.

5.2.5 Network building

Building a network is another typical SNM element (Raven, 2012), that is also addressed by the Climate KIC Accelerator and has been experienced and is highly appreciated by most interviewed start-ups (S1; S3; S4; S5). Yet, the one interviewee, not being completely satisfied with the offered networking opportunities, expresses a necessity for its improvement (S2), which shows the overall importance of networking. As already mentioned above, a peer-to-peer network is built up within the time in the accelerator (S1; S2; S3; S4; S5), complemented by first contacts to possible customers (S3; S4; S5) as well as to investors (S3; S4). Hence, my data analysis reveals – in correspondence to SNM – that building a broad network in an early stage of development is helpful to learn from others, to create a first customer base and to look after financial resources. Furthermore, the long-term nature of networks (M1; S1; S2; S3; S4; S5), especially in relation to peer-to-peer contacts (S1; S2; S4; S5), is pointed out repeatedly in the interviews. Despite its empirically proven relevance, the longevity of networks is in fact not mentioned within the theory of SNM.

As this accelerator is part of the wider ‘Knowledge and Innovation Community’ (KIC), it holds a broad network of 270 partners coming from the private sector and universities (M2), providing a broad range of possible contacts for start-ups. According to the managerial staff of the program, there is even the possibility to get into contact with political actors (M1), however none of the other
interviewees confirm this statement. Further does the program claim to give “access to an extensive international network” (Climate KIC Deutschland, 2018). However, just one interviewed start-up talks about some kind of valuable interaction across borders (S2).

5.2.6 Further interaction

As described above, my empirical data confirms that networking opportunities are an important niche element, in this case comprising both interaction within the specific niche, as well as between the start-ups and customers or investors outside the niche. Yet, I discovered even further interactions between the studied niche setting and its surrounding. There are connections both with other accelerator programs as well as with policy makers, which are no official components of the program and so to speak occur ‘behind the scenes’. Firstly, different accelerator programs do not operate in isolation, but are interconnected in diverse ways. On the one hand, some of the interviewed start-ups reveal that they have been part of more than just one accelerator program (S1; S3). On the other hand, German energy- and sustainability related accelerator programs exchange experiences about ‘their’ start-ups and general trends. However, those talks are often “backroom talks” rather than official collaborations (M2). Secondly, the German Climate KIC Accelerator is part of the Eco Innovation Alliance (M2), which was founded in late 2017 (E4) and comprises a lobbying alliance standing up for the needs of “start-ups and innovation companies from the green economy” (Eco Innovation Alliance, 2017). Yet, as expressed in the following statement, the existing connection to the political sphere is not given too much attention to by the accelerator: “Well there are surely [political] contact points, but right now we do not take care of them very actively” (M2). Summing it up, my findings support the idea of SNM to have a plurality of co-existing niches on a local level, though experiences on that level are only partly aggregated and transferred to a higher global level (Geels & Raven, 2006).
5.3 Regime dynamics
As pointed out by Kemp et al. (1998), "the ultimate fate of processes of niche formation depends as much on successful processes within the niche as on changes outside the niche. It is the coincidence of both developments that gives rise to niche development patterns” (p. 184). In line with this statement, it is necessary to position the studied niche, namely the German Climate KIC Accelerator and its start-ups, within the wider setting. I subsequently explain and analyse the most crucial accelerator-external conditions, which influence the success of start-ups, finally referring back to the role of the accelerator in a separate chapter. Hereby, I refer explicitly to the electricity sector when possible, however also talk about the energy sector as a whole when a distinction cannot be made.

5.3.1 The role of the established industry: Opponents or partners?
The German electricity industry is still dominated by the four big utilities RWE, E.ON, Vattenfall and EnBW, which generate, distribute and sell electricity at home and abroad (Bundesnetzagentur, 2016). Some of the interviewees address the power position of the big players and the rigidity of the sector, yet approaching it from two different angles. The interviewed staff members of the Climate KIC Accelerator picture the stable structure of the energy industry as a barrier towards innovation, explicitly referring to heavy lobbying activities within the sector (M1; M2). Contrary is one of the interviewed Climate KIC start-ups perceiving the industry ‘lock-in’ rather as an opportunity for small actors, such as start-ups, to initiate innovation and finally put big players under pressure to adapt to the new dynamic in the sector (S3). This statement is further stressed by pointing towards valuable
(yet not specified) interactions between the start-up and big industry players: “Definitely have we been in contact with many, many very big players and cooperate, which means you cannot claim start-ups and large corporations to call each other enemies” (S3). As stated by Kungl and Geels (2017), both viewpoints hold true: For many years have lobbying activities aimed to secure the prevailing industry structure while at the same time new market entrants managed to destabilise the industry and push the energy transition. The role of new and small market actors within the German energy transition is well presented in the following chart (Figure 8), displaying the ownership distribution of renewable energy facilities in Germany (Agentur für Erneuerbare Energien e.V., 2018). It shows a clear orientation towards a decentralised renewable electricity production system, in which the ‘Big Four’ only accounted for 5,4% of the ownership in 2016.

![Ownership of renewable energy systems for electricity production in Germany, 2016](image)

**Figure 8.** Ownership of renewable energy systems for electricity production in Germany, 2016 (Own illustration based on Agentur for Erneuerbare Energien e.V., 2018)

Yet, it is important to note that while this development holds true for renewables, it does not represent the electricity sector as a whole. Even though the joint electricity market share of the ‘Big Four’ dropped by a few percent since the beginning of the ‘Energiewende’, they still hold the vast majority of around 70% of the market (Bundesnetzagentur, 2016), retaining their power position towards new entrants.

### 5.3.2 The role of the market: Fighting for acceptance and capital

My findings reveal two tendencies in the overall German energy market, which play a crucial role for the growth of the targeted start-ups: user acceptance and financing opportunities. Those are surely main success factors for any kind of new business, yet does the energy market stand out by posing especially high barriers, which I explain in the following.

Firstly, there is still resistance on the demand side to accept and include innovations in the energy sector (M1; S2; S3; S5), clearly contrasting the general high support for the ‘Energiewende’ within the German population (Agentur für Erneuerbare Energien e.V., 2017). In order to grasp this
contradiction better, I identify two influential factors within the issue of customer acceptance: long sales cycles and price sensitivity. Long sales cycles imply a long time-period between the first customer contact and the actual selling process, which, as clearly stated by an expert interviewee, is strongly connected to the rigidity in the industry: “You have a highly regulated market, [...] a very conservative sector, which makes your sales-cycles extremely long” (E2). Other interviewees also explicitly state the problem of time-intense sales processes (M1; S5), which clearly differentiate the energy market from other markets, in which innovation and quick changes are more common.

Further, price sensitivity is an important issue on the demand side, both when it comes to actively changing the way energy is produced (e.g. installation of PV) (S2; S3; S5) and how it is consumed (e.g. installation of energy efficiency measurements) (E1). Even though price sensitivity might differ between different consumer groups (such as industry vs. private households) (E1), it still represents an overall factor to keep in mind when talking about consumer acceptance. This finding is in line with a recent report published by the Federal Ministry for the Environment, Nature Conservation, Building and Nuclear Safety (2017), stating that “the shift in demand to electricity from renewable energy sources is primarily due to cost aspects” (p. 29).

Finally, poor financing opportunities constitute the other central market-related barrier for start-ups in the energy sector. The issue of capital generation becomes urgent as soon as the start-ups leave the accelerator program and consequently do not receive the financial support anymore. Two interviewed start-ups as well as the official letter by the Eco Innovation Alliance point specifically to the connection between poor financing opportunities for start-ups and the energy sector (Eco Innovation Alliance, 2018; S1; S4). A subsequent expert interview with a venture capitalist further supports this finding (E2). The main reason for this barrier is the poor scalability of energy-related innovations (E2), which holds especially true for hardware devices (E2; M2; S4). Independent investors, such as business angels or venture capitalists are typically investing in start-ups which promise a respectable profit, whereby profitability is indicated by high scalability or an existing customer base (E2; S1; S4). Therefore, especially hardware devices with their long development and sales cycles (E2; M1; M2) are less attractive for investors. Consequently, “if it’s about big energy projects, [...] namely hardware [...], then [the start-ups] rather enter the funding landscape again” (M2). Hereby, the interviewee refers specifically to the Horizon 2020 budget, which was set up by the EU inter alia to reduce the just described financing barrier for innovative small companies or organisations (European Union, 2014). The Eco Innovation Alliance further demands the German government to ensure “better access to venture capital for start-ups [in the areas energy, heat and mobility], for example, through the establishment of high-tech specialised venture capital funds” (2018, p. 2).
5.3.3 The role of politics: Regulations and bureaucracy

The role of politics in influencing the development of start-ups becomes even more obvious when looking at regulations (Eco Innovation Alliance, 2018; M2; S3; S5) and bureaucratic structures (Eco Innovation Alliance, 2018; M1; S2), which presently represent central barriers to fast niche development. Even though the German government claims to support innovations and start-ups to push the energy transition (Federal Ministry for Economic Affairs and Energy, 2015), its current actions clearly speak against that claim. The government puts the interests of incumbents in front of the ones of newcomers, which is summarized in the following statement: “[Germany’s] former leading role in energy transition and climate action hardly exists anymore. To blame is the political framework, which protects the conventional companies, leaving little room for disruptive new actors” (Eco Innovation Alliance, 2018, p. 1). For example, the latest EEG amendment replaced the feed-in-tariffs with auctions, which means that the remuneration rates for electricity coming from renewables are not set by the state anymore but are instead determined in market auction procedures (Bundesministerium für Wirtschaft und Energie, 2018b). This will lead to more competition between suppliers and disadvantage small- and medium-sized companies, as they do not have the same financial means as large ones to create scale effects (E3). Finally, “the decentralised market for renewable energies will probably become more centralised again” (E3), which means innovations ‘from below’ are expected to have an even harder time to successfully enter the rigid energy sector.

5.3.4 The role of technology: Price drop ahead

Lastly, my empirical data reveals that recent technological trends are expected to notably influence the future of the electricity sector in favour of small market actors. Firstly, two interviewed start-ups expect to benefit from the price drop for technological devices (S2; S5), such as photovoltaic systems. A recent report published by the International Renewable Energy Agency (2017) supports this claim, stating that “renewable generation technologies in the power sector are already economically viable, and innovation, together with economies of scale, will continue to reduce their costs” (p. 15). As already described in a prior section, price sensitivity is a crucial factor for customers to accept innovation in the energy sector. Consequently, a price drop in technologies could lead to a higher acceptance and application thereof, provided that the price drop is actually forwarded to the consumers. Secondly, blockchain models are mentioned as a new technological trend, holding the potential to facilitate the expansion of peer-to-peer energy systems (S2) as well as improve financing opportunities for energy start-ups (E2).
5.4 The Climate KIC Accelerator within its wider setting

As described and analysed in detail above, my empirical data reveals three main barriers for start-ups to successfully grow into the existing energy regime: slow customer acceptance, poor financing opportunities and the unfavourable present political setting. The next step is now to draw a connection between the niche and regime level to finally understand the actual and potential role of the Climate KIC Accelerator within its wider context. Referring back to the theory of SNM, a niche should be managed in a way that optimally supports the successful development of sustainable technologies, hence it would be logical to tackle obstacles on the regime level. Therefore, I subsequently go through the identified barriers step by step, showing if and how the studied accelerator program addresses them.

Firstly, by pushing for a “customer-centric-development method” (M1), which is appreciated by all interviewed start-ups (S1; S2; S3; S4; S5), the accelerator program addresses the issue of customer acceptance to a certain extent. An early customer-contact might eventually help to speed up long sales cycles, yet the customers’ price sensitivity still holds a problem for now, although this issue is expected to be tackled by a price drop in technologies. Secondly, the barrier of poor financing opportunities is addressed within the program, in which the last of three stages particularly aims for “investment readiness” (Climate KIC Deutschland, 2018). Provided networking opportunities (S3; S4; Climate KIC, 2016; Climate KIC Deutschland, 2018) as well as training about how to convince investors (S1; S4) are valuable first steps towards finding financing opportunities. Yet, the most crucial step to receive venture capital is to prove the start-up’s financial affordability, expressed through scalability or a customer base (E2). As explicitly stated by the interviewed venture capitalist, it is important for start-ups to have the possibility to test things and experiment in the real world, as “otherwise you barely have a chance to prove yourself” (E2). Hence, the Climate KIC Accelerator addresses the identified financing barrier in two ways: it enables an early contact with investors as well as pushes for an early market entry and customer-centred testing. Thirdly, the issue of bureaucracy and unfavourable political regulations is, in contrast to the other two issues, barely addressed by the Climate KIC Accelerator. Even though political channels exist, those are, as previously described, presently barely used (M2). Accelerators are typically not active in lobbying activities (E4), however, from now on, the Eco Innovation Alliance provides a platform on the global level to aggregate experiences and influence the political framework respectively.

Interestingly, the program description of the Climate KIC Accelerator does not explicitly state to thematise certain barriers on the regime level, which one interviewee indicates as well: “In coaching sessions, which are provided for all start-ups [...], one rather concentrates on opportunities and
analyses, less on barriers. Certainly, the individual coaching sessions give hints [towards barriers], but less on the meta-level” (S3). Yet, the studied accelerator program implicitly prepares its start-ups for the first two barriers, while neglecting the third. In line with that, there is no consistent answer by the start-ups to my question if the accelerator program prepared them for the barriers they had experienced in the energy sector.
6 Discussion

Drawing on my empirical results, the underlying theory and relevant secondary literature on energy transitions, I subsequently discuss the key findings of my study, which can be grouped into three main categories. Firstly, I discuss practical implications for the chosen case study. Secondly, I reflect on the theoretical foundation of my thesis, aiming for theoretical generalisation of my findings. And lastly, I contribute to the general discussion on energy transition governance, pointing towards valuable future research questions in the field of sustainability science.

6.1 Practical implications

The analysis of my empirical data reveals that there is a discrepancy between the way the German Climate KIC Accelerator presents itself and the way it actually operates. Outwardly, the accelerator is strongly characterised by its sustainability focus. However, within the program, training and coaching sessions mainly focus on business development. Even though those trainings are highly appreciated, I still argue that it would be valuable to include more knowledge creation in the field of sustainability and climate change. This seems necessary in order to assure that all start-ups follow the same underlying vision of fighting climate change and develop a sense of belonging, which might finally help to adopt a united stance against big industry players. Furthermore, the Climate KIC Accelerator stands out from other German accelerators due to its European wide network, which is a connection that could be better used in order to benefit all start-ups taking part in the program.

Having said that, I consequently zoom into the accelerator’s role as possible niche manager and ground my analysis in the theory of SNM. As described and analysed above, the Climate KIC Accelerator provides highly valued protection for their start-ups through monetary support, pushes customer-centred experimentation on the market as well as offers certain networking opportunities and learning possibilities. All of those elements speak in favour for successful niche development (Kemp et al., 1998), which is why the early SNM scholarship would have pictured the accelerator program as a valuable niche manager. While analysing the primary data, it stuck out that there are only few conflicting descriptions orvaluations of the main program elements by the interviewed start-ups, which would further have supported the positive valuation of the program. Yet, later SNM scholars have more recently pointed towards the need for an active exchange between the local and global level, which the studied accelerator program falls short on. More precisely, the local network, namely, all actors involved in the studied niche, is only partly exchanging experiences with the global network, namely the emerging field of energy-related start-ups (Geels & Raven, 2006). Even though the Climate KIC Accelerator shares experiences with other accelerators in the field and is further part
of the newly found Eco Innovation Alliance, those interactions rather happen in the background. So even if niche actors collect and further exchange niche-experiences, there is a limited “circulation of knowledge […] and formulation of generic lessons” (Geels & Raven, 2006, p. 378). However, focusing more on the aggregation and communication of learning outcomes would be very valuable in order to reveal common problems in the field (Geels & Raven, 2006) and to share best practices (Geels & Deuten, 2006). That means that the accelerator program could focus more on specific barriers in the field as a subject for discussion. In this case study, especially the issue of unfavourable political regulations could be addressed better through a more active collection and presentation of the start-ups’ respective experiences, finally pushing lobbying activities, for example through the Eco Innovation Alliance or other existing political channels (M2). The Climate KIC Accelerator has a valuable position within the Eco Innovation Alliance, as it can offer good insights into barriers for start-ups in different cleantech sectors (E4). The alliance has already been successful within the coalition talks in 2018 (Eco Innovation Alliance, personal communication, 2018; E4), so now it is important to keep this alliance alive and strengthen the political involvement in the future.

The proposal to actively involve more into lobbying is very much in line with the idea of ‘intermediation’, stating that the role of intermediaries in sustainability transitions consist of “niche creation and regime (de)stabilisation” (Kivimaa, 2014, p. 1371). While the first is covered within the accelerator program fairly well, destabilisation should be improved by actively influencing the regime level for the benefit of their start-ups. As emphasised by some later SNM scholars, practice has shown the need for niche advocates to get involved into political work “in order to institutionalise policy measures that would encourage and help firms to develop [their sustainable innovation]” (Smith, Kern, Raven & Verhees, 2014, p. 117).

6.2 Theoretical generalisation

While I cannot generalise the previous practical implications and apply them directly to other accelerators in other contexts, I can still make use of my findings to inform the underlying theory of SNM, achieving theoretical generalisation (Ritchie & Lewis, 2003). Starting with the main practical outcome of this study, there is a strong possibility and need for niche managers to actively exert influence on the regime level. This finding strongly supports the more recent development of SNM, stressing the value of niche advocates engaging in lobbying activities (Smith et al., 2014). In order to respectively expand the niche element of ‘networking’, SNM could draw from the theory of Technological Innovation System (TIS), which I described as an alternative theory in a previous chapter. The theory claims that support from advocacy coalitions, such as lobbying activities, is a
necessary system function to facilitate the development of a technological innovation (Suurs & Hekkert, 2012). Furthermore, my results reveal the importance of striving not only for ‘broad’, but also for ‘long-term’ networking, which could be added as another valuable characteristic describing the niche element of social networking more accurately.

Next to those two issues, my empirical findings further reveal a major discrepancy between theory and practice. More specifically, my case study findings contradict the theoretical claim that an innovation must be scalable before moving from a technological to a market niche (Caniëls & Romijn, 2008). Instead, practice shows that the market setting and the close connection to diverse regime actors are needed as early as possible in order to test and evaluate the new product. Consequently, the niche level should not be pictured as preceding the regime level, but should rather be placed within it, actually and figuratively acting as a “seed for change” (Geels, 2004, p. 37). This theoretical adjustment is perfectly represented in the following illustration (Figure 9), which pictures a TIS. Hence, the theoretical understanding of TIS can once again serve as valuable input to complement SNM by rearranging the niche level within its wider setting, while keeping its detailed niche internal processes.

**Figure 9.** Technological Innovation System within the MLP framework. Niches are placed central within the regime and landscape setting (Markard & Truffer, 2008)

Furthermore, my empirical findings reveal that the formulation and adjustment of a clear business model or strategy is practically more relevant for start-ups in the accelerator than the formulation and adjustment of clear expectations and a common vision. This does not mean, however, that the niche process of developing expectations and a vision is outdated, instead it is located on another level. In this case, the vision to fight climate change is stated by the European-wide KIC initiative and
the expectation to achieve an energy transition is formulated by the German state. This means that my empirical data supports the findings of some SNM scholars, who show that the development of expectations is less influenced by happenings on the niche level than by dynamics on the regime or landscape level (Geels & Raven, 2006). Yet, both those factors are important underlying elements to push the creation of a sustainable energy niche in the first place and can be used to unify the start-ups and strengthen their collective action on a political level. Nevertheless, the accelerator’s focus on strategy development as well as the start-ups’ early market entry finally point towards the need to add a more business- and market-oriented focus into the niche internal processes suggested by SNM. As proposed by Geels (2011), the inclusion of business and strategic management literature might be helpful, for example to better understand the dynamics between new market entrants and existing firms (Hockerts & Wüstenhagen, 2010).

6.3 The crux of governing an energy transition

6.3.1 Power dynamics

Taking up the relation between new market entrants and big industry players once more, my empirical study clearly reveals an imbalance in their power position. Even though the German energy transition was decided by policy makers and has ever since been supported by the German population, there is no even playing field for newcomers and incumbent firms. The traditional big energy companies have pursued the strategy of lobbying for their interests while small firms have most of the time been underrepresented on the political level (E4). Within the first years of the ‘Energiewende’, policies favoured new market entrants, continuing the successful expansion of renewable energies while creating resistance of incumbent firms (Kunig & Geels, 2017). Eventually, the latest changes in energy regulations favour the big players again, which is expected to slow down the energy transition (Bundesverband Erneuerbare Energie e.V., 2016). Drawing from energy economics, it is not unusual that top-down reforms, which aim to “introduce changes in the ownership, industry structure, governance mechanisms and the nature of transactions” (Bhattacharyya, 2011, p. 689) create resistance of diverse actors who protect their own interests. If the threatened actors (in this case the incumbent firms) have a higher bargaining power than the advantaged ones (in this case new market entrants), the implementation of the reforms becomes hampered (Bhattacharyya, 2011). This is why I am pointing towards the need for the accelerator to use the ability to ‘unite’ small firms, collect their interest and finally raise their joint bargaining power to prevent the big players from dictating the future of the energy transition. Identified barriers for newcomers in the market need to be represented on a political level to balance out the uneven power structure. In general, the power struggle between innovative new market actors and the
established, locked-in firms as well as the potential for cooperation might not only be interesting to study further within the setting of the German ‘Energiewende’, but could be a valuable contribution to transition studies in other contexts too.

6.3.2 Multi-level governance

Obviously, it is a complex and challenging task to govern an energy transition as it includes many different actors on different levels. While this study explores accelerator programs as possible niche managers and intermediary actors, it is important to acknowledge that effective niche management never depends on just one actor, but is rather “a collective endeavour” (Kemp et al., 1998, p. 188). So even if accelerators are suited to organise niche internal processes practically and create a bridge between the niche and regime level, the government will always act as an additional niche manager. Political measures typically play a central role in facilitating niche internal processes, as for example through the provision of financial aid or the passing of supportive policies (Kemp et al., 1998). In this case, the German government additionally takes over the niche process of formulating a long-term vision and setting clear goals to guide the energy transition. Yet, as analysed previously, the latest political decisions are paradoxically expected to slow down the energy transition, which should set alarm bells ringing. Even though every energy transition is unique, in this case we could learn from our neighbouring country, the Netherlands, where constantly changing policies finally jeopardised the creation of sustainable energy niches (Raven, 2012). Surely, the final outcome of the German energy transition is still to be seen. Yet, my study already contributes to the academic discussion on energy transition governance by pointing towards the government’s central role in the whole process. Finally, further studies within the field should have a closer look at the regime dimension of ‘policies’ and their implications for a successful niche development and the eventual shift in the dominant regime.
7 Conclusion

I started this thesis by pointing towards the necessary but Herculean task of radically changing the present unsustainable energy system to a sustainable one. Now, many months and a case study later, my empirical findings give further evidence to the complexity of governing an energy transition, which is a process involving many different actors on different levels (Geels et al., 2004). I addressed this issue by zooming into the ongoing German ‘Energiewende’ and explored the role of accelerator programs as possible facilitators for the energy transition, pushing innovation ‘from below’.

By using the Climate KIC Accelerator as a ‘real-life’ example and drawing and reflecting on the theory of SNM within the wider MLP, this thesis represents a great example for a sustainability science study, where “scientific exploration and practical application [...] occur simultaneously” (Kates et al., 2001, p. 641). My overall aim was to contribute to the field of energy transition governance both practically and theoretically. In order to do so, I first analysed how the chosen accelerator program facilitates the growth of start-ups in the field of sustainable electricity production and supply (RQ1). Thereafter I analysed the most relevant conditions outside of the accelerator program, which eventually influence the success of start-ups in that field (RQ2). A combined analysis of my empirical findings allowed me to detect ways to improve the accelerator’s operations to better support the start-ups (practical aim) as well as generalise the outcome of this study theoretically (theoretical aim).

The main practical outcome of my study is a recommendation for the accelerator to not just support the start-ups with money, strategy development, experimentation, knowledge and networks, but make barriers to success more visible and further act as an active intermediary between the start-ups and policy makers. Innovation ‘from below’ needs support not only on the niche level, but also on the regime level. As shown in this case, even if a sustainability transition is decided ‘from above’, existing power dynamics can finally keep a government from acting in the interest of the most sustainable and innovative market actors. By putting the accelerator into its wider context and using the theory of SNM to analyse its functions in detail, I could finally critically reflect on the main elements of the theory and propose valuable adjustments to it. In line with the practical outcome of this study, I propose a more central placement of a niche within its wider regime setting and further argue to include more business related elements into niche processes.
With this empirical study about the role of accelerator programs in energy transitions, I successfully contributed to reducing the research gap on the function of intermediary actors within socio-technical transitions (Bush et al, 2017). Yet, future research is needed to further explore power dynamics and niche-regime interactions in energy transitions, creating a broader knowledge base to finally support the necessary transition towards a global sustainable energy system.
8 References


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9 Appendices

Appendix A: List of interview partners

<table>
<thead>
<tr>
<th>Category</th>
<th>Name and position</th>
<th>Type of interview</th>
<th>Date</th>
<th>Abbreviation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Managerial staff</td>
<td>Daniel Grassinger, Head of Operations, Munich</td>
<td>Video</td>
<td>07.02.18</td>
<td>M1</td>
</tr>
<tr>
<td>Start-up</td>
<td>Martin Baart, CEO ecoligo</td>
<td>Phone</td>
<td>14.02.18</td>
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<tr>
<td>Start-up</td>
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<td>S2</td>
</tr>
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<td>S3</td>
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<td>Managerial staff</td>
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<td>Face-to-Face</td>
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<td>Expert (venture capitalism)</td>
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<td>Phone</td>
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<td>Expert (energy-related policies)</td>
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<td>Expert (political interaction)</td>
<td>David Wortmann, initiator of the Eco Innovation Alliance</td>
<td>Phone</td>
<td>24.04.18</td>
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Appendix B: Interview guides translated from German into English

Before every interview:
- Question: Is it okay to record the interview? (in case of a phone, video or face-to-face interview)
- Question: Should the answers be anonymised?
- Question: Are there any further questions?
- Clarification of the year the start-up was founded/ the position the interviewee has (if needed)

Interview guide for the managerial staff of the Climate KIC Accelerator (M1)

Structure
1. How is the Accelerator Program connected within Germany and the EU?
2. In which way are political actors (EU) involved into the design of the program?
3. Which other Accelerator Programs in Germany are you in contact with?
4. Which kind of exchange is there between the start-ups, the academia and industry? And why?

Dynamics
1. What is the main motivation for start-ups to apply to the program with innovative ideas in the energy sector?
2. What do you think, in which direction is the field of renewable energies developing in Germany?

Program steps
1. Which are the criteria to choose new start-ups?
2. Why is the program divided into three phases?
3. Which are the criteria to decide how much money is given to a start-up in each phase?
4. How was the program changed since its establishment in 2013? And why?
5. How can a successful market entry be described? And when does it happen?
6. Which are the barriers start-ups in the energy sector have to expect when entering the market?
7. How does the Accelerator prepare the start-ups for those barriers?
8. How can start-ups benefit from the Accelerator Program after leaving it after 18 months?

Activities
1. Is every start-up formulating a clear vision, goal and strategy?
2. Which topics are covered in the workshops and trainings? And in which way?
3. How do coaches support the start-ups?
4. Which contacts/ networks are especially important for the growth of start-ups in the energy sector? And how does the Program help to build those up?
Interview guide for the managerial staff of the Climate KIC Accelerator (M2)

1. How was the program changed since its establishment in 2013? And why?
2. In which way is the Climate KIC Accelerator working together with other accelerators?
3. Which kind of exchange is there between the start-ups, the academia and industry? And why?
4. What do you think, in which direction is the energy sector developing in Germany?
5. Which typical problems exist in acquiring customers in the energy sector?
6. Which are the typical financing opportunities for start-ups in the energy sector? Especially in the field of renewable energies? And which problems arise in that context?
7. How does the accelerator program prepare the start-ups for those barriers?
8. Which topics are covered in workshops and trainings?

Interview guide for the founders of the start-ups, which completed the German Climate KIC Accelerator (S1, S2, S3, S4, S5)

Development

1. How did your vision and product/service change over time within the Accelerator Program and afterwards?
2. How did you grow since leaving the Accelerator Program?

Experience in the Accelerator

1. Which kind of support in the Accelerator Program was for you in hindsight most helpful in order to grow?
2. Which kind of support was missing in hindsight?
3. Which kind of networks were built within the program and were those beneficial in the end?
4. About which topics have you learned something new, e.g. through the coaching or workshops?
5. How can you still benefit from the Accelerator even after leaving the program?

Experience in the market

1. Which are the main barriers/difficulties you face after leaving the Accelerator? And are those specific for the (German) energy sector?
2. Have you been prepared for those barriers within the Accelerator Program?
3. Which chances do you see for your company in the energy market at the moment and in the future?
4. Which role do internal and external stakeholders play for the success of innovations in the energy sector?
Interview guide for the expert for energy management (E1)

1. In which way do energy efficiency measurements support the expansion of renewable energies?
2. How would you describe the general dynamics on the demand/ consumer side in the energy sector?
   → Further question if needed: Does the energy transition come along with a change in thinking and acting on the consumer side?
3. Which factors are relevant for consumers to actively deal with energy consumption and – efficiency?
   → Further question if needed: Is there a difference between different consumer groups (for example private persons, industry, cities)?
4. How open is the average consumer towards start-ups in the energy sector?
5. The energy efficiency measurements by the government can be manifold: Providing information, financial incentives, legal requirements. Which seem most useful? Are there other expedient measurements?
   → Further question if needed: Which measurements seem most useful for the different consumer groups?

Interview guide for the expert in start-ups financing/ venture capitalism (E2)

1. Why is it especially hard for start-ups in the energy sector to find investors?
   → Further question if needed: Could it be the factors software, hardware, time for the development or the cleantech sector in general?
   → Further question if needed: On the basis of which criteria does a Venture Capitalist decide to support a start-up?
2. How big is the share of Venture Capitalist in Germany, which focus on energy- or cleantech start-ups and what is their motivation to do so?
3. Was the situation on the capital market the same ten years ago or is it changing lately?
   → Further question if needed: How could its future look like?
4. How could the financing options be improved for start-ups in the energy sector?
   → Further question if needed: Can the politics do something about it?

Interview guide for the expert in energy-related regulations (E3)

1. Which role does the EEG play in the energy transition? Are there any other regulations or laws, which play an important role or have played an important role?
2. Can the EEG be called ‘a success’? If yes, why?
3. In which way did the EEG change over the years? And who benefitted mostly in which time period from it: New, innovative market players (start-ups, small enterprises, prosumers, ...) or the ‘top dogs’ of the energy sector (Big 4, big network operators, ...)?
4. Which impact will the newest amendment of the EEG most probably have for the energy transition?
Interview guide for the expert in lobbying (Eco Innovation Alliance) (E4)

1. Since when does the Eco Innovation Alliance exist?
2. How is the Eco Innovation Alliance organised? How does the interaction with the members look like?
3. How many accelerator or incubator programs are part of the Eco Innovation Alliance?
4. In which way does the Climate KIC Accelerator contribute to the Alliance?
5. How big is the influence on the political level?
   → Further question if needed: How could this be improved?
## Appendix C: List of documents used as secondary sources

<table>
<thead>
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<th>Name of the document</th>
<th>Type of document</th>
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<td>European Commission (2017)</td>
<td>Give context, track change and development</td>
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<td>Horizon 2020 in brief</td>
<td>Public document</td>
<td>European Union (2014)</td>
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<td>Accelerating the energy transition through innovation</td>
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<td>International Renewable Energy Agency (2017)</td>
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<td>Monitoringbericht 2016</td>
<td>Public document</td>
<td>Bundesnetzagentur (2016)</td>
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<td>BEE-Bilanz zum EEG 2017</td>
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<td>Bundesverband Erneuerbare Energie e.V. (2016)</td>
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<td>Vorschläge an die künftige Bundesregierung Deutschland bei grünen Innovationen zurück in die erste Liga zu heben</td>
<td>Internal document</td>
<td>Eco Innovation Alliance, personal communication, 2018 (Received from Head of Climate KIC)</td>
<td>Verify findings</td>
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<td>EIT-Climate KIC (2018b)</td>
<td>Give context</td>
</tr>
<tr>
<td>Who we are. Making an impact.</td>
<td>Website</td>
<td>Climate KIC Deutschland (2018)</td>
<td>Give context, supplement data base (RQ 1)</td>
</tr>
<tr>
<td>Accelerator Overview</td>
<td>Website</td>
<td>Eco Innovation Alliance (2017)</td>
<td>Verify findings</td>
</tr>
<tr>
<td>Eco Innovation Alliance</td>
<td>Website</td>
<td>Climate KIC (2016)</td>
<td>Give context, supplement data base (RQ 1)</td>
</tr>
<tr>
<td>Climate-KIC Accelerator programme: Germany 2016</td>
<td>Video</td>
<td>Climate KIC (2016)</td>
<td>Give context, supplement data base (RQ 1)</td>
</tr>
</tbody>
</table>
## Appendix D: Coding table 1

<table>
<thead>
<tr>
<th>Category</th>
<th>Category description</th>
<th>Sub category</th>
<th>Sub category description</th>
<th>Coding rule</th>
<th>Anchor example</th>
</tr>
</thead>
<tbody>
<tr>
<td>Networking</td>
<td>Important to create a customer base, to encourage interaction between relevant stakeholders and to provide resources</td>
<td>Broad</td>
<td>A diverse set of internal and external stakeholder is included to include different point of view</td>
<td>Als/Network zu anderen Energie-Start-Ups und sonstigen Kontakten sehr gut.</td>
<td>Man kann auch kein Unternehmen aufbauen mit einem Team was nicht wirklich gut harmoniert, gut zusammen arbeitet.</td>
</tr>
<tr>
<td>Learning</td>
<td>Necessary to improve the innovative outcome following new knowledge in different areas: Technological aspects, market and user preferences, cultural mapping, infrastructure, industry dynamics, policies, societal and environmental impacts</td>
<td>First-order</td>
<td>Facts and data are only presented</td>
<td>Als es viele Workshops gab, zum Beispiel im Bereich Vertrieb, gerade auch Vertrieb-Business-to-Business, und auch Marketing, Marketing-Kommunikation</td>
<td>Immer wieder Feedbackschleifen zu drehen, ihre Kunden wirklich in den Entwicklungsprozess mit einzubeziehen.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Second-order</td>
<td>Facts and data are reflected on and final adjustment in all areas are made</td>
<td>Any description of a statement which reflects the promised, actual or proposed appearance of a sub-category is assigned in MARKIDA respectively.</td>
<td>Als die beiden Team, die wir jetzt hier in dem Bereich beobachtet haben, also in den letzten Monaten und Jahren, da kann ich dich durchaus sagen, dass die alle persönlich schon sehr starkes Interesse an dem Beitrag zur positiven Umwelt- und Klimabilanz haben.</td>
</tr>
<tr>
<td>Experiments</td>
<td>Needed to test and develop new technologies</td>
<td>Interaction</td>
<td>Experiments lead to interaction and exchange between different actors</td>
<td>Als die beiden Team, die wir jetzt hier in dem Bereich beobachtet haben, also in den letzten Monaten und Jahren, da kann ich dich durchaus sagen, dass die alle persönlich schon sehr starkes Interesse an dem Beitrag zur positiven Umwelt- und Klimabilanz haben.</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Learning</td>
<td>Experiments lead to learning processes about the technology within its social scope</td>
<td>Als man muss jeden Tag irgendwie was testen und dann Erkenntnisse daraus ziehen und dann Veränderungen machen. Und diese Skills haben wir dann quasi aus dem Accelerator aus solche.</td>
<td>Die finanzielle Unterstützung ist sicherlich das Wichtigste.</td>
</tr>
<tr>
<td>Protection</td>
<td>Needed to provide a space for experiments where there is no exposure to incumbent technologies</td>
<td>Monetary support</td>
<td>Monetary support is given within the first phase of product development (e.g. tax relief, subsidies)</td>
<td>Alle die unterstützten nicht direkt in Form von Engineering oder Produktionsweiterentwicklung.</td>
<td>Als geht eigentlich gar nicht mehr da drum, ja Geld zu verdienen, sondern eher darum einer regulativen Rahmen so weiter zu entwickeln, dass sich der Realität dieser präsumtiven Welt stellt. Und da gibt es relativ wenig Analysen in Deutschland dass das geschehe.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Research and Development</td>
<td>Research and Development activities are set up to initiate product development</td>
<td>Alle die unterstützten nicht direkt in Form von Engineering oder Produktionsweiterentwicklung.</td>
<td>Als geht eigentlich gar nicht mehr da drum, ja Geld zu verdienen, sondern eher darum einer regulativen Rahmen so weiter zu entwickeln, dass sich der Realität dieser präsumtiven Welt stellt. Und da gibt es relativ wenig Analysen in Deutschland dass das geschehe.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Reduction of institutional constraints</td>
<td>Institutional barriers are reduced to benefit</td>
<td>alle die unterstützten nicht direkt in Form von Engineering oder Produktionsweiterentwicklung.</td>
<td>Als geht eigentlich gar nicht mehr da drum, ja Geld zu verdienen, sondern eher darum einer regulativen Rahmen so weiter zu entwickeln, dass sich der Realität dieser präsumtiven Welt stellt. Und da gibt es relativ wenig Analysen in Deutschland dass das geschehe.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Gradual withdrawal</td>
<td>As soon as the innovation is ready to be up-scaled, the protection should gradually be withdrawn while a transition from the technological niche to a market niche is happening</td>
<td>Als/Go to their investment in Innovation is ready to be up-scaled, the protection should gradually be withdrawn while a transition from the technological niche to a market niche is happening</td>
<td>Als/Go to their investment in Innovation is ready to be up-scaled, the protection should gradually be withdrawn while a transition from the technological niche to a market niche is happening</td>
</tr>
<tr>
<td>New components</td>
<td></td>
<td></td>
<td>Any repeated description or statement which reflects the promised, actual or proposed appearance of a sub-category is assigned in MARKIDA respectively under a new fitting title.</td>
<td>Als/Go to their investment in Innovation is ready to be up-scaled, the protection should gradually be withdrawn while a transition from the technological niche to a market niche is happening</td>
<td>Als/Go to their investment in Innovation is ready to be up-scaled, the protection should gradually be withdrawn while a transition from the technological niche to a market niche is happening</td>
</tr>
</tbody>
</table>
## Appendix E: Coding table 2

<table>
<thead>
<tr>
<th>Category</th>
<th>Category description</th>
<th>Sub-categories</th>
<th>Sub-category description</th>
<th>Coding rule</th>
<th>Anchor example</th>
<th>Approach</th>
</tr>
</thead>
<tbody>
<tr>
<td>Contextual factors</td>
<td>Market, user preferences</td>
<td>Barriers and opportunities in the operating environment can be of material or non-material nature. Barriers slow down or hinder the growth of start-ups and make it difficult for them to enter the energy market. Opportunities support or push the growth of start-ups and make it easier for them to enter the energy market.</td>
<td>The way users act on the energy market or the way in which the market functions has an influence on the growth of start-ups</td>
<td>Ich meine es ist allgemein denke ich mal in Deutschland schwankt eine Finanzierung zu bekommen, insbesondere wenn man ein hardware Startup ist.</td>
<td></td>
<td>Descriptive</td>
</tr>
<tr>
<td></td>
<td>Industry</td>
<td>Incumbents or the general structure of the energy sector make a market entry for start-ups difficult or easy.</td>
<td>Any statement which depicts the existence of a sub-category is assigned to MAXQDA respectively. In a second step it is marked as being a barrier or an opportunity.</td>
<td>Es herrscht in Deutschland immer noch eine extrem starke Lobby und die extrem verschlossene Industrie.</td>
<td></td>
<td>Inductive (SLIP)</td>
</tr>
<tr>
<td></td>
<td>Risky</td>
<td>Policies strongly influence the development of start-ups in the energy sector</td>
<td></td>
<td>Die einzige Voraussetzung bei Energiewende und Klimaschutz ist kaum noch vorhanden. Schuld sind politische Rahmenbedingungen, die heterarchische Geschäftskulturen etablierter Unternehmen schützen und wenig Spielraum für disruptive neue Akteure bieten.</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Technology</td>
<td>Technological components have an impact on the development of start-ups in the energy sector</td>
<td>Die Energiewende wird nicht technisch scheitern, sondern wird an nacheilender Akzeptanz</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Culture</td>
<td>The symbolic meaning of ideas technology, innovation and the energy-related values within the operating environment have an impact on the development of start-ups in that field</td>
<td>Und nicht immer diese Skepsis, denn gegenüber hat. Ich meine gerade wo Deutschen sind ja de extern was so “Angst vor Neuem” angeht.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Science</td>
<td>Scientific knowledge plays a role for the successful development of start-ups in the energy sector</td>
<td>Start-ups haben in vielen Branchen unter Beweis gestellt, welchen wichtigen Beitrag sie zur Schließung der bestehenden Lücke zwischen Forschung und Markt leisten können.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>New components</td>
<td>Any statement which repeatedly reveals a new category or sub-category is assigned to MAXQDA respectively under a new fitting title.</td>
<td>Also eigentlich fokussieren sich viele Acceleratoren erstmal darauf ja das Geschäftsmodell anzupassen, zu perfektionieren und das Startup Investor-ready zu machen. Das heißt bereits für die meisten Investors zu machen... Und weniger auf das Zusammenbringen mit Kunden, also die unterstützen das, aber so suchen nicht albo nach Kunden für die Startups. → “Role of the Accelerator”</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Appendix F: Coding example