SUSTAINABLE ENTREPRENEURSHIP AND THE BIOECONOMY TRANSITION

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Abstract

Transgressing planetary boundaries endangers the safe operating space for humanity. Thus, a transition of socioeconomic systems toward sustainable development is needed. Prior research elevated the role of sustainable entrepreneurship (SE) in the transition process toward sustainable development in general and the bioeconomy in specific, which has been identified as a promising framework to ensure sustainable and circular economic activity with planetary boundaries. Bioeconomy strategies worldwide acknowledge the importance of entrepreneurship for the transition process. There is consensus in research that entrepreneurs are needed to implement the vision of a bioeconomy as defined in these strategies. However, it remains unclear how opportunities for entrepreneurial activity in the bioeconomy come into existence and how entrepreneurs contribute to the bioeconomy transition by acting on the provided opportunities. Thus, this dissertation aims to shed light on the interface of SE and the bioeconomy, specifically by investigating the interplay between SE and the bioeconomy transition in light of planetary boundaries and the role of entrepreneurs within the transition. The four empirical studies included in this dissertation take different perspectives on the interface of SE and the bioeconomy and thus contribute different insights to the overall picture drawn in this dissertation.

For instance, Study 1 examines a transition pathway to a sustainable bioeconomy by involving an international expert sample in a Delphi survey and subsequent cross-impact analysis. Based on the experts' views, Study 1 presents a list of events necessary to achieve the transition ranked by the experts to reflect their urgency. The cross-impact analysis facilitates combining the eight most urgent events to create an integrated model of the transition to a sustainable bioeconomy. The findings suggest that rather than bioeconomy strategies, technological progress leveraged by innovative bioeconomy startups and investments in the relevant sectors currently constitute the main bottleneck hindering a transition to a bioeconomy.

While Study 1 elaborates on the role of innovation and entrepreneurship on the level of the transition pathway, Study 2 zooms into the level of new bioeconomy ventures. Based on interviews with ten bioeconomy entrepreneurs from six European countries, it investigates how entrepreneurial opportunities emerge in the bioeconomy context and what competencies entrepreneurs need to act on them. Conceptualizing the bioeconomy transition as an external enabler for SE, Study 2 opens new avenues for research on sustainable development and innovation

policy. Furthermore, Study 2 shows that new venture creation in the bioeconomy requires unique knowledge and specific competencies.

Study 3 asks how to scale sustainable new ventures and puts it in the context of the ongoing de-growth debate. In recent years the de-growth paradigm has gained popularity in the sustainability discourse. Questioning the absolute decoupling of economic growth from environmental degradation, de-growth proponents suggest downscaling production and consumption to reduce resource extraction and energy consumption. Applying latent class analysis to reveal de-growth attitudes among 393 surveyed entrepreneurs and subsequent regression analysis, Study 3 answers how de-growth attitudes among (sustainable) entrepreneurs are associated with their decision-making on scaling strategies for their ventures. Furthermore, it shows that the development level of the economy an entrepreneur is active in is an essential factor in the decision-making on scaling strategies.

Study 4 investigates how sustainable new ventures gain legitimacy to acquire the necessary resources to grow. Previous research suggested being distinctive yet understandable as key to legitimacy for new ventures. However, Study 4 describes complex entrepreneurial identities, i.e., unconventional combinations of entrepreneurial identity claims from the founder and venture levels, as an additional source of legitimacy that benefits only sustainable new ventures but not conventional ones. Since sustainable startups aim to tackle complex problems, external audiences expect them to be different from established conventions of the status quo. An analysis of 15,116 crowdfunding campaigns and their creators' user profiles via topic modeling and subsequent regression analysis supports this argumentation. The findings show that sustainable ventures with complex – or even odd – entrepreneurial identities receive more support from crowdfunders, while conventional ventures do not.

Overall, this dissertation conceptualizes a bi-directional and potentially reinforcing relationship between SE and the bioeconomy transition by building on extant literature and collecting and analyzing new data in four empirical studies. Moreover, it highlights the role of entrepreneurs who need unique knowledge and specific competencies and differ significantly from conventional entrepreneurs in their behavior and entrepreneurial identity. Finally, this dissertation discusses how policy and societal norms can foster productive entrepreneurship that is innovative and sustainable within planetary boundaries.

Zusammenfassung

Das Überschreiten planetarer Grenzen birgt für die Menschheit die Gefahr des Verlustes eines sicheren Handlungsspielraums zur Sicherung ihrer Lebensgrundlage. Daher ist die Transformation sozioökonomischer Systeme hin zu nachhaltiger Entwicklung erforderlich. Frühere Forschung hat die Rolle nachhaltigen Unternehmertums (Englisch: Sustainable Entrepreneurship, abgekürzt SE) im Übergangsprozess zu einer nachhaltigen Entwicklung im Allgemeinen und der Bioökonomie im Besonderen hervorgehoben. Die Bioökonomie gilt dabei als vielversprechendes Konzept für die Gewährleistung einer nachhaltigen und zirkulären Wirtschaftstätigkeit unter Berücksichtigung der planetaren Grenzen. In Bioökonomie-Strategien weltweit wird hierbei die Bedeutung des Unternehmertums für den Übergangsprozess anerkannt. In der Forschung besteht Konsens darüber, dass Unternehmerinnen und Unternehmer benötigt werden, um die Vision einer Bioökonomie, wie sie in diesen Strategien definiert ist, umzusetzen. Es bleibt jedoch unklar, wie unternehmerische Opportunitäten in der Bioökonomie entstehen und wie genau Unternehmer durch die Verwertung dieser Opportunitäten zur Bioökonomie-Transformation beitragen. Diese Dissertation zielt daher darauf ab, die Schnittstelle zwischen SE und der Bioökonomie zu beleuchten. Einerseits durch die Untersuchung des Zusammenspiels zwischen SE und der Transformation zur Bioökonomie angesichts planetarer Grenzen. Und andererseits durch eine Betrachtung der Rolle von Unternehmerinnen innerhalb dieser Transformation. Die vier empirischen Studien dieser Dissertation, betrachten die Schnittstelle von SE und Bioökonomie dabei aus unterschiedlichen Blickwinkeln und tragen somit unterschiedliche Erkenntnisse zu dem in dieser Dissertation gezeichneten Gesamtbild bei.

So wird in Studie 1 ein Transformationspfad zu einer nachhaltigen Bioökonomie untersucht, indem eine internationale Expertengruppe in eine Delphi-Befragung und eine anschließende Cross-Impact-Analyse einbezogen wird. Auf der Grundlage der Expertenmeinungen geht aus Studie 1 eine Liste von Ereignissen hervor, die für die Transformation erforderlich sind und von den teilnehmenden Expertinnen und Experten nach ihrer Dringlichkeit geordnet wurden. Die Cross-Impact-Analyse ermöglicht die Kombination der acht dringendsten Maßnahmen zu einem integrierten Modell eines Transformationspfades hin zu einer nachhaltigen Bioökonomie. Die Ergebnisse deuten darauf hin, dass nicht Bioökonomie-Strategien, sondern technologischer Fortschritt - hervorgebracht durch innovative Bioökonomie-Startups - und Investitionen in den

entsprechenden Sektoren derzeit den größten Engpass darstellen, der den Übergang zu einer Bioökonomie behindert.

Während Studie 1 die Rolle von Innovation und Unternehmertum auf der Ebene des Transformationspfades beleuchtet, geht Studie 2 auf die Ebene neuer Bioökonomie-Startups ein. Auf der Grundlage von Interviews mit zehn Bioökonomie-Unternehmern aus sechs europäischen Ländern wird untersucht, wie unternehmerische Opportunitäten im Kontext der Bioökonomie entstehen und welche Kompetenzen Unternehmerinnen benötigen, um sie zu nutzen. Durch die Konzeptualisierung der Bioökonomie-Transformation als Katalysator für SE eröffnet Studie 2 neue Perspektiven für die Forschung zu Innovationspolitik mit dem Ziel nachhaltiger Entwicklung. Darüber hinaus zeigt Studie 2, dass die Gründung neuer Unternehmen in der Bioökonomie einzigartiges Wissen und spezifische Kompetenzen erfordert.

Studie 3 geht der Frage nach, wie nachhaltige Gründungsunternehmen skaliert werden können und stellt dies in den Kontext der aktuellen Debatte über die Vereinbarkeit von Wirtschaftswachstum und Umweltschutz. In den letzten Jahren hat das Postwachstums- bzw. De-Growth-Paradigma im Nachhaltigkeitsdiskurs an Popularität gewonnen. Die Befürworter des De-Growth-Paradigmas stellen die Möglichkeit einer absoluten Entkopplung des Wirtschaftswachstums von der Umweltzerstörung in Frage und schlagen deshalb vor, Produktion und Konsum herunterzufahren, um so die Ressourcenentnahme und den Energieverbrauch zu verringern. Durch die Anwendung einer latenten Klassenanalyse zur Ermittlung von De-Growth-Einstellungen bei 393 befragten Unternehmern und einer anschließenden Regressionsanalyse gibt Studie 3 Aufschluss darüber, wie De-Growth-Einstellungen bei (nachhaltigen) Unternehmerinnen mit ihren Entscheidungen über Skalierungsstrategien für ihre Unternehmen zusammenhängen. Außerdem zeigt sie, dass das Entwicklungsniveau der Wirtschaft, in der ein Unternehmer tätig ist, ein wesentlicher Faktor bei der Entscheidung über Skalierungsstrategien ist.

Studie 4 untersucht, wie nachhaltige Gründungsunternehmen Legitimität erlangen, um die für ihr Wachstum erforderlichen Ressourcen zu erhalten. Frühere Forschung legt nahe, dass der Schlüssel zur Legitimität neuer Unternehmen darin liegt, Neuartigkeit zu signalisieren, aber gleichzeitig etablierten Normen zu entsprechen, um von Stakeholdergruppen verstanden und eingeordnet werden zu können. Studie 4 beschreibt nun jedoch komplexe unternehmerische Identitäten, im Sinne unkonventioneller Kombinationen von unternehmerischen Identitäten auf Gründer- und Unternehmensebene, als zusätzliche Legitimitätsquelle, die nur nachhaltigen, nicht aber konventionellen Neugründungen zugutekommt. Da nachhaltige Neugründungen darauf

abzielen, komplexe Probleme zu lösen, erwarten Stakeholder von ihnen, dass sie sich von den etablierten Konventionen des Status quo unterscheiden. Eine Analyse von 15.116 Crowdfunding-Kampagnen und den Nutzerprofilen ihrer Ersteller mittels Themenmodellierung und anschließender Regressionsanalyse unterstützt diese Argumentation. Die Ergebnisse zeigen, dass nachhaltige Unternehmungen mit komplexen - oder sogar eigenartigen - unternehmerischen Identitäten mehr Unterstützung von Crowdfundern erhalten, während konventionelle Unternehmungen dies nicht tun.

Insgesamt konzeptualisiert diese Dissertation eine bidirektionale und potenziell verstärkende Beziehung zwischen SE und der Bioökonomie-Transformation, indem sie auf vorhandener Literatur aufbaut und neue Daten in vier empirischen Studien sammelt und analysiert. Darüber hinaus wird die Rolle von Unternehmerinnen und Unternehmern hervorgehoben, die einzigartiges Wissen und spezifische Kompetenzen benötigen und sich in ihrem Verhalten und ihrer unternehmerischen Identität deutlich von herkömmlichen Unternehmerinnen und Unternehmern unterscheiden. Schließlich wird in dieser Dissertation erörtert, wie politische und gesellschaftliche Normen ein produktives, innovatives und nachhaltiges Unternehmertum innerhalb planetarer Grenzen fördern können.

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1 Introduction

The transgression of planetary boundaries through mainly economic activity endangers the safe operating space for humanity, which depends on the integrity of the earth system (Rockström et al., 2009; Steffen et al., 2015). In addition, transgressing planetary boundaries has significant implications for social justice (Rockström et al., 2023). Especially climate change carries the risk of increasing social inequality and severe health effects for the poorest (Levy & Patz, 2015; UNDP, 2019). Hence, there can be no doubt that human societies must transform toward sustainable development to stay within the thresholds defined by planetary boundaries.

Several national and international strategies have been set up to operationalize and implement this transformation, maybe most prominently and comprehensively, the United Nations' Sustainable Development Goals (SDGs; UN, 2015). Various governments identified transforming mainly linear and fossil- based economies so far into sustainable and circular bioeconomies that rely on renewable and biobased resources as a viable solution to achieve the SDGs (El-Chichakli et al., 2016). Thus, they developed dedicated bioeconomy strategies to envision this transition toward a sustainable bioeconomy (German Bioeconomy Council, 2018). Interestingly, these bioeconomy strategies emphasize the role of entrepreneurs in achieving the targeted bioeconomy transition and assign entrepreneurship an elevated importance (Kuckertz, 2020).

Additionally, within the past two decades, sustainable entrepreneurship (SE) emerged as a sub-domain of entrepreneurship research (Muñoz & Cohen, 2018). It captures the idea of entrepreneurial activity that aims to sustain its ecological and social environments (Muñoz & Dimov, 2015) and to contribute to a transition toward sustainable development (Hall et al., 2010). Thus, SE is not seen as a further root of environmental degradation and social inequality but rather as a solution to achieve sustainable development (Muñoz & Cohen, 2018). And indeed, research has identified SE as a critical factor in successfully implementing and achieving the bioeconomy transition (Kuckertz, Berger, et al., 2020). However, it remains unclear what constitutes the "opportunity space" (Kuckertz, Hinderer, et al., 2019, p. 4) for entrepreneurial activity in the bioeconomy and how entrepreneurs contribute to the bioeconomy transition by acting on the provided opportunities (Kuckertz, Berger, et al., 2020). In sum: Some of the most fundamental research questions in entrepreneurship research (Shane & Venkataraman, 2000) transferred to the interface of entrepreneurship and the bioeconomy.

Thus, this dissertation aims to shed light on this interface. On the one hand, by investigating the interplay between SE and the bioeconomy transition in light of planetary boundaries. And on the other hand, by investigating the role of entrepreneurs within the transition. Figure 1-1 summarizes the research framework of this dissertation. The aim is to contribute to the intersection of the SE discourse and the emerging literature stream discussing how to achieve a successful transition toward a sustainable bioeconomy.

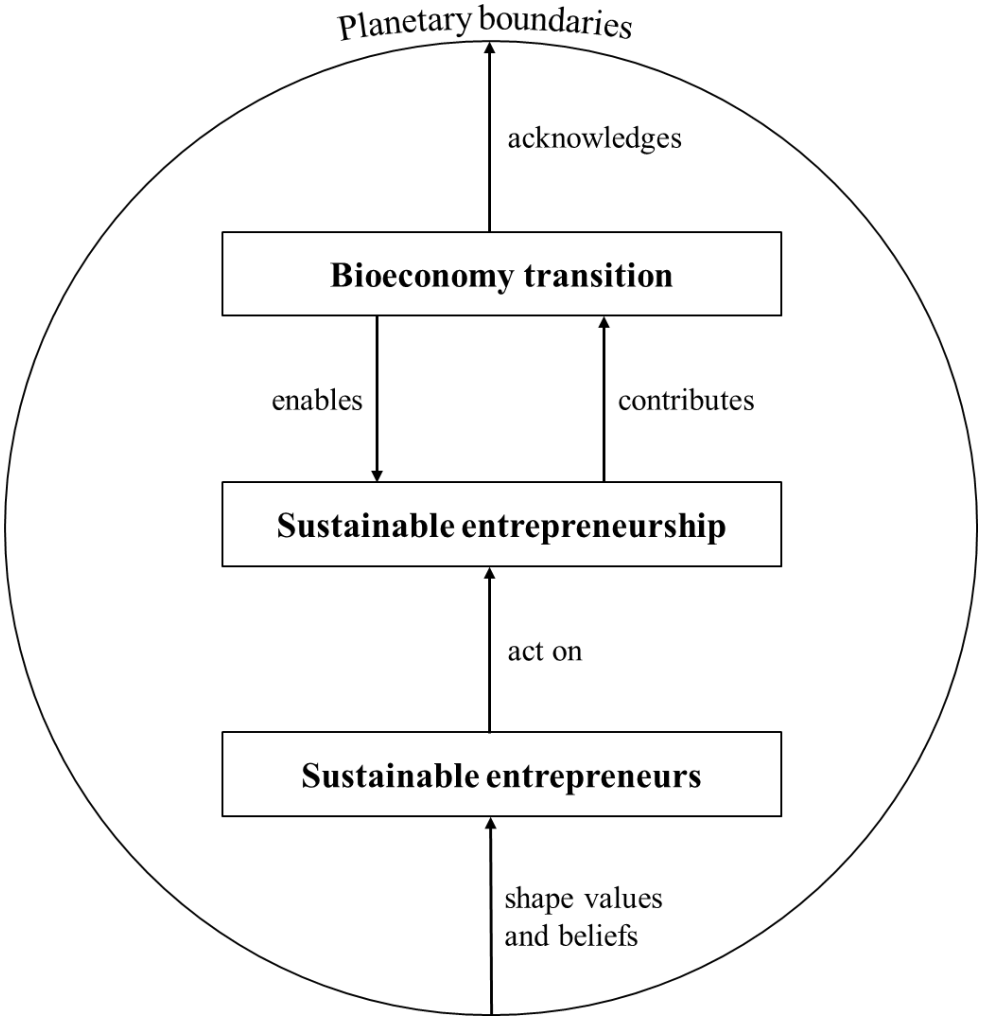

Figure 1-1: Research framework of the dissertation

In addition to that, this dissertation aims to link these two literature streams more closely together. In particular, this dissertation proposes that innovation leveraged by bioeconomy startups is a critical and central element in the transition pathway to a sustainable bioeconomy (Study 1), while the transition enables SE by offering attractive opportunities for entrepreneurial action (Study 2). Moreover, this dissertation sheds light on the role of entrepreneurs' traits in the context of the bioeconomy transition in specific and sustainability transitions in general (Studies 2 to 4). Its findings indicate what knowledge and competencies are needed for sustainable entrepreneurial action (Study 2) and how personal values, beliefs, and identity shape sustainable entrepreneurs' behavior and decisions (Studies 3 and 4). Thus, I argue a bi-directional relationship exists between the design and course of the bioeconomy transition and sustainable entrepreneurs and their actions. Hence, in the following chapters, I briefly introduce the literature streams of SE and the bioeconomy transition, especially highlighting extant links between the two.

1.1 Sustainable entrepreneurship

As outlined above, in light of humanity's sustainability-related challenges, SE has been recognized as a solution to environmental degradation and social inequality (Muñoz & Cohen, 2018). Early conceptualizations of the field described environmental degradation and social inequality as market imperfections that offer viable opportunities for sustainable entrepreneurs to act on (Cohen & Winn, 2007; Dean & McMullen, 2007). Thus, "[SE] is focused on the preservation of nature, life support, and community in the pursuit of perceived opportunities to bring into existence future products, processes, and services for gain, where gain is broadly construed to include economic and non-economic gains to individuals, the economy, and society" (Shepherd & Patzelt, 2011).

However, SE is not the only sub-domain of entrepreneurship research focusing on the intersection of entrepreneurship and sustainability-related issues. It is closely related – and partly overlapping – with the fields of environmental entrepreneurship and social entrepreneurship (Binder & Belz, 2015). Indeed, SE has been conceptualized as the convergence of social and environmental entrepreneurship (Belz & Binder, 2017). While social and environmental entrepreneurs follow a double-bottom line approach (i.e., pursuing social and economic or environmental and economic goals, respectively), those converge to a triple-bottom-line approach in SE, where entrepreneurs pursue social, environmental and economic goals through entrepreneurial action (Belz & Binder, 2017; Schaefer et al., 2015). However, this view neglects

that social entrepreneurship has frequently been described as addressing social and environmental problems (Doherty et al., 2014).

Hence, (Vedula et al., 2021) analyzed the fields of social and environmental entrepreneurship based on bibliometric network analysis and subsequent qualitative analysis of the literature, showing that they emerged in different scholarly communities with different epistemological roots, although sharing some common elements today. Environmental entrepreneurship is primarily rooted in Austrian economics (Kirzner, 1979; Schumpeter, 1934), focusing on the origins of environmental entrepreneurial opportunities, thus emphasizing the synergies in pursuing environmental and economic goals (Vedula et al., 2021). In contrast, social entrepreneurship is rooted in multiple epistemological perspectives, including strategy, non-profit management, and sociology, emphasizing the trade-offs between economic and social goals, which is also reflected in its proximity to the literature on institutional logics and hybridity (Vedula et al., 2021). Thus, for this dissertation, I rely on the concept and refer to the term SE, understanding it as an umbrella that claims to incorporate the ideas, principles, and concepts of environmental and social entrepreneurship (Schaltegger & Wagner, 2011; Shepherd & Patzelt, 2011).[1]

Unique for the field of SE compared to the literature on social and environmental entrepreneurship is the emphasis on its transformative power (Binder & Belz, 2015). Sustainable entrepreneurs not only directly tackle environmental or social issues; ideally, they act as change agents transforming markets and society toward sustainable development (Anand et al., 2021; Muñoz & Dimov, 2015; Schaltegger & Wagner, 2011). While operating on the micro level, they trigger causal mechanisms that lead to transformational change on the macro level (Johnson & Schaltegger, 2020). As sustainable entrepreneurs enter the market with innovative new sustainable business models, they push incumbents to transform their business models toward more sustainability (Hockerts & Wüstenhagen, 2010). By changing the market institutions (e.g., norms, property rights, and legislation), they level the playing field for even more sustainable business models (Pacheco et al., 2010). And indeed, empirical research has shown that SE fosters sustainable development by contributing to achieving the SDGs (Horne et al., 2020) and addressing the

[1] Study 4 is the only study of this dissertation referring to the term social entrepreneurship instead of SE. The theoretical framework of Study 4 is mainly based on institutional theory, specifically legitimacy, institutional logics and hybridity. Historically, social entrepreneurship and its scientific community are stronger rooted within this body of literature (Anand et al., 2021; Vedula et al., 2021). Thus, for Study 4 the co-authors and I decided to adapt the term used in the relevant literature to address its respective community. However, my understanding and usage of the term social entrepreneurship in Study 4 is synonymous and interchangeable with my understanding of SE in the remainder of this dissertation. Thus, in Chapter 1 and 6 as well as in Studies 1 to 3 I refer solely to SE.

transgression of planetary boundaries (Kuckertz, Berger, et al., 2019). Thus, SE offers a suitable epistemological lens for this dissertation's aim to investigate entrepreneurship's contribution to the bioeconomy transition.

However, it is not a panacea to all sustainability-related issues (Hall et al., 2010). Indeed, SE may have a problem with solutionism, claiming to provide solutions to problems where sound public policy may be the more effective solution (Chalmers, 2021). Moreover, SE so far misses a linkage to the concept of planetary boundaries (Hummels & Argyrou, 2021; Schaltegger et al., 2018). While SE's contribution to sustainable development remains often abstract, linking it closer to the planetary boundaries concept could help make SE's impact more visible and explicit (Schaltegger et al., 2018). Eventually, acting in compliance with planetary boundaries represents a *sine qua non* to the idea of SE (Hummels & Argyrou, 2021). The same applies to the transition to a sustainable bioeconomy. Hence, in the following chapter, I will briefly outline the concepts and ideas behind the bioeconomy transition.

1.2 The sustainable bioeconomy and entrepreneurship

Governments worldwide acknowledge transitioning to a sustainable bioeconomy as an effective measure to achieve the SDGs (El-Chichakli et al., 2016) and, thus, have set up strategies to implement such a transition (German Bioeconomy Council, 2018). There are different understandings, visions, and narratives about the bioeconomy (Bauer, 2018; Bugge et al., 2016; Vivien et al., 2019), but it is commonly defined as "the production, utilization, and conservation of biological resources, including related knowledge, science, technology, and innovation, to provide information, products, processes, and services in all economic sectors aiming toward a sustainable economy" (Global Bioeconomy Summit, 2018, p. 4). For this dissertation, the bioeconomy vision and strategy of the European Union (EU; European Commission, 2018) aiming to implement a sustainable and circular bioeconomy is of special importance, as it represents the conceptual reference framework of Studies 1 and 2. First launched in 2012 (European Commission, 2012), the EU's bioeconomy strategy was updated in 2018 (European Commission, 2018), but its origins and conceptual predecessors date back to the 1990s (Patermann & Aguilar, 2018).

However, the EU's bioeconomy has been criticized for using sustainability only as a "selling-point" (Ramcilovic-Suominen & Pülzl, 2018, p. 4170) and for "hijacking" (Vivien et al., 2019, p. 189) the term "bioeconomics" coined initially by Georgescu-Roegen (1977). Based on the law of thermodynamics, Georgescu-Roegen (1975) argues that every economic activity is entropic,

i.e., using fossil fuel energy and low entropic resources to produce goods and waste of higher entropic matter. Thus, economic activity decreases the amount of low entropic matter and available energy in a system, while both are necessary for further economic activity (Georgescu-Roegen, 1975). Hence, he suggests considering economic systems as sub-systems of the natural environment and as dependent on its capacities to reproduce natural resources of low entropy and to recover from degradation through economic activity (Georgescu-Roegen, 1975). It is thus not surprising that many proponents of the de-growth paradigm suggesting a downscaling of production and consumption to keep the environmental impact of economic activity within the planetary boundaries refer to the work of Georgescu-Roegen (e.g., Bonaiuti, 2011; Kallis, 2011). Though, there is far from a consensus on whether Georgescu-Roegen's concept of bioeconomics contains a de-growth logic (Missemer, 2017). Nevertheless, critics arguing from a de-growth perspective see the EU's and others' – e.g., the OECD's (2009) – bioeconomy strategies at odds with Georgescu-Roegen's bioeconomics since these strategies carry a green growth vision and Schumpeterian vision of industrial revolutions through innovation (Giampietro, 2019; Ramcilovic-Suominen et al., 2022; Vivien et al., 2019). Recently Ramcilovic-Suominen et al. (2022, p. 1) termed the discourse between these two dominant but opposing bioeconomy visions as "pro-economic growth" (referring to a green growth logic) versus "pro-planetary limits" (referring to a de-growth logic) bioeconomy visions.

This discourse is important for this dissertation, as both visions come with different implications for the role of entrepreneurship in the bioeconomy transition. As mentioned above, the "pro-economic growth" (Ramcilovic-Suominen et al., 2022, p. 1) vision implicitly carries Schumpeter's (1942, p. 83) famous idea of "creative destruction", where disruptive innovation leads to the destruction of an old industry sector and the simultaneous creation of a new one, and which serves as a blueprint for the bioeconomy transition (Vivien et al., 2019). Since, for Schumpeter, the entrepreneur is at the heart of economic development carrying out the process of innovation (Schumpeter, 1934), bioeconomy startups play a central role in the bioeconomy transition according to the "pro-economic growth" (Ramcilovic-Suominen et al., 2022, p. 1) vision. Thus, many bioeconomy strategies carrying a "pro-economic growth" bioeconomy vision – including the EU's bioeconomy strategy – emphasize the importance of entrepreneurship for the bioeconomy transition (Kuckertz, 2020). And indeed, research has shown that entrepreneurship plays a significant role in implementing the bioeconomy transitions envisioned by these strategies (Kuckertz, Berger, et al., 2020).

In contrast, the "pro planetary limits" (Ramcilovic-Suominen et al., 2022, p. 1) bioeconomy vision remains widely silent about entrepreneurship and innovation. However, it contributes an essential perspective on the transition process by highlighting the importance of considering planetary boundaries in the bioeconomy transition and understanding the economy as a sub-system of the natural environment (Ramcilovic-Suominen et al., 2022). Research has shown that a bioeconomy transition is not sustainable per se but needs to be evaluated continuously regarding its contribution to sustainable development (Pfau et al., 2014). Claiming sustainability based on the substitution of fossil through biobased resources is not sufficient (Giurca & Befort, 2023); entrepreneurs need to prove the sustainability of such substitutes through the appropriate assessment of the environmental and social impact of production (Schulte et al., 2021).

Thus, this dissertation investigates SE's contribution to a bioeconomy transition in light of planetary boundaries. Therefore, I lend from Baumol (1996), drawing on his notion of productive entrepreneurship as an epistemological lens for this dissertation. Building on Schumpeter's (1934) seminal work on innovations, Baumol (1996) differentiates between productive, i.e., innovative entrepreneurship, and unproductive or even destructive entrepreneurship driven by pure rent-seeking, e.g., through litigation or tax avoidance and evasion. Remarkably, Baumol, 1996 (p. 7) proposes that allocating entrepreneurial resources to these three types of entrepreneurship can be influenced by "the rules of the game that determine the relative payoffs to different entrepreneurial activities". These "rules of the game" can be policy and the perception and desirability of entrepreneurship in a society (Baumol, 1996, p. 7).

Consequently, in the context of this dissertation, productive entrepreneurship represents innovative entrepreneurial activity that fosters sustainable development while respecting planetary boundaries. Hence, when investigating SE's contribution to and entrepreneurs' role within the bioeconomy transition, I do so by considering the productivity of entrepreneurial activity and asking how the "rules of the game" (Baumol, 1996, p. 7) need to be changed to increase the allocation of entrepreneurial resources to productive entrepreneurship.

1.3 Thesis structure

This dissertation contains four empirical studies. These four studies investigate SE's contribution to the transition toward a bioeconomy and how individuals act on entrepreneurial opportunities in the bioeconomy and engage in SE. Together, these four studies support the main propositions of this dissertation that SE plays a crucial and central role in the bioeconomy transition

but that the "rules of the game" (Baumol, 1996, p. 7) need to change for entrepreneurship to be genuinely sustainable and innovative, thereby contributing to a transition within planetary boundaries.

In Study 1, the co-authors and I examine a transition pathway to a sustainable bioeconomy. Since the field of bioeconomy research is still young and somewhat fragmented (Birner, 2018; Bugge et al., 2016), there is no consensus yet about the vision of a future bioeconomy and a transition pathway to get there. Instead, there are rather opposing visions of a future bioeconomy (Ramcilovic-Suominen et al., 2022; Vivien et al., 2019) implicating two different perspectives on the bioeconomy transition (Priefer et al., 2017): A technology-based transition perspective emphasizing technology, innovation and market efficiency as key drivers, and a socio-ecological transition perspective highlighting changed consumption patterns and sustainable production processes. Thus, we aimed to reveal an integrated perspective on a bioeconomy transition reconciling the two competing views. Hence, we invited 231 leading bioeconomy experts from 18 European countries, including industry representatives, entrepreneurs, scholars, and policymakers, to participate in a Delphi survey and a subsequent cross-impact analysis (Bañuls & Turoff, 2011). Based on the responses of the 50 participating experts, we present a list of events necessary to achieve the desired transition ranked by the experts to reflect their urgency. The cross-impact analysis facilitates combining the eight most urgent events to create an integrated model of the transition to a sustainable bioeconomy. The findings suggest that, rather than bioeconomy strategies, technological progress and investments in the relevant sectors currently constitute the main bottleneck hindering a transition to a bioeconomy. Thus, Study 1 can be seen as an elaborated problem statement, revealing the role of innovation and entrepreneurship in the transition to a sustainable bioeconomy. On the one hand, it reveals the need for innovative bioeconomy startups to leverage technological progress and scale solutions to sustainability-related challenges. On the other hand, it sheds light on the issue of financing such startups.

Study 2 zooms from the macro-level of the bioeconomy transition to the micro-level of new bioeconomy ventures. The co-author and I investigate how entrepreneurial opportunities emerge in the bioeconomy context and what knowledge and competencies entrepreneurs need to act on them. We conducted semi-structured interviews with 10 (co-) founders of bioeconomy startups from six European countries and analyzed them inductively by applying the Gioia-method (Gioia, Corley, et al., 2013). We build on the concept of external enablers from Davidsson et al. (2020, p. 311) as "external conditions such as new technologies; regulatory or demographic shifts; and

changes to the socio-cultural, economic, political, or natural environments" that facilitate entrepreneurial action. Drawing on the external enablement framework (Davidsson et al., 2020), we propose a bi-directional and potentially reinforcing relationship between the envisioned bioeconomy transition and SE. While prior research found that SE contributes to the bioeconomy transition (Kuckertz, Berger, et al., 2020), we suggest that the environmental changes induced by the bioeconomy transition represent an external enabler facilitating sustainable entrepreneurial action. Therewith, we open new avenues for research on sustainable development and innovation policy and raise the question how such policy needs to be designed to enable SE. This lays the foundation for the synthesized discussion at the end of this dissertation (Chapter 6). Furthermore, we show that new venture creation in the bioeconomy requires unique knowledge (transformative knowledge, cf. Urmetzer et al., 2018) and specific competencies (sustainable valorization of biomass, marketing of biobased products, and management of limited resources). These include the ability to scale newly created ventures and to ensure the required funding, on which I focus in Studies 3 and 4 respectively.

Study 3 asks how to scale sustainable new ventures and their solutions to sustainability-related problems (Shepherd & Patzelt, 2022) and puts it in the context of the ongoing de-growth debate. In particular, the co-author and I ask how sustainable and conventional entrepreneurs' attitudes toward economic growth on a macro level relates to their attitude toward firm growth and its operationalization on the micro level. Although Study 3 is not explicitly set in a bioeconomy context, the de-growth debate is highly relevant for the discourse on bioeconomy transition pathways, as shown above. Questioning the absolute decoupling of economic growth from environmental degradation, de-growth proponents suggest downscaling production and consumption to reduce resource extraction and energy consumption (Kallis, 2011; Schneider et al., 2010; van den Bergh, 2017). In contrast, proponents of the opposing green growth paradigm promote innovation and entrepreneurship as key to "greening" the economy and decoupling growth from environmental degradation through cleaner production (Bowen et al., 2012; Fernandes et al., 2021; van den Bergh, 2017). Thus, we argue that a de-growth attitude is at odds with conventional principles of entrepreneurship, having implications for entrepreneurs' scaling decisions. Specifically, we suggest that entrepreneurs' scaling strategies differ in their temporal orientation, since business sustainability is about time (Bansal & DesJardine, 2014): While business operations often can be accelerated and compressed in time, this is not possible for the natural environment's processes they are dependent from (Bansal & Knox-Hayes, 2013). Moreover, we consider in our

theorizing and analysis the development level of the economy an entrepreneur is active in, since the discourse of the de-growth and green growth paradigms mainly takes place in high-income countries and neglects implications for developing countries (Cosme et al., 2017; Weiss & Cattaneo, 2017). To test our theorizing, we surveyed 393 sustainable and conventional entrepreneurs about their preferred scaling strategies using newly developed scales to differentiate between preferences for scaling fast and scaling slow strategies. Moreover, we used a "Growth vs. Environment" survey module developed by Drews et al. (2019) to reveal de-growth attitudes by applying latent class analysis to the responses. A subsequent hierarchical OLS regression analysis showed that a de-growth attitude is negatively associated with scaling fast strategies, whether entrepreneurs consider themselves sustainable or not. However, SE is positively associated with scaling slow strategies. Furthermore, we show that the development level of the economy an entrepreneur is active in is an essential factor in the decision-making on scaling strategies. The findings of Study 3 indicate that the scaling decisions of sustainable entrepreneurs consider more factors and are, thus, more complex. I take these indications up in the synthesized discussion of this dissertation in Chapter 6.

Study 4 sheds light on how sustainable new ventures gain legitimacy to acquire resources on crowdfunding platforms. Prior research suggests that new ventures must be optimal distinctive, i.e., demonstrating novelty while referring to established and known reference categories, to gain legitimacy. However, in Study 4, the co-authors and I propose complex or even odd entrepreneurial identities, which we define as the unconventional combination of entrepreneurial identity claims from the founder and venture levels, as an additional source of legitimacy for sustainable new ventures. Therefore, we build on legitimacy as a multi-dimensional concept (Suchman, 1995): While cognitive legitimacy is defined as a venture's comprehensibility, normative legitimacy describes a venture's congruence with normative expectations. Thus, we argue that complex entrepreneurial identities lead to lower comprehensibility of new ventures by external audiences and thus reduce their cognitive legitimacy. However, stakeholders expect sustainable new ventures to couple multiple and contradictory identity claims (Pache & Santos, 2013; Wry & York, 2017; York et al., 2016) to tackle complex challenges (Ferraro et al., 2015) and to bring social change to established conventions (Ruebottom, 2013). Thus, we argue they gain normative legitimacy due to (and not despite) their complex entrepreneurial identities compensating or even exceeding cognitive legitimacy liabilities. Study 4 relies on crowdfunding data to test the proposed theorizing. We analyze 15,116 campaigns from the crowdfunding platform Kickstarter and apply topic

modeling (Hannigan et al., 2019) to their creators' user profiles to determine the degree of their entrepreneurial identity complexity. A Poisson quasi-maximum likelihood (QML) regression reveals, that crowdfunding investors are generally less likely to support new ventures with complex entrepreneurial identities. However, sustainable new ventures with complex entrepreneurial identities receive enhanced support from crowdfunding backers. Study 4 pioneers the concept of entrepreneurial identity complexity as an additional source of legitimacy for sustainable new ventures. Thus, the findings of this study indicate that the "rules of the game" (Baumol, 1996, p. 7) for sustainable entrepreneurship may already have changed in comparison to conventional entrepreneurship. I discuss these thoughts in more detail in the synthesized discussion in Chapter 6.

Table 1-1: Structure of this thesis

Study	Research question	Theoretical framework	Methods	Key findings
Study 1: Transition to a sustainable bioeconomy	What does an integrative and navigable transition pathway toward a sustainable bioeconomy look like?	Bioeconomy transition discourse	Delphi study with 50 bioeconomy experts, Cross-impact analysis	• Investments in relevant sectors are a main bottleneck. • Technological progress and innovation leveraged by startups play a central role.
Study 2: The bioeconomy transformation as an external enabler of sustainable entrepreneurship	RQ1: How do entrepreneurial opportunities emerge in the bioeconomy context? RQ2: What skills and competencies do sustainable entrepreneurs need to act on such opportunities?	External Enablement, SE competence frameworks	Gioia-method based on 10 semi-structured interviews	• The bioeconomy transition serves as an external enabler of SE. • New venture creation in the bioeconomy requires transformative knowledge and specific competencies.
Study 3: The limits to firm growth? De-growth attitudes among sustainable entrepreneurs	How does sustainable entrepreneurs' attitude toward economic growth on a macro level relate to their attitude toward firm growth and its operationalization on the micro level?	De-growth discourse, Scaling of new ventures as a spatiotemporal phenomenon	Latent class analysis, OLS regression analysis, 393 sustainable and conventional entrepreneurs	• A de-growth attitude is negatively associated with scaling fast strategies. • SE is positively associated with scaling slow strategies. • Development level of the economy an entrepreneur is active in is an essential factor.
Study 4: Legitimately odd – Unconventional social startups win more support on crowdfunding platforms through entrepreneurial identity complexity	How do sustainable ventures generate legitimacy in the eyes of relevant stakeholders?	Legitimacy, Institutional complexity and Hybridity	Topic modeling, Poisson QML regression analysis, 15,116 crowdfunding campaigns	• Complex entrepreneurial identities reduce new ventures legitimacy. • However, sustainable new ventures gain legitimacy due to (not despite) complex identities.

2 Study 1 - Transition to a sustainable bioeconomy[2]

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Abstract: Exceeding planetary boundaries, and especially climate change, requires economies worldwide to decarbonize and to incorporate principles of sustainable development. Transforming a traditional economy into a sustainable bioeconomy by replacing fossil resources through renewable biogenic resources offers a solution to this end. However, seemingly opposing transition perspectives (i.e., technology-based vs. socio-ecological) lead to fragmented efforts, and the exact form of the transition pathway to the goal of a bioeconomy remains unclear. We examine the issue by involving an international expert sample in a Delphi survey and subsequent cross-impact analysis. Based on the experts' views, we present a list of events necessary to achieve the transformation ranked by the experts to reflect their urgency. The cross-impact analysis facilitates combining the eight most urgent events to create an integrated model of the transition to a sustainable bioeconomy. Our findings suggest that, rather than bioeconomy strategies, investment in the relevant sectors currently constitutes the main bottleneck hindering such a transition.

Keywords: bioeconomy; biobased economy; transition; transformation; sustainability; Delphi

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2.1 Introduction

The transgression of planetary boundaries—and most prominently climate change—endangers the well-being of human societies, which depends on the integrity of the earth system, thus, requiring humanity to identify a safe operating space for future societal development within planetary boundaries (Steffen et al., 2015). Against this background, there is a strong call from scientists, citizens, politicians, and business leaders to transform the economy into a sustainable one, where exiting the era of fossil resources and commencing the era of the bioeconomy offers a promising option (D'Amato et al., 2017; Lewandowski et al., 2018; Loiseau et al., 2016). A bioeconomy can be broadly defined as "an economy where the basic building blocks for materials, chemicals and energy are derived from renewable biological resources" (McCormick & Kautto, 2013). A plethora of national and international bioeconomy strategies seeks ways to transform economies into bioeconomies (German Bioeconomy Council, 2018), and academic research supports this goal (Ingrao et al., 2018); not least, because a successful transition towards a bioeconomy bears the potential to contribute significantly to the achievement of many of the United Nations' Sustainable Development Goals (El-Chichakli et al., 2016; Ronzon & Sanjuán, 2020).

However, since the field of bioeconomy research is still young and rather fragmented, there is as of yet no universal definition of the topic. Instead, the understanding of the term and its underlying visions and values is multifaceted (Birner, 2018; Bugge et al., 2016). Two seemingly opposing perspectives in the transition from a fossil to a biobased economy emerged (Priefer et al., 2017). That is, (1) the *technology-based transition perspective* introducing technology, innovation, and market efficiency as the key drivers of the economic transition (Bröring et al., 2020; Dupont-Inglis & Borg, 2018) and (2) *the socio-ecological transition perspective* highlighting a change in consumer behavior and awareness as well as a change toward sustainable production processes as crucial enablers of a bioeconomy transition (Vivien et al., 2019).

In addition, the perspective of social sciences on the targeted transition process seems to be underdeveloped but is urgently needed to take account of the various political, societal, and economic implications (Sanz-Hernández et al., 2019). Furthermore, previous research

indicates that adopting the lens of stakeholders seems to be advantageous when assessing and shaping the transition process (Falcone et al., 2019). And indeed, approaches to develop international (Robert et al., 2020), national (Woźniak et al., 2021) and also regional (D'Adamo et al., 2020) monitoring frameworks benefitted from involving various stakeholders to create multi-dimensional and comprehensive frameworks.

Fortunately, there is initial progress on combining those two prevalent perspectives on the transition process through interdisciplinary multi-stakeholder debates and the integration of the two perspectives (D'Amato et al., 2019; Priefer & Meyer, 2019). Nevertheless, academic, political, and economic efforts worldwide are mostly scattered across many different areas without channeling resources into an actionable pathway leading, step by step, to the targeted bioeconomy transition (Wohlgemuth et al., 2021). Consequently, it remains unclear how, where, and when the transformation will gain momentum and how an actionable transition pathway might look like.

Thus, this study aims to provide an integrative and navigable transition pathway toward a sustainable bioeconomy giving a clear guideline to decision makers and future research. Therefore, we conducted a Delphi study involving experienced European bioeconomy experts representing different transition perspectives, spanning various disciplines and organizations. As a result, we identify important and urgent events essential to achieving the transition toward a bioeconomy. Moreover, we illustrate how these events—presented as milestones along the transition pathway—impact each other and eventually constitute a navigable transformation pathway. The resulting model responds to the call for climate action by providing decision makers and researchers with pathways by which the vision of entering the era of bioeconomy can be turned into reality.

In the remainder of this paper, we first present the theoretical underpinnings of recent bioeconomy transformation research. Second, we explain in detail our research design and the applied methods. Afterward, we present the results of our study and finally discuss the implications of the presented transformation pathway for future bioeconomy policy and research.

2.2 Theoretical background

The current bioeconomy discourse shows a variety in the understanding of the term, its underlying visions and narratives, and, consequently, the resulting implications for the transition to a bioeconomy (Bugge et al., 2016; Vivien et al., 2019). For example, based on an extensive literature review, Bugge et al. (2016) identified three distinct ideal-type visions of the bioeconomy. These are (1) a bio-technology vision, (2) a bio-resource vision, and (3) a bio-ecology vision of the desired future bioeconomy. Of course, these visions are not mutually exclusive and may overlap (Bugge et al., 2016), but they still provide valuable orientation in the ongoing bioeconomy discourse.

While the first two visions differ mainly in their emphasis on the role of either the application of biotechnology (i.e., bio-technology vision) or, respectively, the conversion and upgrading of biomass (i.e., bio-resource vision), they both promise green economic growth and assume sustainability to be inherent in the bioeconomy per se (Bugge et al., 2016). In contrast, the bio-ecology vision focuses on sustainability and the conservation of ecosystems and questions the compatibility of the former with perpetual economic growth (Bugge et al., 2016). Consequently, the latter vision implies a strong sustainability approach, while the previous two imply only a weak sustainability approach (Vivien et al., 2019).

Along this dividing line between the ideal-type bioeconomy visions, two distinct theoretical conceptualizations of an implementation pathway emerge (Priefer et al., 2017): On the one hand, a *technology-based transition approach*, highlighting the importance of innovations in biotechnology and increased biomass production, as well as resource efficiency (Bröring et al., 2020; Priefer et al., 2017). On the other hand, a *socio-ecological transition approach* promoting social innovation through the participation of civil society, reduced resource demand, and agro-ecological biomass production (Priefer et al., 2017; Ramcilovic-Suominen & Pülzl, 2018).

2.2.1 Technology-based bioeconomy transition

A technology-based perspective stresses the importance of technological innovation for the bioeconomy transformation (Bröring et al., 2020; Dupont-Inglis & Borg, 2018; Laibach et al., 2019). Fundamental to these innovations is academic research on underlying bio-

technologies opening up avenues of industrial applications (Dupont-Inglis & Borg, 2018). Hence, collaborations between research institutes and industry actors turn research outcomes into competitive biobased products on existing markets (Mengal et al., 2018). Bioeconomy start-ups (often spin-offs from research institutes) play a vital role in commercializing and diffusing these new technologies and substituting fossil-based industry standards (Borge & Bröring, 2017; Kuckertz, Berger, et al., 2020; Schanz et al., 2019; Viaggi, 2015). According to the technology-based perspective, without significant technological progress and innovation, biobased products would be either unavailable due to resource constraints (Chandra et al., 2019; Lewandowski, 2015; Małyska & Jacobi, 2018) or not competitive due to a lack of value-generating efficiency (Dupont-Inglis & Borg, 2018).

The narrative underlying the *technology-based transition pathway* dominates the current bioeconomy discourse (Priefer et al., 2017; Vivien et al., 2019). That is, it finds its implementation in policies around the world (e.g., it is the inherent vision of the European Union's bioeconomy strategy; Bugge et al., 2016; European Commission, 2018; Vivien et al., 2019).

2.2.2 Socio-ecological bioeconomy transition

However, especially the understanding of sustainability and the green growth paradigm inherent in the bio-resource vision increasingly have aroused criticism. For instance, criticism flares up at the EU bioeconomy policy's relatively weak sustainability ambitions that are stated to be used only as a "selling point" to promote mainly economic interests (Ramcilovic-Suominen & Pülzl, 2018) and the conceptual hijacking of the term bioeconomy, as originally coined by Georgescu-Roegen (Vivien et al., 2019). In contrast to the currently dominating bioeconomy policy, Georgescu-Roegen argues that based on the laws of thermodynamics, every economic activity is entropic and results in the consumption of resources. Hence, to operate within the biosphere's boundaries, current economic growth needs to slow down to a level that aligns with the biosphere's supply capacity for renewable resources and its regeneration capacity for ecological externalities from economic activities (Georgescu-Roegen, 1975; Giampietro, 2019).

In addition to the rather conceptual criticism, various empirical studies underpin the criticism concerning the questions of sustainability and growth. Indeed, the bioeconomy cannot be considered sustainable per se, but needs to set sustainability as a central target to contribute to sustainable development (Pfau et al., 2014). Furthermore, many bioeconomy scholars question whether bioeconomy is truly capable of contributing to sustainable development without incorporating a degrowth perspective (D'Amato et al., 2019). Furthermore, the feasibility of the current bioeconomy policy to reconcile both the targeted economic growth on the one hand and sustainability goals on the other hand might be questionable as well (Hausknost et al., 2017).

2.2.3 Integrated perspective on a bioeconomy transition

The current bioeconomy discourse is divided into two theoretically conceptualized transition pathways (*technology-based approach* vs. *socio-ecological approach*) that summarize the respective extreme positions on ten key issues critical for the success of the bioeconomy transformation, i.e., the understanding of sustainability, biomass production, perspective on nature, resource utilization, consumer behavior, innovation, spatial level, the scale of technology solutions, participation, and research funding (Priefer et al., 2017). However, across these key issues, the single positions are not necessarily incompatible with each other (Priefer et al., 2017). Indeed, there are first indications that some of these elements may be combined, e.g., an improvement of resource efficiency, which is central to the technology-based approach, and the promotion of sustainable consumption patterns, central to the socio-ecological approach (Priefer & Meyer, 2019). However, to integrate both positions, governments may need to play a stronger role in the bioeconomy transition (Hausknost et al., 2017; Kuckertz, 2020) to fulfill a two-fold function: on the one hand, an enabling function to level the field for biobased products and to compensate for competitive disadvantages in comparison to fossil-based products; on the other hand, a limiting function to ensure compliance with ecological and social sustainability targets (Gawel et al., 2019).

For a successful transition toward a sustainable bioeconomy, mere techno-economic knowledge will not be sufficient, but needs to be complemented by systems knowledge (i.e., knowledge about how relevant systems work), normative knowledge (i.e., knowledge about the

desired system states), and transformative knowledge (i.e., knowledge about how to transform systems; Urmetzer et al., 2018, 2020). However, the current discourse is dominated by a rather technological perspective and lacks research from social sciences applying mixed methods and multidisciplinary approaches (Sanz-Hernández et al., 2019). Thus, to move the discussion on integrated transition pathways forward, research needs to consider the perspective of multiple bioeconomy stakeholders (Sanz-Hernández et al., 2019; Urmetzer et al., 2018).

What is needed is an actual debate across representatives from different disciplines and transition perspectives to avoid juxtaposing potential pathways and, instead, synthesizing perspectives into an integrated pathway (Priefer & Meyer, 2019). Hence, the present study applies the Delphi technique—a method specifically designed to bridge various perspectives and gain mutual understanding—to answer the research question of how an integrated transition to a bioeconomy will gain momentum and which milestones lie down the road. The subsequent cross-impact analysis allows modeling a concrete transition pathway to a future bioeconomy. The following section describes in detail the methodological foundations of the Delphi technique as applied in this study and the subsequent cross-impact analysis.

2.3 Method

The Delphi technique is used to forecast the future where historical data misses and, thus, the input of experts is necessary (Rowe & Wright, 1999). It aims to obtain a group opinion from individually contributing experts (Landeta & Barrutia, 2011) that can be geographically dispersed (Rowe & Wright, 1999). It is characterized by four key features: anonymity, iteration, controlled feedback, and the statistical aggregation of group response (Rowe & Wright, 1999). The Delphi technique has been utilized and has proven its validity in various contexts within the social sciences (Landeta, 2006) and previous applications to bioeconomy-related research questions revealed their potential to contribute with a multi-stakeholder perspective to the ongoing bioeconomy discourse (Devaney & Henchion, 2018a; Hurmekoski et al., 2018). The combination with a cross-impact analysis (CIA) allows to create a model out of the findings from the Delphi process (Bañuls & Turoff, 2011) and has also been applied in previous research, though in different context than the bioeconomy case (Bañuls et al., 2013; Turoff et al., 2016).

Three main tasks structured the research design of this study and the remainder of this section. First, we reported the procedure to identify a qualified sample of European bioeconomy experts. Second, we conducted a Delphi survey that generates and subsequently ranks a list of events necessary to achieve a transition to a bioeconomy. Finally, we conducted a CIA combined with interpretive structural modeling (ISM) to be able to visualize a model of the proposed transition pathway. The single steps of the data collection and analysis process, i.e., the Delphi procedure and the subsequent CIA and ISM, are summarized in Table 2-1.

2.3.1 Identification of the Delphi expert sample

In total, we identified and eventually invited 231 leading bioeconomy experts from 18 European countries. The invited experts represent industry (from both established firms and start-ups), public administration, and academia (Devaney & Henchion, 2018b). To ensure rigor, transparency, and reproducibility, we determined and applied selection criteria for each expert category (Paré et al., 2013). To identify representatives from industry, we consulted the member list of the Bio-Based Industries Consortium (BIC). Furthermore, we contacted bioeconomy-related entrepreneurs who engage with one of the accelerator programs of the European Institute of Innovation and Technology (EIT). To identify experts from public administration, we searched the Global Bioeconomy Summit (GBS) 2018 attendees list for participants from institutions involved in the bioeconomy strategy formulation of their respective countries. Finally, we conducted a Scopus search to identify bioeconomy scholars who were most cited and/or published most in recent years. The applied selection criteria ensured a broad scope of this study beyond mere techno-economic knowledge (Urmetzer et al., 2018) and also allowed integrating knowledge from the social sciences. Especially, by involving experts from public institutions and inviting researchers from all relevant fields—beyond economics, natural sciences, and engineering—the sample selection equally accounts for the technology-based and the socio-ecological transition perspective.

The initial Delphi round involved 50 experts, and 29 experts were retained to share their insights in the fourth and final round of the Delphi, and 41 experts evaluated the results of the Delphi for the final CIA. Table 2-2 contains a summary of the number of participants from each

expert category over each step of the study. Moreover, Appendix A shows an anonymized list of the eventually participating experts.

Table 2-1: Subsequent steps of the data collection and analysis process

Steps	Content of Rounds	Participants
Step 1	Open question asking for necessary events to achieve a full transformation towards the bioeconomy. Research task: qualitative content analysis resulting in an aggregated list of 14 events.	$n = 50$
Step 2	First ranking of the aggregated list of events regarding their urgency in realization. Research task: statistical aggregation of the responses summarized in a result report providing, in addition to individual's ranking, the mean ranking, degree of consensus and interquartile ranges (IQRs)of each event, and a selection of qualitative arguments given by experts to reason their ranking.	$n = 39$
Step 3	Second ranking of events regarding their urgency in realization. Research task: statistical aggregation of the responses summarized in a result report providing, in addition to individual's ranking, the mean ranking, degree of consensus and IQRs of each event, and a selection of qualitative arguments given by experts to reason their ranking.	$n = 33$
Step 4	Third ranking of events regarding their urgency in realization. Research task: statistical aggregation of the responses summarized in a result report providing, in addition to individual's ranking, the mean ranking, degree of consensus, and IQRs of each event.	$n = 29$
Step 5	Cross-impact analysis of the eight most urgent events. Research task: calculation of cross-impact matrix and derivation of interpretive structural models.	$n = 41$

Table 2-2: Number and proportions of participants per expert category over all five rounds

	Round 1		**Round 2**		**Round 3**		**Round 4**		**Round 5**	
Category	*n*	%	*n*	%	*n*	%	*n*	%	*n*	%
Established Firms	12	24.00	9	23.08	8	24.24	7	24.14	9	21.95
Entrepreneurs	8	16.00	7	17.95	6	18.18	3	10.34	6	14.63
Policy Makers	13	26.00	9	23.08	8	24.24	8	27.59	11	26.83
Researchers	17	34.00	14	35.90	11	33.33	11	37.93	15	36.59
∑	50	100	39	100	33	100	29	100	41	100

2.3.2 Delphi study

We conducted a two-phased ranking-type Delphi (Schmidt, 1997) to generate a ranked list of events. In the first phase, participants brainstormed online to determine important events necessary to achieve a full transition to bioeconomy. Based on a rigorous identification of concepts in the participant's responses and the subsequent grouping of these very specific concepts to more general categories (Brady, 2015; Corbin & Strauss, 1990), two of the authors coded the responses independently, using the software MAXQDA 12.3.6 from VERBI. In an inductive category formation approach, the coders gradually built categories when processing the material while at the same time checking for formative and summative reliability in accordance with the research question (Mayring, 2004). Finally, both coders compared the results of their individual coding, resulting in an aggregated list of 14 events, containing a short and a more detailed description for each event. Table 2-3 illustrates the coding process exemplarily.

In the second phase, we asked participants to assess the aggregated list of events in terms of urgency in a three-rounded iterative ranking process. Additionally, participants were asked to provide a reason for their ranking qualitatively. Furthermore, they were asked to verify whether they perceived the aggregated list of events as complete or whether it was missing anything essential they mentioned in the first round (Schmidt, 1997). Including this step contributed to achieving validity and, consequently, to enhancing rigor (Hasson & Keeney, 2011). Four event descriptions were changed slightly to reflect the feedback from the participants. After each iteration, we provided to every participant an intermediate result report

containing quantitative statistics of the ranking process as well as qualitative arguments mentioned by the participating experts. A combined feedback of statistics and reasoning was more likely to increase the performance of a Delphi expert sample in terms of its accuracy, change in judgment, and the degree of consensus (Rowe & Wright, 1999). This way, we facilitated an exchange of opinion, yielding eventually stable ranking results (measured by the Wilcoxon matched-pairs signed-rank test; von der Gracht, 2012) and a slightly increased degree of consensus among the participants (measured by Kendall's coefficient of concordance W; Schmidt, 1997). We computed both the Wilcoxon test as well as Kendall's W using IBM's SPSS.

Table 2-3: Exemplary category formation in the coding process (table based on Brady (2015))

Example Response	**Concepts**	**Category**	**Category Description**
"Acceptance of and interest in buying biobased products from customers."	Consumer awareness	Consumer awareness	Consumers who are aware of the consequences of their consumption behavior on the environment and change their consumption behavior accordingly
"Reduction of personal/public/societal demands/requirements."	Sufficiency		
"People should eat much less animal-based protein and more plant/fungi-based protein."	Urban food production		
"Encouragement of gardening in urban areas."			
"Sustainable decentralized vertical farming becoming mainstream."			

2.3.3 Cross-impact analysis and interpretive structural modeling

CIA complements the Delphi method by allowing the introduction of greater complexity to its results (Bañuls & Turoff, 2011). It assesses the type of events, which may or may not occur in the time interval under investigation and for which no statistically significant data are

available to infer its probability of occurrence from history (Turoff, 1971). Basically, it is the estimation of the relationships among *n* events considering two at a time and is, therefore, only an approximation of the real world where, in fact, relationships among more than two events are thinkable and possible (Bañuls & Turoff, 2011).

Core of the CIA is the cross-impact matrix in which each cell represents the cross-impact factor C_{ij} of the event in the j-th row on the event in the i-th column (Turoff, 1971). $C_{ij}$is specified as:

$$C_{ij} = \frac{1}{1 - P_j} \left[\ln(R_{ij}/(1 - R_{ij}) - \ln(P_i/(1 - P_i)\right]$$

where P_i represents the experts' aggregated estimations of the probability of occurrence of the i-th event and R_{ij} experts' aggregated estimations of the probability of occurrence of the i-th event under the condition that the j-th event will certainly occur in the investigated time interval (Turoff, 1971).

This means surveying the data for the CIA was undertaken in two steps (Turoff, 1971): In the first step, participants were asked to estimate the probability of occurrence P_i for the i-th event in the time interval from now to the year 2030. The second step perturbed the participants' view of the world by assuming certainty that one of the considered events will definitely occur in the investigated time interval. Subsequently, the participants were asked to estimate the probability of occurrence R_{ij} of the i-th event under the condition that the j-th event will certainly occur in the investigated time interval. We decided to undertake the CIA with only the eight most urgent ranked events, which required each participant to make 64 estimations, that is, $n = 8$ estimations of P_i and n * (n-1) = 56 estimations of R_{ij}. An event set of 14 events would have been too comprehensive to assess all potentially existing cross-impacts in a survey-based CIA, since it would have required each participant to make 196 estimations. Our procedural choice was also justified by a leap in the means of the urgency ranking between the eighth and the ninth event.

Subsequent ISM permitted the visualization and a graphical mapping of the detected cross-impact relationships among the investigated eight most urgent-ranked events in a multilevel diagraph (Bañuls & Turoff, 2011). Input for the ISM algorithm was a binary version

of the cross-impact matrix, where all C_{ij}- values greater or equal to 1.55 (percentile 70 of the C_{ij}- values distribution) were transformed to a "1", values below that threshold to a "0".

To visualize the binary ISM input matrix in a multilevel diagraph, the events were illustrated as vertices, while the considered cross-impact relationships, that is, the value "1"s in the ISM input matrix, were illustrated as edges with arrows in the direction of the detected cross-impact relationship (Bañuls & Turoff, 2011). Furthermore, the vertices (i.e., the events) had to be divided into two sets: antecedents and consequences. These two sets had to then be compared for intersections. If the intersection set was equal to the consequences set, the vertices (events) of the intersection set formed the highest level of the diagraph. This procedure was then repeated for the following lower levels of the diagraph, though the vertices (events) of the already identified higher levels of the diagraph were not further considered (Bañuls & Turoff, 2011; Warfield, 1976). The algorithm used and the profound mathematical foundations of ISM were described in detail in (Warfield, 1976). For the purpose of this study, the binary ISM input matrices were processed by means of the ISM package of the statistic software R (Anand & Bansal, 2017).

The following section describes in detail the generated and ranked list of events, the cross-impact matrix, and, finally, the transition pathway resulting from the application of Delphi, CIA, and ISM.

2.4 Results

The four rounds of anonymous discussions among experts from industry, public administration, and academia yielded stable results on a list of the most important events that might drive the transition to bioeconomy, ranked according to their urgency in realization. Table 2-4 summarizes the 14 generated events, including a short definition of each and the final rank, and the mean rank of the last iteration. Additionally, it contains the value of Kendall's W (W = 0.334) after the final iteration of the ranking, which indicated only a weak degree of consensus but still a clear increase in comparison to the first (W = 0.078) and the second iteration (W = 0.267) of the ranking. Table 2-5 shows the results of the Wilcoxon matched-pairs signed-rank test, proving stable results after the third iteration of the ranking. The results reflect the multidisciplinary and multi-sectoral background of the experts who agreed on the diverse

events whose occurrence will be driven by the public and private sector and by society as a whole.

The two events ranked the most urgent to facilitate a transition to bioeconomy were *strategies and action plans* and *legislation and standards*, which are clearly policy-driven. They were followed by industry-driven aspects such as the *competitiveness of biobased products* and also *investments* in research and bioeconomic products and processes. The events considered markedly less urgent included innovation-driven events such as the *biomass supply* and *technological progress* and societally driven events such as the *development of a common understanding* and *consumer awareness*.

As Table 2-4 shows, the mean ranks sharply dropped after the eighth event *consumer awareness.* This justified a cut-off after the eight most urgent ranked events to receive a manageable number of events for the CIA, as reasoned in the previous section. Notably, also the lower ranked events could have been assigned to one of the previously identified drivers of the transition: While *consumer policy* and *public procurement* are clearly policy driven, *bioeconomy ecosystems* and *industry collaboration* can be considered as industry-driven. *Informing society* and *education and empowerment* are rather societally driven but showing an overlap to the category of policy-driven. Additionally, without a doubt, each of the dropped events represents an important step of the transition to bioeconomy and can possibly serve itself as a reference point for future research on the bioeconomy transition.

Having obtained the ranking and dropped the six least urgent events, we conducted a CIA to investigate potential cross-impacts among the eight most urgent identified events.

We aggregated the experts' estimations on these potential cross-impacts and computed them into cross-impact factors that were summarized in a cross-impact matrix (Table 2-6). To reduce complexity and to simplify the interpretation of the CIA's results, we visualized them in a multilevel diagraph by applying ISM (Figure 2-1). The diagraph considers the strongest 30% of the measured cross-impacts, representing 48% of the sum of the measured cross-impacts. In Figure 2-1, each box represents a unique event.

The multilevel diagraph suggested four hierarchical levels indicating the ratio between antecedents and consequences of the single events within the respective level. The higher the

level, the fewer the number of consequences and the greater the number of antecedents. Accordingly, the event *investments* at the bottom level of the diagraph showed no antecedents but several consequences, while in contrast, the events *biomass supply* and *competitiveness of biobased products* had several antecedents but no consequences. Hence, the event *investments* is part of the very foundation of the combined transition pathway, while *biomass supply* and *competitiveness of biobased products* can be seen as the final outcome of the desired transformation.

Table 2-4: Final ranking of the list of events. Columns one and two contain the event title and a more detailed short description of each event. Column three contains the final rank of the respective event based on the mean rank reached in the final round of the ranking (column four)

Event	**Short Description**	**Final Rank**	**Final Mean Rank**
Strategies and action plans	Development and establishment of national and international bioeconomy strategies, including action plans with concrete targets.	1	2.79
Legislation and standards	Bioeconomy-friendly legislation and the establishment of standards for the biobased sector considering a long-term perspective and principles of sustainable development.	2	3.93
Competitiveness of biobased products	Biobased products that are available and competitive in comparison to fossil-based products. Better competitiveness can be delivered by corporate strategies dedicated to bringing biobased products to market as well as taxation of fossil solutions and an end to subsidies for fossil solutions.	3	4.90
Investments	Investments in research but also in products and processes within the biobased sector.	4	4.97
Biomass supply	Sufficient and sustainably produced biomass supply which requires the integration of farmers, forestry owners, and fishermen into biobased value chains.	5	6.41

Table 2-4 (continued)

Technological progress	Further development and application of key technologies for the biobased sector, e.g., cascade biomass utilization in biorefineries, biobased construction materials or carbon capture.	6	7.07
Common understanding	Development of a common understanding of the bioeconomy concept, especially considering questions of sustainability, circularity, growth, and the impact of the bioeconomy on the environment and biodiversity.	7	7.28
Consumer awareness	Consumers that are aware of the consequences of their consumption behavior for the environment and change and/or reduce their consumption behavior accordingly.	8	7.69
Informing society	A society that is informed about the concept of bioeconomy, aware of the necessity of a transformation towards bioeconomy and is included in the debate about the design of the transformation.	9	8.86
Consumer policy	Consumer policy aiming to increase consumer awareness but also to set standards regarding sustainability of products, e.g., by bans of pesticides or single-use plastics.	10	9.10
Bioeconomy ecosystems	Bioeconomy ecosystems that facilitate innovation, (interdisciplinary) research and networking among involved actors of the bioeconomy.	11	9.17
Education and empowerment	Members of society who are educated and empowered to actively engage in the transformation towards bioeconomy.	12	9.31
Industry collaboration	An industry that collaborates with each other, also across industry sectors and value chains.	13	9.52
Public procurement	Public procurement that prioritizes biobased products to increase the demand from the biobased sector.	14	9.69 *
Kendall's W			0.334

* Due to its comparably low mean rank, we took public procurement out of the ranking task after round 2, to increase the clarity of results of the subsequent rankings (Schmidt, 1997).

Table 2-5: Results of the Wilcoxon matched-pairs signed-rank test after rounds 3 and 4

		Strategies and Action Plans	Legislation and Standards	Competitiveness of Bio-Based Products	Investments	Consumer Awareness	Biomass Supply	Technological Progress	Common Understanding	Informing Society	Consumer Policy	Bio-Economy Ecosystems	Education and Empowerment	Industry Collaboration
Between round 2 and 3	Z	−3.150 b	−3.491 b	−2.800 b	−3.377 b	-0.523 c	−1.630 b	-0.631 b	-.834 b	−1.242 c	−1.339 c	−1.886 c	-0.782 c	−1.070 c
	Asymptotic significance (2-sided) a	0.002	0.000	0.005	0.001	0.601	0.103	0.528	0.404	0.214	0.181	0.059	0.434	0.285
Between round 3 and 4	Z	−1.000 c	−1.000 b	0.000 d	0.000 d	0.000 d	−1.000 b	0.000 d	0.000 d	0.000 d	0.000 d	0.000 d	−1.000 c	−1.732 b
	Asymptotic significance (2-sided) a	0.317	0.317	1.000	1.000	1.000	0.317	1.000	1.000	1.000	1.000	1.000	0.317	0.083

[a] $p = 0.05$; [b] based on negative ranks; [c] based on positive ranks; [d] the sum of the negative ranks is equal to the sum of the positive ranks.

Table 2-6: Cross-impact matrix of the eight most urgent events

	Strategies and Action Plans	Legislation and Standards	Competitiveness of Biobased Products	Investments	Biomass Supply	Technological Progress	Common Understanding	Consumer Awareness
Strategies and action plans	-*	2.78	1.86	0.98	1.88	1.31	1.77	1.77
Legislation and standards	1.58	-*	1.98	1.12	1.37	1.39	1.45	1.32
Competitiveness of biobased products	0.16	1.48	-*	0.62	1.40	1.24	0.94	1.24
Investments	1.09	1.98	2.66	-*	2.34	2.72	1.20	1.46
Biomass supply	0.65	1.21	1.11	0.34	-*	0.93	0.39	0.68
Technological progress	0.52	1.84	2.77	1.36	1.37	-*	0.21	1.17
Common understanding	1.13	1.82	1.02	0.41	0.93	0.44	-*	1.83
Consumer awareness	0.41	1.74	1.61	0.65	0.83	0.73	1.55	-*

*for the diagonal of the matrix (i.e., the intersections of each event with itself) cross-impact values cannot be calculated.

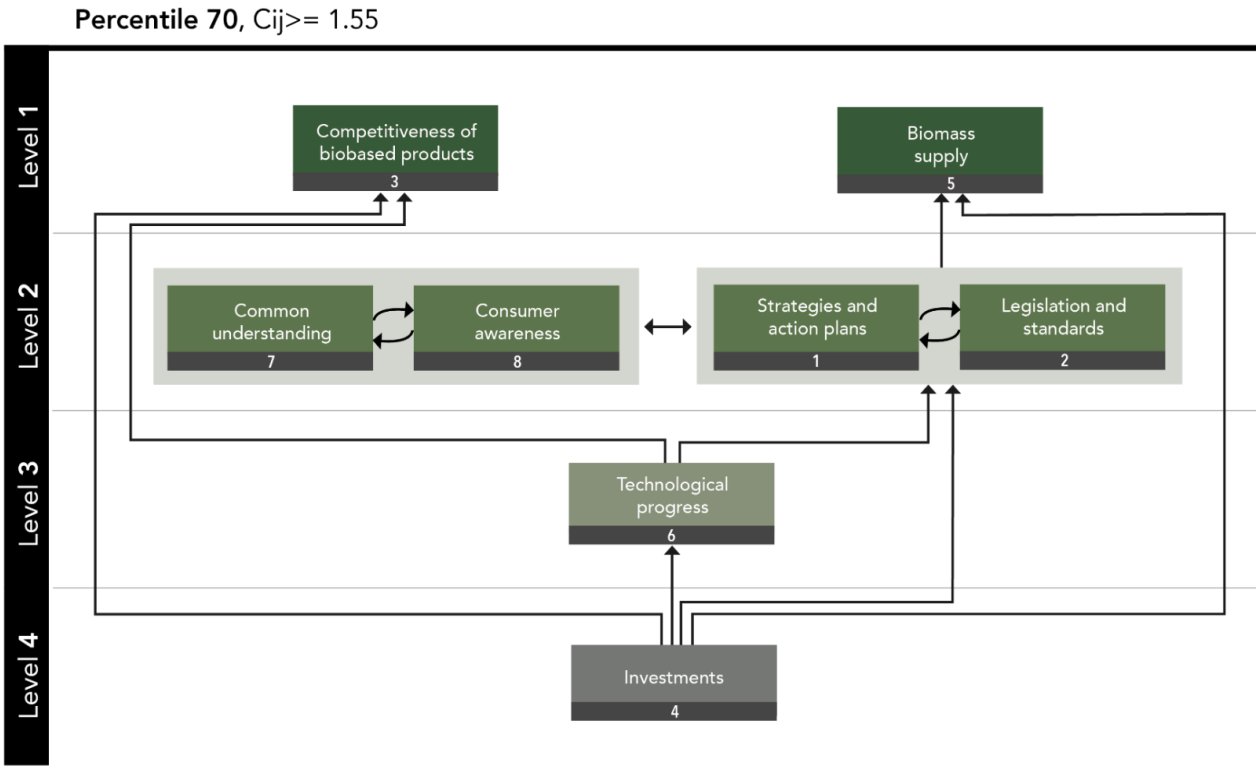

Figure 2-1: Multilevel diagraph of the bioeconomy transition pathway. Each box represents an event, while the numbers at the bottom indicate the urgency ranking of the respective event. An arrow represents the cross-impact relation between the two connected events in the direction of the arrow

The remaining events occupy both central levels of the diagraph. Level three contains only *technological progress*, which plays an enabling role in the transformation pathway and is strongly affected by *investments*. Level two stands out by including two mini-scenarios, each composed of two events, and which lie at the heart of the revealed transition pathway. Mini-scenarios consist of events with exactly the same set of antecedents and consequences. Remarkably, the events *common understanding* and *consumer awareness*, both representing the strong role of society in the transformation process, take such a prominent position, despite being ranked less urgent in the Delphi phase of this research. More expectedly, *strategies and action plans* and *legislation and standards* together illustrate the need for dedicated bioeconomy policy to facilitate the transformation pathway and tie together the single events required to succeed.

What the multilevel diagraph in Figure 2-1 does not reveal is the relative strength of the depicted cross-impact relations. To increase interpretability, the ISM process reduces complexity,

thereby neglecting information obtained in the CIA process; however, that information was preserved in the cross-impact matrix (Table 2-6). The cross-impact matrix illustrates that among the several cross-impact relations rooted in investments, the strongest lead to *competitiveness of biobased products* and *technological progress*. Additionally, the impact of *technological progress* on *competitiveness of biobased products* was the second strongest measured cross-impact relation within the whole analysis. Hence, the cross-impact relations among these three predominant industry-driven events build a strong case emphasizing the important role of the private sector in the transition process to a bioeconomy.

2.5 Discussion

The results of this analysis provide valuable information for policymakers aiming to initiate or adjust initiatives and can illustrate to researchers where they might focus their efforts. The list of most urgent events suggested by the Delphi experts is, however, only the first step, and any recommendation based on urgency alone must be considered somewhat insubstantial. Of course, each of the identified and urgently needed events themselves provide a reference point for future activities and research in the field. Greater potential, however, resulted from the novel combination of a Delphi procedure with a subsequent CIA and ISM approach. It allowed placing events into a logical, interdependent sequence to eventually form a transition pathway that provided explicit guidance.

This study aimed at combining seemingly opposing bioeconomy transition perspectives (i.e., *technology-based approach* vs. *socio-ecological approach*) through a Delphi study with leading bioeconomy experts into an integrated pathway to a sustainable bioeconomy. We thereby contributed to the convergence of so far divergent perspectives and visions of the bioeconomy transition, potentially affecting the success of the bioeconomy project (Giurca, 2020). Our results indicate how these different perspectives could be integrated into a common transition pathway. This is illustrated by the central role of consumers and policies in harmonizing technological progress toward a sustainable bioeconomy (Ladu et al., 2020).

More specifically, *common understanding* and *consumer awareness* in combination with *strategies and action plans* as well as *legislation and standards* mediate technological progress toward a sustainable *supply of biomass*. They show the crucial importance of finding compromises between technological progress and socio-ecological demands through mechanisms of national

strategy developments and legislation. That is, to involve consumers, i.e., citizens, in these discussions to raise, on the one hand, awareness, but to also increase, on the other hand, the acceptance for the resulting policy measures. Previous research has shown that not only scholars, but also citizens are critical for the sustainability of the bioeconomy (Vainio et al., 2019) and that broad societal participation is necessary to ensure a good governance of the transition to a sustainable bioeconomy (Devaney et al., 2017).

The study's results indicating that strategies to implement a transition to a bioeconomy along with legislation and standards are situated on level two of the transformation pathway model (and accordingly rather represent an outcome than a starting point) might initially be astonishing; however, although any policymaker would consider such strategies the initial step of any transition process, the results indicate that with the overall adoption of such strategies worldwide (German Bioeconomy Council, 2018; Staffas et al., 2013), the first important step has already been taken. Now, based on the emerging technological progress, bioeconomy policymakers must adjust existing strategies and translate them into action plans backed by legislation and regulation that meet the requirements of the biobased sector.

Such action plans will differ from those considered valid for decades to foster a fossil-based economy. Rather than strategies, investments are the bottleneck hindering the transformation. Once resolved, the resulting technological progress will heighten the competitiveness of biobased products (see also in Sturm and Banse (2021)) and propel those responsible for bioeconomy policy to organize the transformation in line with the needs of society. To transform the various required events into a navigable pathway will require dedicated bioeconomy policies and, at the same time, policymakers must involve all relevant stakeholders in the transition process. To this end, special focus needs to be placed on societal actors and their acceptance of the proposed measures (D'Amato et al., 2019). Moreover, social sciences need to further increase their contribution to inform the transition process appropriately (Sanz-Hernández et al., 2019).

As a corollary, rather than relying on general programs that fund innovation, dedicated investment programs will be necessary if the transition to a bioeconomy is not to stall. Previous research has already suggested that there might be a "green finance gap" (Hafner et al., 2020), and it is mainly this measure the Delphi experts consider the next logical transformation step. As policy plays a more important role in investments in green technology than technological progress in the field alone (Popp et al., 2011) and can also facilitate the development of lead markets for environmental innovation (Beise & Rennings, 2005), the model clearly indicates that action from

politics is needed. Moreover, policies and standards for sustainable investments serve as an enabler for sustainable venture capital (Antarciuc et al., 2018), which contributes to the success of sustainable start-ups (Bocken, 2015), which in turn contribute crucially to the bioeconomy transformation process (Kuckertz, Berger, et al., 2020).

2.6 Conclusions

The transition toward a sustainable bioeconomy requires an integrated and actionable transition pathway that combines and reconciles elements from the *technology-based approach* as well as from the *socio-ecological approach*. Our study considered various perspectives of bioeconomy experts from different professions and backgrounds to model such an integrated transition pathway. Our results suggest that it is time to move from strategy to action, and that it is investments into the biobased sector that have the most considerable leverage to get the transition rolling.

3 Study 2 - The bioeconomy transformation as an external enabler of sustainable entrepreneurship[3]

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Abstract: Bioeconomy strategies worldwide emphasize the importance of entrepreneurship in the transformation toward a sustainable and circular bioeconomy. However, the bioeconomy transformation itself also offers great opportunities for creating new ventures. Based on interviews with bioeconomy entrepreneurs from six European countries, we investigate how entrepreneurial opportunities emerge in the bioeconomy context and what competencies entrepreneurs need to act on them. By conceptualizing the bioeconomy transformation as an external enabler of entrepreneurial activity, we open new avenues for research on sustainable development and innovation policy. We conceptualize sustainable entrepreneurship as a phenomenon that can be enabled externally via the transformation toward sustainable development. Furthermore, we show that new venture creation in the bioeconomy requires unique knowledge (*transformative knowledge*) and specific competencies (*sustainable valorization of biomass, marketing of biobased products, and management of limited resources*).

Keywords: Sustainable entrepreneurship, bioeconomy, sustainable development, external enablement, sustainable innovation policy, competencies

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3.1 Introduction

Early conceptualizations of sustainable entrepreneurship (SE) described sustainable entrepreneurs as individuals who respond to environmental degradation or social harm by identifying and exploiting relevant entrepreneurial opportunities and creating ventures (Cohen & Winn, 2007; Dean & McMullen, 2007). Therefore, SE is "focused on the preservation of nature, life support, and community in the pursuit of perceived opportunities to bring into existence future products, processes, and services for gain, where gain is broadly construed to include economic and non-economic gains to individuals, the economy, and society" (Shepherd & Patzelt, 2011).

In entrepreneurship research, and in line with the seminal paper by Shane and Venkataraman (2000), the SE field describes the entrepreneurial process as consisting of opportunity recognition, evaluation, and exploitation. Consequently, the idea of the individual–opportunity nexus (Shane & Venkataraman, 2000), which describes the fit between an entrepreneurial opportunity and the individual pursuing it (Davidsson, 2015), is a key concept. Shane and Venkataraman (2000) argued that questions of "why, when and how" entrepreneurial opportunities emerge and "why, when and how" entrepreneurs act on them are central in entrepreneurship research. Moreover, contextualization is a critical factor in understanding entrepreneurship, especially "why, when and how" entrepreneurship happens and who becomes involved in the entrepreneurial process (Welter, 2011).

However, for SE in general and for SE in the bioeconomy transformation context, it remains unclear how entrepreneurial opportunities emerge and how entrepreneurs act on them. Although scholars have proposed different interpretations and visions of the bioeconomy (Bugge et al., 2016; Vivien et al., 2019), it is widely understood to encompass "all primary production sectors that use and produce biological resources (agriculture, forestry, fisheries and aquaculture); and all economic and industrial sectors that use biological resources and processes to produce food, feed, bio-based products, energy and services (…) [with] sustainability and circularity at its heart" (European Commission, 2018, p. 4).

Scholars have made initial attempts to describe the bioeconomy's specific opportunity space (Kuckertz, Hinderer, et al., 2019) and the relevant business models (D'Amato et al., 2020) and business strategies (Fotiadis & Polemis, 2018; Urbaniec et al., 2022). However, conceptualizations of entrepreneurship in the bioeconomy have remained rather simplistic, and

little is known about the processes of opportunity identification, evaluation, and exploitation (Kuckertz, Berger, et al., 2020).

The bioeconomy transformation provides valuable opportunities for sustainable development in alignment with the United Nations Sustainable Development Goals (Ronzon & Sanjuán, 2020) and thus for SE (Esteves et al., 2021; Kuckertz, 2020; Sehnem et al., 2021; Viaggi, 2015). Consequently, several countries have developed dedicated bioeconomy strategies (German Bioeconomy Council, 2018), highlighting SE's critical role in a successful bioeconomy transformation (Kuckertz, 2020).

Previous research addressed the question of how sustainable entrepreneurs act on entrepreneurial opportunities and acknowledged that SE requires specific knowledge and competencies (Muñoz & Cohen, 2018; Patzelt & Shepherd, 2011). Various scholars have addressed this question by considering entrepreneurship training programs in higher education (Biberhofer et al., 2019; Foucrier & Wiek, 2019; Lans et al., 2014; Ploum et al., 2018; Renfors, 2020). Such studies typically present SE competence frameworks in general terms, without specifically examining the bioeconomy context. However, entrepreneurship education requires discipline-based frameworks that account for profession- or industry-specific entrepreneurial competencies (Thomassen et al., 2020).

Therefore, we posed the following two research questions:

1. How do entrepreneurial opportunities emerge in the bioeconomy context?
2. What skills and competencies do sustainable entrepreneurs need to act on such opportunities?

We approached the bioeconomy transition as an external enabler, building on Davidsson et al.'s (2020) framework for new venture creation through external enablement (EE) and Davidsson's (2015) reconceptualization of the individual–opportunity nexus. This re-conceptualization distinguishes between objectively existing external enablers that may potentially trigger entrepreneurial activity and subjective assessments by potential entrepreneurs who may eventually act on these enablers (Davidsson, 2015). External enablers include "external conditions such as new technologies; regulatory or demographic shifts; and changes to the socio-cultural, economic, political, or natural environments" (Davidsson et al., 2020, p. 311). Consequently, the EE framework allows treating the bioeconomy transition as a set of changing external conditions that trigger entrepreneurial activity.

Based on this framework, we propose a model of the individual–opportunity nexus for the bioeconomy that describes how entrepreneurial opportunities emerge and what knowledge and competencies sustainable entrepreneurs need to act on such opportunities. Consequently, this article makes three contributions to the existing literature. First, by analyzing the bioeconomy context, we extend the frameworks that describe the skills and competencies needed for SE and show that such skills and competencies are sector-specific. Second, by applying the EE framework, we substantiate our understanding of SE in the bioeconomy context and show that there is a mutually beneficial relationship between SE and the transformation toward sustainable development. Third, by introducing the EE framework, we open new avenues for future research on transformation and innovation policy.

The rest of this article is structured as follows: First, we examine the relevant literature. Second, we explain our research design. Third, we present our results, including the model of the individual–opportunity nexus in the bioeconomy. Finally, we discuss our findings and their implications for theory and practice.

3.2 Theoretical framework

In the entrepreneurship field (Shane & Venkataraman, 2000), entrepreneurial opportunities and their identification, evaluation, and exploitation are considered central to SE (Belz & Binder, 2017; Eller et al., 2020). We contribute to this field by looking at (1) how sustainable entrepreneurial opportunities emerge in the context of the bioeconomy transformation and (2) what knowledge and competencies are needed to act on such opportunities. Therefore, we build on Davidsson's (2015) recent reconceptualization of the individual–opportunity nexus and the EE framework for entrepreneurial activity. In the rest of this section, we first discuss the EE concept and apply it to SE in the bioeconomy. Second, we review the extant literature on SE competence frameworks and point out their shortcomings in relation to SE and the bioeconomy.

3.2.1 External enablement of new venture creation in the bioeconomy

Davidsson's (2015) reconceptualization of the individual–opportunity nexus provides an alternative perspective on the relationship between individuals and by introducing the concepts of *external enablers* (e.g., regulatory changes, technological breakthroughs), *new venture ideas* (i.e., "imagined future ventures"), and *opportunity confidence* (i.e., an individual's subjective favorability assessment of an *external enabler* and/or a *new venture idea*). What distinguishes the framework from previous research on entrepreneurial opportunities is its proposed division

between a particular venture's aims (new venture idea) and the perceived beneficial external factors (external enablers) (Davidsson et al., 2020).

Moreover, the framework allows theorizing how external enablers, such as technological breakthroughs, regulatory changes, or socio-cultural and natural-environmental developments, trigger and facilitate entrepreneurial activity (Davidsson et al., 2020). Therefore, the framework is perfectly suited for explaining entrepreneurial activity in the context of the bioeconomy transition. The transition toward a sustainable bioeconomy involves a complex interplay of many factors (Hinderer et al., 2021), with innovation fostered by entrepreneurial activity being a central element (Kuckertz, 2020). However, we argue that the transition itself also serves as an external enabler of entrepreneurial activity. In other words, entrepreneurial activity and the transition toward a sustainable bioeconomy share a two-way mutually beneficial relationship.

The EE framework conceptualizes external enablers according to three elements (Davidsson et al., 2020). First, *characteristics* describe an external enabler based on its scope and onset, determining its actionability and market potential. Second, *mechanisms* describe an external enabler's function by specifying the cause-effect relationships that external enablers generate. Third, *roles* describe an external enabler's higher-order functions (e.g., triggering, shaping, outcome-enhancing) at different stages of the new venture's development process. Below, we outline the relevant aspects of the bioeconomy transition understood as an external enabler of entrepreneurial activity.

3.2.1.1 Characteristics

The characteristics of an external enabler include its spatial, temporal, sectoral, and socio-demographic scope as well as its onset defined according to gradualness, predictability, and evolution (Davidsson et al., 2020; Kimjeon & Davidsson, 2022). The spatial scope of the bioeconomy transition is multi-faceted. Although dedicated bioeconomy strategies are being developed worldwide (German Bioeconomy Council, 2018), such strategies can have a multi-national, a national, and sometimes even a regional focus (de Besi & McCormick, 2015). The strategic regional focus is not surprising as, in developing and developed countries, the bioeconomy transition is related to regional development hopes (Callo-Concha et al., 2020; Refsgaard et al., 2021). Specifically regarding sustainability, the bioeconomy's regional scale is essential because it allows entrepreneurs to adapt to locally available biomass and reduces transportation costs as well as greenhouse gas emissions (Pfau et al., 2014).

As the updated bioeconomy strategy of the European Union (EU) shows, bioeconomy in Europe is multi-sectoral but can be mainly divided into two sectors: the sectors that mainly supply biomass, such as agriculture, forestry, fishing, and aquaculture, and the sectors that use biomass, such as food and beverages, bioenergy, or biobased chemicals and materials (European Commission, 2018). Moreover, the processing and valorization of biomass has benefitted significantly from advances in industrial biotechnology (Dupont-Inglis & Borg, 2018).

The EU's bioeconomy strategy says a lot about the onset of the bioeconomy transition as an external enabler. While the strategy's first version was launched in 2012 (European Commission, 2012), the updated version was released in 2018 (European Commission, 2018). On the one hand, this shows the relatively gradual development of the discourse about the bioeconomy transition and, on the other hand, its relatively high degree of predictability.

3.2.1.2 Mechanisms

Although characteristics describe an external enabler's nature, the mechanisms category provides more details on an external enabler's influence on entrepreneurial activity (Davidsson et al., 2020). First, opacity describes "the extent to which the benefits of an enabling mechanism for specific purposes is rather obvious or requires specialized knowledge and/or extraordinary imagination" (Kimjeon & Davidsson, 2022, p. 5). Second, agency intensity describes "the extent to which activation of an enabling mechanism requires tenacity, risk-bearing and resource investments" (Kimjeon & Davidsson, 2022, p. 5).

Although Kimjeon and Davidsson (2022) proposed several potentially beneficial mechanisms for entrepreneurial activity, the following two mechanisms are best suited for describing the bioeconomy transformation case: *resource creation*—"making a previously nonexisting (type of) resource available to the focal venture" (Kimjeon & Davidsson, 2022, p. 4)—and *resource substitution*—"replacement of one resource with another for the focal venture" (Kimjeon & Davidsson, 2022, p. 4). Overall, the bioeconomy transition aims, by definition, to enhance the utility of renewable biogenic resources in phasing out finite fossil resources.

In the bioeconomy transition context, the concept of cascading biomass use (see Figure 3-1) plays an important role (Laibach et al., 2019). Cascading biomass use describes the efficient use of biomass for different purposes over time (e.g., residues from agricultural food production being used to produce bioplastics, and residues from bioplastic production being used for energy generation; (Keegan et al., 2013; Zörb et al., 2018). In addition, cascading biomass use closes

material and energy flows by transforming linear production processes into circular ones (e.g., by using digestate from biogas production as fertilizer for new biomass cultivation; (Keegan et al., 2013; Zörb et al., 2018). Consequently, we closely link the bioeconomy transition's enabling mechanisms with the concept of cascading biomass use.

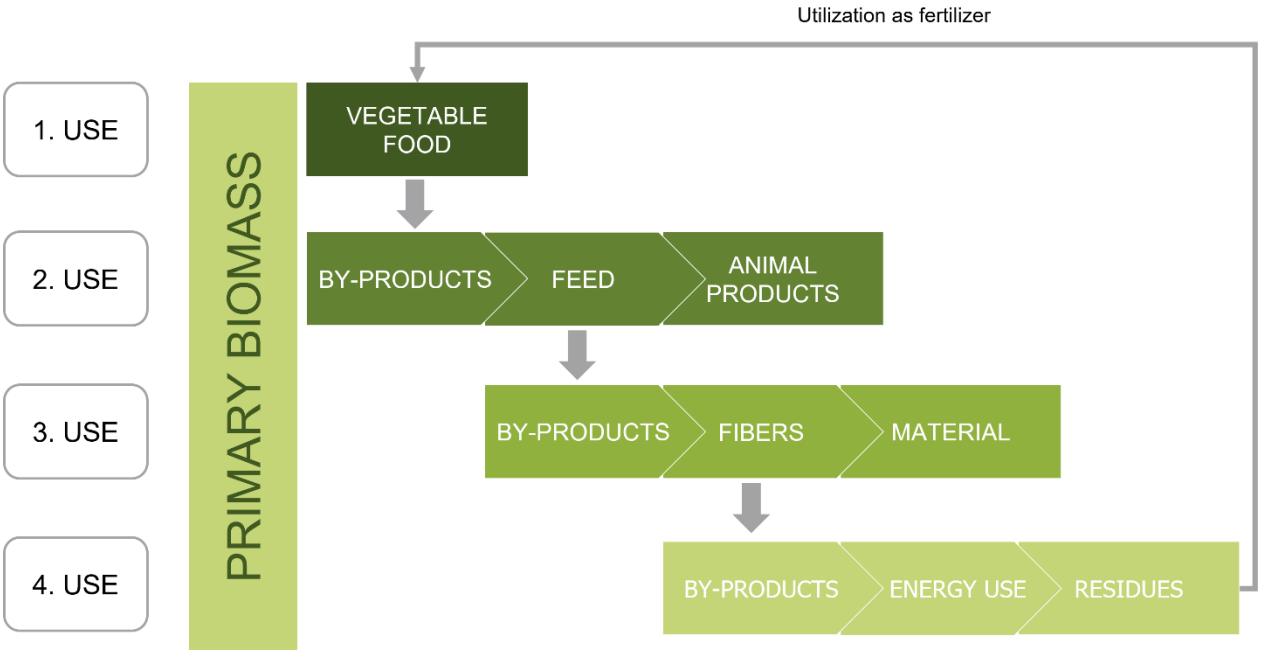

Figure 3-1: Concept of cascading biomass use based on Zörb et al. (2018)

In addition to the supply perspective (i.e., the cascading use of biomass), the demand perspective of the bioeconomy transition entail further enabling mechanisms. In the bioeconomy transition, consumers are active actors (Wilke et al., 2021) and generally tend to buy biobased products (Wensing et al., 2021). Therefore, the bioeconomy transition also provides beneficial enabling mechanisms through *demand creation*—the "creation of demand for a product/service where no demand previously existed" (Kimjeon & Davidsson, 2022, p. 4)—and demand substitution—the "increase in demand that is due to making a focal venture's market offerings more needed/attractive or competitors' offerings less needed/ attractive" (Kimjeon & Davidsson, 2022, p. 4).

As a consequence of changed consumer demand due to higher sustainability awareness, a further enabling mechanism becomes relevant for the bioeconomy context: legitimation, the "increase in the legality or psychological/socio-cultural acceptability of the focal venture, its offerings, or its practice, or reduction in such acceptability of competitors" (Kimjeon & Davidsson,

2022, p. 4). Considering public discourse on sustainability and climate change, it seems reasonable that the socio-cultural acceptability of sustainable bioeconomy ventures should increase, while that of competitors who completely neglect the principles of sustainable development should decrease.

3.2.1.3 Roles

In the EE framework, roles refer to the higher-order functions that external enablers play during the venture creation process (Davidsson et al., 2020). The EE mechanisms brought about by the bioeconomy transition mainly play triggering and shaping roles. Previous research has shown that the bioeconomy transition triggers entrepreneurial activity in various sectors (Kuckertz, Hinderer, et al., 2019; Urban et al., 2017). However, the cascading use of biomass, as described above, is not only the reason behind resource- and demand-related mechanisms; but also determine the *product shaping*—"EE influencing the focal venture's product(s) or service(s)" (Kimjeon & Davidsson, 2022, p. 5)—and *market shaping*—"EE influencing the focal venture's choice of spatial, sectoral, or socio-demographic market(s)" (Kimjeon & Davidsson, 2022, p. 5)— role of the bioeconomy transition as an external enabler.

3.2.2 SE competence frameworks

Scholars have proposed different SE competence frameworks, all mainly intended to contribute to SE training programs in higher education. However, no specific framework has been developed for the context of the bioeconomy transformation. Lans et al. (2014) laid the foundation for SE competnece frameworks by linking sustainable development competencies with entrepreneurship competencies. The resulting integrated framework was later validated in a separate study (Ploum et al., 2018) and included six competencies: system thinking competence, embracing diversity and interdisciplinary competence, foresighted thinking competence, normative competence, interpersonal competence, strategic management, and action competence.

Other competence frameworks (Biberhofer et al., 2019; Renfors, 2020) have built on this framework. Renfors (2020) explicitly focused on business competencies, while Biberhofer et al. (2019) extended the framework's scope beyond competencies toward values and worldviews. The resulting frameworks reflect different perspectives. Biberhofer et al. (2019) framework is highly similar to (Ploum et al.'s (2018) validated framework and includes the following five competencies: systemic competence, anticipatory competence, normative competence, strategic competence, and interpersonal competence. By contrast, Renfors (2020) competences reflect the business perspective: product development competence, consumer communication competence, brand

management competence, supply chain competence, digital competence, and strategic management competence.

Interestingly, these frameworks all emphasize the concept of entrepreneurial opportunities (Biberhofer et al., 2019; Lans et al., 2014; Renfors, 2020) by stating that the identification and pursuit of business opportunities (i.e., the individual–opportunity nexus) are distinctive features of entrepreneurship (Biberhofer et al., 2019; Lans et al., 2014). However, none of these studies have explicitly included the individual–opportunity nexus or the entrepreneurial process of opportunity recognition, evaluation, and exploitation in their frameworks.

Against this background, Foucrier and Wiek (2019) proposed a process-oriented SE competence framework. As the framework was based on an extensive review of research on entrepreneurship, sustainability, social entrepreneurship, and SE, the identified competencies overlap with those of the frameworks described above. This framework's novelty lies in its process-orientation, which links SE competencies and SE tasks using five process steps ranging from "discovery" to "consolidation" (Foucrier & Wiek, 2019). However, the framework's broad scope results in the individual–opportunity nexus receiving little attention.

By applying the EE concept, we develop a framework that explains how entrepreneurial opportunities emerge in the context of the bioeconomy transformation and what competencies are needed to act on such opportunities. In the next section, we outline our research design and methods in detail.

3.3 Methods

We employed a qualitative research design to explore the new venture development process of young bioeconomy startups. More specifically, we conducted semi-structured interviews with bioeconomy entrepreneurs. The analysis of the gathered data was twofold. First, we used the Gioia approach (Gioia, Corley, et al., 2013) to create a data structure and identify the concepts inherent in the data. Second, we engaged with the existing literature in the bioeconomy and (sustainable) entrepreneurship fields to complement our development of an SE model for the bioeconomy context (Shepherd & Sutcliffe, 2011).

3.3.1 Data collection

To identify and select interview partners, we relied on the networks of the partner institutions associated with the European Bioeconomy University, a joint undertaking of six European universities for educating bioeconomy experts, fostering research, and transfering

knowledge to society and the economy (European Bioeconomy University, 2019). In line with the European Commission's bioeconomy definition (European Commission, 2018) and the EE framework (Davidsson et al., 2020), we defined bioeconomy startups as follows:

> Bioeconomy startups are the result of new venture creation that is externally enabled by the bioeconomy transformation. They seize the opportunities for entrepreneurial activity provided by the bioeconomy transformation by producing biological resources, offering products and services related to the production of such resources, and/or by using biological resources and processes to offer products or services related to food, feed, biobased products, and energy, all the while considering sustainability and circularity.

In total, we selected 10 (co-)founders of bioeconomy startups from six different European countries that matched our definition, were younger than seven years, and pursued an innovative business model (Table 3-1). We screened firm websites and news articles for potential interviewees and checked the suitability and compliance of the startups with the inclusion criteria. The screening process also served as interview preparation and provided us with background information and context. Furthermore, we selected interviewees from each level of the biomass cascade.

3.3.2 Interviews

We conducted and recorded semi-structured interviews via the video conferencing software Zoom. In total, we recorded 9 hr 35 min of video interviews, with an average duration of 53 min per interview. We asked the interviewees about (1) their personal backgrounds and (2) their ventures' business models to gain a better understanding of the context before asking them about (3) their process of starting up and (4) the challenges they were confronted with (the complete interview guidelines can be found in Appendix B). While the first two questions provided us with information about the context in which the startups were operating, the answers to the other two questions revealed the process of opportunity identification, evaluation, and exploitation. We avoided explicitly asking about the opportunity identification process or knowledge and competencies to keep the questions as open as possible. We engaged the services of a professional transcription company (AmberScript) to transcribe the collected recordings, resulting in 152 single-spaced pages of text.

Table 3-1: Interviewees

No.	Sector	Level of biomass cascade	Country	Founding date	Business model	Interview duration
1*	Forestry Bioenergy	Primary production Energy recovery	Finland	2015	Measurement technology for timber Plant technology for torrefied pellets	00:53:50
2	Wood processing (furniture)	Material usage	Poland	2020	Processing technology for bended wood products	01:01:52
3	Food	Food production	Germany	2017	Snacks from unused food-industry byproducts	00:51:59
4	Agriculture (smart farming)	Primary production	Germany	2018	Drone-based herbicide application maps	00:56:18
5	Food, cosmetics (ingredients)	Food production, material usage	Austria	2019	Processing of fruit pits into raw material for new products	00:39:42
6	Marine cultivation	Primary production	Netherlands	2019	Living breakwater technology for cultivating marine ecosystems and protecting shore lines	00:54:05
7	Fashion	Material usage	Netherlands	2018	Vegan high-quality fabrics from mycelium	00:50:54
8	Food, cosmetics (ingredients)	Food production, material usage	France	2019	Re- and up-cycling of eggshells	00:53:56
9	Bioenergy	Energy recovery	Germany	2019	Ball mill to shred biomass for biogas plants	00:47:42
10	Food	Food production	Austria	2019	Natural chewing gum from pine resin	00:58:56

*Interviewee 1 co-founded two different bioeconomy startups that were both discussed in the interview.

3.3.3 Data analysis

We used the MAXQDA software to process the data by applying the following steps (Gioia, Corley, et al., 2013): First, we employed open coding to identify first-order concepts regarding what knowledge and competencies entrepreneurs need to identify and act on opportunities in the sustainable circular bioeconomy context. Second, we used axial coding to generate second-order themes. Third, based on second-order themes, we established the aggregate dimensions of a framework for describing what knowledge and competencies are required to act on SE opportunities in the bioeconomy context. To ground our findings in the data, we allowed codes to emerge without having a predefined list (Bryant & Charmaz, 2007). The open-coding process resulted in a large number of first-order concepts, which we then distilled into more abstract second-order themes using an iterative process of axial coding and later into aggregate dimensions, thus building the data structure (Gioia, Corley, et al., 2013). Whenever possible, we used in vivo coding in open coding to give the interviewees a voice (Bryant & Charmaz, 2007; Gioia, Corley, et al., 2013; Saldaña, 2013). Once the first interviews had been coded, our evolving understanding of the coding scheme resulted in adjustments to our interview guidelines for the remaining interviews (Strauss & Corbin, 2003). Finally, we terminated data collection once we had achieved theoretical saturation (Glaser & Strauss, 1967).

Only then did we begin to engage deeply with the extant literature (Corley & Schinoff, 2017) to complement our development of a model for new venture creation in the bioeconomy context. Engaging with the extant literature helped us to understand how our findings from the inductive analysis of the interview data could explain new venture creation in the bioeconomy context. We used the emerging concepts from the data structure to incorporate the existing frameworks of cascading biomass use and EE into our model of new venture creation in the bioeconomy. Overall, our model reveals useful insights for both the bioeconomy and SE fields, something that has been rarely done before.

3.4 Results

Figure 3-2 shows the data structure that emerged from the coding process. The representative quotations in Appendices C–F exemplify how the data structure emerged from the interview transcripts. The data structure contained 14 second-order themes, which can be further summarized into four aggregate dimensions describing the knowledge and competencies needed to seize the entrepreneurial opportunities provided by the bioeconomy transformation. These

aggregate dimensions served as the building blocks for our conceptualization of sustainable venture creation enabled by the biomass cascade and the bioeconomy transition and thus for the model in Figure 3-3. Building on Davidsson (2015, p. 689), we found that new sustainable venture creation depends on the actor–external-enabler nexus, which, in the bioeconomy context, is represented by the sustainable entrepreneur (actor) and the bioeconomy transition (external enabler).

The conceptualization of the actor–external-enabler nexus allowed us to distinguish between objectively existing enabling factors and sustainable entrepreneurs' subjective perceptions of and actions on such factors when creating new sustainable ventures (Davidsson, 2015). Our research revealed that at the individual level, sustainable entrepreneurs need specific competencies and knowledge to take advantage of the enabling function performed by cascading biomass use. On its own, the enabling function of cascading biomass use is not a sufficient condition for creating a new sustainable venture in the bioeconomy context. Instead, the agency exerted by a subject—that is, a sustainable entrepreneur—is also needed.

More specifically, sustainable entrepreneurs need *transformative knowledge*—that is, knowledge of transforming systems (Urmetzer et al., 2018). Transformative knowledge enables sustainable entrepreneurs to assess whether a new venture idea has the potential to generate profit and contribute to the targeted transformation toward a sustainable and circular bioeconomy, the fundamental rationale behind SE (Stubbs, 2017). Transformative knowledge generally requires (1) systems knowledge about how relevant systems work and (2) normative knowledge about the desired system states (Urmetzer et al., 2018). For new venture creation in the bioeconomy context, this means (1) understanding the regionality of biomass value chains and incorporating it into the business model and (2) being able to assess the business model's favorability and desirability in terms of its social-ecological sustainability.

This does not mean that new sustainable ventures can only operate at the regional level. However, the regional nature of biomass value chains influences the overall sustainability impact of products and services created from such biomass value chains. And sustainable entrepreneurs need to consider this factor, especially when expanding their businesses. Therefore, sustainable entrepreneurs need to be able to measure their sustainability impact and understand the main factors behind it; only then can they align with the overall goal of a transformation toward a sustainable and circular bioeconomy. In addition, sustainable entrepreneurs need to successfully communicate their sustainability impact to relevant actors, such as customers, investors, or community members, as this is necessary for unleashing the full transformative potential of their ventures.

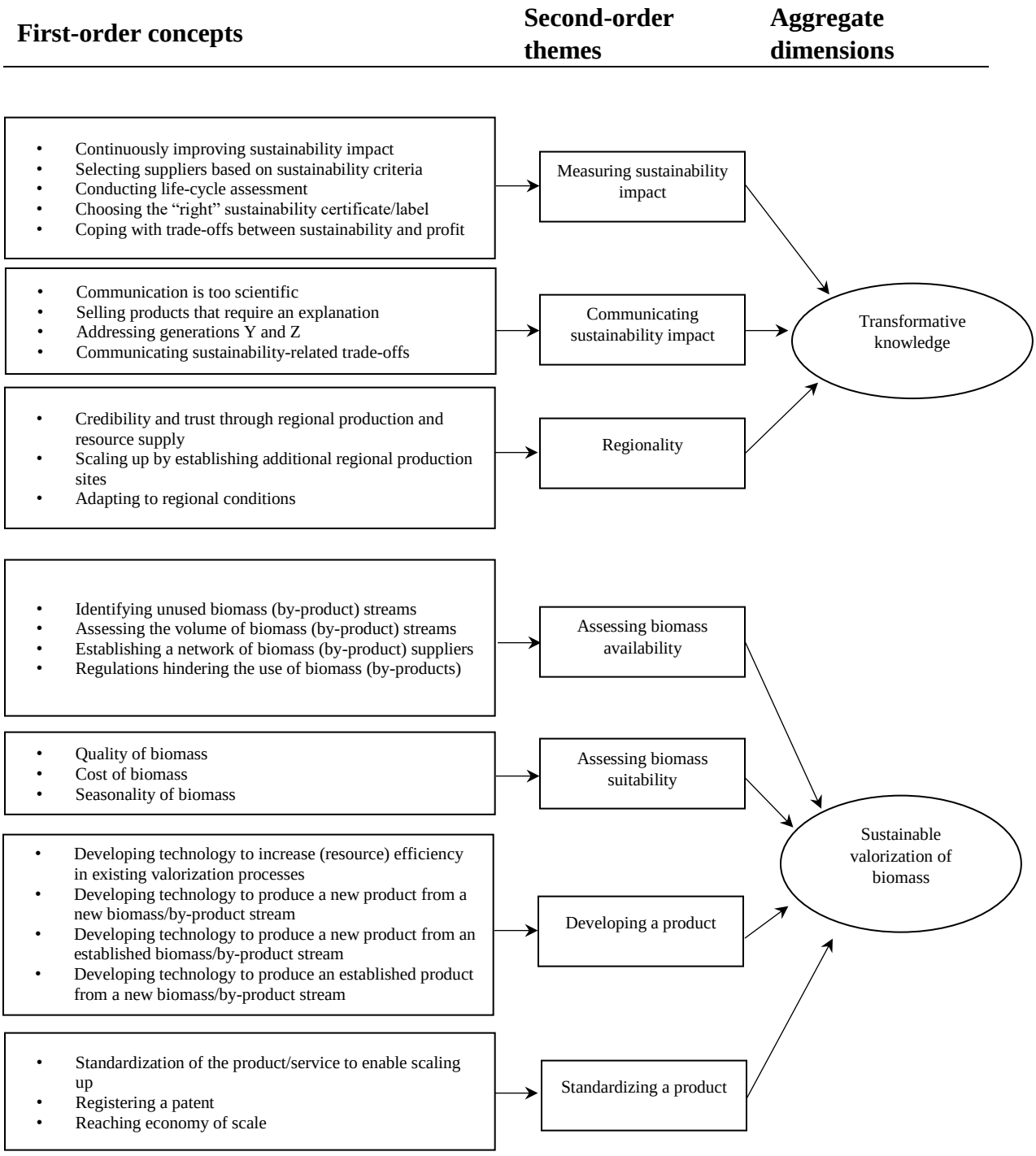

Figure 3-2: Data structure

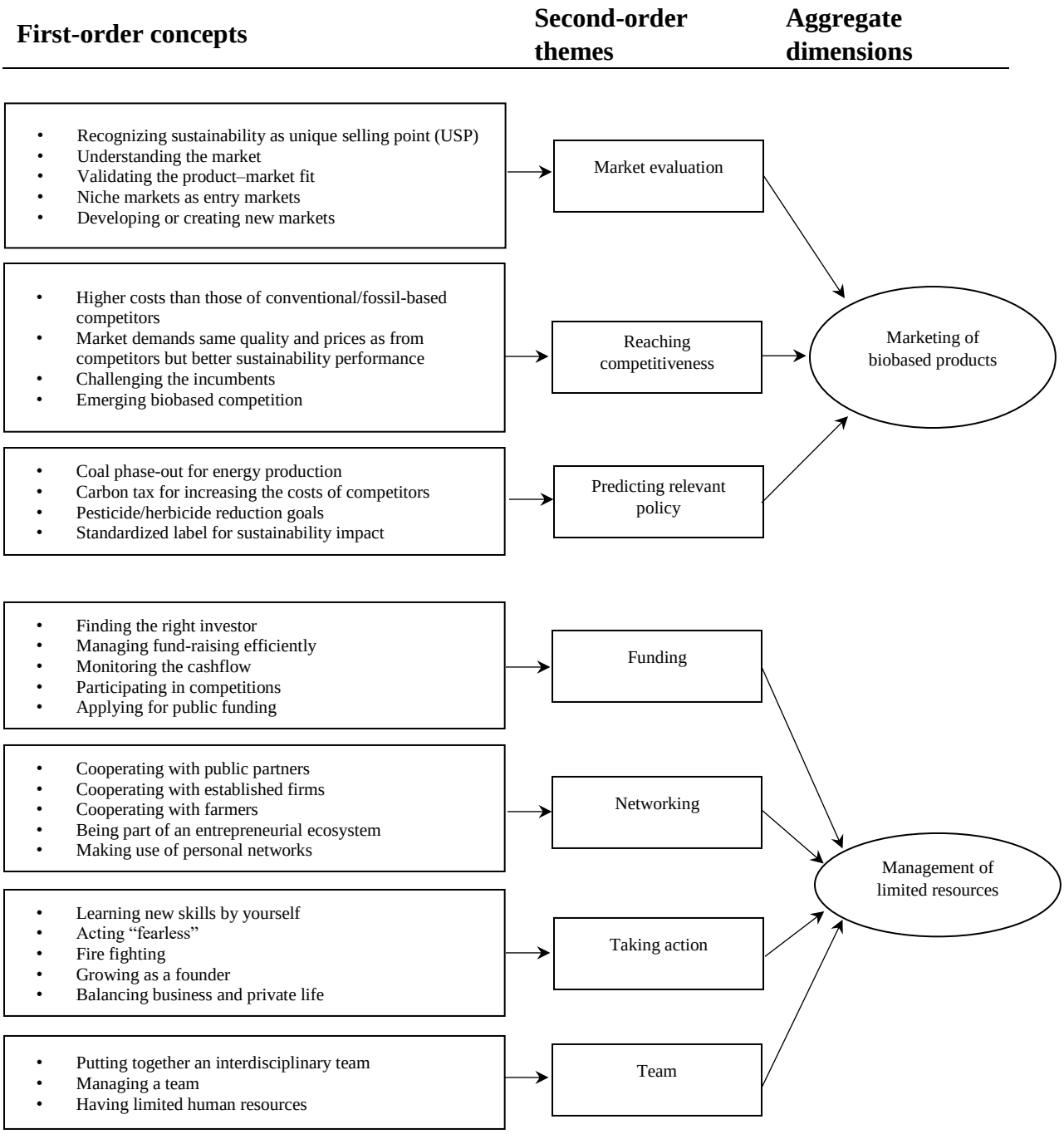

Figure 3-2 (continued)

To unlock the positive potential of cascading biomass use, sustainable entrepreneurs should pay attention to the following three aggregate dimensions of the data structure: *sustainable valorization of biomass*, *marketing of biobased products*, and *management of limited resources*. While transformative knowledge enables sustainable entrepreneurs to assess the desirability of new venture ideas, sustainable valorization of biomass enables sustainable entrepreneurs to evaluate the

feasibility of their ideas—that is, to assess the quantity and quality of biomass and to develop a product that solves real customer problems.

Technology plays a key role in the development of biobased products. It enables various ways of exploiting established or new biomass sources to produce new products or replace established fossil-based products (Bröring et al., 2020). Furthermore, technology can improve resource efficiency in established biomass valorization processes. Due to the significance of technology in new bioeconomy ventures, registering patents is key for many ventures to protect their intellectual property when going to market. Moreover, bioeconomy entrepreneurs need to standardize their products and services to scale up their business and benefit from economies of scale.

To assess the demand for their products and services, sustainable entrepreneurs need to engage in the marketing of biobased products. To do this, they must evaluate the market for biobased products. Frequently, sustainable entrepreneurs offer biobased and more sustainable alternatives to incumbents' products, which are based on non-renewable resources but are highly competitive in terms of price and market penetration. Therefore, sustainable entrepreneurs need to evaluate the market and search for strategies to quickly become competitive—for example, by entering niche markets that appreciate higher sustainability performance at the same product quality. A further factor that can enhance the competitiveness of new sustainable ventures is policy change in relation to sustainability targets—for example, a carbon tax or a ban on single-use plastic can boost the competitiveness of many biobased products. Therefore, sustainable entrepreneurs need to anticipate and adapt to such policy changes without entirely relying on them when making business plans.

The management of limited resources is needed just as much when creating new sustainable ventures as it is for ventures without a sustainability mission. While sustainable valorization of biomass and the marketing of biobased products require close engagement with the enabling mechanisms of cascading biomass use, managing limited resources involves handling supporting conditions to adapt them to the new venture. For example, ensuring sufficient funding of the right type is an important factor for sustainable entrepreneurs (Demirel & Danisman, 2019), as is hiring and managing a team, networking with relevant partners, and taking action when necessary.

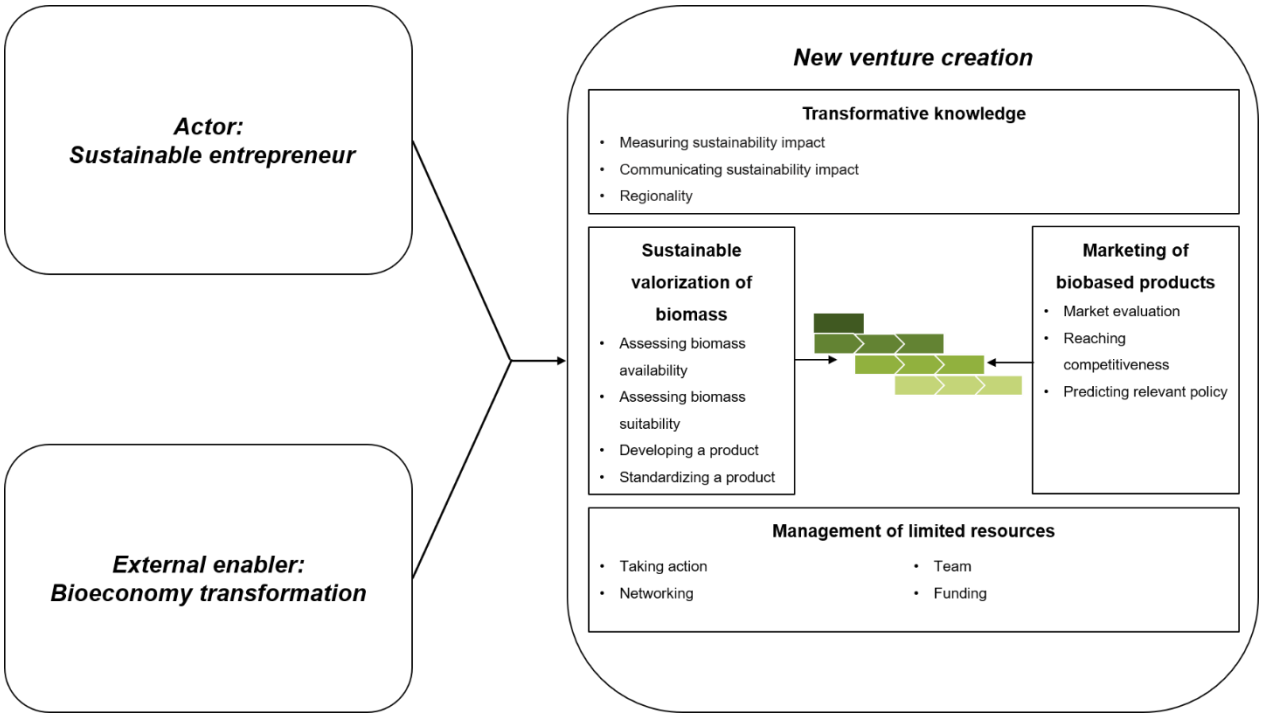

Figure 3-3: Model of new venture creation in the bioeconomy

3.5 Discussion

Our study examined (1) how entrepreneurial opportunities emerge in the bioeconomy context and (2) what skills and competencies sustainable entrepreneurs need to act on such opportunities. Consequently, we proposed a model of the individual–opportunity nexus that conceptualizes the bioeconomy transformation as an external enabler of entrepreneurial activity. Our findings link SE competencies and knowledge to the entrepreneurial processes of opportunity identification, evaluation, and exploitation, which represents the core of entrepreneurship research.

Our study contributes to the existing literature in three ways. First, we extend the frameworks that describe SE skills and competencies and show that such skills are sector-specific. Second, the EE framework substantiates our understanding of SE in the bioeconomy context. More specifically, we show that SE helps the transformation toward sustainable development and that the envisioned transformation enables and facilitates SE. Third, our EE framework opens avenues for future research on transformation and innovation policy.

3.5.1 Extending SE skills and competencies frameworks

Our findings are in line with the previously developed competence frameworks (Biberhofer et al., 2019; Lans et al., 2014; Ploum et al., 2018). Competencies related to transformative knowledge (Urmetzer et al., 2018) encompass what has been previously described as system-thinking competence and normative competence (Biberhofer et al., 2019; Ploum et al., 2018). Furthermore, the management of limited resources overlaps with strategic management and action competence, interpersonal competence, and embracing diversity and interdisciplinary competence (Biberhofer et al., 2019; Ploum et al., 2018).

However, the competencies related to the dimensions of sustainable valorization of biomass and the marketing of biobased products are unique to the bioeconomy context, which shows that SE skills and competencies are sector-specific. Previous studies have argued that SE drivers (Argade et al., 2021; Jensen et al., 2020; Jolink & Niesten, 2015; Niemann et al., 2020; Schaltegger & Wagner, 2011) as well as sustainable business models (Bocken et al., 2014) can be context-specific. Moreover, bioeconomy-specific factors influence sustainable entrepreneurs' business-strategy choices (Urbaniec et al., 2022). The same applies to entrepreneurial skills and competencies: As prior research on entrepreneurship education has shown, they can be context-specific (Thomassen et al., 2020). The identification of bioeconomy-specific SE competencies means they can be integrated into entrepreneurship education programs to improve opportunity-recognition patterns (Baron, 2006), which can positively influence sustainable entrepreneurs' business performances (Teruel-Sánchez et al., 2021).

3.5.2 The bioeconomy transformation as an external enablers of SE

Although SE theory is being developed, research on SE in the bioeconomy context is relatively rare and limited to emphasizing the importance of entrepreneurship for the bioeconomy transition instead of describing SE's micro-foundations (Kuckertz, Berger, et al., 2020). By conceptualizing the individual–opportunity nexus for the bioeconomy context, we take up a core concept in entrepreneurship research and create a solid foundation for a better understanding of SE in relation to a specific setting (Welter, 2011), namely the bioeconomy transformation.

Moreover, we show that entrepreneurial activity is a phenomenon that can be externally enabled by an envisioned bioeconomy transformation. In the literature, SE has been widely acknowledged as an important factor in the transformation toward sustainable development in general (Horne et al., 2020; Johnson & Schaltegger, 2020; Schaltegger et al., 2018) and toward the

bioeconomy in particular (Kuckertz, Berger, et al., 2020). Bioeconomy strategies worldwide approach entrepreneurship as a driver of the desired transformation toward the bioeconomy (Kuckertz, 2020). In fact, entrepreneurship is needed to develop innovations and technologies to reduce greenhouse gas emissions (Leendertse et al., 2021) and successfully transform the current fossil-based economies into bioeconomies (Bröring et al., 2020; Lokko et al., 2018). Sustainable entrepreneurs push incumbents toward more sustainable activities (Hockerts & Wüstenhagen, 2010), which can subsequently lead to sustainability transformations of whole industries (Bohnsack et al., 2020; Hockerts & Wüstenhagen, 2010).

Finally, conceptualizing the bioeconomy transformation as an external enabler reveals that SE and the bioeconomy transformation mutually enable each other and share a bi-directional relationship. Our proposed EE framework describes the micro-foundations of this enabling relationship in detail, thus opening new avenues for the design of transformation strategies that account for this bi-directional enabling relationship.

3.5.3 Making the EE framework useful for transformation and innovation policy

So far, the rationale behind entrepreneurship policy in the bioeconomy strategies of many governments has been to support entrepreneurial ecosystems and entrepreneurs in their endeavors to implement the governments' envisioned bioeconomy transformations (Kuckertz, Berger, et al., 2020). However, conceptualizing the bioeconomy transformation as an external enabler implies that governments can foster entrepreneurship via their bioeconomy strategies in more ways than simply introducing direct support measures. In fact, policy makers can envision the bioeconomy transformation and design policies in a way that enables entrepreneurship and leaves space for entrepreneurial ventures to contribute to the envisioned transformation.

Davidsson et al. (2020) discussed the EE framework's potential as an analytic tool for policy designers: On the one hand, the EE framework can help assess the likely consequences of societal changes for entrepreneurial activity. On the other hand, it can guide regulatory design changes to stimulate entrepreneurial activity. Indeed, for the bioeconomy context, previous research has shown that, for example, innovation policies are less effective when they do not address sufficient biomass availability (Maes & van Passel, 2019). This issue also came up in our interviews.

Therefore, we propose understanding entrepreneurship, especially SE, as something that can be enabled by suitably designed transformation and innovation policies. Mazzucato (2018)

coined the term mission-oriented innovation policies for tackling "grand societal challenges." These mission-oriented innovation policies require the creation of new markets instead of "fixing" the existing markets that are unable to tackle—or may even be the cause of—the "grand challenges" (Mazzucato, 2016). We believe that the EE of entrepreneurship can be a useful means of supplementing mission-oriented innovation policy and of conceptualizing and explaining the role of entrepreneurship in such innovation policy. We believe that this finding opens a promising avenue for future research and contributes to the discourse on suitable policy for fostering SE (Genus, 2021).

In conclusion, we propose understanding the bioeconomy transformation as an external enabler of sustainable entrepreneurial activity. By conceptualizing the individual–opportunity nexus for the bioeconomy context based on the EE framework, we have shown that to make use of the opportunities for entrepreneurial activity provided by the bioeconomy transformation, bioeconomy entrepreneurs need transformative knowledge and competencies related to sustainable valorization of biomass, the marketing of biobased products, and managing limited resources. Furthermore, we propose that conceiving SE as something that can be enabled externally opens new ways of understanding SE's role in the transformation toward sustainable development and the design of innovation policy targeting this transformation.

4 Study 3 - The limits to firm growth? De-growth attitudes among sustainable entrepreneurs[4]

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Abstract: In recent years the de-growth paradigm has gained popularity in the sustainability discourse. Questioning the absolute decoupling of economic growth from environmental degradation, de-growth proponents suggest downscaling production and consumption to reduce resource extraction and energy consumption. Our research answers how de-growth attitudes among (sustainable) entrepreneurs are associated with their decision-making on scaling strategies for their ventures. Differentiating between scaling fast and scaling slow strategies, we show that a de-growth attitude is negatively associated with scaling fast strategies, whether entrepreneurs consider themselves sustainable or not. However, sustainable entrepreneurship is positively associated with scaling slow strategies. Furthermore, we show that the development level of the economy an entrepreneur is active in is an essential factor in the decision-making on scaling strategies.

Keywords: Sustainable entrepreneurship, scaling, social impact, de-growth, green growth

[4] Presented at G-Forum 2022 in Dresden and ACIEK Conference 2023 in Madrid; Under review at Business Strategy and the Environment.

4.1 Introduction

Within the last decade, sustainable entrepreneurship has emerged as a prominent sub-field of entrepreneurship research (Anand et al., 2021). It has been promoted as a promising factor in fostering economic activity without undermining the ecological and social environment, thereby contributing to a transition toward sustainable development (Shepherd & Patzelt, 2011). Recently, researchers have introduced the concept of scaling social impact into the debate (Islam, 2020; Shepherd & Patzelt, 2022). It promises to accelerate the growth of sustainable startups and, thus, solutions to pressing social and ecological problems addressed by them.

In contrast, the question of whether unlimited economic growth is possible and desirable on a planet with limited resources has been central to the sustainability discourse since the Club of Rome published "The Limits to Growth" (Meadows et al., 1972). Undeniably, human activity has pushed the Earth system beyond planetary boundaries, bearing the risk of exiting a "safe operating space" for humanity (Steffen et al., 2015). And indeed, economic growth and consumption of affluent households in high-income countries have the most substantial environmental and social impact (Fanning et al., 2021; Wiedmann et al., 2020). Hence, especially in these countries, a debate evolved on whether economic growth, ecological degradation reduction, and a transition to sustainable development are combinable.

Moreover, research often conceptualizes business sustainability as balancing short- and long-term goals on firm and system levels (Bansal & DesJardine, 2014). It seems evident that fast growth strategies risk favoring short-term over long-term outcomes. However, sustainable entrepreneurs skeptical about growth cannot unfold the full potential of their venture, as they can only have a significant impact when scaling their startups (Hörisch, 2015). Thus, it remains unclear how sustainable entrepreneurs deal with the tensions and ambiguities of the growth debate and how it affects their decisions. So far, we know little about whether the discussion and confusion about different growth paradigms on a macroeconomic level influence their behavior as decision-makers within their firm on the micro level.

Hence, this study addresses the research question of how sustainable entrepreneurs' attitude toward economic growth on a macro level relates to their attitude toward firm growth and its operationalization on the micro level. In doing so, we provide two potential contributions to the academic discourse: First, we move forward our understanding of scaling sustainable ventures by investigating factors influencing entrepreneurs' decision-making on scaling. Second, we link the

sustainable entrepreneurship field closer to the theory on sustainability transitions, especially the inherent growth paradigms.

In the remainder of this paper, we first explain the underlying theoretical framework, focusing mainly on the dominant positions of the "growth vs. environment" debate and the phenomenon of scaling social impact. Subsequently, we describe the data collection and analysis process before illustrating our findings in detail in the results section. Finally, we discuss our work's contribution and potential implications for theory and practice before we close with a brief conclusion.

4.2 Theoretical framework

4.2.1 Scaling of sustainable new ventures

Next to innovative behavior and profit-seeking, growth orientation has been one of the critical characteristics of an entrepreneurial firm, differentiating it from small businesses (Carland et al., 1984). While gaining access to the resources needed for firm growth has been described as the "first" entrepreneurial problem, keeping the typical and advantageous flexibility of an entrepreneurial firm after the accumulation of these resources is the "second" entrepreneurial dilemma (Jarillo, 1989). More recently, the challenge of internal organization in phases of rapid firm growth has been debated under the term "scaling" (Desantola & Gulati, 2017), defined as "spreading excellence within an organization as it grows" (Shepherd & Patzelt, 2022, p. 255).

Recent conceptualizations of sustainable entrepreneurship include social and environmental goals beyond the classical ideal of profitability (Battilana & Dorado, 2010; Shepherd & Patzelt, 2011). Doing so leads to the question of how to scale not only the entrepreneurial firm, i.e., the organization, but also its intended social and environmental impact – in the extant literature, often termed simply as social impact but meant to include social and environmental dimensions of sustainable development. While scaling the organization can complement scaling its social impact, it does not necessarily have to (Shepherd & Patzelt, 2022).

Thus, a separate literature stream emerged addressing the question of social impact scaling strategies (Gupta et al., 2020; Islam, 2022). In accordance with the definition of organizational scaling, scaling social impact can be defined as "spreading the solution to address a social problem" (Shepherd & Patzelt, 2022, p. 256). However, scaling social impact strategies can vary regarding the intended increased positive changes to society – either qualitative or quantitative - and can be reached through one or more scaling paths (Islam, 2020).

Two overarching strategies characterize these different scaling paths (Islam, 2022): On the one hand, an ecosystem growth strategy aims to create a supportive environment for sustainability-oriented ventures. On the other hand, an organizational growth strategy seeks to scale impact by introducing new products and services and expanding the venture's geographical outreach. While both strategies are not mutually exclusive, the first does not necessarily require organizational scaling, whereas the latter is complementary to scaling the organization.

Focusing only on organizational growth strategies, Kim and Kim (2022) recently proposed a new concept for the growth of sustainability-oriented ventures. They conceptualized venture growth as a spatiotemporal phenomenon that unfolds at a particular spatiotemporal scale (Kim & Kim, 2022). They follow up on the recent discourse to view scale in the context of organizations from an ecological perspective defined as "the spatial and temporal attributes of a process" (Bansal et al., 2018, p. 220). Applied to the concept of scaling, entrepreneurs face the option to either scale up (fast geographical expansion) or to scale deep (slow strengthening of local embeddedness; Kim & Kim, 2022). Both modes of venture growth can be potentially beneficial for sustainable development. However, they differ in either an explosive and widespread contribution (scaling up) or a locally focused and enduring contribution (scaling deep; Kim & Kim, 2022).

Still, what remains unclear are the factors affecting the decision for a particular scaling strategy. Research has shown that strategic decision-making on achieving social impact is complex and not just simply a dichotomy between social and economic missions (Liu et al., 2021; Muñoz & Kimmitt, 2019). Moreover, not only organizational characteristics but also factors on the individual level affect scaling decisions (B. R. Smith et al., 2016). Thus, in the following, we briefly describe the three dominant positions in the "growth vs. environment" debate and outline their implications on entrepreneurship and firm growth.

4.2.2 Growth paradigms

The Club of Rome's famous report "The Limits to Growth" raised the question of whether unlimited economic growth is feasible and desirable on a planet with finite resources (Meadows et al., 1972). It sparked an ongoing and polarized "growth versus environment" debate (van den Bergh, 2011). To avoid confusion right from the beginning, growth or economic growth always means growth of gross domestic product (GDP) or GDP per capita in the context of this debate. It resulted in three growth-related paradigms and respective underlying visions of a transition toward sustainable development. These paradigms are the agrowth, green growth, and de-growth

paradigms, where agrowth emerged as an option to depolarize the debate between proponents of the green growth and the opposing de-growth paradigm (van den Bergh, 2017). In the following, we outline the basic idea of each growth paradigm before we describe in more detail the implications of each paradigm on entrepreneurship and firm growth, revealing the de-growth paradigm as the one most at odds with the conventional principles of entrepreneurial action.

4.2.2.1 Agrowth, green growth, and de-growth

The agrowth paradigm emerged as a "third option" (van den Bergh, 2017) in the polarized debate of pro-growth (i.e., green growth) proponents versus anti-growth (i.e., de-growth) proponents. The agrowth paradigm is agnostic to growth, putting the increase of social welfare within planetary boundaries as the central target, regardless of whether this results in an increase or decrease in growth (van den Bergh, 2011, 2017). In this sense, "economic growth then becomes desirable or undesirable only to the extent that it increases or decreases welfare" (Jakob & Edenhofer, 2014, p. 453).

In contrast, the green growth paradigm is explicitly pro-growth. It gained attention in the "growth versus environment" debate as several influential international institutions, such as the OECD (2011), UNEP (2011), and the World Bank (2012), promote it in several of their reports (Hickel & Kallis, 2020; Jakob & Edenhofer, 2014). Thus, it is the currently dominating paradigm in most climate policies. The paradigm assumes that decoupling economic growth from environmental impact is possible (Hickel & Kallis, 2020). However, such a decoupling would mean that increased resource efficiency would be insufficient; instead, greenhouse gas emissions or the extraction of non-renewable resources must decline as fast as economic output rises (Jackson & Victor, 2019). Thus, absolute decoupling requires technological advancements in cleaner production (Jackson & Victor, 2019), brought about by investments in education, infrastructure, and entrepreneurship (Bowen et al., 2012).

However, proponents of the de-growth paradigm question whether absolute decoupling is possible since there is no evidence for such absolute decoupling in historical data on increases in resource efficiency (Hickel & Kallis, 2020). Thus, they propose sustainable de-growth (Kallis, 2011), defined as "equitable downscaling of production and consumption that increases human well-being and enhances ecological conditions at the local and global level, in the short and long term" (Schneider et al., 2010, p. 511). On the other hand, critics state that the de-growth paradigm is neither efficient nor effective in reducing ecological damage (Jakob & Edenhofer, 2014; van den

Bergh, 2011). It is ineffective since it will hardly receive much social and democratic-political support due to its implied reduction of income and the risk of a period of economic instability characterized by high unemployment (van den Bergh, 2011, 2017). Moreover, it is also inefficient since, e.g., in the case of greenhouse gas emissions, the most expensive technological mitigation options are considered less costly than simply reducing income (Jakob & Edenhofer, 2014). Furthermore, since a period of de-growth can hardly be controlled or planned, there is no guarantee that production will not become less resource-efficient and, thus, even more polluting (van den Bergh, 2017). Additionally, the de-growth debate mainly occurs in high-income countries (Weiss & Cattaneo, 2017) and neglects implications for developing economies (Cosme et al., 2017). Thus, it is less relevant to these economies and considered a call to developed economies "where reduced consumption can save "ecological space" enabling people in poor countries to enjoy the benefits of economic growth" (Xue et al., 2012, p. 85).

4.2.2.2 Implications for entrepreneurship and firm growth

As mentioned above, agrowth is agnostic about economic growth and puts an increase in social welfare at the center of economic policy. Hence deriving implications on entrepreneurship and firm growth is complex. But eventually, from an agrowth perspective, entrepreneurship and firm growth must also be evaluated based on their contribution to increasing social welfare.

In contrast, the green growth paradigm contains obvious implications for entrepreneurship and firm growth. Efforts to stimulate entrepreneurship are central to the green growth paradigm to generate the innovations needed for a transformation toward sustainable development (Bowen et al., 2012) and promoted by the OECD (2011) and the World Bank (2012) in their respective policy papers. Green growth includes a Schumpeterian perspective where "greening" the economy can be seen as an industrial revolution offering enormous opportunities for innovations by creative entrepreneurs who challenge incumbents of the fossil economy (Bowen & Fankhauser, 2011). Exploiting these opportunities may trigger "a Schumpeterian burst of growth" (Stern, 2008, p. 11) while sustainable technology transfer and sustainable innovations in turn further promote green growth (Fernandes et al., 2021).

The de-growth literature, however, remains vague regarding implications for entrepreneurship, innovation, and firm growth (Cyron & Zoellick, 2018). While the de-growth debate is well established within ecological economics (Martínez-Alier et al., 2010) and also gained popularity in the popular scientific literature (Jackson, 2016), business has been so far mostly left

out in the debate (Khmara & Kronenberg, 2018). De-growth in a business context seems to be an "oxymoron" (Khmara & Kronenberg, 2018) or a "paradox" (Edwards, 2021) and potentially discourages entrepreneurs to grow and scale their businesses (Chistov et al., In-Press). However, two recent special issues show the increasing interest of scholars in the implications of de-growth for business, innovation, and technology (Banerjee et al., 2021; Kerschner et al., 2018), though implications specifically for entrepreneurship are rare.

The de-growth paradigm requires a fundamentally different understanding of business (Khmara & Kronenberg, 2018), including organizations contributing to wealth distribution instead of accumulation, resource restoration instead of extraction, cooperation instead of competition, and sufficiency instead of consumerism (Banerjee et al., 2021). Thus, business model innovation within the de-growth paradigm requires small-scale businesses operating in spatially bounded markets and a shift from products to less capital- and resource-intensive services, e.g., in the case of car-sharing business models (Wells, 2018)

However, de-growth does not necessarily imply abandoning firm growth altogether. Instead, a de-growth perspective requires firm growth embedded in the firm's social-ecological environment (Edwards, 2021) and minimizing its social-ecological impact (Khmara & Kronenberg, 2018). Muñoz and Cohen (2017) propose a similar understanding of sustainable entrepreneurship as new venture creation in synchronicity with the social-ecological systems surrounding the new venture, though not relating this to de-growth. And indeed, sustainable entrepreneurs sometimes tend to be opposed to consumerism and growth because they worry they have to abandon their ideals (Hockerts & Wüstenhagen, 2010). Moreover, empirical data shows that a significant fraction of small and medium-sized enterprises grow only slowly or have no intention to grow (Gebauer, 2018). However, it is unclear whether this results from a de-growth attitude or simply provides a more realistic picture of entrepreneurship, where fast-growing unicorns, that is, startups achieving a valuation of more than one billion USD in a very short time, are rather the exception than the rule (Aldrich & Ruef, 2018). However, "if sustainable entrepreneurs follow a de-growth logic in the sense that they limit the market effect of their own venture and the respective positive externalities to small niches, the paradigm is picked up by those very businesses whose growth will support a more sustainable development" (Hörisch, 2015b, p. 296).

4.3 Hypotheses development

In the following, we argue for the linkage between scaling strategies and a de-growth attitude, the development level of the entrepreneurs' countries of origin, and the self-perception as a sustainable entrepreneur. Figure 4-1 visualizes the resulting hypothesized model.

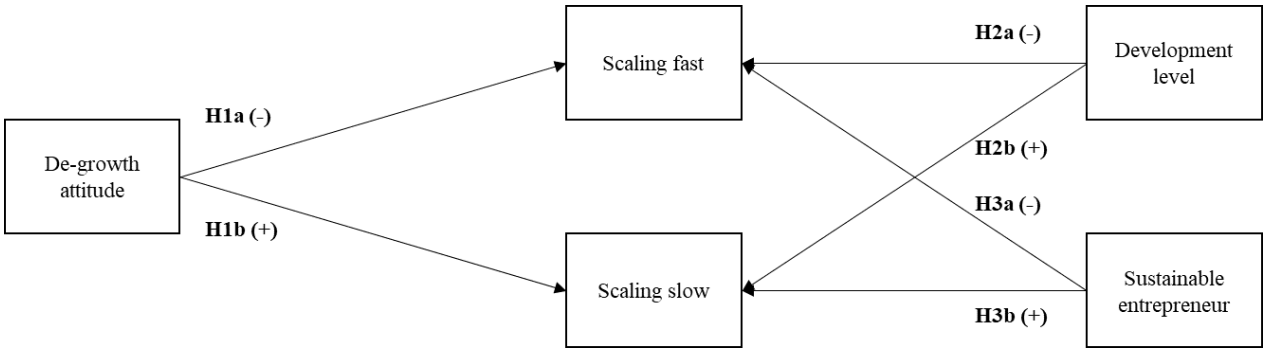

Figure 4-1: Visualization of the hypothesized model

As outlined above, sustainable entrepreneurs can achieve social impact scaling by scaling their venture, a spatiotemporal phenomenon (Islam, 2022; Kim & Kim, 2022). Focusing only on the concept's temporal axis allows one to differentiate between *scaling fast* and *scaling slow* strategies, as has been done in previous research (Stallkamp et al., 2022). While *scaling fast* strategies aim for fast speed and exponential growth, *scaling slow* strategies aim for an enduring contribution unfolding with lower speed over a longer time horizon (Kim & Kim, 2022).

Interestingly, personal values influence the choice of a scaling strategy (B. R. Smith et al., 2016). Entrepreneurs' opinions on the "growth versus environment" debate are personal values. Research has summarized these values in mutually exclusive opinion clusters, each showing agreement with one of the dominant paradigms in the discussion, i.e., green growth, de-growth, and agrowth (Drews et al., 2019). As mentioned above, the green growth paradigm is not only pro-growth but also sees innovation and entrepreneurship in a Schumpeterian sense of "creative destruction" as a key toward sustainable development (Bowen & Fankhauser, 2011). In contrast, the de-growth paradigm is generally anti-growth and seems contradictory to the conventional principles of entrepreneurial action. It promotes firm growth embedded in the social-ecological environment (Edwards, 2021), showing longer time cycles typically as those compressed time cycles of socio-material constructs like firms and markets (Bansal & Knox-Hayes, 2013). Hence,

H1a. A *de-growth attitude* of entrepreneurs is negatively associated with a preference for *scaling fast* strategies.

H1b. A *de-growth attitude* of entrepreneurs is positively associated with a preference for *scaling slow* strategies.

The "growth versus environment" debate has shown that GDP is a flawed measure of welfare (van den Bergh, 2011) and has, indeed, weaknesses in measuring the multiple dimension of well-being (Kubiszewski et al., 2013). Nevertheless, growth in GDP per capita shows correlations with individuals' well-being, though at the cost of ecological sustainability (Fritz & Koch, 2016), and is positively correlated with human development (Suri et al., 2011). Furthermore, and maybe more importantly, whether appropriate or not, GDP evolved over the last decades in politics but also in the broader public as a standard indicator for development and prosperity (van den Bergh, 2010). However, the de-growth discourse mainly takes place in high-income economies (Weiss & Cattaneo, 2017), and implications for developing economies have been largely neglected (Cosme et al., 2017). However, in contrast, in these economies, de-growth is seen as a call to developed economies to reduce consumption and production to allow for growth within planetary boundaries in developing economies (Xue et al., 2012). And prior research has shown that entrepreneurship is essential in promoting economic growth and contributing to employment and innovation (Acs et al., 2011; Galindo & Méndez, 2014; Van Praag & Versloot, 2007). Thus, in developing economies, a possible *de-growth attitude* may not sufficiently explain the decision for a particular scaling strategy. Hence,

H2a. The *development level* of the economy an entrepreneur is active in is negatively associated with a preference for *scaling fast* strategies.

H2b. The *development level* of the economy an entrepreneur is active in is positively associated with a preference for *scaling slow* strategies.

Through the lens of temporality, research defines business sustainability as "the ability of firms to respond to their short-term financial needs without compromising their (or others') ability to meet their future needs" (Bansal & DesJardine, 2014, p. 71). Hence, short-termism potentially compromises sustainable development (Bansal & Knox-Hayes, 2013), as shown by recent empirical research (DesJardine & Durand, 2020). Furthermore, through the lens of temporality, research defines venture scaling as organizational growth that unfolds in at a particular temporal scale (Kim & Kim, 2022). However, while the time needed to scale a new venture can be compressed, the biophysical cycles of the natural environment (e.g., carbon absorption by plants

for growth through photosynthesis) cannot be compressed in time (Bansal & Knox-Hayes, 2013). Thus, sustainable entrepreneurs sometimes seem critical of fast growth since they worry they must abandon their ideals (Hockerts & Wüstenhagen, 2010). Hence, applying the logic of scaling,

H3a. Considering oneself as a *sustainable entrepreneur* is negatively associated with a preference for *scaling fast* strategies.

H3b. Considering oneself as a *sustainable entrepreneur* is positively associated with a preference for *scaling slow* strategies.

4.4 Methods

4.4.1 Sample and data collection

Our research design and data collection received approval from our university's ethics committee. In a pre-test, we investigated the connection between entrepreneurs' attitudes toward economic growth and their preferred scaling strategies. Therefore, we surveyed 98 entrepreneurs from the "Sustainability" category from Crunchbase. Over the years, the Crunchbase database established itself as a reliable and premier source for startup-related research (Dalle et al., 2017). An OLS regression analysis revealed a significant negative association between a *de-growth attitude* and *scaling fast* for the pre-test sample ($b = - 1.8118$, $p < .001$, adjusted $R^2 = 0.234$). These findings gave us the confidence to commission an online panel provider to survey a more comprehensive global sample and test the complete hypotheses.

Consequently, we surveyed entrepreneurs via the online research platform Prolific. They received financial compensation for their participation. Compared to other research platforms, participants from Prolific are less dishonest and fail fewer attention checks while producing data of higher quality (Peer et al., 2017). Furthermore, the Prolific master data allow prescreening for entrepreneurs as the only possible survey participants. Thus, it has already been used for rigorous entrepreneurship research (Engel et al., 2020; Gunia et al., 2021). In total, 501 entrepreneurs finished the survey. After deleting those who failed our own screening for business owners and those entrepreneurs with a business older than ten years, we ended up with a sample of $n = 393$ entrepreneurs. The final sample was, on average, 32.25 years old. While 40% identified as male, 59% identified as female, and 1% as diverse. The entrepreneurs' firms were, on average, 3.80 years old. Furthermore, Table 4-1 illustrates the industries of the participants' ventures.

Table 4-1: Industries of the participants' ventures

Industries	Percentage
Services	45.04
Retail Trade	24.94
Finance, Insurance, And Real Estate	7.63
Manufacturing	5.85
Transportation, Communications, Electric, Gas, And Sanitary Services	4.83
Other	11.71
*Standard Industrial Classification (SIC) codes	

4.4.2 Measures

For the dependent variables, we created new scales based on the conceptualization of venture scaling as a spatiotemporal phenomenon by Kim and Kim (2022). We developed a six-item scale to measure participants' preference for *scaling fast* strategies and a three-item scale to measure a preference for *scaling slow* strategies (items in Table 4-2). Participants could answer on 7-point Likert scales from 1 (strongly disagree) to 7 (strongly agree).

For the independent variable *de-growth attitude*, we applied a 16-items survey module from Drews et al. (2019) to assess participants' opinions on "growth versus environment" (see items in Appendix G). Participants could assess different statements on economic growth on 7-point Likert scales. Following Drews et al. (2019), we used the "poLCA" package in R (Linzer & Lewis, 2011) to perform a latent class analysis (LCA). The LCA allows distinguishing between three opinion clusters: Green growth, de-growth, and agrowth. We coded the variable *de-growth attitude as* "1" if participants were in the de-growth cluster and "0" if not. We had successfully employed this approach already in our pre-test with a reduced 5-item question module validated by Savin et al. (2021).

Furthermore, we used the Inequality-adjusted Human Development Index (IHDI) from the United Nations Development Programme (UNDP, 2022b) to indicate the development level. It is based on the Human Development Index (HDI) but accounts for inequalities, i.e., "the IHDI value equals the HDI value when there is no inequality across people but falls below the HDI value as inequality rises" (UNDP, 2022a). The HDI was created with the conviction that the well-being of

people cannot be captured alone by measuring growth. Thus, the HDI covers the critical dimensions of a long and healthy life, knowledge, and a decent standard of living (UNDP, 2022a). It ranges from 0 to 1.

We relied on operationalizations borrowed from the Global Entrepreneurship Monitor (GEM) to measure whether participants consider themselves sustainable entrepreneurs. Following the GEM (2022, p. 40), we asked participants to answer, "when making decisions about the future of my business, I always consider social implications" and "when making decisions about the future of your business, I always consider environmental implications" on a 5-point Likert scale from 1 (strongly disagree) to 5 (strongly agree). We coded participants as sustainable entrepreneurs when they answered both questions with 4 or 5.

Finally, we included *age*, *gender*, and *firm age* as control variables. Moreover, to control for the potential effects of resource or knowledge constraints on the preferred scaling strategy, we included two established scales to measure possible financial and knowledge constraints (Keupp & Gassmann, 2013). Table 4-3 summarizes the descriptive statistics and correlations of all considered variables.

4.4.3 Reliability and validity

Since the measurement scales for *scaling fast* and *scaling slow* had to be newly developed, we first created a sizeable initial item pool of candidates for inclusion in the scales (DeVellis & Thorpe, 2021). To ensure content validity, we stayed close to the wording of Kim and Kim (2022) when generating 15 item candidates for each scale (DeVellis & Thorpe, 2021). We then used these item candidates in our pre-test.

To reduce the number of items to those performing best in revealing the latent variables and ensuring internal consistency and unidimensionality of the scales (DeVellis & Thorpe, 2021), we applied exploratory factor analysis (EFA) using the FactorAnalyzer package in Python (Persson & Khojasteh, 2021). To further validate the two scales, we subsequently applied confirmatory factor analysis (CFA) using the semopy package in Python (Igolkina & Meshcheryakov, 2020).

To measure *scaling fast* and *scaling slow* in our final sample, we used the six best-performing items from the pre-test for each variable. We repeated EFA and CFA for the final sample to further validate the two scales. Table 4-2 summarizes the outcomes. Following our theoretical reasoning for the EFA, we extracted two factors by applying a varimax rotation. The results showed significant factor loadings for all items (Hair et al., 2019). However, the EFA

revealed critical cross-loading of one item, so we deleted it before repeating the EFA. The resulting factors of the final EFA have eigenvalues greater than one and explain 53,3 % of the variance, which can be considered satisfactory in social sciences studies (Hair et al., 2019; Peterson, 2000).

The subsequent CFA revealed factor loadings below the critical threshold of 0.5 (Hair et al., 2019) for two items, which also led to their deletion before we also repeated the CFA resulting in a good model fit ($\chi 2 = 177.11$; GFI = 0.91; CFI = 0.92; TLI = 0.89; RMSEA = 0.12). The AVE for the remaining items of each scale is above 0.5 (*scaling fast* AVE = 0.58, *scaling slow* AVE = 0.62), indicating convergent validity (Hair et al., 2019). The AVEs of both constructs are greater than the square of the correlation estimate of the two constructs ($0.23^2 = 0.05$), indicating discriminant validity between the two constructs. The Cronbach's alphas for both scales are higher than 0.7 (*scaling fast* $\alpha = 0.89$, *scaling slow* $\alpha = 0.77$).

To determine the appropriate number of opinion clusters to code the variable *de-growth attitude,* we followed Drews et al. (2019) and Savin et al. (2021)considering three Information Criteria (ICs): consistent Akaike Information Criterion (cAIC), Bayesian Information Criterion (BIC) and adjusted BIC (aBIC). We decided to use three clusters as suggested by the BIC, though the cAIC suggests two clusters and the aBIC suggests four clusters but with only a marginal difference to three clusters (see Appendix H). However, the BIC is considered the superior IC (Nylund et al., 2007), and three clusters allow for a meaningful interpretation following (Drews et al., 2019). Appendix I shows the distribution of the three clusters for the 16 questions that assess the participants' opinions. For the control variables, *financial constraints* and *knowledge constraints*, we calculated Cronbach's alpha (*financial constraints* $\alpha = 0.83$, *knowledge constraints* $\alpha = 0.76$).

Table 4-2: Results of the EFA and CFA for *scaling fast* and *scaling slow*

Items	Loadings in EFA (factor scaling fast)	Loadings in EFA (factor scaling slow)	Loadings in CFA
Scaling fast (α = 0.89; AVE = 0.58; Sample mean = 4.56; SD = 1.29)			
*We aim for the greatest possible impact within the shortest possible time.	0.68	0.11	0.67
*To address our mission, we have speeded up our growth.	0.78	0.10	0.75
*We aim for the exponential growth of our venture.	0.72	0.13	0.72
*Fast growth has a high priority for us.	0.91	-0.08	0.92
*We have grown quickly.	0.60	0.22	0.59
*Fast growth is essential to us.	0.86	-0.05	0.88
Scaling slow (α = 0.76; AVE = 0.62; Sample mean = 4.97; SD = 1.17)			
*We have created new longstanding jobs.	0.39	0.50	0.50
We aim for duration instead of speed when expanding our business activity.	-0.11	0.49	
*We have made an enduring contribution to our customers' lives and society.	0.19	0.80	0.92
*Our organization's approach allows us to create an enduring contribution to our customers' lives and society.	0.17	0.82	0.87
We take the time we need to expand our business activities.	0.02	0.47	
Sum of squares (eigenvalue)	4.40	2.31	
Cumulative variance explained (%)	34.02	53.29	

Notes: Measured on a seven-point Likert scale. CFA: $\chi 2 = 177.11$; GFI = 0.91; CFI = 0.92; TLI = 0.89; RMSEA = 0.12. Asterisks indicate final items.

Table 4-3: Descriptives and correlations of the considered variables

Variable	Mean	SD	α	1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	11.	12.	13.	14.
1. Scaling fast	4,56	1,29	.891	-/-													
2. Scaling slow	4,97	1,17	.765	0.37***	-/-												
3. Firm age	3,80	2,26	-/-	-0.09*	0.1*	-/-											
4. Age	32,25	9,13	-/-	-0.34***	-0.18***	0.28***	-/-										
5. Gender male (0 = no / 1 = yes)	0,40	0,49	-/-	-0.04	-0.1**	0.09*	-0.02	-/-									
6. Gender female (0 = no / 1 = yes)	0,59	0,49	-/-	0.04	0.12***	-0.09*	0.02	-0.98***	-/-								
7. Gender diverse (0 = no / 1 = yes)	0,01	0,09	-/-	-0.02	-0.08	0.03	0.02	-0.07	-0.11**	-/-							
8. Financial constraints	4,16	1,67	.836	0.12**	-0.03	-0.12**	-0.15***	-0.04	0.04	0.02	-/-						
9. Knowledge constraints	3,45	1,36	.762	0.09	-0.06	-0.06	-0.12**	-0.02	0.0	0.09	0.44***	-/-					
10. De-growth (0 = no / 1 = yes)	0,20	0,40	-/-	-0.34***	-0.17***	0.01	0.25***	0.0	-0.02	0.1**	-0.15***	-0.1*	-/-				
11. Green growth (0 = no / 1 = yes)	0,30	0,46	-/-	0.38***	0.24***	-0.06	-0.25***	0.02	-0.01	-0.06	0.12**	0.1*	-0.32***	-/-			
12. Agrowth (0 = no / 1 = yes)	0,50	0,50	-/-	-0.08**	-0.09*	0.05	0.04	-0.02	0.03	-0.03	0.0	-0.01	-0.5***	-0.66***	-/-		
13. Sust. Entrepreneur (0= no /1 = yes)	0,61	0,49	-/-	0.11**	0.32***	-0.04	-0.05	-0.19***	0.19***	0.01	0.07	0.0	-0.03	0.09*	-0.06	-/-	
14. Development level	0,65	0,18	-/-	-0.48***	-0.32***	0.14**	0.38***	0.11	-0.12	0.03	-0.31***	-0.22***	0.36***	-0.45***	0.13***	-0.24***	-/-

4.5 Results

As Figure 4-2 shows, 61.07 % of the survey participants consider themselves sustainable entrepreneurs, while 38.93 % do not. This finding is in line with the numbers of the latest GEM, showing that in most economies, more than half of the business owners consider the social and environmental implications of their decisions (GEM, 2022). The mean IHDI of the participants' countries of origin is 0.655. The median is 0.761, which is in the HDI range of countries considered to have high human development (e.g., Mexico, China, Albania) but below the threshold for countries with very high human development (0.800 and above, e.g., United States, Norway, South Korea) and above the threshold for medium human development (from 0.699 to 0.550, e.g., Venezuela, India, Ghana).

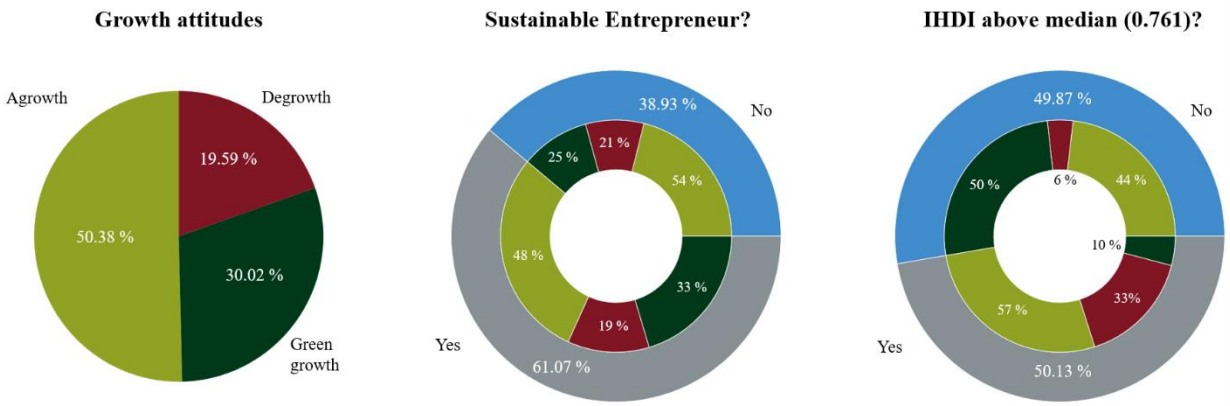

Figure 4-2: Share of growth attitudes, sustainable entrepreneurs, and entrepreneurs from countries above and below the IHDI median

The LCA revealed that 50.38 % of the surveyed entrepreneurs have an agrowth attitude, 30.02 % have a green growth attitude, and 19.59 % have a *de-growth attitude*. However, the picture is slightly different when differentiating between sustainable and non-sustainable entrepreneurs and between entrepreneurs from countries above and below the IHDI sample median (see Figure 4-2). Among sustainable entrepreneurs, 33 % share a green growth attitude, while only 25 % among non-sustainable entrepreneurs do so. More drastically are the differences for entrepreneurs from countries above or below the IHDI sample mean: While for those above the median, only 10% share a green growth attitude, 33 % share a *de-growth attitude*. For entrepreneurs from countries below the median, it is the other way around: Only 6 % have a *de-growth attitude,* and 50 % have a green growth attitude. These findings confirm the low relevance of the de-growth discourse in

developing economies. There, de-growth is perceived as a call to the industrialized nations primarily responsible for climate change and environmental degradation. In contrast, it is now developing economies' turn to benefit from the hoped-for advances coming with (green) growth.

Table 4-4: Regression analysis for associations with *scaling fast* and *scaling slow*

Dependent variables	**Scaling fast**		**Scaling slow**	
Variables	**Model 1**	**Model 2**	**Model 3**	**Model 4**
Constant	5.6725***	7.2123***	5.7125***	6.3699***
Control variables				
Firm age	.0113	-.0032	.0927***	.0914***
Age	-.0470***	-.0233**	-.0315***	-.0170**
Gender female	.1288	.0078	.3121**	.1281
Gender diverse	-.2471	.1661	-.8415	-.7785
Financial constraints	.0438	-.0328	-.0162	-.0732*
Knowledge constraints	.0295	-.0045	-.0554	-.0665
Main effects				
Sustainable entrepreneur		-.0303		.6042***
Development level		-2.5645***		-1.6355***
De-growth attitude		-0.5599***		-.1703
Model Fit				
Adj. R^2	.110	.268	.075	0.217
Adj. R^2 change		.158		0.142

We adopted a hierarchical OLS regression approach to assess the association between the proposed independent variables and entrepreneurs' preferred scaling strategy. Model 1 in Table 4-4 shows that the control variable *age* is significantly but weakly associated with *scaling fast* strategies ($b = -0.0470$, $p < 0.001$). Model 2 shows, in line with our theoretical reasoning, that a *de-growth attitude* has a significant negative association with *scaling fast* ($b = -0.5599$, $p < .001$).

Thus, we can accept H1 (a). Furthermore, model 2 shows that the *development level* is significantly and negatively associated with *scaling fast* ($b = -2.5645$, $p < 0.001$). Thus, we can also accept H2 (a). However, considering oneself a *sustainable entrepreneur* is not significantly associated with *scaling fast*. Hence, we need to reject H3 (a).

Model 3 in Table 4-4 illustrates a weak significant and positive association ($b = 0.0927$, $p < .001$) for *firm age* and a weak significant and negative association ($b = -0.0315$, $p < .001$) for *age* with a preference for *scaling slow* strategies. Model 4 illustrates that no significant association exists between a *de-growth attitude* and *scaling slow*. Thus, we must reject hypothesis H1 (b). Furthermore, contrary to our reasoning, model 4 shows that the *development level* is significantly negatively associated with *scaling slow* ($b = -2.5645$, $p < 0.001$). Thus, we need to reject H2 (b). However, considering oneself a sustainable entrepreneur is significantly and positively associated with *scaling slow* ($b = 0.6042$, $p < 0.001$). Thus, we can accept H3 (b).

4.6 Discussion

4.6.1 Contribution

Our research answers how sustainable entrepreneurs' attitude toward economic growth influences their decisions on scaling strategies. We show that a *de-growth attitude* is significantly and negatively associated with *scaling fast* strategies, whether the participants are sustainable entrepreneurs or not. However, we also show that the variable *sustainable entrepreneur* is significantly and positively associated with *scaling slow* strategies, strongly indicating the preferences of sustainable entrepreneurs for such strategies. Moreover, we show that the *development level* of entrepreneurs' economies is essential in scaling decisions. In summary, our research contributes twofold to the academic discourse, as we will point out in the following.

First, we contribute by moving forward our understanding of scaling new ventures. We build on the conceptualization of venture scaling as a spatiotemporal phenomenon (Kim & Kim, 2022) and, more generally, on the importance of scale for organizational theory, i.e., the temporal and spatial dimensions of organizations' actions (Bansal et al., 2018), especially in the context of business sustainability (Bansal & DesJardine, 2014; Bansal & Knox-Hayes, 2013). By showing that entrepreneurs differentiate between *scaling fast* and *scaling slow* strategies, we provide empirical evidence for the temporal dimension of scaling as a spatiotemporal construct. With this differentiation, we follow up on recent research (Stallkamp et al., 2022) and open new avenues for further research by proposing two new scales to measure this differentiation.

Moreover, it seems true that "business sustainability […] is about time" (Bansal & DesJardine, 2014, p. 70). Therefore, accepting H3 (b) indicates that considering oneself as a sustainable entrepreneur makes *scaling slow* strategies more attractive, although the opposite is not true since we had to reject H3 (a). This result hints at an underlying assumption among sustainable entrepreneurs saying that a longer time horizon for the growth strategy of their venture is easier to reconcile with their sustainability mission. The result is also in line with Bansal and Knox-Hayes (2013, p. 61), arguing that "the compression of time and space in and by organizations is disrupting the cycles of the natural environment."

Additionally, we could show a negative association between a *de-growth attitude* and *scaling fast* strategies (as indicated by the pre-test and eventually successfully replicated), indicating clearly that entrepreneurs' attitude toward economic growth influences their decision-making about firm growth and scaling strategies. Eventually, we show that the development level of the economies where entrepreneurs are active plays an essential role in the decision for scaling strategies. Some propose entrepreneurship as a solution to poverty (Bruton et al., 2013) and an economic development engine (Acs et al., 2011). Accepting H2 (a) indicates that entrepreneurs from developing economies perceive *scaling fast* strategies as the most effective way to achieve both. Though we had to reject H2 (b), the negative coefficient for *development level* in model 4 in study 2 was smaller than in model 2. This relationship indicates that at least the logic behind our reasoning was correct: A high level of development makes *scaling fast* less attractive than *scaling slow*.

Furthermore, we contribute by linking the field of sustainable entrepreneurship closer to the theory on sustainability transitions and especially the inherent growth paradigms (Schaltegger et al., 2023). As we have outlined in section 2, the de-growth literature is largely silent about the role of innovation and entrepreneurship in a de-growth economy and society. However, our research has shown that sympathies for the de-growth paradigm can be observed among entrepreneurs similarly to other populations (Drews et al., 2019). But while we could show that entrepreneurs with a *de-growth attitude* tend to decline *scaling fast* strategies, it remains unclear what scaling strategies these entrepreneurs actually follow to establish their businesses. Building on the few publications about de-growth in business (Khmara & Kronenberg, 2018) and, more specifically, business model innovation (Wells, 2018), the de-growth literature could benefit from making implications of the paradigm for entrepreneurship and innovation more explicit. Doing so could help to remove views on de-growth attitudes among entrepreneurs as a self-constraining factor

(Hörisch, 2015b) and establish a vision of entrepreneurs with de-growth attitudes as agents contributing actively to an envisioned de-growth economy and society.

4.6.2 Limitations and future research

Our research design limited us to a dichotomous differentiation between *scaling fast* and *scaling slow* strategies. However, our results indicate that this dichotomous differentiation does not fully capture the complexity of entrepreneurs' decisions for a specific scaling strategy. While we could find support for H1 (a), stating a negative association between a *de-growth attitude* and *scaling fast*, we had to reject H1 (b), stating a positive association between a *de-growth attitude* and *scaling slow*. Similarly, we had to reject H3 (a), stating a negative association between *sustainable entrepreneur* and *scaling fast;* still, we found support for H3 (b), stating a positive association between *sustainable entrepreneur* and *scaling slow*. Thus, it seems like entrepreneurs with a deg-rowth attitude and sustainable entrepreneurs choose multiple or even hybrid spatial and temporal configurations of the spatiotemporal conceptualization of scaling that our research design does not allow to capture.

Moreover, scaling decisions are complex and depend on many factors, internal and external to the firm, and on time. We focused on a possible *de-growth attitude*, being a *sustainable entrepreneur,* and the *development level*. Furthermore, we controlled for firm internal factors such as *financial* and *knowledge constraints* but could not cover all the factors potentially affecting entrepreneurs scaling decisions. Thus, what remains are the typical limitations of cross-sectional survey data and diverse samples with entrepreneurs from multiple countries and industries, who thus operate under different conditions. Nevertheless, replicating the main effect between a *de-growth attitude* and *scaling fast* in our pre-test and our actual study indicates our findings' robustness.

Future – possibly qualitative – research is needed to investigate further growth and scaling strategies of entrepreneurs with de-growth attitudes and sustainable entrepreneurs. Qualitative research could uncover different spatial and temporal configurations of scaling strategies beyond the dichotomous differentiation between fast and slow scaling. Moreover, it could reveal further critical factors affecting entrepreneurs' scaling strategies and extend our understanding of sustainable and conventional entrepreneurship (Klapper et al., 2021). Thus, such research could inform quantitative research designs like ours to account for a more comprehensive picture of entrepreneurs' decision-making processes.

4.7 Conclusion

In conclusion, by illustrating the negative association between a *de-growth attitude* and *scaling fast* in two samples, we show that entrepreneurs' attitude toward economic growth on the societal level influences their decision-making on scaling strategies on the firm level. Moreover, we underline the importance of time in business sustainability by showing that sustainable entrepreneurs perceive *scaling slow* strategies more attractive than non-sustainable entrepreneurs. Finally, we introduce the development level of the entrepreneurs' surrounding economy to the scaling debate, as our research indicates that a lower level of development makes scaling fast strategies more attractive than scaling slow strategies.

5 Study 4 - Legitimately odd – Unconventional social startups win more support on crowdfunding platforms through entrepreneurial identity complexity[5]

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Abstract: New ventures need to build legitimacy to acquire resources. Previously established theories emphasize the importance of new ventures being distinctive yet understandable to gain legitimacy. However, we argue that entrepreneurs initiating social ventures operate under unique conditions that differ from those of profit-driven ventures. Social ventures gain legitimacy because of unconventional or even odd identities, as they meet stakeholders' expectations to tackle grand challenges. Our analysis of 15,116 crowdfunding campaigns and their creators' user profiles via topic modeling supports our argument. We find that social ventures with a high degree of entrepreneurial identity complexity (EIC), i.e., the unconventional combination of entrepreneurial identity claims from the founder and venture levels, receive more support from crowdfunders. In this study, we pioneer the concept of complexity as an additional source of legitimacy for emergent social ventures, thereby broadening our understanding of how new social ventures garner support and legitimacy.

Keywords: Legitimacy, crowdfunding, entrepreneurial identity, complexity, social entrepreneurship

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5.1 Introduction

Social ventures rely on favorable legitimacy judgments from stakeholders to tackle social or environmental challenges (Battilana & Lee, 2014; Ruebottom, 2013). Prior research on new ventures has convincingly shown that, to be perceived as legitimate, new ventures need to be different (Taeuscher et al., 2021). At the same time, extant research states that for distinctiveness to resonate with investors, a venture's entrepreneurial identity—understood as the venture's claims of "who we are" and "what we do" (Albert & Whetten, 1985; Gioia, Patvardhan, et al., 2013; Navis & Glynn, 2011, p. 482)—needs to "cohere into a meaningful whole" (Navis & Glynn, 2011, p. 482). As such, while being a potential source of distinctiveness, combining multiple contradictory claims in entrepreneurial identities poses the risk of stakeholders finding the whole of identity elements implausible and difficult to comprehend (Martens et al., 2007; Pontikes, 2012; Suchman, 1995).

However, we challenge the assumption that a social venture's entrepreneurial identity complexity (EIC), which we define as *the unconventional combination of entrepreneurial identity claims from the founder and venture levels*, reduces its legitimacy. Social ventures are complex, as they combine social and commercial logics and pursue multi-bottom lines in their business models (Dacin et al., 2011; Vedula et al., 2021; Zahra et al., 2009). Thus, they have been conceptualized as hybrid organizations (Battilana & Dorado, 2010; Battilana & Lee, 2014; W. K. Smith & Besharov, 2019). Due to the conflicting external demands resulting from their hybridity, they face institutional complexity (Pache & Santos, 2021), that is, the "multiplexity of different pressures from a plurality of institutional logics" (Greenwood et al., 2011, p. 357). As such, social ventures differ from conventional ventures since they mix "elements that would conventionally not go together" (Battilana et al., 2017, p. 129) in their entrepreneurial identity (Pache & Santos, 2013; Wry & York, 2017; York et al., 2016). Despite these fundamental differences in the complexity of social ventures' entrepreneurial identities, we know relatively little about how social ventures generate legitimacy in the eyes of relevant stakeholders.

Our study examines the role of the unconventional combination of identity elements, i.e., EIC, in legitimizing social ventures. The main argument of our paper is that social ventures gain legitimacy because of—not despite—their complex identities. Based on the notion of legitimacy as a multi-dimensional construct (Aldrich & Fiol, 1994; Scott, 1995; Suchman, 1995; Suddaby et al., 2017), we follow prior research on distinctiveness as a trade-off between decreasing cognitive

legitimacy and increasing normative legitimacy for novelty-seeking audiences (Taeuscher et al., 2021). While cognitive legitimacy is defined as a venture's comprehensibility, normative legitimacy describes a venture's congruence with normative expectations (Suchman, 1995). Accordingly, we argue that although complex entrepreneurial identities seem odd and implausible, coupling multiple contradictory identity claims (Pache & Santos, 2013; Wry & York, 2017; York et al., 2016) increases social ventures' credibility with regard to tackling complex challenges (Ferraro et al., 2015) and bringing about social change to established conventions (Ruebottom, 2013) in the eyes of their socially motivated stakeholders (Fisher et al., 2017; Parhankangas & Renko, 2017).

We test our theoretical arguments in a crowdfunding context, as the use of platforms such as Kickstarter has become one of the most significant sources of investment for social ventures (Böckel et al., 2021). To measure EIC, we follow prior studies on distinctiveness measures in crowdfunding (Soublière & Gehman, 2020; Taeuscher et al., 2021) and apply topic modeling (Hannigan et al., 2019) to identify common entrepreneurial identity claims in the self-description of user profiles on the crowdfunding platform Kickstarter. We find that, while crowdfunding investors are generally more likely to support enterprises with distinct entrepreneurial identities, they are less likely to support enterprises with complex entrepreneurial identities. However, social ventures with complex entrepreneurial identities receive enhanced support from crowdfunding backers.

Our paper contributes to the literature by shedding light on the legitimation process of new social ventures. First, we introduce complex identities as another type of distinction and, thus, as a further source of legitimacy. While the literature describes legitimacy as dependent on the consistency of organizations' identity claims (Martens et al., 2007; Navis & Glynn, 2011; Suchman, 1995), we argue that this is different for social ventures. In general, entrepreneurial identity complexity lowers a venture's comprehensibility and thus its cognitive legitimacy; however, social ventures' normative legitimacy gains exceed potential cognitive liabilities because of—and not despite—their high entrepreneurial identity complexity. Their complex entrepreneurial identities are congruent with social investors' expectations of social startups' capabilities to unify contradictory elements and logics to bring about social change, thus increasing social ventures' normative legitimacy.

Second, while prior studies that argued that a venture's prosocial orientation increases its legitimacy have produced mixed results (Allison et al., 2015; Böckel et al., 2021; Calic &

Mosakowski, 2016; Defazio et al., 2021; Hörisch, 2015a), we argue that complex entrepreneurial identity claims are a boundary condition for this relationship. Hence, due to a venture's prosocial orientation, investors' judgment of a venture's legitimacy depends on whether it matches the degree of complexity of the venture's entrepreneurial identity.

Third, we contribute to the literature on complex entrepreneurial identities. Prior research described complex identities on the venture level as hybridity (Battilana et al., 2017; Battilana & Lee, 2014) or institutional complexity (Greenwood et al., 2011) and theorized complex founder identities based on social and role identity theory (Fauchart & Gruber, 2011; Wry & York, 2017). However, entrepreneurial identities contain identity claims on the organizational (venture) and individual (founder) levels (Navis & Glynn, 2011). Thus, we conceptualize complex entrepreneurial identities based on identity claims from both levels of analysis.

In what follows, we first provide more detail on our theorizing and formulate hypotheses. Second, we describe the data collection and analysis process to test our hypotheses. Third, we present the results of our study before we assess the implications of our findings and recognize the constraints within our research. Finally, we encapsulate the essence of our study and provide a succinct conclusion.

5.2 Theoretical framework and hypotheses

5.2.1 Distinctiveness and legitimacy of new ventures

Gaining legitimacy is essential for every new venture—whether prosocial-oriented or not—to acquire the resources needed to establish itself in the market (Aldrich & Fiol, 1994; Dart, 2004; Nicholls, 2010; Zimmerman & Zeitz, 2002). A new venture gains legitimacy when resource-providing audiences perceive its entrepreneurial identity as "desirable, proper, or appropriate within some socially constructed system of norms, values, beliefs and definitions " (Suchman, 1995, p. 574).

In general, an organization's identity is its definition of itself (Corley et al., 2006) that details "who we are as an organization" (Gioia, Patvardhan, et al., 2013, p. 123). It gives meaning to an organization and allows individuals within and outside an organization to make sense of it (Fisher et al., 2016). Organizational identity is of even greater importance under conditions of uncertainty and ambiguity, under which new ventures usually operate (Fisher et al., 2016; Navis & Glynn, 2011). Organizations convey their identities by making identity claims (Ashforth & Mael, 1989; Glynn, 2000; Navis & Glynn, 2011; Porac et al., 1999). In this regard, entrepreneurial

identities are unique, as they include identity claims on different levels of analysis: the individual level (i.e., the founder(s)) addressing "who we are" and the organizational level (i.e., the proposed new venture) addressing "what we do" (Navis & Glynn, 2011). In this way, entrepreneurial identity claims make new ventures understandable to external audiences (Fisher et al., 2016).

Prior research on the legitimacy of new ventures' entrepreneurial identity claims suggests the idea of optimal or legitimate distinctiveness (Lounsbury & Glynn, 2001; Martens et al., 2007; Navis & Glynn, 2011; Zhao et al., 2017, 2018), which refers to balancing legitimating claims that address established expectations and conventions of relevant stakeholders with distinctiveness claims that differentiate the new venture from such expectations (Navis & Glynn, 2011). More recently, Taeuscher et al. (2021) even suggested that, without other legitimacy sources, distinctiveness claims alone increase new ventures' legitimacy. Therefore, they draw on the theory that conceptualizes legitimacy as a multi-dimensional construct (Aldrich & Fiol, 1994; Scott, 1995; Suchman, 1995; Suddaby et al., 2017). While prior research on new ventures' legitimacy mainly focused on cognitive legitimacy—defined as a venture's comprehensibility (Suchman, 1995)—they shift the focus on normative legitimacy—defined as a venture's congruence with the normative expectations of relevant stakeholders (Suchman, 1995). Departing from there, Taeuscher et al. (2021) argue that novelty-seeking stakeholders expect new ventures to be different; thus, the normative legitimacy that results from their distinctiveness exceeds potential cognitive liabilities.

However, one commonality among these studies is the underlying assumption that legitimating and differentiating entrepreneurial identity claims need to be coherent to achieve the intended effect on stakeholders' evaluation. Navis and Glynn (2011, p. 482) note that "[a]lthough an entrepreneurial identity can contain elements of legitimacy and distinctiveness, this does not necessarily make it legitimately distinctive. Rather than standing in contradiction, the identity elements need to cohere into a meaningful whole" to create a comprehensible entrepreneurial identity. Thus, new ventures should reduce ambiguity in their identity claims to achieve positive stakeholder evaluations (Fisher et al., 2016; Navis & Glynn, 2011). While most prior research has focused on the distinctiveness of entrepreneurial identities, researchers have paid less attention to the complexity of entrepreneurial identities.

5.2.2 Entrepreneurial identity complexity and legitimacy of new social ventures

Entrepreneurial identities can be complex. A prominent example of a complex entrepreneurial identity is the combination of social and commercial identity claims in social

ventures known as hybridity (Battilana & Dorado, 2010; Battilana & Lee, 2014; Shepherd et al., 2019). Hybrid organizations "[mix] identities […] that would not conventionally go together" (Battilana et al., 2017, p. 139). However, since Battilana et al. (2017) lend their definition of hybridity from the seminal work on organizational identities of Albert and Whetten (1985), it includes only identity claims on the organizational level. The same applies to the concept of institutional complexity, which is defined as the "multiplexity of different pressures from a plurality of institutional logics" (Greenwood et al., 2011, p. 357). Thus, hybridity and institutional complexity provide valuable insights into how ventures can effectively deal with unconventional combinations of identity claims on the organizational level (Pache & Santos, 2013, 2021; Smets et al., 2015) but neglect the individual level of entrepreneurial identity claims (Navis & Glynn, 2011).

In contrast, Wry and York (2017) theorize that social entrepreneurs combine different entrepreneurial identity claims on the individual level, associating them with either social or commercial logic. By coupling different role identities (e.g., being a parent, teacher, or social worker associated with a social logic and being an accountant, manager, or investor associated with a commercial logic), social entrepreneurs can develop innovative multi-bottom line business models while simultaneously fulfilling stakeholder expectations of a prosocial and profit orientation (Wry & York, 2017; York et al., 2016).

Moreover, Fauchart and Gruber (2011) argue that entrepreneurs can have complex identities when combining elements of archetypical founder identities. Based on social identity theory, they differentiate founder identities into the following identities: Darwinian, communitarian, and missionary identities (Fauchart & Gruber, 2011). Social identity theory defines social identity as an individual's knowledge of belonging to a social group (Hogg & Terry, 2000). Thus, darwinian entrepreneurs focus mainly on themselves and are driven by self-interest, while communitarians focus on their social community and thus aim to serve this community, and missionary entrepreneurs focus on society at large and aim to advance social missions (Fauchart & Gruber, 2011; Gruber & MacMillan, 2017). However, entrepreneurs frequently combine elements of these "pure" identity types, resulting in identity complexity (Fauchart & Gruber, 2011). Social identity complexity (Roccas & Brewer, 2002) describes this phenomenon, although it does not explicitly address entrepreneurs. It "reflects the degree of overlap perceived to exist between groups of which a person is simultaneously a member" (Roccas & Brewer, 2002, p. 88). Social identity complexity is low when the overlap of groups is perceived to be high "whereby memberships in different groups converge to form a single ingroup identification" and high when

"memberships in multiple ingroups are not fully convergent or overlapping" (Roccas & Brewer, 2002, p. 88).

In summary, prior research conceptualizes complex entrepreneurial identities either on the organizational (Battilana et al., 2017; Greenwood et al., 2011) or on the individual level (Fauchart & Gruber, 2011; Wry & York, 2017) but not on both levels of entrepreneurial identity claims. Thus, we build on these prior concepts of complex entrepreneurial identity claims on the organizational and individual levels and synthesize them into the EIC concept.

> **Definition**. Entrepreneurial identity complexity (EIC) is the unconventional combination of entrepreneurial identity claims from the founder and venture levels.

Having defined the concept, we now turn to the relationship between new social ventures' EIC and their legitimacy. We argue that a high degree of EIC increases the legitimacy of new social ventures while decreasing the legitimacy of new ventures in general. As outlined above, prior research on the legitimacy of new ventures could lead to the assumption that EIC is a variety of distinctiveness, and thus, a high degree of EIC leads to legitimacy gains. However, we argue that EIC is genuinely different from distinctiveness.

5.2.3 Hypothesizing the role of EIC in crowdfunding

Reward-based crowdfunding allows new ventures to fund their endeavors through a relatively large number of crowdfunders who individually contribute small amounts of money and, in return, receive some tangible or intangible reward (Mollick, 2014). As a result, crowdfunding has become an essential financing mechanism for new ventures (Agrawal et al., 2014; Short et al., 2017), and crowdfunders are thus one of the most critical audiences of new ventures in obtaining legitimacy (Fisher et al., 2017). Moreover, researchers have previously used crowdfunding to enhance our understanding of the legitimation of new ventures (e.g., Soublière & Gehman, 2020; Taeuscher et al., 2021).

The optimal distinctiveness proposition from prior research on the legitimacy of new ventures states that they gain legitimacy by balancing the need to refer to well-established categories to be understandable and the need to be distinctive from these categories to demonstrate novelty in their entrepreneurial stories (Navis & Glynn, 2011). This proposition could lead to the assumption that complex identity claims offer an opportunity for new ventures to demonstrate

distinctiveness. However, complex identity claims are not distinctive per se. Indeed, optimal distinctive identity claims still need to cohere to a meaningful whole (Navis & Glynn, 2011).

In contrast to distinctiveness, in which a novelty-seeking audience expects ventures to be distinctive (Taeuscher et al., 2021), new ventures have no normative legitimacy gains due to high EIC. Stakeholders do not expect new ventures to show complex identities. Instead, they appreciate unambiguous identity claims that refer to familiar and typical categories in the venture's context (Martens et al., 2007). Prior research from the film industry has shown that producers, critics, and consumers perceive film projects that span categories (i.e., genres) less favorably than films they can match with established and well-known categories (Elsbach & Kramer, 2003; Hsu, 2006). Hence, new ventures benefit from resolving ambiguity (Fisher et al., 2016; Lounsbury & Glynn, 2001; Navis & Glynn, 2011).

Thus, in line with the notion of legitimacy theory as a multi-dimensional construct (Aldrich & Fiol, 1994; Scott, 1995; Suchman, 1995; Suddaby et al., 2017), we argue that a high degree of EIC reduces new ventures' comprehensibility by stakeholders and, thus, decreases their cognitive legitimacy (Suchman, 1995). Consequently, we propose that EIC, as defined and outlined above, is genuinely different from the concept of distinctiveness. Instead, EIC represents the contradictoriness, unconventionality, or even oddness of new ventures' entrepreneurial identity claims, regardless of whether these claims are distinctive from those of other ventures. Thus, a high degree of EIC increases ambiguity, decreases the comprehensibility of entrepreneurial identity claims, and eventually reduces the cognitive legitimacy of new ventures. Hence, we formulated the following hypotheses:

H1. Entrepreneurial identity complexity is negatively associated with new ventures' resource acquisition from crowdfunders.

However, the situation is different for new social ventures. Stakeholders expect social ventures to have complex—or even odd—entrepreneurial identities. Thus, social ventures gain normative legitimacy by satisfying these expectations. Hence, social ventures gain legitimacy because of—and not despite—a high degree of EIC, since the normative legitimacy gains exceed the cognitive legitimacy liabilities due to reduced comprehensibility.

We argue that the expectations of socially motivated stakeholders differ from the expectations of those who are not explicitly socially motivated (Anglin et al., 2022; Fisher et al., 2017; Parhankangas & Renko, 2017). Since social ventures aim to tackle problems that have been described as wicked and framed as grand challenges (George et al., 2016), they benefit from

complex identities, as these identities enable multivocal problem inscription that allows "different interpretations among various audiences with different evaluative criteria" (Ferraro et al., 2015, p. 373). Prior research has shown that coupling various identity claims represents a viable strategy for social ventures to achieve their social missions (Pache & Santos, 2013; Wry & York, 2017; York et al., 2016). Furthermore, fragmented or contradictory identities are viable strategies for coping effectively with ambiguous and inconsistent demands that social ventures frequently face due to their multi-bottom line approach (Brown, 2015; Clarke et al., 2009; Lok, 2010).

Moreover, Ruebottom (2013) describes how social enterprises that aim to reduce social injustice and create institutional change weave together different narratives that extend beyond commercial and social logic to gain legitimacy to change the status quo. While gaining cognitive legitimacy by referring to established narratives, they gain normative legitimacy by blending them in a way that presents them as unconventional—and thus legitimate—actors to tackle social injustice (Ruebottom, 2013). Furthermore, complex identities on the individual level correlate with tolerance and openness to change, since individuals with complex identities are more sensitive to differences between social groups and are less likely to accept social norms shaped by dominant social groups (Roccas & Brewer, 2002). This correlation resonates with the role expectations of social entrepreneurs as "communal, compassionate, empathic, and concerned about social causes, such as inequality and social justice" (Anglin et al., 2022). Thus, we argue that socially motivated stakeholders expect social ventures to show complex or odd entrepreneurial identities and that social ventures consequently gain legitimacy because of their complex identities.

Prior research on social ventures gaining legitimacy on crowdfunding platforms has produced mixed outcomes. However, most of these studies did not explicitly investigate the legitimacy of social ventures; instead, these studies focused on their funding success on crowdfunding platforms (Böckel et al., 2021). While some studies have found positive associations between ventures' prosocial orientation and their funding success (Allison et al., 2015; Calic & Mosakowski, 2016; Moss et al., 2018), others hint at a negative association (e.g., Hörisch, 2015). In sum, more studies have found a positive association than a negative one (Böckel et al., 2021). The findings of Defazio et al. (2021) represent an exception in this regard, stating that a strong emphasis on a prosocial orientation is negatively associated with crowdfunding success, while a moderate positive emphasis is positively associated with crowdfunding success.

However, we argue that a prosocial orientation is a boundary condition for new ventures with a high degree of EIC to gain legitimacy on crowdfunding platforms such as Kickstarter. Thus,

we depart from the prior theory that a high degree of EIC is a cognitive liability for new ventures in general; instead, we argue that, for new social ventures, a high degree of EIC is an asset because it aligns with stakeholders' expectations. For example, the following excerpt from the Kickstarter forum illustrates how crowdfunders' expectations differ for campaigns with a prosocial orientation (KickstarterForum, 2019):

> "With my focus on charities and non-profits of late, those usually catch my attention first, followed by nifty ideas related to science, tech, education, games, art...journalism...ok, to be fair, I appreciate any heartfelt effort where someone is putting themselves out there, whether they're spreading their artistic wings, breaking new technological ground, trying to make people laugh, and so on."

Thus, we argue that crowdfunders who prefer new ventures that emphasize the prosocial orientation of their campaigns expect these ventures to have complex entrepreneurial identities. As reasoned above, an unconventional or odd entrepreneurial identity demonstrates the ability to tackle wicked problems (Ferraro et al., 2015) and change social norms (Ruebottom, 2013). Consequently, a high degree of EIC increases the normative legitimacy of new social ventures while compensating for or even exceeding potential cognitive legitimacy losses due to reduced comprehensibility.

To avoid the cancelation of different effects for the humanity-related and environment-related dimensions of a prosocial orientation, we differentiate between these as the "consciousness about the wellbeing of humans and of the society as a whole and consciousness about and the care for the environment," respectively (Defazio et al., 2021, p. 363). Both startups with pro-humanity orientations and startups with pro-environment orientations are driven by prosocial motives and aim to create societal value (Vedula et al., 2021). However, while the former focus on addressing social problems, the latter focus on tackling environmental problems (Defazio et al., 2021; Vedula et al., 2021). Thus, we formulate separate hypotheses for these dimensions of prosocial orientation:

H2a. A pro-humanity orientation of crowdfunding campaigns negatively moderates the negative association between entrepreneurial identity complexity and new ventures' resource acquisition from crowdfunders.

H2b. A pro-environment orientation of crowdfunding campaigns negatively moderates the negative association between entrepreneurial identity complexity and new ventures' resource acquisition from crowdfunders.

Figure 5-1 illustrates the overall research model and combines all hypothesized relationships.

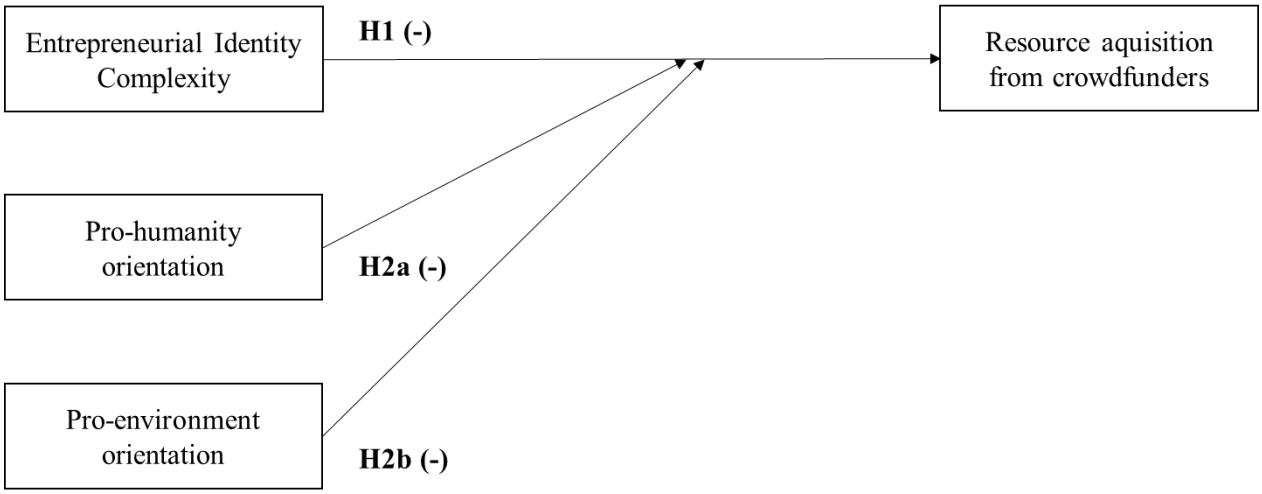

Figure 5-1: Research model

5.3 Methods

5.3.1 Data and sample

To test our hypotheses, we relied on crowdfunding data. Crowdfunding data has proven to be a viable source for entrepreneurship research, since it mirrors the heterogeneity of entrepreneurship and overcomes survivorship bias through full data availability of successful and unsuccessful campaigns (Taeuscher et al., 2021). We retrieved data from Kickstarter, the world's largest reward-based crowdfunding platform. Since April 2009, more than 21 million crowdfunders have jointly contributed over 6 billion USD to roughly 230,000 successfully funded projects launched on the platform (Kickstarter, 2023).

When constructing the sample, we aimed to balance two goals: first, a sample large enough to represent the heterogeneity of Kickstarter projects and to achieve the statistical power of the analysis, and second, only consider projects from a limited period to avoid errors in the measurement of ventures' prosocial orientation. Since public debate and perception of prosocial

behavior are dynamic, the emphasis and meaning of prosocial framing in crowdfunding campaigns may change over time (Defazio et al., 2021). Thus, we included campaigns launched from August 2018 to May 2021. We considered campaigns from all sub-categories under the main categories of design and technology and from those sub-categories under the main categories of art and food that implied entrepreneurial activity beyond the funding of the campaigns. We used web scrapes of the Kickstarter website provided by webrobots.io (2023) to gather campaign-related data for campaigns from the selected period. We enriched this data by web scraping the self-descriptions from the user profiles of the campaign creators. In our sample, we considered only the newest campaign for users who had launched more than one campaign in the selected period.

After preliminary data analysis, we eliminated extreme outliers by excluding campaigns with more than 30,000 backers, durations of more than 82 days, and funding goals of more than 5 million USD. Furthermore, we removed cases in which the campaign or the user profile was not in English. Additionally, we removed cases with less than 10 analyzable words in either the title and blurb of the campaign or the user profile (Defazio et al., 2021). A total of 15,116 campaigns were included in the final sample.

5.3.2 Dependent variables

Our dependent variable was the number of backers who supported a crowdfunding campaign. We follow Taeuscher et al. (2021) in their reasoning for using the number of backers as a suitable proxy for resource acquisition and, thus, legitimacy. New ventures launch reward-based crowdfunding campaigns to acquire financial and non-financial resources by raising awareness of their product or service and developing social capital (Butticè et al., 2017; Mollick, 2014). Furthermore, the success of new ventures on crowdfunding platforms increases their legitimacy in the eyes of other stakeholders (Fisher et al., 2017). Moreover, the number of backers is more reliable than the alternative—the operationalization of funds raised by a campaign—since a small number of backers contributing disproportionately large amounts can distort this measure.

5.3.3 Independent variables

Entrepreneurial identity complexity. To measure EIC, we relied on topic modeling. We used latent Dirichlet allocation (LDA), a well-established method for topic modeling in management research (Hannigan et al., 2019), to identify common topics within the self-descriptions in the user profiles of the campaign creators. LDA allows us to represent latent topics within an analyzed text corpus consisting of several documents (i.e., the users' self-descriptions)

as a probability distribution over included words, i.e., the word–topic distribution ϕ. At the same time, all documents in the corpus can be represented as a probability distribution over these latent topics, i.e., the topic–document distribution θ (Blei et al., 2003; Maier et al., 2018).

We followed the three-step process of rendering the corpus, topics, and theoretical artifacts suggested by Hannigan et al. (2019), along with practical guidance provided by Maier et al. (2018), to apply LDA for topic modeling. Thus, we rendered the corpus (Hannigan et al., 2019) using the *Natural Language Toolkit* package in Python (Bird et al., 2009) by tokenizing the documents (i.e., dividing them into word units), transforming all words to lowercase, and removing punctuation marks and special characters (Maier et al., 2018). Furthermore, we removed stop-words, such as prepositions and articles (Maier et al., 2018), using the list of English stop-words of the *Natural Language Toolkit* package (Bird et al., 2009). We unified terms by lemmatizing instead of stemming since the lemma of a word is more interpretable than its stem in this context (Maier et al., 2018). For example, the lemma of "organized" is "organize," while the stem is "organ" (Maier et al., 2018). Finally, we pruned the corpus to strip infrequent and very frequent terms, improving the LDA's algorithm performance and stochastic inference (Maier et al., 2018). Thus, we removed all terms that either occurred in more than 50% of the documents or less than 10 times overall (Taeuscher et al., 2021). After pre-processing, we were left with a corpus of 15,116 documents (i.e., self-descriptions from the user profiles) and 5,057 unique words.

To render topics (Hannigan et al., 2019), we applied the LDA algorithm using the *genism* Python package (Řehůřek & Sojka, 2010). To select a suitable topic model, we aimed for high human interpretability and followed a systematic approach by calculating different models based on various combinations of LDA parameters (Maier et al., 2018). Thus, we systematically varied the number of topics K (in steps of 5–100) and the parameter α (.01, .05, .1, .2, .5, 1), which shapes the topic–document distribution θ (Maier et al., 2018). Moreover, we set the parameter β, which shapes the word–topic distribution ϕ, at a fixed value of $1/K$ (Maier et al., 2018). For each value of α, we calculated models for each value of K (i.e., $6 \times 19 = 114$ models). We ran the models with 400 iterations (Taeuscher et al., 2021). For each value of α, we then plotted the UMass measure of topic coherence (Mimno et al., 2011) over all values of K from 5 to100 and selected the models in which the coherence graph plateaued as our candidate models did (Hannigan et al., 2019; Stevens et al., 2012). Subsequently, we compared the coherence scores of these candidate models and selected the model with the lowest score, i.e., the solution for $\alpha = 1$ and $K = 15$. Topic coherence quantifies topic quality in terms of clear and well-bounded topics based on the frequency of co-

occurrences of word pairs in the documents (Hannigan et al., 2019), with the UMass measure of topic coherence (Mimno et al., 2011) being one of the most popular measures for topic modeling (Hannigan et al., 2019; Stevens et al., 2012). We inspected the topic model using the Python package *pyLDAvis* (Sievert & Shirley, 2014), which allowed us to visualize topics based on their occurrence in the corpus, as well as inter-topic distances. Furthermore, the *pyLDAvis* output shows the most relevant words of each topic based on a relevance metric that accounts not only for the word's overall frequency in the corpus but also for its contribution to the specific semantics of a given topic (Maier et al., 2018; Sievert & Shirley, 2014). Thus, it is a helpful tool for the interpretation of the topic model. We used the information provided to identify and exclude topics with no reasonably interpretable entrepreneurial identity claims. Figure 5-2 shows a screenshot of the *pyLDAvis* output.

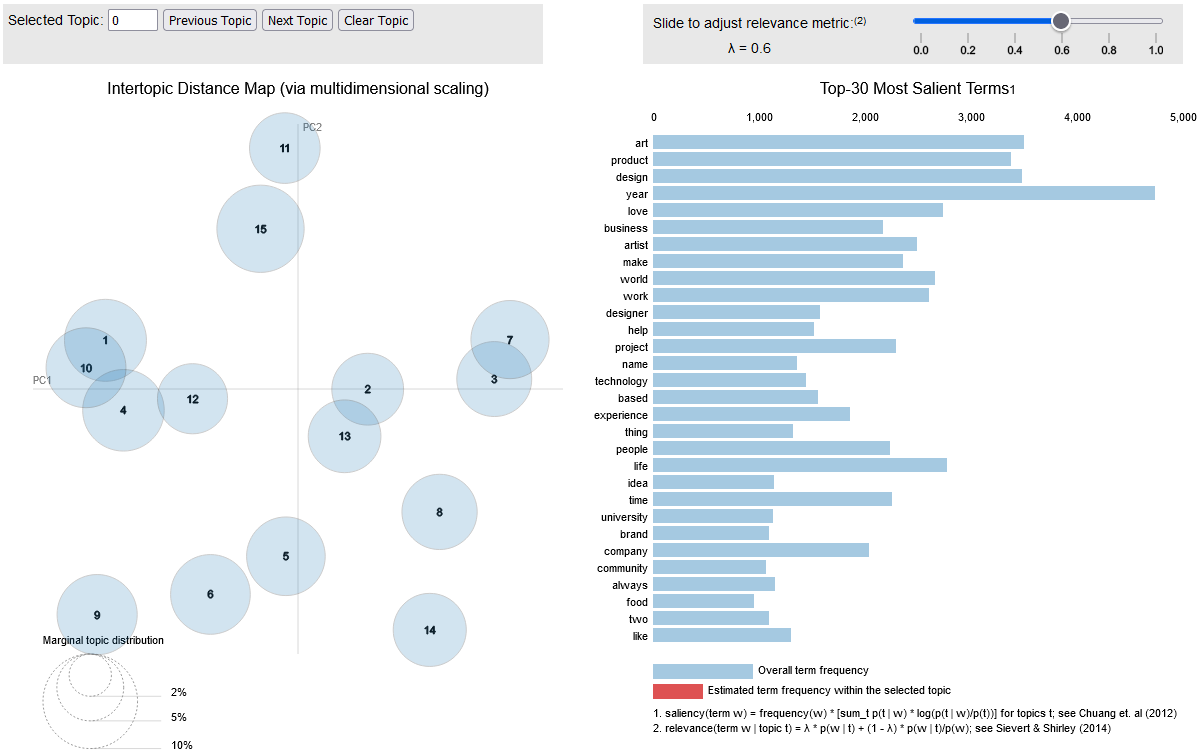

Figure 5-2: Screenshot of the *pyLDAvis* output of the topic model

Furthermore, we excluded boilerplate topics, which are topics that "have no substantive meaning, but their emergence sharpens other meaningful topics 'by segregating boilerplate terms in a distinct location' (DiMaggio et al., 2013, p. 586)" (Maier et al., 2018, p. 108). Excluding such topics allows for a meaningful interpretation of the topic model and the theoretical artifacts derived from it (Maier et al., 2018). After excluding boilerplate topics, we ended up with 13 meaningful

topics representing entrepreneurial identity claims on the individual, organizational, and institutional levels. Table 5-1 shows an overview of all topics (including the two boilerplate topics) and the 20 most representative words for each topic.

Table 5-1: Overview of topics

Topic ID	20 most representative words for topic
1	university, school, degree, student, college, currently, city, state, master, award, education, born, graduated, California, raised, science, York, American, program, bachelor
2	food, home, good, family, free, local, natural, tea, farm, water, chef, healthy, plant, vegan, craft, single, beer, restaurant, planet, kitchen
3 (excluded)	day, get, coffee, great, around, every, best, world, give, way, hard, even, part, become, sport, enthusiast, take, along, adventure, long
4	art, work, book, painting, artist, London, studio, medium, gallery, fine, museum, visual, photography, artistic, color, paint, exhibition, film, collection, series
5	community, health, learning, personal, woman, human, individual, interest, environment, provide, challenge, skill, opportunity, training, space, non, learn, social, vision, fitness
6	design, brand, quality, fashion, made, unique, high material, watch, designed, shoe, accessory, customer, clothing, line, style, affordable, production, modern, price
7	love, thing, always, like, dream, something much, hope, passion, enjoy, little, feel, see, making, lot, everything, know, trying, really, make
8 (excluded)	help, idea, project, bring, people, together, kickstarter, support, looking, life, problem, app, young new, team, one, lover bringing, campaign, thank
9	technology, engineer, system, software, solution, engineering, computer, company, team, research, tech, development, innovation, developing, smart, device, electronics, mobile, application, developer
10	business, experience, founder, year, industry, entrepreneur, marketing, management, working, company, building, background, worked, professional, successful, platform, sale, manager, project, past
11	name, two, old, child, hi, game, pin, hello, year, kid, time, father, wife, mother, husband, girl, video, owner, cat, daughter
12	designer, artist, based, illustrator, graphic, creator, drawing, shop, illustration, creating, maker, living, instagram, freelance, cute, inspired, follow, independent, character, draw
13	music, creative, story live, nature, heart, light, card, world, journey, life, writing, tarot, beauty, musician, set, deck, author, inspiration, black
14	product, make, create, better, use, passionate, mission, world, believe, everyone, change, innovative, travel, dedicated, fun, simple, future, creating, everyday, easy
15	started, year, since, back, first, many, decided, career, job, age, could, began, ago, grew, time, became, came, country, spent, got

To render the theoretical artifact (Hannigan et al., 2019), i.e., the degree of EIC, we relied on the output data of the topic model, i.e., the word–topic distribution ϕ of the included topics and the topic–document distributions θ of the included topics. Hence, we calculate the entrepreneurial identity complexity of venture v :

$$EIC_v = \frac{\sum_{i=1;j=1}^{T} \mathrm{D}(\Phi_i, \Phi_j) * (\Theta_{i,v} * \Theta_{j,v})}{(T^2 - T)}, for\ T = number\ of\ topics$$

where $\mathrm{D}(\Phi_i, \Phi_j)$ refers to the Hellinger distance between topic i's term distribution Φ_i and topic j's term distribution Φ_j, $\Theta_{i,v}$ refers to venture v's weight for topic i, and $\Theta_{j,v}$ refers to venture v's weight for topic j. Hellinger distance is commonly measured to quantify the similarity of topics in topic modeling (Beykikhoshk et al., 2018; Dahlke et al., 2021) and describes the distance between two probability distributions ranging from 0 to 1, in which values closer to 0 indicate a smaller distance and therefore a larger similarity. For example, topic 9 (technology focus) and topic 10 (business focus) are comparably close to each other and are both comparably distant from topic 7 (focus on a passion to create new things). Hence, the entrepreneurial identity complexity of a venture v represents the mean similarity between all topics occurring in the venture's user profile description multiplied by the topics' weights of occurrence in the venture's user profile description. Table 5-2 shows examples of user profiles with a high degree of EIC. Since all input factors for calculating the degree of hybridity ranged between 0 and 1, we standardized the measure for further analysis.

Table 5-2: Excerpts from user profiles with a high degree of EIC

Excerpts from user profiles
"As an entrepreneur I have always tried to think of ways to make life better for parents and kids. In the past I created a patented baby pant for crawlers called Bee's Knees - my pants were recommended by pediatric therapists at hospitals such as McMaster and Yale Pediatric and sold at boutiques and major retailers across North America. My second company I co-founded with an American pediatrician; GOOD BAG for KIDS was sold on Amazon, at Wrigley Field, retail/entertainment locations and we did events with Disney and Major League Baseball. As an inventor of products that serve a gap in the marketplace, my products have been seen on The Today Show, The View, ET, The Marilyn Dennis Show, The Mom Show, endorsed by celebrity moms such as Courteney Cox and featured in numerous magazines and online sites such as Huffington Post, American Baby, Today's Parent & Parent's Magazine. Our founding team is a dedicated group of professionals who are also parents directly impacted by childhood disabilities and passionate about our mission."

Table 5-2 (continued)

Excerpts from user profiles
"I started painting in 2015 as a way to reduce stress and express myself. I taught my niece how to paint when she was 4 months old with a paint brush. I had 5 paintings featured in a mental health gallery the highlight being my multi-coloured self portrait displayed in video. I registered Rusted studioz as a business in 2017 and started creating custom shoes for friends, family and clients. My personal favourite thus far is either the Toy story pair I made for my nieces first birthday or the Moana shoes because I'm a sucker for teal like colours and they were vibrant and adorable. I work as a full time welder-fitter. I am obsessed with my dog Jem. I love learning new things and challenging myself, the most recent things I have taught myself is how to make digital art using procreate, knit and to make simple jewellery, I have made myself 2 necklaces. I am a huge Harry Potter fan, my second favourite movie is the 1986 movie labyrinth with David Bowie. I have gone to fan expo and Comic-Con in Toronto once each and have done two cosplays the first of Alice from the video game Alice madness returns and the second of a female version of Jareth from labyrinth."
"CEO and Founder of Clutch Creations. University of Georgia '16 graduate. K. is a creator to the core. She is the inventor of The Clutch Strap, an avid creative fashionista & street wear stylist, thrifter, content creator, entrepreneur girl boss and music loving festival-goer. Her passion for style and business are poured into her company Clutch Creations and her love for diversity, travel and cultural slang compliment her visions for the future of her life and brand."
"Hi! I'm B.--artist and founder of Plant Posse--a posse of plant-powered people producing jewelry & art promoting plant pride. I was born in Eugene, Oregon and graduated from the University of Oregon in 2011 with a Bachelor of Arts. Currently, I live in Corvallis, Oregon and spend most of my time in my downtown Plant Posse studio or oil painting. For over 8 years, I have enjoyed a plant-based lifestyle (vegan), have many years experience working in the produce department at a food coop, working for a local farm, and take pride in being a plant mom to over 70 houseplants. I view the plant and fungi kingdom as unique pieces of art that I feel inspired to showcase through my work. Over the last 14 years, I've enjoyed donating prints, original artwork and a portion of my proceeds to various animal rights and human development organizations"
"M.is the creator of "U Can Lift It", a trashcan that improves and makes taking out and handling the trash easier. He is the CEO of PII, a company that designs and improves household and everyday products. As an innovator and visionary, he believes in improving everyday items to optimize and improve usage for everyday users, and has sought to do this for the past 8 years. He holds a bachelor's degree in political science- pre law, and has an MPA from Grambling State University. M. is married to D. and is the proud father of 5 children. He enjoys serving in his local church as a mentor and pastor. He loves basketball, innovation, table tennis, and anything that will make life easier and fun!"

Prosocial orientation of the campaign. We used computer-aided text analysis (CATA) to measure the humanity-related and environment-related dimensions of the prosocial orientation of crowdfunding campaigns. Therefore, we relied on dictionaries developed and validated by Defazio et al. (2021) containing 532 terms denoting the humanity-related dimension and 180 terms denoting the environment-related dimension of a prosocial orientation. We used the software LIWC-22 to analyze the prosocial orientation of the titles and blurbs of the campaigns.

5.3.4 Control variables

Similar to prior studies, we included seven control variables and differentiated between *campaign-level controls, creator-level controls,* and *platform-level controls* (Butticè et al., 2017; Defazio et al., 2021; Mollick, 2014; Taeuscher et al., 2021).

Campaign-level controls. We included the following control variables on the campaign level: funding goal, duration, title and blurb text length, and anglophone country. The *funding goal* refers to a crowdfunding campaign's targeted amount to raise in logged USD. *Duration* represents the number of days between the launch of a campaign and its successful or unsuccessful termination on the platform. The *title and blurb text length* represents the logged word count of the title and blurb of a campaign. *Anglophone country* captures whether a campaign originates from a country in which English is widely spoken and holds significant cultural influence. This binary indicator takes a value of 1 if campaigns are launched from the United States, Canada, the United Kingdom, Australia, or New Zealand, which are recognized as Anglophone countries. It serves as an indicator of the campaign's potential association with English-speaking cultural contexts.

Creator-level controls. On the creator level, we included the control variable *user profile text length*. This represents the logged word count of the self-description in the user profiles of the campaign creators.

Platform-level controls. We included the following control variables: staff pick and the main categories on the platform level. *Staff pick* is a dummy variable coded as 1 if the platform has endorsed the campaign under the label "Projects we love." Furthermore, we coded dummy variables based on the main categories of the platform, i.e., *art, fashion, design, food, and technology*.

5.4 Results and robustness

5.4.1 Results

Table 5-3 provides an overview of the descriptive statistics of the variables and the correlations among them. On average, each venture gained support from 234.67 backers.

Table 5-4 summarizes the results of our main analysis. Similar to other studies that rely on count data (e.g., Ebersberger & Kuckertz, 2021), we use a Poisson quasi-maximum likelihood (QML) regression to regress the number of backers. A Poisson QML estimation allows for overdispersion and therefore provides more robust results than a Poisson regression (Wooldridge, 2013). We used the *statsmodels* Python package to run the analysis (Seabold & Perktold, 2010). We followed a hierarchical regression approach, starting with the control variables in model 1 and adding the main and interaction effects in models 2 and 3.

In Hypothesis 1, we posit that EIC is negatively associated with resource acquisition from crowdfunders. Model 2 shows that the coefficient for EIC is significant and negative ($p < 0.001$), supporting our hypothesis.

In Hypothesis 2a, we posit that a pro-humanity orientation of ventures' crowdfunding campaigns negatively moderates the negative association between EIC and resource acquisition from crowdfunders. Model 3 shows a significant and positive regression coefficient for this moderation effect ($p = 0.016$) and thus supports Hypothesis 2a. Figure 5-3 illustrates the relationship between a venture's EIC and the number of backers for different degrees of the pro-humanity orientation of a campaign. The plot shows the predicted number of backers for different degrees of EIC and fixed levels of the pro-humanity orientation of a campaign. All other variables were fixed at the mean. As we hypothesized, the relationship between EIC and the number of backers is negative for campaigns with no (dotted curve) or an average (solid curve) pro-humanity orientation. However, the curve flattens considerably for campaigns with a high pro-humanity orientation (dashed curve). Moreover, for campaigns with a very high pro-humanity orientation (dash-dotted curve), the curve even flips, indicating a positive relationship between EIC and the number of backers that support a campaign. Thus, ventures launching campaigns with a very high pro-humanity orientation benefit from a high degree of EIC.

Table 5-3: Descriptive statistics and correlations

	Variable	Mean	SD	Min	Max	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
1	Backers	234.67	946.23	0.00	26,198.00	1.00														
2	Art	0.25	0.43	0.00	1.00	-0.08	1.00													
3	Fashion	0.15	0.36	0.00	1.00	-0.05	-0.25	1.00												
4	Design	0.15	0.36	0.00	1.00	0.18	-0.25	-0.18	1.00											
5	Food	0.10	0.30	0.00	1.00	-0.04	-0.20	-0.14	-0.14	1.00										
6	Technology	0.34	0.47	0.00	1.00	0.00	-0.42	-0.30	-0.30	-0.24	1.00									
7	Title and blurb text length [a]	3.05	0.31	2.30	3.78	0.07	-0.13	-0.03	0.02	0.02	0.11	1.00								
8	User profile text length [a]	3.77	0.81	2.30	7.20	0.02	-0.02	-0.02	0.01	0.05	0.00	0.14	1.00							
9	Funding goal[a]	8.59	1.79	0.69	15.42	0.10	-0.38	-0.14	-0.01	0.09	0.40	0.15	0.17	1.00						
10	Duration	34.44	12.67	1.00	81.00	0.05	-0.15	-0.09	-0.04	0.05	0.20	0.05	0.06	0.30	1.00					
11	Staff pick	0.10	0.29	0.00	1.00	0.23	0.01	-0.06	0.09	0.05	-0.06	0.03	0.03	0.11	-0.02	1.00				
12	Anglophone country	0.80	0.40	0.00	1.00	0.01	0.10	0.00	-0.07	0.09	-0.09	-0.04	0.00	-0.06	-0.01	-0.02	1.00			
13	EIC[b]	0.00	1.00	-5.02	2.11	-0.05	0.16	0.06	-0.06	-0.01	-0.13	-0.09	-0.14	-0.12	-0.07	0.05	0.05	1.00		
14	Pro-humanity	0.70	2.20	0.00	28.57	-0.04	-0.05	0.06	-0.03	0.07	-0.02	0.00	0.05	0.07	0.03	0.01	0.02	0.02	1.00	
15	Pro-environment	0.34	1.60	0.00	26.09	-0.01	-0.07	0.02	-0.01	0.17	-0.06	-0.01	0.03	0.05	0.02	0.01	-0.01	0.01	0.09	1.00

[a] After logarithmic transformation

[b] After standardization

Table 5-4: Poisson quasi-maximum likelihood regression results for the number of backers

Variable	Model 1	Model 2	Model 3	Model 4
Constant	0.8614**	0.9919**	0.9925**	1.2737***
Control variables				
Art[a]	-0.5907***	-0.5250***	-0.5293***	-0.5392***
Fashion[a]	-0.2689**	-0.1734*	-0.1789*	-0.1697*
Design[a]	0.9540***	0.9581***	0.9560***	0.9644***
Food [a]	-0.7442***	-0.6774***	-0.6808***	-0.6766***
Title and blurb text length	0.7248***	0.6919***	0.6927***	0.6839***
User profile text length	-0.0121	-0.0304	-0.0320	-0.0959**
Funding goal	0.1350***	0.1407***	0.1411***	0.1401***
Duration	0.0138***	0.0138***	0.0139***	0.0137***
Staff pick	1.5169***	1.5423***	1.5418***	1.5431***
Anglophone country	0.3953***	0.3938***	0.3955***	0.3918***
Main effects				
EIC		-0.1226***	-0.1235***	-0.1376***
Pro-humanity orientation		-0.1078***	-0.1085***	-0.1084***
Pro-environment orientation		-0.0044	-0.0133	-0.0059
Distinctiveness				0.0894**
Interaction effects				
EIC × pro-humanity orientation			0.0388*	
EIC × pro-environment orientation			-0.369**	
Pseudo R^2	0.1426	0.1487	0.1518	0.1499

N = 15,116

[a] in comparison to the Technology category (baseline)

***p < 0.001, **p < 0.01, *p < 0.05

Variance inflation factors (VIFs) for all included variables range from 1.03 to 1.76

Hypothesis 2b states that a pro-environment orientation of ventures' crowdfunding campaigns negatively moderates the negative association between EIC and resource acquisition from crowdfunders. Since the regression coefficient of the interaction term is significant but negative ($p = 0.005$), we rejected hypothesis 2b. Figure 5-4 depicts the relationship between a venture's EIC and the number of backers for different degrees of the pro-environment orientation of a campaign. The plot shows the predicted number of backers for different degrees of EIC and fixed levels of the pro-environment orientation of a campaign. Again, all other variables were fixed at the mean. The plot shows that for high (dashed curve) and very high (dash-dotted curve) degrees of pro-environmental orientation, the curves indicating the negative relationship between EIC and the number of backers steepens, compared to zero (dotted curve) or an average (solid curve) pro-environment orientation. Contrary to our hypothesis, the negative association between EIC and the number of backers becomes even more substantial for ventures launching a campaign with a high degree of pro-environment orientation. In our discussion, we elaborate on possible alternative explanations for this finding.

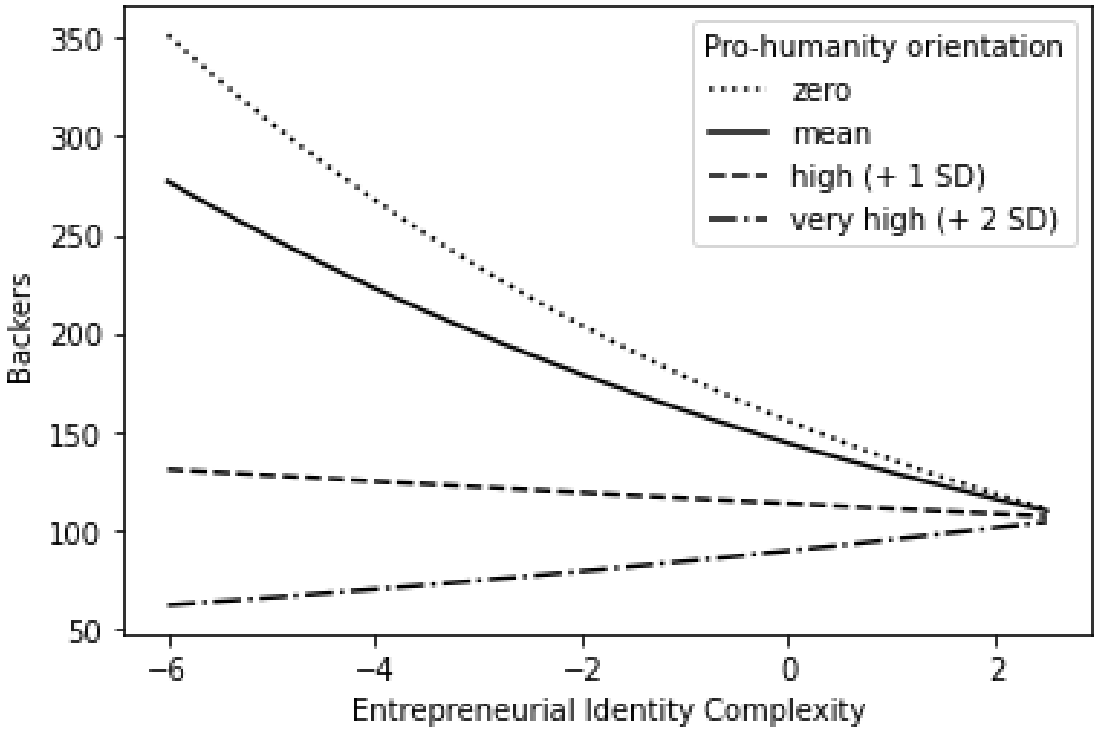

Figure 5-3: The moderating effect of a campaign's pro-humanity orientation on the relationship between EIC and the number of backers

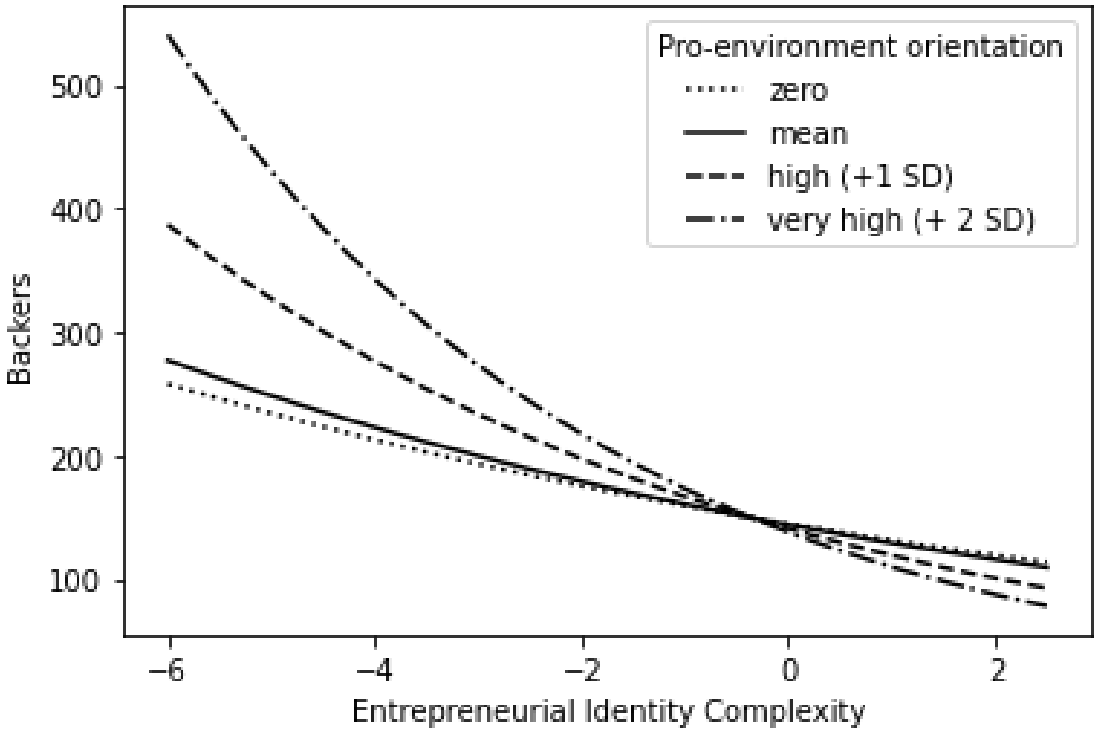

Figure 5-4: The moderating effect of a campaign's pro-environment orientation on the relationship between EIC and the number of backers

5.4.2 Robustness

To rule out distinctiveness as an alternative explanation for our findings, we ran another Poisson QML regression with a distinctiveness variable included. Therefore, we followed the approach of Taeuscher et al. (2021) to operationalize distinctiveness based on a topic model of crowdfunding campaigns. They calculated distinctiveness as follows (Taeuscher et al., 2021, p. 157):

$$\sum_{T=1}^{13} abs(\Theta_{T,i} - \overline{\Theta}_T)$$

"where $\Theta_{T,i}$ refers to venture i's weight for topic T and $\overline{\Theta}_T$ represents the […] average weight for topic *T."*

Model 4 in Table 5-4 shows the results when distinctiveness was included as an additional independent variable. In accordance with the findings of Taeuscher et al. (2021), the association between distinctiveness and the number of backers was significant and positive (p = 0.001). Similar to models 2 and 3, the association between EIC and the number of backers is significant and

negative ($p < 0.001$). These findings indicate that complex entrepreneurial identity claims are genuinely different from the concept of distinctiveness.

5.5 Discussion

5.5.1 Contributions

Our study explores the role of complex entrepreneurial identities in the legitimation process of new ventures—especially new social ventures—in the context of resource acquisition on crowdfunding platforms. Our findings show that, for ventures in general, EIC is a liability, although it can be an asset for social ventures when seeking legitimacy. Our paper contributes threefold to the literature at the intersection of legitimacy, social entrepreneurship, and complex entrepreneurial identities, as outlined in the following.

First, we expand the literature on new ventures' legitimacy based on optimal distinctiveness (Navis & Glynn, 2011; Zhao et al., 2017). While prior research has argued that new ventures gain legitimacy by being optimally distinctive, we introduce EIC as a further option for distinction and a potential source of legitimacy. Following recent research on distinctiveness (Taeuscher et al., 2021), we recognize legitimacy as a multi-dimensional construct (Suchman, 1995), arguing that EIC reduces cognitive legitimacy but increases normative legitimacy for ventures that address audiences that expect complex or odd entrepreneurial identities. Thus, complex entrepreneurial identities are an asset for audiences when normative legitimacy gains exceed cognitive legitimacy liabilities. Our research has shown that this can be the case for new social ventures. Future research may investigate whether there are further instances where ventures address audiences that expect or at least accept complex or even odd entrepreneurial identities. Though there are similarities between the mechanisms explaining the relationship between legitimacy and distinctiveness and between legitimacy and complexity, it is essential to note that EIC is genuinely different from distinctiveness. While distinctiveness reflects a venture's unconventionality compared to the average of ventures of the same category (Haans, 2019; Taeuscher et al., 2021), complexity reflects the unconventionality of combining different identity claims, regardless of whether other ventures make similar or different claims.

This difference also serves as the reason why we shifted our focus to the self-descriptions of crowdfunding campaign creators in their user profiles. Prior studies investigating the legitimacy of new ventures on crowdfunding platforms (e.g., Soublière & Gehman, 2020; Taeuscher et al., 2021), as well as studies investigating social startups' performance on crowdfunding platforms

(e.g., Calic & Mosakowski, 2016; Defazio et al., 2021; Moss et al., 2018), focused on the text descriptions of campaigns in their analyses. Therefore, we extend the analyzed dataset by one further concept by including campaign creators' self-descriptions from their user profiles in our analysis.

Second, prior research has identified a gap in knowledge about the legitimation process of social ventures and obtained mixed results regarding the relationship between ventures' prosocial orientation and their success in acquiring resources on crowdfunding platforms (Böckel et al., 2021). Our study addresses these issues by finding that only ventures with both a prosocial orientation and a complex entrepreneurial identity gain legitimacy on crowdfunding platforms and are thus successful. Hence, EIC is a boundary condition for social ventures to gain legitimacy, especially when they have a high degree of prosocial orientation. However, contrary to our theorizing, this relationship was observed only in the pro-humanity dimension of a prosocial orientation and not in the pro-environment dimension. One possible explanation could be that the challenges tackled by ventures with a pro-humanity orientation are often much more complex, as they require entrepreneurs to change social systems and their inherent conventions. In contrast, ventures with a pro-environmental orientation often reduce their energy and resource consumption or substitute them with more sustainable alternatives to fulfill their mission, which is challenging but often not as complex as changing society. Two ventures from our sample—one with a high pro-humanity orientation and the other with a high pro-environment orientation—may illustrate this. With a high pro-humanity orientation, the first venture aims to fight homelessness in a metropolis by providing affordable housing. In contrast, with a high pro-environment orientation, the second venture sells fairly produced organic cotton fashion. While both missions are challenging, the causes of homelessness seem more complex and deeper rooted in socioeconomic inequality, failures in the real estate market, and individuals' fortunes.

Third, we contribute to the literature by synthesizing prior research on complex entrepreneurial identities. EIC has been addressed through different concepts and lenses. However, none of these concepts covered identity claims on both the venture and founder levels. We contribute to the hybridity (Battilana et al., 2017) and institutional complexity (Greenwood et al., 2011) discourses by including identity claims on the individual level and not associating identity claims ex ante to different and contradictory institutional logics. Instead, we define complexity through the unconventionality of the combinations of observed identity claims. Moreover, we contribute to the literature on entrepreneurial identities (Fauchart & Gruber, 2011; Wry & York,

2017) through the following measures: 1) including entrepreneurial claims on the venture and founder levels (Navis & Glynn, 2011) and 2) showing the implications of complex entrepreneurial identities for the legitimation process of new ventures.

5.5.2 Limitations and future research

Our operationalization of EIC is based on the self-descriptions of the campaign creators in their user profiles on Kickstarter. Of course, these are written for a very specific context, and entrepreneurs do not write these descriptions free of intention to present themselves in a favorable light. Nevertheless, we believe that this is similar to other situations in which entrepreneurs present themselves. Thus, our findings likely generalize to entrepreneurs' self-presentations, such as in investor pitches, on their websites, or in media coverage.

Moreover, we measured EIC based on the semantic distance between the modeled topics and the unconventional combination of distant topics. However, our measure does not reflect whether and to what extent crowdfunders perceive these unconventional combinations of entrepreneurial identity claims as complex. While our study captures the complexity of the signal as sent by ventures, it does not cover how crowdfunders rate the complexity of the received signal. Future research could address this by including crowdfunders' or general stakeholders' perceptions of EIC in the scope of analysis, e.g., by testing it experimentally. Such studies could strengthen the internal validity of our theorizing, while our findings support external validity.

Similarly, our study does not capture how crowdfunders' evaluations differ between ventures with pro-humanity- and pro-environment-oriented missions. In their review of the origins of the literature streams on social and environmental entrepreneurship, Vedula et al. (2021) found that the two literature streams differ in how they conceptualize the goals of entrepreneurs. Social entrepreneurship emphasizes trade-offs between social and financial value creation, while environmental entrepreneurship emphasizes synergies between environmental and financial goals (Vedula et al., 2021). Thus, in the social entrepreneurship literature, markets are often considered as means to achieve broader social benefits, while in the environmental entrepreneurship literature, they are often an end goal in itself (Vedula et al., 2021). If this observation also applies to crowdfunders' perceptions of pro-humanity- and pro-environment-oriented ventures, this could provide a further explanation for the different evaluations of EIC for pro-humanity- and pro-environment-oriented ventures by crowdfunders. Thus, future research should include this

consideration and investigate how stakeholders' perceptions and evaluations differ for ventures tackling environmental problems and ventures addressing social equality.

Finally, similar to other studies researching the legitimacy of new ventures (Barlow et al., 2019; Haans, 2019; Taeuscher et al., 2021; Zhao et al., 2018), our research design did not allow us to measure legitimacy directly, which represents a further limitation of our study. Other studies that investigated crowdfunding campaigns used third-party endorsements, such as media websites or blog posts, to operationalize legitimacy (Calic & Mosakowski, 2016). However, it is questionable whether legitimacy can be observed directly (Suddaby et al., 2017). Future research could address this issue by operationalizing legitimacy differently and may even differentiate between normative and cognitive legitimacy.

5.6 Conclusion

Our study found that complex entrepreneurial identities are a source of distinction for new ventures and a potential source of legitimacy. Building on prior research, we define EIC as the combination of unconventional identity claims from the venture and founder levels. New social ventures can gain normative legitimacy due to a high degree of EIC, as it aligns with their stakeholders' expectations and signals the ability to tackle grand challenges and change social norms and conventions. However, complex entrepreneurial identities reduce new ventures' comprehensibility and, thus, their cognitive legitimacy, which leads to a negative perception by stakeholders of ventures without a prosocial orientation.

6 Discussion and conclusion

This dissertation aims to shed light on the interface of SE and the bioeconomy transition. Four empirical studies investigate the interplay between the bioeconomy transition and SE and the role of entrepreneurs within this transition. The results indicate a bi-directional and potentially reinforcing relationship between SE and the bioeconomy transition, where innovation induced by SE is a critical factor for the success of the bioeconomy transition. In addition, the transition itself externally enables SE. Moreover, sustainable entrepreneurs' behavior and identity differ significantly from conventional entrepreneurs.

For instance, Study 1 reveals investments, especially in technological progress and innovation leveraged by bioeconomy startups, as a main bottleneck for the success of the bioeconomy transition. Study 2 complements these findings by introducing the bioeconomy as an external enabler triggering entrepreneurial activity. Moreover, Study 2 shows sustainable entrepreneurs need unique knowledge and specific competencies to act on entrepreneurial opportunities provided by the bioeconomy transition. Furthermore, Study 3 indicates that sustainable entrepreneurs differ from conventional entrepreneurs in their scaling and growth strategy decisions. Finally, Study 4 shows that external audiences perceive and evaluate sustainable entrepreneurs and their identities differently than conventional entrepreneurs. In the following, I outline the theoretical contributions at the intersection of the bioeconomy and SE literature implicated by these findings. Moreover, I discuss how the "rules of the game" (Baumol, 1996, p. 7) need to change to foster productive entrepreneurship that is innovative, sustainable, and respects the planetary boundaries.

6.1 Sustainable entrepreneurships' contribution to the bioeconomy transition

Study 1 shows that technological progress and innovation – driven by sustainable bioeconomy startups – are central factors in the sketched transition toward a sustainable bioeconomy. They are critical to achieving competitive biobased products. Thus, Study 1 supports the approach of many national and international bioeconomy strategies to emphasize the role of entrepreneurship, although many of them need to strengthen their focus on entrepreneurship (Kuckertz, 2020). Study 2 complements the picture describing the relationship between SE and the bioeconomy transition and has implications for bioeconomy strategies and policy on sustainability transitions. Building on the EE framework of Davidsson et al. (2020), Study 2 conceptualizes the bioeconomy transition as an external enabler that triggers the creation of new sustainable ventures.

Thus, the findings of Study 1 and Study 2 draw the picture of a bi-directional and potentially reinforcing relationship between SE and the bioeconomy transition. For bioeconomy strategies, this implies that emphasizing the role of entrepreneurship and providing direct support measures may not be sufficient. Instead, policymakers need to design policy to externally enable SE while leaving space for new ventures to contribute to the envisioned bioeconomy transition. Hence, I suggest understanding and using the EE framework (Davidsson et al., 2020) to design and analyze mission-oriented innovation policies that aim to tackle grand challenges (Mazzucato, 2018). Moreover, Study 2 contributes to the EE framework literature in general (Kimjeon & Davidsson, 2022) and its application to the case of SE in specific (Horne & Fichter, 2022).

Study 1 does not only reveal the central role of SE in the bioeconomy transition, but it also contributes to reconciling and combining opposing bioeconomy visions that have been summarized as "pro-economic growth" versus "pro-planetary limits" visions (Ramcilovic-Suominen et al., 2022, p. 1). While the "pro-economic growth" vision dominates most bioeconomy strategies (Ramcilovic-Suominen et al., 2022, p. 1), the resulting transition pathway bears clear traces of both visions. Especially the call to develop a shared understanding concerning the sustainability of the bioeconomy reflects the call of proponents of the "pro-planetary limits" (Ramcilovic-Suominen et al., 2022, p. 1) vision to understand the economy as a sub-system of the natural environment in the sense of Georgescu-Roegen's (1977) bioeconomics.

In particular, the latter seems to be a fruitful perspective for future research on SE. Although some scholars have called to integrate the principles of ecological economics (Stål & Bonnedahl, 2016) into SE and to link the field closer to the concept of planetary boundaries (Hummels & Argyrou, 2021; Schaltegger et al., 2018), this development seems to be still in its infancy. However, putting "greater emphasis on renewable resources and greater effort to ensure sufficient time for such resources to regenerate" (McMullen, In-Press, p. 40) could help to strengthen the sustainability within SE. It would mean learning from the bioeconomy discourse that seems to benefit from combining Schumpeterian and Georgescu-Roegian views (Pyka et al., 2019). Such an extension to the concept of SE could also inform a change in the "rules of the game" in the sense of Baumol (1996, p. 7). Adding the consideration of sustainability within planetary boundaries as a further criterion besides innovativeness to evaluate the productiveness of entrepreneurship could change policymakers' view on entrepreneurship and their measures to foster it.

6.2 Sustainable entrepreneurs' role in the bioeconomy transition

Study 1 revealed that sustainable entrepreneurs in the bioeconomy need unique knowledge and specific competencies. It showed that the individual level is essential to the interplay between SE and the bioeconomy transition. Studies 3 and 4 added to this insight, though not exclusively focusing on SE in the bioeconomy transition but on SE in a broader context. Study 3 sheds light on sustainable entrepreneurs' decision-making on growth and scaling strategies revealing that they differ in this regard from conventional entrepreneurs. Their preference for scaling slow strategies indicates that they consider the natural environment's capacities and time needed to recover from impact through economic activity.

Moreover, Study 3 revealed present de-growth attitudes among entrepreneurs and showed that this attitude is negatively associated with a preference for scaling fast strategies. As outlined above, de-growth attitudes indicate a stronger focus on planetary boundaries and doubt whether economic growth can be decoupled from transgressing these boundaries. Study 3 shows that these considerations influence entrepreneurs' growth and scaling strategies.

Finally, Study 4 shows that sustainable entrepreneurs differ from conventional entrepreneurs in the way they can gain legitimacy. Unlike conventional entrepreneurs, sustainable entrepreneurs can gain legitimacy because of (and not despite) unconventional – or sometimes even odd – combinations of entrepreneurial identity claims. Study 4 shows that crowdfunders apply other evaluation criteria for sustainable entrepreneurs compared to conventional entrepreneurs. Crowdfunders are, in this regard, an audience of particular interest, as they act – especially in reward-based crowdfunding - as investors and consumers simultaneously and, thus, evaluate startups from both perspectives simultaneously. Moreover, their individual evaluations aggregate to a collective level. Thus, the results of Study 4 indicate that on the societal level, the "rules of the game" (Baumol, 1996, p. 7) have already started to change. The collective evaluation of SE by crowdfunders seems to acknowledge that SE is genuinely different from conventional entrepreneurship. Hence, it requires different evaluation criteria that are more tolerant toward unconventional approaches. Perhaps this shift in the perception and evaluation of entrepreneurship can also contribute to a more realistic public picture of entrepreneurship by reducing stereotypical media coverage of entrepreneurs (Prochotta et al., 2022) and questionable hypes like unicorn startups (Kuckertz, Scheu, et al., 2023).

Future research could take this up by exploring the perception and evaluation of sustainable entrepreneurs compared to conventional entrepreneurs among different external audiences beyond crowdfunders. Furthermore, following up Study 3, future research could investigate what role planetary boundaries play in the mental model of sustainable entrepreneurs when making business decisions or imagining the future development of their business. Moreover, it would be interesting to see how entrepreneurs integrate the consideration of a literally planetary concept into the daily doing and decision-making of their businesses.

6.3 Concluding thoughts

Research has shown that entrepreneurship is a critical factor for sustainability transitions in general and the bioeconomy transition in specific (Kuckertz, Berger, et al., 2020). Especially climate change requires fast and effective measures, and research has shown that entrepreneurship can be an effective measure to fight crisis (Kuckertz, Bernhard, et al., 2023; Kuckertz, Brändle, et al., 2020), though it is not a panacea (Hall et al., 2010). This dissertation adds to this discourse by detailing the contribution of SE to the bioeconomy transition and highlighting the role of entrepreneurs in this transition process.

The findings of this dissertation show that SE contributes through innovation significantly to the bioeconomy transition, while at the same time, the transition enables innovative SE. Moreover, the findings show that sustainable entrepreneurs are critical in the interplay between SE and the transition process. Sustainable entrepreneurs differ in the required knowledge and competencies, as well as in their behavior and identity, from conventional entrepreneurs. Thus, I conclude that the "rules of the game" (Baumol, 1996, p. 7) need to be changed in a way that ensures that the majority of entrepreneurial resources are allocated to productive entrepreneurship in the sense of innovative entrepreneurship that contributes through innovation to a sustainability transition and the collective endeavor of stopping the transgression of planetary boundaries.

Fortunately, the findings of this dissertation indicate that on the societal level, the "rules of the game" (Baumol, 1996, p. 7) have already started to change. As outlined above, sustainable entrepreneurs consider additional criteria in their decision-making. Additionally, the perception and evaluation of sustainable entrepreneurs have altered compared to the evaluation criteria applied to conventional entrepreneurs. Furthermore, policy is essential to change the "rules of the game" (Baumol, 1996, p. 7). Policymakers should consider how policy can enable entrepreneurship that contributes with innovation to the collective target of staying within planetary boundaries.

However, SE should remain a free choice entrepreneurs are encouraged to make wherever possible but not forced to by normative or legal obligations (McMullen & Warnick, 2016). Only in that way entrepreneurship can unfold its full potential of creativity and diversity to innovate within planetary boundaries. Thus, ideally, policy creates a legal framework that ensures that entrepreneurial and economic activities move within planetary boundaries without prescribing which paths to choose.

The physicist Levermann, 2022 (p. 1) proposes a mathematical model of folding that ensures "past avoidance in finite space", and that can also serve as a "paradigmatic system for infinite economical growth on a finite planet with finite resources". He describes music as an example where generations of composers created new melodies in their own artistic style over centuries while avoiding repeating their predecessors (Levermann, 2022). In this sense, folding within finite space can serve as a beautiful inspiration for productive entrepreneurship that creates sustainable innovations through new combinations within planetary boundaries.

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Appendix

Appendix A: Affiliation and positions of participating experts who agreed to disclosure. The participants represent themselves and not necessarily the opinion of their organizations or institutions.

Category	Organization	Position	Country
Corporates	BioEconomy Cluster Management GmbH	Anonymous	Germany
	Bio-mi Ltd.	CEO	Croatia
	CLIC Innovation ltd.	CEO	Finland
	Cluster Food+i	Cluster Manager	Spain
	Corporación Tecnológica de Andalucía (CTA)	Biotechnology Technical Officer	Spain
	MetGen Oy	CEO	Finland
	Novamont SpA	Anonymous	Italy
	Orineo	CEO	Belgium
	Process Design Center	CEO	The Netherlands
	5 further anonymous experts		
Entrepreneurs	Chrysalix Technologies	CEO and Founder	United Kingdom
	Essento Food AG	CEO and Founder	Switzerland
	FineCell Sweden AB	CEO and Founder	Sweden
	Green Code SrL	CEO	Italy
	Ingelia	CEO	Spain
	9 further anonymous experts		
Policy Makers	Department of Agriculture, Food and the Marine	Agricultural Inspector	Ireland
	Energy Institute Hrvoje Pozar	Post-doctoral researcher	Croatia
	Italian Council for Agricultural Research and Economics	Head of Research	Italy
	Ministry of Agriculture, Regions and Tourism	Ministerial Council	Austria
	Ministry of Economic Affairs	Anonymous	The Netherlands
	Ministry of Science, Innovation and Higher Education	Head of Division	Denmark
	Norwegian Institute of Bioeconomy Research (NIBIO)	Special Adviser	Norway
	Teagasc	Principal Research Officer	Ireland
	VTT Technical Research Centre	Technology Manager	Finland
	7 further anonymous experts		
Researchers	Helmholtz Centre for Environmental Research	Head of Department Bioenergy and Professor of Bioenergy Systems	Germany

	Institute of Bioorganic Chemistry Polish Academy of Science	Head of Department of RNA Technology	Poland
	Karlsruhe Institute of Technology	Head of Bioelectrics Group	Germany
	Lappeenranta University of Technology	Professor of Strategy Research and Sustainable Value Creation	Finland
	Nordic Institute for Studies in Innovation, Research and Education (NIFU)	Research Professor	Norway
	The Institute of Technology and Businesses in České Budějovice	Senior Researcher	Czech Republic
	Universidade Europeia Lisboa	Post-doctoral researcher	Portugal
	University of Bonn	Anonymous	Germany
	University of Bonn	Professor of Technology and Innovation Management in Agribusiness	Germany
	University of Freiburg	Research Associate at the Forest and Environmental Policy Group	Germany
	University of Graz	Professor at the Institute of Systems Sciences, Innovation and Sustainability Research	Austria
	University of Helsinki	Post-doctoral Researcher at the Department of Forest Science	Finland
	University of Hohenheim	Professor of Biobased Products and Energy Crops	Germany
	University of Hohenheim	Post-doctoral researcher at the Department of Crop Science	Germany
	University of Natural Resources and Life Sciences, Vienna	Professor at the Institute of Marketing and Innovation	Austria
	University of York	Post-doctoral researcher	United Kingdom
	5 further anonymous experts		

Appendix B: Interview guidelines

My research aims to understand the challenges faced by sustainability-oriented bioeconomy firms when starting up. The research is part of an EU-funded Erasmus + project called Fostering Entrepreneurship for the BioEconomy (FOEBE) and is associated with the European Bioeconomy University, an alliance of six European universities involved in bioeconomy research and education.

- Can you please introduce yourself? Who are you?
    - Educational background?
    - Professional experience?
- What is your startup's business model?
    - Value proposition:
        - What is your product/service?
        - What are your customer segments?
        - How do you manage customer relationships for those customer segments?
    - Value creation and delivery
        - What are your key activities? (Which technology do you use to process biomass?)
        - What are your key resources? (What kind of biomass do you process?)
        - Who are your key partners?
        - What are your distribution channels?
    - Value capture
        - What is your cost structure?
        - What are your revenue streams?
- Can you please describe your process of starting up? From your first idea until today?
- What challenges have you been confronted with along the way?
    - Have you faced challenges regarding …
        - … funding?
        - … sales and business development?
        - … product development?
        - … growth/scalability?
        - … cashflow/liquidity?
        - … human resources planning/recruitment?
- Have you developed any specific strategies for managing these challenges?
- Did I forget to ask something during the course of this interview that you regard as important in the context of my research aim?

Appendix C: Representative quotations for the dimension of *transformative knowledge*

Second-order theme	**Representative quotations for *transformative knowledge***
Measuring sustainability impact	"But if I look at the bioeconomy, then what I feel is like, okay, in the end, we want to make the bioeconomy work with residues. And that's going to be tricky too, because if you use virgin resources, then there's always plenty. But if you use the residues, then you're dependent on one partner, and you're dependent on the quality of the stream, and you're also, it's really important that you show what's your impact. So it's going to be for us important, as we perform the LCA [life-cycle analysis], that we communicate the environmental benefits of using our product." (Interview 7) "They must have the certificate, FSC or BFC, anyhow, but it must be certified somehow. All customers, buyers are requiring certified raw material." (Interview 1)
Communicating sustainability impact	"The packaging must be sustainable, the product must be sustainable. It has to be as regional as possible, as organic as possible, preferably not from corporations or whatever, then it's just extremely expensive at the end. And then you have to communicate the whole thing so that the consumer understands why he is now paying three euros for his package instead of one. So that's an extreme challenge." (Interview 10) And I think that's tricky because that means you have such a drive to make a difference, but to actually make the difference, you cannot be 100 percent perfect at once. And to communicate that clearly and to still keep people aligned with your vision, and that's, I think, very tiring and very difficult." (Interview 7) "We do lack this marketing aspect and often the view from the outside. (...) Every time we've tried—even in a pitch and so on—to explain our product, it was maybe a bit too scientific and not enough on the point that people understood it or wanted to understand it. And that's where we had to, I guess, work very hard to just recognize that, how we're trying to sell our product, and just explain it." (Interview 3)
Regionality	"We tried for a long time to find someone who could do the complete product, but there is hardly anyone. (...) So we decided to do it ourselves, even though it's more expensive, even though it's more time-consuming, even though the machines always break down at some point. We are the only ones in Austria who do it. There is no one else in Austria who makes chewing gum. We just wanted to have regional and local production." (Interview 10) "When we're looking at that localised model, the idea that we go to a project place and we say, okay, who can construct it here? Who can manage the aquaculture here or grow the aquaculture here? I think that's a barrier to scalability because it's not like if we're manufacturing all the units ourselves, you can buy economies of scale, if you produce a lot, you can reduce the cost of it. The costs may always be different depending on the inputs of the place in which you're going. And we would like to have an impact on the local economy." (Interview 6) "(…) That also supports the production in remote areas because that saves the transport costs when calorific value is higher. So per ton of transported material, you get more energy transported. It supports, in a way, the production in remote areas like Siberia." (Interview 1) "And I think that our process has the potential to enable local production, and that's also a really cool factor. Even though sometimes, in the end, if you look at the environmental analysis, transportation costs are actually not often contributing as much to the final impact. But I like the idea that we can enable local production." (Interview 7)

Appendix D: Representative quotations for the dimension of *sustainable valorization of biomass*

Second-order theme	**Representative quotations for *sustainable valorization of biomass***
Assessing biomass availability	"There is a company that is cutting trees for the new roads or new area for buildings—so when you have trees that are close to the road. They're cutting trees because they need wider space. They are cutting this, and normally they are milling this for dust, for nothing. (…) This is very useful for me, to use this kind of material, which nobody [is] interested in." (Interview 2) "We are a processor of fruit stones, and these fruit stones have been a waste product in the juice and fruit industry in general. (...) We have focused on stone fruit, such as apricot, cherry, and plum pits, and they are disposed of in huge quantities every year." (Interview 5)
Assessing biomass suitability	"(…) Many people think: 'Yes, you can get a sidestream like that for free.' No, of course they want to earn a bit of money with it, and the fact that they have to process it—such as drying it—means that our raw materials are also significantly more expensive than mainstream raw materials, such as potato starch or cornmeal or others." (Interview 3)
Developing a product	"And then, of course, there is the research, which none of us has actually learned. Well, none of us has really done research on a grand scale, and we really had to teach ourselves that. Also, of course, in a very pragmatic environment that must not cost a lot and where none of the professors will help either, but that really has to be home grown." (Interview 5) "So what we are really doing, and this is perhaps our scientific background again, is that we are already doing research projects on this, that we are saying: 'What is the agriculture of the future? What is also biodiversity, species diversity, and agroecosystem of the future?' And we are trying to say in cooperation projects with other research institutions or also industry partners, 'What will an agricultural system look like in the future?' And can't we somehow now, because we recognize every single little plant, say for once that you really specifically leave weeds there as well. Maybe they don't have a high damage potential, they don't have to be removed." (Interview 4)
Standardizing a product	"Our key milestone right now, it's developing the prototype further, but mainly to work toward a patent. And that's very important because we have some bigger American competitors. And, yeah, if they start filing a lawsuit in your direction, then you're dead. So you need to be protected." (Interview 7) "The big challenge for me is to move this design prototype to production that is [made] by a group of 10 people, not me. I am doing this with minimum waste of wood and the minimum waste of some house of production, so the big challenge for me is to move this production to some small factory and keep quality." (Interview 2)

Appendix E: Representative quotations for the dimension of *marketing of biobased products*

Second-order theme	**Representative quotations for *marketing of biobased products***
Market evaluation	"We have to reach this market because there is a larger demand, they can sell it for a price, which is more interesting for us. So it was a good thing to begin with the market and not with the process." (Interview 8) "Check your market before you start your business. So take the facts about the market potential. There's so much of this thing going around at the moment about any sustainability or climate change, or you name it. (…) But that's not the proof that there will be a market for your business. Lesson learnt is that check your market, and check it again and not think so much about the subsidies or what the politicians are talking or papers are writing. Because the market is what really defines if your company is going to survive. There must be demand." (Interview 1) "We noticed that when we went out in public and gave presentations to more and more biogas plant operators, people weren't beating down our doors like we expected. We even have great results, we have such a, for us, great product. Something is not right." (Interview 9) "I think mycelium has the potential to be a new type of material on its own. And it doesn't need to be an alternative to animal-derived products or whatever. I think it will grow in its own niche. So that's a bit more difficult because then you are developing new markets." (Interview 7)
Reaching competitiveness	"At the beginning, we thought that because of all the environmental aspects, we can sell it more expensively than the alternative. But we understand that because we discussed with a lot of different customers, we understand that the price is more important than the environmental aspects." (Interview 8) "And accordingly, we are also very high at the moment in our manufacturing costs, which again also affects the RRP [recommended retail price] in the store we propose, so we are in [supermarkets] for 1.99 [euros] for a 50 gram package. That is, of course, in terms of chips seen already quite high, in terms of such protein chips seen again exactly what the others also offer, so there is also often 50 grams for two euros." (Interview 3)
Predicting relevant policy	"And we were told that time that there will be a radical change. OK, it's also a little bit big picture because in 2015 when we started, the cost of CO_2 ton was close to 30 euros per ton. And then it went down to seven or eight euros per ton, which made fossil coal really the cheapest fuel in Europe. Only now the cost of CO_2 emissions are growing and going up. As I told you, no serious actions anywhere to replace fossil coal by some renewables." (Interview 1) "We also focused on the Nutri-Score because we were able to achieve our A well, which can then also really be a selling point—at the moment it is not yet mandatory, but we strongly assume that it will then really be mandatory in one, two, three years, and then we will of course have a starting advantage over others." (Interview 3)

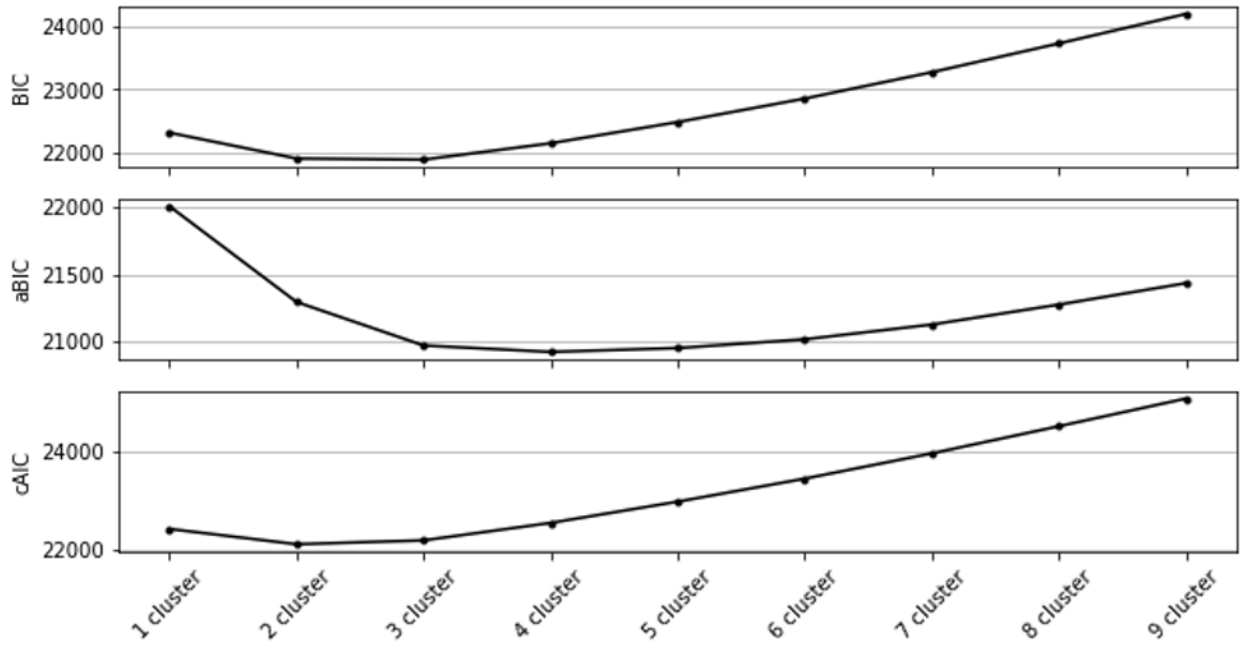
Appendix F: Representative quotations for the dimension of *management of limited resources*

Second-order theme	**Representative quotations for *management of limited resources***
Funding	"Ever since I started paying people, the burn rate is so high that I feel like to know that in three months you have no money. I mean, that's too short to get funding, actually. But yeah, we have to make it work because I was tired of waiting or tired to go slow and our competitors go fast." (Interview 7) "So to the funding in general, who says that it is not a challenge has not [tried to get funding] yet... Either it is really given to him, or he has not yet intensively pursued it himself. (...) That is always a challenge! Until we found an investor, (...) six-to-nine months went by. Nevertheless, the topic is socially interesting as well as economically." (Interview 4) "And subsidies, I mean, subsidies are for projects like ours, large hardware that potentially has a great impact, but just need some funding that isn't crippling in terms of what you give up in order to receive it. Subsidies are a good fit." (Interview 6)
Networking	"(…) By having market companions, we legitimize ourselves, you know what I mean, that just shows the interest is there, the potential is there, the market is there. And if I'm the only one doing it now for the next and the last 20 years, then the demand can't be that great. From that point of view, it's definitely great." (Interview 10) "We actually had a project in a university course, where it was about investigating one's own idea further for a semester. And that's where I met my 'co-founder', my first 'co-founder', (...) and that's where we started the project, so to speak. Yes, the project then became a company, and we have now taken on a wide variety of roles." (Interview 5)
Taking action	"We are already, as I said, food technologists, and accordingly it is most fun for us to actually create products. And that is completely missing right now. So it's really just a lot of different things right now that actually have nothing to do with our original studies, and you have to kind of dig into it without ever having learned it." (Interview 3) "(…) Of course, the number one topic is always firefighting. So, if there really is a problem somewhere, that you can deal with it as quickly as possible in order to avoid damage or perhaps also to simply solve this problem or find a better solution to it—that is definitely a point." (Interview 5)
Team	"Where we definitely invested a lot of time is in the team. Until we have put together a proper team—I don't mean until we have put together a proper team, but until we have found all the key technical people and people who match the philosophy in terms of orientation and mentality—that is still not complete. It's an ongoing process, but it's definitely taken a lot of time. But it's definitely worth investing the time." (Interview 4) "(…) Because circular economy always has a technical part or at least a focus on maybe eliminating food or raw materials, but this economic side must also always be added because it must, of course, be economical in the long term, the whole thing must be economically sustainable, and we have noticed that this is often lacking in technical people. So, it really needs the combination of technology and economy that it can really take shape, I would say now." (Interview 5)

Appendix G: Items to assess participants' opinion on "growth versus environment" (Drews et al., 2019).

Item label	Item wording
Development space	In view of limited natural resources, rich countries may have to give up their economic growth to assure that all poor people in the world can reach a fair standard of living.
Energy rebound	Energy savings due to technological advances are partly undone by further economic growth.
Environmental damage	Economic growth always harms the environment.
Environmental protection	Economic growth is necessary to finance environmental protection.
Excessive political attention	Politicians are too concerned about economic growth.
Flawed welfare measure	The GDP is a flawed measure of social welfare.
Full employment	Full employment can be achieved without economic growth.
Good life	A 'good life' without economic growth is possible.
Governmental control	Economic growth can be controlled by the government.
Income inequality	Making the income distribution more equal should get a higher priority than economic growth.
Life satisfaction	Continued economic growth is essential for improving people's life satisfaction.
Post-materialism	Economic growth raises incomes which in turn make people care more about the environment.
Public services	Economic growth is necessary to finance public health and pension systems.
Recovery	Future economic growth will recover and again be as high as in the past.
Stability	Without economic growth the economy will become less stable.
Techno-fix	Technology can solve all environmental problems associated with economic growth.

Appendix H: Plot of information criteria for 1- to 9-cluster solutions for opinions on "growth versus environment."



Appendix I: Response distribution among the three opinion clusters on "growth versus environment" for the 16 items.