



Support Systems for Sustainable Entrepreneurship and Transformation (SHiFT)

SHiFT WP6: Final Report on the Role of Investors, Financial Institutions and Public Funding Programmes

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1 Introduction

1.1 Background and Relevance of Support Type

In the ECO-INNOVERA project “Support Systems for Sustainable Entrepreneurship and Transformation” (SHIFT), different actors and approaches that provide support to start-ups as well as innovative MSMEs developing eco-innovation are examined. The central questions are: how well does existing entrepreneurship support work for sustainable entrepreneurs and how can it be adapted to better support these?

Investors, financial institutions and public funding programmes play a central role in entrepreneurial finance, which is of crucial importance for most entrepreneurs while presenting a particular challenge for new companies. In early years, start-ups often struggle with access to external finance for a range of reasons (cf. Cosh, Cumming, & Hughes, 2009; Kerr & Nanda, 2009; Megginson & Smart, 2008; Starobom, 2013): Income is low or non-existent, while at the same time there is a lack of collateral or assets, which means that banks consider newly established companies to be unable to repay loans and/or as too risky prospects. There is often a high level of uncertainty arising from the product/service (as these are often new technologies with no market history), which makes it difficult for investors or funders to assess the business model. Similarly, there is uncertainty surrounding the entrepreneur or the company itself due to an inexistent credit history. These informational asymmetries between entrepreneur and investor or funder make it difficult for the former to convince the latter of the soundness of their business (Bergset, 2015). These challenges can be assumed to diminish somewhat for more established, innovative MSMEs with a proven track record and a growing business network. While external financial resources can provide a buffer for start-ups that helps them deal with initial low performance and liquidity difficulties (Gimeno, Folta, Cooper, & Woo, 1997), insufficient capital is a key reason for failure in early-stage companies (Carter & Van Auken, 1990).

Examining the role of investors and public funding programmes specifically for sustainable entrepreneurs and green start-ups developing eco-innovation can be considered warranted for two reasons: First, due to potential differences in business model, entrepreneurial motivation and strategies between green start-ups and other start-ups (as explored in the literature review), it is of interest to assess how these differences might have an impact on access to finance and funding. Second, as the promotion of a Green Economy is a clear political goal at national and EU levels, it is of interest to know how specific financing challenges might arise for new companies that are involved in eco-innovation development in order to adapt policies and programmes to the needs of these companies.

1.2 Goal of Work Package 6

Work Package 6 (WP6) thus aims at identifying financial instruments, investor types and public funding programmes used by green start-ups (up to the age of 8 years) and assessing real and perceived gaps in the access to finance and funding at the early stages of companies developing eco-innovative products and services. While some fairly recent studies on eco-innovation have looked at the topic of finance (European Commission, DG Environment, 2011), these do not focus specifically on the early stages of companies or the different types of start-ups developing eco-innovation. This work package

aims to address this research gap. The empirical work in the WP6 focuses particularly on the perspective of the demand-side (i.e. the start-ups themselves), but does also seek to verify these findings by involving the supply-side (i.e. investors and public funders). The empirical work includes explorative interviews, a survey of different green start-ups' use of financial instruments, investors and funding programmes and a workshop with investors and public funders.

WP6 seeks to increase knowledge about the issue of financing in start-ups that are developing eco-innovation. The goal is to develop recommendations for policy on how to adapt public funding programmes and provide adequate incentives to private investors as well as recommendations for investors on how to adapt their services to the needs of green start-ups.

1.3 Research Focus and Research Questions

While it was initially the idea to include start-ups in addition to established micro enterprises as well as small and medium-sized enterprises (MSMEs) on the demand-side, the scope of this work package has since been narrowed down to focus on start-ups. The reason for this is as explored above, first, that the financial needs, challenges and types of access of start-ups distinctly diverge from that of more established MSMEs; and, second, that the financing of eco-innovation in established MSMEs has already been more extensively researched than that of start-ups.

The main questions to be answered in Work Package 6 are the following:

- (1) How and to what extent are the specific financial needs of different types of sustainable entrepreneurs in start-ups at different phases met by private investors and financial institutions and public funding programmes?
- (2) Where do real and perceived gaps and barriers exist (both on demand- and supply-sides)?

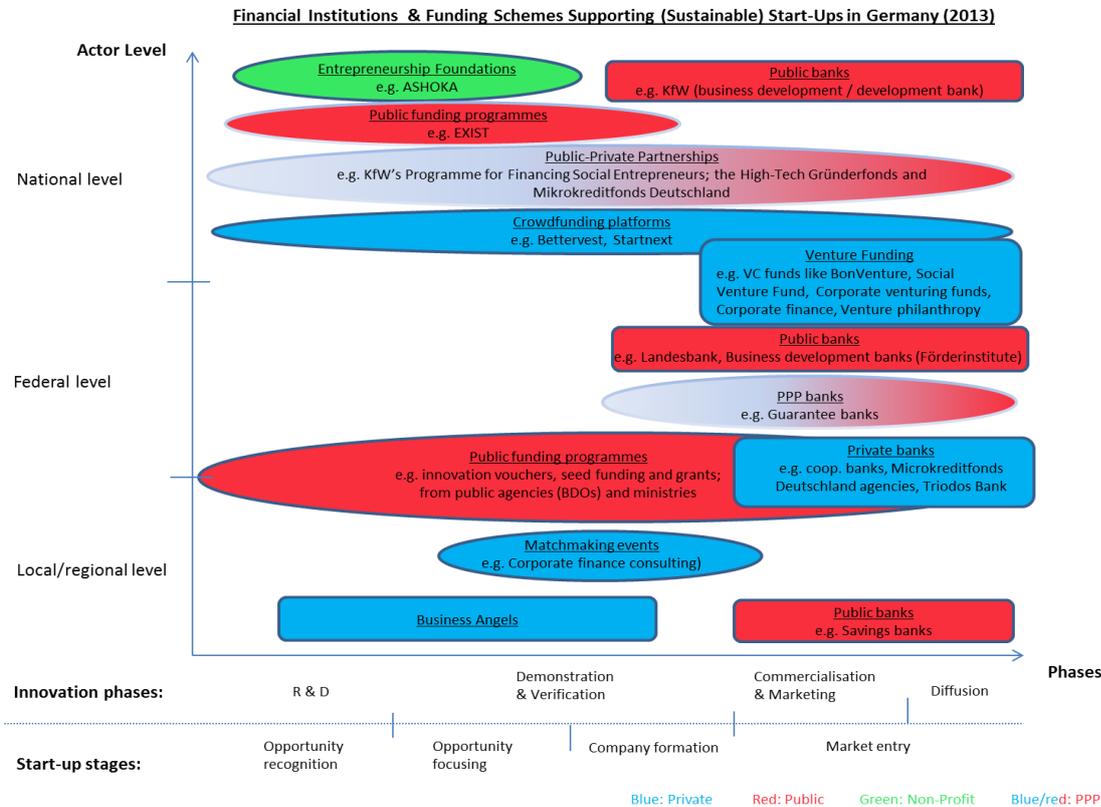
These questions should be answered in order to be able to develop concrete and realistic recommendations for how the role of private financial institutions in financing sustainable entrepreneurship can be strengthened and how public funding programmes can be adapted to the specific needs and challenges of specific types of sustainable entrepreneurs.

1.4 Actor and Approach Type(s) and Diversity of Support

The report for Work Package 1 of SHIFT (Chapter 3.1) describes the types of support that are of relevance to entrepreneurs. In the context of finance, all – informal, formal, soft and hard – types are of significance. Investors and public funding programmes primarily provide a “hard” type of support (i.e. money) in both a formal (contractual and institutional) and an informal (e.g. through social networks, e.g. family, friends or crowdfunding or in the form of business angel investment) manner. “Soft” support is, however, also provided by some of these actors. An example is the provision of business advice and network contacts by investors in addition to the money they invest. Furthermore, intermediaries might not provide the money themselves, but help through networks to match the right investor with the right start-up.

Figure 1 below shows a rough overview of the types of investors and funding programmes found in Germany that provide entrepreneurship support of a financial character. Depending on the innovation or company development phase as well as the geographical level of support there is a diversity of actor types involved. While there are a few investors and public funding programmes that specifically target sustainable entrepreneurs and green start-ups, most of the latter seek funding and investment from investors and public funding programmes that do not specifically target them (i.e. the general entrepreneurial finance or funding programmes). In order to best assess the relevance of these individual types of actors and approaches for green start-ups it is deemed necessary to do both qualitative and quantitative empirical research in WP 6.

Figure 1: Overview of financial institution types and funding programmes relevant for entrepreneurship in Germany



2 Empirical Methods

2.1 Exploratory Interviews

Short exploratory interviews have been carried out in a first step of the empirical work of WP6 in the first half of 2014. 8 interviews were carried out with entrepreneurs in start-ups in each country. In total 24 interviews were completed. The goal of these interviews was to generate background information and knowledge of the language used by these entrepreneurs in order to use these insights when conceptualising the survey of start-ups to be carried out in the second step. The selection criteria for choosing the interviewees were the following: a) the company was founded 2006 or later (or not yet officially founded); b) the company provides a green product/technology or service /product-service system; c) the companies to be interviewed have a range of *estimated* financial needs and capital intensities. The interview questions were rather broad and intended as a direction. The interviewer was therefore able to react to the information given by the interviewee in order to comprehensively assess the financial situation described. The questions used were the following:

- (1) What type of financial instruments and funding programmes has the start-up used in what stages? What type of investor or funder was involved in each case? How much money was received? Please be specific (i.e. names of programmes etc.).
- (2) What type of barriers or challenges has the entrepreneur/team encountered in finding finance or funding? These may be related to amongst others investor/funder, internal issues such as administration capacity or knowledge of financing options, and external issues such as regulations or tax.
- (3) Has the entrepreneur/team had positive experiences in accessing finance/funding, i.e. opportunities not anticipated in advance?
- (4) Where does the entrepreneur/team perceive a gap in finance or overlap between private investment and public funding?

2.2 Survey

A survey was carried out starting with the development of the survey design in the summer of 2014, the distribution of the survey and completion by companies between autumn 2014 and winter 2015 and analysis completed in the summer/autumn of 2015. The survey was designed to explore entrepreneurs' actual use of financial instruments as well as their needs, challenges and opportunities. Additionally a range of control questions were included which helped take account of the companies' specific innovation field (technology, sector, national context). It was distributed in all three project countries (Finland, Germany and Sweden).

The topic clusters of questions included the following:

- **Financial access and usage** – Instruments used, sums received/required, financial actors involved, in different phases.
- **“Sustainability-orientation”** – Most of the resulting variables are latent (i.e. non-observable) variables, which poses a challenge for operationalisation. A search of qualitative and quantitative

empirical literature was carried out for items/questions to be included in the survey. Additionally, the researchers' own questions have been developed where none were found.

- **Perceived challenges/support** – Also here, a search of qualitative and quantitative empirical literature has been carried out for items/questions to be included in the survey. Some questions also resulted from the analysis of the interviews carried out in advance.
- **Personal / company characteristics** – Especially such that may be of relevance, e.g. profitability, size, age, stage, innovativeness, level of technology, entrepreneur characteristics etc.

The survey was distributed to 2000 companies in each country (in total 6000 companies), which were randomly selected in three national company registers (Creditreform in Germany, UC in Sweden and Asiakastieto in Finland). Including all types of companies (i.e. green start-ups and non-green start-ups from a range of sectors and industries) allowed a comparison in the analysis between green start-ups and non-green start-ups.

The companies that replied to the survey were individually assessed in terms of their product/service portfolio in order to ascertain whether or not they had green products/services. This was done by a team of three research assistants, one in each country, who were trained in advance. The information source used was the companies' websites. The assessment itself was carried out by applying the Environmental Goods and Services Sector" (EGSS) classification provided by the EU statistical office Eurostat (EUROSTAT, 2009). The reason for a researcher assessment of the products and services was to avoid a non-consistent self-assessment by the companies themselves. The companies were assessed to have a "full green product/service portfolio", a "partially green product/service portfolio" (i.e. also to have some products with no discernible positive environmental impact) or "no green products/services".

In terms of the analyses carried out, a logistic regression analysis was initially planned. Unfortunately, due to a relatively low number of green start-up participants this turned out to be difficult to realise. The hypotheses developed are therefore tested with contingency tables, as this form of analysis only requires a very low number of participants. The statistical significance of differences between green and non-green start-ups as well as different groups of green start-ups was tested with Pearson's chi square. This allowed for an analysis of the correlation levels between individual characteristics of the companies and, for instance, of their challenges in access to finance. In those cases, in which analytical group numbers are very low, Fisher's exact test is employed, as this statistic can be used with any number of participants (Backhaus, Erichson, Plinke, & Weiber, 2013). The strength of the significant differences is also assessed by using the Phi-coefficient (a value above $\phi = 0.3$ is considered substantial).

The hypotheses developed focussed primarily on the issues explored in existing research on finance in the literature on sustainable entrepreneurship, environmental entrepreneurship and social entrepreneurship (see literature review below). In addition to these hypotheses a range of explorative analyses was carried out due to the early stage of research in the field.

2.3 Workshop

In the above described empirical work, a strong focus lay on the demand side of green start-ups and their challenges, difficulties and opportunities in accessing finance and funding. In order to also explore the perceptions and realities of the supply side, a workshop was carried out with investors, public funding organisations, intermediaries as well as a few start-ups. In this workshop key findings from the interviews and survey were presented and discussed. The perspective of start-ups was also directly presented by two start-ups: one service-based company offering a green and sustainable household insurance and one high-tech renewable wind energy company. In reply to the SHIFT presentation, a representative of the venture capital industry, the *German Venture Capital Association (BVK e.V.)*, presented his viewpoint on the situation of venture capital generally in Germany and specifically for young Cleantech companies. Furthermore, representatives for both early stage investors – *Business Angels Netzwerk Deutschland (BAND)* – and sustainability-oriented investors – *Forum Nachhaltige Geldanlagen (FNG)* – presented key figures and the rationales of their respective investor groups. Subsequently, the results and presentations were discussed in a group of approximately 30 invited experts.

3 Findings from Work Package 6

3.1 Literature Review

The literature review was carried out with the aim of exploring existing theoretical explanations for challenges in green start-up finance as well as existing empirical findings in the area. Hypotheses for the survey were then developed on the basis of this analysis. The literature review is based on literature in the fields of sustainable entrepreneurship, environmental entrepreneurship and social entrepreneurship. For the comprehensive literature review, we refer to two journal articles that were written in the context of the project (see Bergset & Fichter, 2015, in Appendix 1 below and Bergset, 2015, in Appendix 2 below). In the following section, we describe selected findings briefly.

3.1.1 Theoretical Explanations

There are many authors who suggest that there might be differences in entrepreneurial finance for green start-ups compared to other start-ups (Ghosh & Nanda, 2010; Shepherd & Patzelt, 2011). As environmental protection is a central “by-product” of green start-ups’ core business, they operate in business areas where market failure often arises (Di Domenico, Haugh, & Tracey, 2010; Patzelt & Shepherd, 2011; York & Venkataraman, 2010). They thus provide a mix of public and private goods (see (Bergset, 2015)), which is likely to have an impact on their profitability levels, even if they are generally for-profit or financially self-sufficient in the long term (see (Bergset & Fichter, 2015)).

The literature review revealed the following distinguishing characteristics of green start-ups that might differentiate them among themselves as well as from other start-ups:

- Green start-ups by definition develop **environmentally friendly products/services**, such as car-sharing, ethical fashion, supermarkets without packaging or renewable energy technology (see (Bergset & Fichter, 2015)).
- In terms of the products green start-ups offer, these are often developed with **high-quality** (durable) materials while using eco-design and renewable resources (see (Bergset & Fichter, 2015)).
- Green start-ups, especially when operating in a niche, often enjoy a **high reputation** amongst consumers (Petersen, 2003).
- The **customers** of green start-ups are generally so-called “LOHAS” (Lifestyles of Health and Sustainability) in industrial countries. Some green start-ups, however, target consumer groups in developing countries and emerging economies as the need for sustainable solutions may be particularly urgent there (Panapanaan, Bruce, Virkki-Hatakka, & Linnanen, 2014; Prahalad & Hammond, 2002).
- Many green start-ups are **highly innovative**: Green start-ups more often develop radical new solutions, while incumbent companies are more likely to develop incremental eco-innovation (Fichter & Weiß, 2013). Radical market change may, however, require a substantially longer time-frame both in terms of research and development as well as market breakthrough (Freimann, 2005; Linnanen, 2002).

- The **motivation** of the entrepreneurs in green start-ups sometimes is sustainability-related (Bocken, 2015; Parrish, 2010; Patzelt & Shepherd, 2011; Schaltegger & Wagner, 2011). Others are “unintentionally green” start-ups where the environmental benefit is more of a side-product and not a goal in itself (see (Bergset & Fichter, 2015)).
- Some entrepreneurs in green-start-ups have been observed to **lack a business education** (Choi & Gray, 2008; Nicholls & Pharoah, 2008).
- Some green start-ups are **regionally or locally oriented** in terms of market strategy (Frederking, 2011; Vickers & Lyon, 2012).
- A range of green start-ups are observed as being wary of **company growth** as they fear having to compromise on company sustainability issues (Howard & Jaffee, 2013; Parrish, 2010; Vickers & Lyon, 2012), product quality (Hockerts & Wüstenhagen, 2010) or even potentially diminishing product exclusivity (Petersen, 2003). Others may embrace micro-economic growth as a strategy for more sustainable macro-economic growth (see (Bergset & Fichter, 2015)).
- **Yielding company control and allowing external influence** may for some green start-ups, particularly those that are sustainability-driven, lead to “mission drift” (see (Bergset & Fichter, 2015)). On the other end, however, sustainability-oriented start-ups are noted to integrate stakeholder concerns and include a broad range of decision-makers (Ridley-Duff, 2009). Green start-ups are also observed to engage in collective action with other companies and organisations, due to their social orientation or in order to overcome resource constraints within the company (Pinkse & Groot, 2015).
- Green start-ups may engage in **institutional entrepreneurship** in order to overcome barriers in the regulatory or market environment (Dean & McMullen, 2007; Pinkse & Groot, 2015).

These characteristics of green start-ups may lead to challenges (and opportunities) in accessing finance with regard to level of profitability, time-horizon of investment as well as risk levels.

3.1.2 Existing Empirical Evidence

Existing empirical evidence found was primarily anecdotal or qualitative in nature. Some key findings in the literature on sustainable entrepreneurship, environmental entrepreneurship and social entrepreneurship include the following.

3.1.2.1 Evidence from Sustainable Entrepreneurship Research

The issue of entrepreneurial finance has yet to receive substantial attention in sustainable entrepreneurship research (Bergset & Fichter, 2015; Moore, Westley, & Brodhead, 2012) and the literature here is only starting to evolve (Bocken, 2015). Some issues that have been pointed out are the following:

- Sustainable venture capitalists have been observed to bring together profit-orientation with a triple bottom line and have thus been coined “**pragmatic idealists**” (Bocken, 2015).
- Sustainable venture capitalists offer their investees both sustainability-related **business advice and networks**, in addition to money (Bocken, 2015).

- Green start-ups may have some added **opportunities** in sustainable venture capital, as some of these investors specifically wish to invest where there is an investment gap (Bocken, 2015).

3.1.2.2 Evidence from Environmental Entrepreneurship Research

In research on environmental entrepreneurship, there has been more exploration of financial issues, even if the focus is also fairly narrow, i.e. primarily dealing with Cleantech and venture capital (Bocken, 2015; Bürer & Wüstenhagen, 2009; Caprotti, 2012; Ghosh & Nanda, 2010; Hargadon & Kenney, 2011; O'Rourke, 2005; Randjelovic, O'Rourke, & Orsato, 2003; Wüstenhagen & Teppo, 2004):

- In an early study, it was estimated that 45 (or 4.5% of all) **venture capital firms** had a focus on green start-ups, that their investment horizons were longer than that of conventional VC firms, that their investment sums on average were much smaller than that of conventional VC firms' (\$1.1 million vs. \$120 million) and that these funds raised their money from high net worth individuals and not pension funds and banks, which are typically involved in conventional VC funds (Randjelovic et al., 2003).
- **Longer investment horizons** have been found to be necessary for a range of green start-ups due to their generally long development periods (Ghosh & Nanda, 2010; Hargadon & Kenney, 2011; Randjelovic et al., 2003; Wüstenhagen & Teppo, 2004).
- Green start-ups have been found to write "**bad**" **business plans** due to an excessive focus on environmental issues over financial issues (Randjelovic et al., 2003).
- Especially the area of renewable energy technology, the **risk** involved is considered to be substantial and manifold: technology risks, exit risk, regulatory risk and "people risk" (due to a green image of the entrepreneurs) are emphasised in one study (Wüstenhagen & Teppo, 2004).
- The role of **specialised intermediaries** who can mitigate information asymmetries between investors and renewable energy start-ups in order to help overcome such risks is considered to be important (Ghosh & Nanda, 2010; Wüstenhagen & Teppo, 2004).
- **Higher investment sums** are needed at early stages for companies developing environmental technologies (Ghosh & Nanda, 2010).

3.1.2.3 Evidence from Social Entrepreneurship Research

While in social entrepreneurship research the focus lies primarily on start-ups that are sustainability-oriented social businesses without any expected profits (Achleitner, Pöllath, & Stahl, 2007; John, 2007; Nicholls & Paton, 2009; Nicholls & Pharoah, 2008), some of the findings might still be relevant for some green start-ups:

- Social businesses in the start-up phase are particularly affected by a financial gap due to their sustainability-orientation, small-scale operations and a fear of debt (Nicholls & Pharoah, 2008). Investors thus consider such companies to **lack "investment readiness"**.
- Social entrepreneurs tend to use credit cards for financing (Nicholls & Pharoah, 2008), i.e. engage in **bootstrapping** (Bhide, 1991).

- For social businesses there seems to be a **gap in intermediation**, i.e. matching supply with demand (Nicholls & Pharoah, 2008), the role of which is also emphasised elsewhere (Emerson & Spitzer, 2007).

3.1.3 Hypotheses Developed

Based on the above literature, the following hypotheses were developed for use in the survey:

- Overall challenge in accessing finance or funding
 - **Hypothesis 1:** Start-ups providing green products/services are likely to have more challenges in accessing finance than other start-ups
- Impact of level of technology
 - **Hypothesis 2:** Green start-ups with their own research and development (R&D) are likely to have more challenges in accessing finance than green start-ups with no own R&D.
- Impact of level of innovation (eco-innovation)
 - **Hypothesis 3.1:** Green start-ups that develop products or services with a high degree of novelty have more challenges in accessing finance than green start-ups with a low degree of product/service novelty.
 - **Hypothesis 3.2:** Green start-ups that develop products or services, which have a high potential to change the market, will experience more challenges in access to finance than green start-ups with products/services with a low potential to change the market.
 - **Hypothesis 3.3:** Green start-ups that offer products or services that require a long development time-frame have more challenges in access to finance than green start-ups that have shorter development time-frame.
- Impact of business background of the entrepreneur or entrepreneurial team
 - **Hypothesis 4.1:** Green start-ups, in which no member of the entrepreneurial team has a business education, will have more challenges in accessing finance than green start-ups, in which at least one member of the entrepreneurial team has a business education.
 - **Hypothesis 4.2:** Green start-ups, in which no member of the entrepreneurial team has substantial business experience, will have more challenges in accessing finance than green start-ups, in which at least one member of the entrepreneurial team has substantial business experience.
- Use of alternative investment sources
 - **Hypothesis 5.1:** Green start-ups are more likely to use “alternative” sources of funding such as their own, family and friends’ money than non-green start-ups.
 - **Hypothesis 5.2:** Green start-ups are more likely to use bootstrapping methods than non-green start-ups.

3.2 Exploratory Interviews

Here the key results from the interviews are presented. For more comprehensive results, see also Appendix 3 (Bergset, 2014).

3.2.1 Usage of Financial Instruments and Public Funding Programmes

One of the most striking results from the 24 interviews carried out in the three countries, was the diversity of financial sources used in the early phases of company development (i.e. pre-seed and seed stages) compared to that of the start-up stage and the expansion stage. While this result might be due to the interview limitation of only including companies up to 8 years of age (most of whom in this case had not reached the expansion stage (Kollmann, 2005)), it might also be an indication of a higher level of “creativity” in financial sourcing in early company stages. Manifestations of this creativity include the foundation of a cooperative for investment purposes and the use of paid parental leave for the start-up development. The prevalent use of the founders’ own funds is observed in personal loans, the use of exit money from earlier companies of the entrepreneurs, working without salary and the cross-subsidisation of the company by working other jobs parallel to the start-up activities.

Some of the main findings in usage of financial sources in the three countries were:

- A majority uses public funding earmarked for innovation and business development.
- The most prevalent private source of funding is business angels.
- The use of bank loans was not too common: Only three out of 24 companies had been able to access debt funding by the help of guarantees issued by public funding institutions or due to long-term personal contact with the bank in question as well as due to contacts arising from a business plan competition.
- The use of public-private partnerships (PPP) was mentioned frequently; it was however also often mentioned to fall through due to a lack of private commitment (no private matching found in time).
- The availability of sustainability-oriented investment or impact investment for start-ups seems to be rather limited still (only small sums on an individual basis and in total the volumes estimated to be rather small). A few companies (3 German and 1 Swedish) mentioned having received money from “sustainability-oriented” investors (from a business angel with renewable energy experience, a venture capital provider with a strict Cleantech portfolio and two family offices).

3.2.2 Challenges in Financial Access

There was a broad variety of challenges in access to finance that were mentioned by the green start-ups in the interviews. Many of them are such that also other start-ups without environmentally friendly products or services have also been observed in the literature to experience. The ones that were mentioned by most start-ups include: long / complex application processes for public funding (29%), difficult access to public money due to (private) matching need (25%) and companies having a longer time-horizon than investors (25%).

The interviewer did not specifically divide types of challenges into general and sustainability-related ones in the interviews, but still some issues mentioned were quite clearly sustainability-related aspects. These included for instance hindering / uncertain regulation (e.g. related to renewable energy policy) and the importance to some entrepreneurs of investors having similar moral values. Some companies seemed to be more affected by such sustainability-related challenges, but on the whole as many as 10 of 24 companies (42%) were affected by at least one challenge related to the sustainability of their company or product/service. A main concern amongst the entrepreneurs, which was formulated in a range of ways, was the lacking investor knowledge about and understanding of sustainability-related issues that in the case of green start-ups might have an impact on product development, market issues or the business model. The entrepreneurs maintained that investors did not understand the type of business they were doing or their choice of legal form, that investors' lack of knowledge arises due to inexistent or few established benchmarks for sustainable services and that investors were sceptical that customers will pay for "green solutions". One interviewee whose company at the time of the interview struggled with their choice of a particularly sustainable legal form of company (a mutual insurance company, which is owned fully by its policyholders) as investors had no understanding for it, a year later admitted that they had had to change their legal form to the more standard German AG in order to get investors on board. It is furthermore possible that reasons listed as "general" reasons (i.e. reasons relevant for all start-ups) might be to a larger or lesser extent sustainability-related (e.g. a long time-horizon could arise due to the development of a radical sustainable innovation).

3.3 Survey

Here the key results from the survey are presented. For more comprehensive results, see also Bergset (forthcoming).

3.3.1 Usage of Financial Instruments and Public Funding Programmes

The survey, certainly due to both its larger participant size and random sample, yielded rather different results with regard to the types of investment instruments and financial sources used in the companies. Also, compared to the interviews carried out, where most companies were in the seed and start-up phases, the majority (77.8%) of the green survey participants identified themselves as already being in the expansion phase. In the survey, due to the broad sample selection, the results from the green start-up participants could be compared to that of a control group of non-green start-ups.

Similarly to the results from the interviews, a strong spread in types of financial instruments used can be observed in the survey. Although there are some substantial differences, most green start-ups get their private financial resources from the same five sources: secured loans (46.3%), overdraft credit (50.9%), family and friends (33.3%), supplier credit (31.4%) and "other" private equity (excluding VC, Business Angels, IPOs/share issue) (15.4%). In the non-green control group, these are also the largest sources. There are, however, some differences worth noting upon: Green start-ups statistically significantly more often use IPOs and share issues as well as private incubators as money sources. In terms of bootstrapping, 50.9% of green start-ups use overdraft credit compared to only 33.3% of the non-

green companies and 31.4% of green start-ups use supplier credit compared to only 18.7% of the non-green start-ups. An aggregated analysis of debt and equity instruments showed no significant differences in usage, even if the green start-ups to larger extent (64.8%) use debt instruments than non-green start-ups (55%) do. Compared to the results in the interviews, many green start-ups in the survey have used bank loans, which might be related to the fact that a majority of the green survey participants had reached the expansion phase, which few of the interviewees had.

On the public side, there is slightly more diversity in the use intensity of the main funding sources between non-green and green start-ups. Here, the five most used sources of green start-ups are: public loans (25.9%), credit guarantees (24.1%), employment grant for staff (22.6%), employment office funding (20.8%) and business development funding (18.5%). Non-green start-ups, on the other hand, use start-up stipends for founders more frequently and less often seek business development funding. Indeed, green start-ups statistically significantly more often use business development funding and credit guarantees. In terms of the public levels approached, green start-ups use regional public funding statistically significantly more often than non-green start-ups. An aggregated analysis of public funding programmes revealed no significant differences in usage, even though the green start-ups to larger extent (67.3%) use public funding than non-green start-ups (52.8%) do.

In the survey, the start-ups were asked which primary types of sources they used at what stage (company internal funds, company external funds and the founders' own funds). In terms of usage of the founders' own funds, 43.5% of green start-ups use these financial means in the expansion stage compared to 25.1% of non-green start-ups, which is statistically significantly more often. At the seed and start-up stages there are no significant differences between the two groups.

3.3.2 Challenges in Financial Access

3.3.2.1 Results

Whereas in the interviews only the barriers or challenges that the interviewees mentioned themselves could be analysed, in the survey different characteristics could be analysed in combination with the participants' indications of difficulties or rejection from investors or funders. Hypotheses on challenges (which was operationalised using "difficulties" and "rejection" as specific survey items) and their potential connection to specific company and entrepreneurial characteristics such as level of technology ("R&D intensity"), eco-innovativeness ("product/service novelty" and "potential to change the market") and business background as well as a range of specifically sustainability-related characteristics were thus developed and tested.

The main findings with regard to difficulties in financial access and rejection from investors/funders are briefly explored here:

- **Overall challenges** (Hypothesis 1): Green start-ups overall were found neither to have more difficulties in accessing finance nor to be rejected more often than their control group "non-green" start-ups.
- **National differences:** At the national levels there are some differences: In Sweden and Germany, green start-ups surprisingly seem to struggle *less* than non-green start-ups; while in Finland it is

as theorised green start-ups that experience more difficulties and rejection across the board (the differences at the national level are not statistically significant, however).

- **Expansion stage:** There is one especially noteworthy result when looking at specific stages: at the expansion stage, 42.9% of the green start-ups indicated they experience “very big difficulties”, while only 29.7% of the non-green start-ups said the same.
- **Technology level** (Hypothesis 2): The green start-ups *significantly* more often (42.3%) carry out their own research and development (R&D) than the non-green start-ups in the sample (28.1%). While both in the green and the non-green group, the survey participants more often experienced difficulty in accessing finance at at least one stage if they were carrying out their own R&D, the difference was bigger in size and statistical strength for the green start-ups.
- **Innovativeness** (Hypothesis 3): The green start-ups in the survey indicated more often that the novelty level of their products/services is high (53% vs. 39.5%) and that the products/services have a large potential to change the market (57.7% vs. 43.1%) compared to the non-green start-ups. For the item “product/service novelty”, there were *significant* differences between degree of novelty and difficulties in financial access for both green (at the expansion stage) and non-green companies (for several stages). The difference established was, however, larger and statistically stronger for the green start-ups. Interestingly, while there were *significant* differences between the item “potential to change the market” and difficulties in financial access for green start-ups at the expansion stage, none such finding could be established for the non-green control group.
- **Business background** (Hypothesis 4): For the item “business education”, there is *statistically significant* support at the expansion stage, where fewer green start-ups including founding members with business education experience “moderate to very high difficulties” (38.5%) than those green start-ups that have no founder members with a business education (80%). As a comparison, no significant differences were found for the control group of non-green start-ups.
- **Alternative investment sources** (Hypothesis 5): Interestingly, while green start-ups use the founder’s own funds more often, it is only for non-green start-ups that difficulties in financial access correlate significantly with the use of such funds. As explored above, green start-ups also significantly more often use bootstrapping instruments such as overdraft credit and supplier credit compared to non-green start-ups.
- For the **sustainability-related characteristics** (e.g. use of environmental labels and certification, reluctance to grow, local/regional orientation and use of collective action), there were not many significant results linked to challenges in financial access. This, however, does not rule out that there might be a joint effect (i.e. on an overall sustainability “dimension” and not on the specific items), which warrants further research in this area.
- The six most mentioned **reasons for rejection** among the green start-ups that had been rejected were: “risk considered too high” (19%), “collateral lacking” (18.8%), “sustainability unfamiliarity of investor/funder” (17%), profit prospect low/uncertain (15.2%), funding criteria of investor/funder (15%) and “sector unfamiliarity of investor/funder” (13.2%).

3.3.2.2 Interpretation

The general results on difficulties and rejection comparing green start-ups as an overall group with non-green start-ups as a control group (for hypothesis 1) make it clear that green start-ups also are a composite group of different types of start-ups that need more detailed analysis. That said, the gaps found in the empirical research done in WP6 of SHIFT to a large extent correspond to gaps observed in the literature on entrepreneurial finance in eco-innovative start-ups (see literature review above), e.g. use of bootstrapping instruments (Nicholls & Pharoah, 2008) or the lack of a business education (Choi & Gray, 2008; Nicholls & Pharoah, 2008). While not all green start-ups in the survey are highly innovative companies, they were significantly more often innovative than their non-green counterparts in the control group. This suggests that the findings on challenges in financial access linked to innovation and high levels of technology are particularly relevant to green start-ups.

Particularly the expansion phase stands out in the survey results as one in which challenges arise particularly for green start-ups: here many green start-ups – 42.9% – indicate that they experience “very big difficulties” in access to finance, while only 29.7% of the non-green start-ups do. The expansion phase also stands out in much of the further analysis carried out.

The result that green start-ups significantly more often use their founders’ own funds in the expansion phase (and that this is not significantly linked to rejection or difficulties at this stage) as well as bootstrapping instruments generally, suggests that some green start-ups might be wary of external involvement from investors who often require decision-making powers in return for investment at this stage.

While almost half of all companies in the interviews mentioned investment barriers related to the sustainability of their company and many the incomprehension of investors for such aspects, 17% of all rejected green companies in the survey mention that a reason for the rejection was that the investor/funder was unable to evaluate the market potential of their sustainability-related product/service or business model. This suggests that many investors and public funders are still not able to assess the relevance of sustainability-related issues in the market context and that there is a gap in knowledge as well as a lack of money. For green start-ups involved in radical innovation this difficulty of convincing investors/funders may be exacerbated due to the inclusion of further business aspects for which no market benchmarks exist.

3.4 Expert Workshop

The results from the expert workshop (with a particular focus on Germany) are comprehensively documented in a separate document, which can be read in Appendix 4 of this report. Here parts of the discussion are presented that are particularly relevant for the results from the exploratory interviews and the survey. In addition, 11 propositions based on the discussion have been developed and are presented here.

3.4.1 Discussion of the Empirical Results with the Supply Side

By presenting the supply-side, investors and intermediaries, with the results of the demand-side interviews and surveys, it was possible to some extent to distinguish whether the gaps observed were

rather perceived or real. The need to further categorise types of green start-ups, which was mentioned several times in the workshop, was also made apparent by the results of the survey. While there was some disagreement with regard to specific challenges for green start-ups, the BVK presentation about difficulties for innovative and expansion phase funding correspond to findings of the survey. The finding in the survey that green start-ups' teams often lack a business background was acknowledged and verified by the participants of the workshop. In this context, the need to make green start-ups "investment ready" was maintained. Similarly, there was an acknowledgement of investors' lack of information and knowledge about green business models. It was argued that more information should be made available in order to enable better investor assessment in this area. However, there was a level of disagreement regarding the existence of investors who might be willing to forego some profits in order to achieve societal impact. One intermediary also mentioned the different "languages" spoken by investors and start-ups and the challenge in overcoming this linguistic gap. Finally, the need for optimised and adapted matching seemed to be a consensus in the group.

3.4.2 11 Key Propositions Resulting from the Workshop

- (1) There is disagreement regarding the existence of particular challenges in financial access for green start-ups. It is nonetheless maintained that certain **characteristics** – such as a sustainability-orientation, a high level of innovativeness and a high level of technology – can lead to a large amount of barriers and challenges in early stage finance for such companies.
- (2) As early stage finance in the green economy impacts both potentially highly profitable Cleantech companies as well as social businesses and social entrepreneurs, a clear differentiation of the **different types of start-ups** and investors is helpful for an optimised matching of green start-ups with investors. It should, however, be noted that "mission-driven" does not mean incompatibility with market activity.
- (3) **ESG (Environment, Social & Governance) issues** play a growing role for investors. Even if sustainability-oriented investors still play a relatively limited role in early stage company finance, it can be assumed that sustainability criteria will become increasingly important also for early stage investors in general due to current societal developments and trends (climate change policies, energy transitions etc.).
- (4) Venture capital is relatively limited in Germany. Early stage investment is thus a general challenge – not only for green start-ups. **Private capital**, which is abundantly available in Germany, should therefore, if need be with public support, be mobilised for risk capital.
- (5) It would be sensible to consider the lifelong **investment cycle** of companies as a whole and build a network, which helps facilitate and enable exit strategies and future investment rounds from early stage to more mature company stages.
- (6) In order to strengthen the investment culture in Germany it might be sensible to encourage the current trend of foreign investors' activity in early stage investment in Germany. Such a strategy would also benefit green start-ups. A **pan-European strategy** (such as e.g. INNEON) might be particularly advantageous.

- (7) Patience is necessary in the financing of many green start-ups: „Patient capital” – a more **long-term oriented investment strategy** – is thus necessary.
- (8) Investors who are interested in green business models should be sensitised to the relevance of sustainability issues for the investment. Green start-ups, on the other hand, should be offered adapted “**investment readiness**” programmes to help them prepare for investor interaction.
- (9) Specialised investor networks and pioneer investors could act as **role models** in start-up investment in the Green Economy and could thus help mobilise other interested investors.
- (10) Radical innovation with high capital demands and regulatory barriers might benefit from the development of **innovation parks with infrastructure for testing and experimentation** as well as regulatory exemptions and special provisions at the early stages.
- (11) More **research** and diffusion of knowledge is needed in the field of early stage finance for the Green Economy, both in terms of quantitative data as well as more qualitative success stories and best practice.

4 Recommendations

It cannot be said that green start-ups as an overall category generally struggle more with access to finance than non-green start-ups. This kind of distinction is too coarse to capture any of the specifics of green start-up finance. So while there might be more market failure facing green start-ups (Bergset, 2015; Di Domenico et al., 2010; Patzelt & Shepherd, 2011; York & Venkataraman, 2010), there might also be specific financial opportunities that exist for such start-ups. The empirical analysis, however, pinpointed certain types of green start-ups and stages that were of particular relevance for the issue of challenges in financial access. One stage of company development that seems to be quite challenging on an overall basis is the expansion phase, which was observed at many levels of the analysis. Furthermore, the survey found that green start-ups are on average more technology-based and innovative than non-green start-ups and that these green start-ups experience particular difficulties when seeking to finance themselves. There is also evidence to suggest that (at least some) green start-ups struggle with particular challenges linked to the sustainability of their companies.

4.1 Recommendations for Investors and Financial Institutions

- As most green start-ups approach “normal” investors and not sustainability-oriented ones, investors and financial institutions might wish to **provide training and information** to their employees on how to adequately assess “green” business models, products and services. A way of mainstreaming this strategy is to develop clear and simple evaluation criteria and key performance indicators for sustainable, green start-ups. Investors and financial institutions might also choose to draw on external expertise to cover any knowledge gaps they might have in this area. Especially banks should consider this an area in need of improvement, as the reliance of green start-ups on banks in the European context can be observed to be high.

4.2 Recommendations for Policy and Public Funding Institutions

- There is evidence that particular challenges in financial access arises for **high-tech, innovative green start-ups** and especially at the expansion phase. This suggests a particular area of concern for policy and could be an area where public funding programmes could be used to target green start-ups where it matters most.
- Radical innovation with high capital demands and regulatory barriers might benefit from the development of innovation parks with infrastructure for testing and experimentation as well as **regulatory exemptions and special provisions** at the early stages.
- The finding that green start-ups significantly more often use their founders’ own funds in the expansion phase (and that this is not significantly linked to rejection or difficulties at this stage) as well as bootstrapping instruments (supplier credit and overdraft credit) generally, suggests that some green start-ups might be wary of external involvement from investors who often require decision-making powers in return for investment. This also suggests that public funding programmes are needed at the **expansion phase** where higher capital demands arise and the use of bootstrapping is likely to be inefficient due to its related potentially high capital costs.

- Public-private partnership (PPP) funding seems to be quite common in all three countries. It, however, also often falls through due to only public and no private commitment (i.e. no private matching found in time). Here, it might be sensible to reduce **bureaucratic requirements** to a necessary minimum and to provide support to start-ups in finding suitable investors.
- It may be a question of public interest and prioritisation to further support green start-ups in their search for money. In order to **steer more funds in the direction of green start-ups**, one option is to increase interest for entrepreneurial finance among sustainability-oriented investors (e.g. high net worth individuals and institutional investors such as pension funds or insurance companies), while another option would be to increase interest for sustainability-oriented investments among early phase investors (conventional VC firms or business angels). Here, potential incentives could be provided in tax alleviations or guarantee instruments by introducing appropriate policies. This public support should, however, be linked to clear criteria for what constitutes as “green start-up investment”. It should also develop clear and simple evaluation criteria and key performance indicators for sustainable start-ups.
- As “alternative” sources of finance seem to be particularly important to a range of green start-ups, crowdfunding might be an option that may become increasingly important. It mobilises money, which otherwise would not be invested in start-ups and it “democratizes access to capital markets” (Rubinton, 2011, 12) making it particularly sustainability-compatible. Here, it is imperative that financial policies support and do **not hinder such small-scale investments** – a role that also needs explicit examination.

4.3 Recommendations for Intermediaries

While the survey and interviews did not explicitly ask the start-ups about the role of intermediaries for accessing financial resources, the above discussion make it clear that their role might be quite central to overcoming a range of challenges found. There is potential for increased intermediary activity in the following areas:

- Founder teams in green start-ups that lack **business education and training** are more likely to struggle in their search for finance. Intermediaries could help green start-ups by ensuring they include all relevant expertise in the founder team, e.g. by recruiting additional founders or employees. Intermediaries could also provide the needed business training, which would ease the start-up’ relations and negotiations with investors.
- There seems to be a need for **adapted matching** between green start-ups and suitable investors in those cases where there are sustainability-related reasons for challenges. Intermediaries could provide such improved matching between demand and supply by taking specific characteristics of green start-ups and their business models into consideration.
- In those situations where substantial sums of money are required at early stages of company development, intermediaries may act as multipliers by organising **syndication** across large investors or several funds. Not only can larger sums be achieved in this manner, risk can also be spread and portfolio effects attained for the investors involved. One way of organising such syndication

is by developing **networks**, such as are seen primarily in the US in this area (e.g. Investors' Circle, Nexus or CREO).

4.4 Recommendations for Future Research

More research and diffusion of knowledge is needed in the field of early stage finance for the Green Economy, both in terms of quantitative data as well as more qualitative success stories and best practice.

- For future research a specific focus on **individual sectors** may help tease out in-depth knowledge on more specific investment challenges. A further deepening of the analysis could also involve a **specific country analysis** including the individual innovation systems (i.e. external factors like regulation, sectoral issues and the national financial market itself). Although the three countries here are deemed similar in terms of innovativeness and regulatory environments, there were some indications that the level of challenges may differ in the three countries. Furthermore, it must be noted that the countries examined are among the most eco-innovative countries in the world and certainly in Europe (see e.g. the Eco-Innovation Observatory). It would therefore be sensible to replicate the survey in other European countries or countries around the world that have not come quite so far in environmental protection and eco-innovation.
- Due to the difficulties in self-assessing challenges and difficulties at different stages for the entrepreneurs, in future research it might be an option to track the different stages of company development and related funding/financing in **qualitative research** by triangulating entrepreneurial statements with different other sources.
- **The use of the founders' own funds and bootstrapping** in green start-ups are worth focussing further analytical attention on in order to determine the underlying reasons for these strategies.
- Finally, the **impact of sustainability-orientation of entrepreneurs** in green start-ups on access to finance is worth an in-depth study of its own.

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Appendices

1. Article Bergset & Fichter (2015)
2. Article Bergset (2015)
3. Conference Paper Bergset (2014)
4. SHIFT Workshop with Investors, Intermediaries and Start-ups in Berlin

Green start-ups – a new typology for sustainable entrepreneurship and innovation research

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Abstract. There is a growing political consensus about the necessity to decouple economic growth from environmental impacts. For a transition towards a green economy radical innovation plays a central role. Start-ups are key market actors in the development and market introduction of radical sustainable innovation, but so far there is little research on the specific challenges and opportunities of green start-ups. In this conceptual paper, we bring together research and theory on entrepreneurship and innovation as well as sustainable business practice and ask why and how different types of green start-ups may encounter specific financing challenges and opportunities when developing their products/services. As existing typologies are too unspecific to properly explain the financing challenges and opportunities of green start-ups, we elaborate on these and develop a new typology of green start-ups. This typology will enable further empirical exploration of specific challenges and opportunities that such start-ups have when looking for finance.

Keywords. Sustainable Innovation, Sustainable Entrepreneurship, Green Start-ups, Typology, Entrepreneur, Strategy, Green Products and Services, Finance.

1 Introduction

There is growing political consensus about the necessity to green the economy and to decouple economic growth from environmental impacts (OECD, 2011). A greening of the economy requires a strategy for sustainable transitions and fundamental changes in production and consumption patterns (UNEP, 2011). One key element in the facilitation and management of the multilevel challenge of sustainable transitions (Geels, 2010a) is the development, implementation, and diffusion of radically new or significantly improved products (goods or services), processes, or practices, which reduce the use of natural resources and decrease the release of harmful substances across the whole life cycle (EIO, 2013, p. 2). Thus, sustainable innovation and its diffusion are considered to be a key in any strategy for a societal transformation process toward sustainable development and a green economy.

Recent empirical results underline the necessity to make a distinction regarding the type of organisation that develops and implements sustainable product or service innovations: Start-ups and new companies are evidently the key market actors in the development and market introduction of radical sustainable innovation, while incremental innovation tends more to be the turf of established companies (Fichter and Weiß, 2013). From this it can be inferred that “green” start-ups, which develop and implement products or services that contribute to the goals of a green economy (reducing greenhouse gas emissions, improving energy efficiency, adopting a circular economy approach etc.), should be a major

concern in innovation and environmental policy. But so far rather little is known about the specific challenges green start-ups are facing. Especially the financing of green start-ups could be substantially different from the financing of more conventional start-ups (cf. Shepherd and Patzelt, 2011). There have been calls for more research in this area (Shepherd and Patzelt, 2011; Nicholls and Pharoah, 2008).

Further research exploring the specific financing challenges and opportunities of green start-ups needs to take into account that entrepreneurs, product and services and market and institutional environments are very diverse. The diversity of start-ups and operating environments has an influence on the type and degree of financing challenges and opportunities experienced. For this reason, it is essential to base further empirical investigations on a sound typology of green start-ups, which allows a proper description and explanation of financing challenges and opportunities.

Against this backdrop, the purpose of this paper is to investigate existing typologies of sustainable entrepreneurship, to analyse the extent to which they are suited to serve as a foundation for empirical research on financial challenges in green start-ups and – if not entirely suitable – to develop an appropriate typology. Building on a typology framework, we can more accurately and explicitly explore the potential impact of individual characteristics on specific challenges and opportunities that such start-ups have in an everyday business context and especially when it comes to looking for finance. The aim of this conceptual paper is thus to provide a foundation for future empirical work in such specific contexts.

2 Literature review

2.1 Sustainable innovation

Sustainability-related innovation and technology studies have received increasing attention over the past 10 to 15 years (Markard et al., 2012, p. 955). The importance of sustainable innovation management is described as growing both in practice and in academia (Schiederig et al., 2012). What exactly is meant by “sustainable innovation”? Numerous terms to describe similar phenomena have been used widely in academia. The key terms used since the mid-1990s include “environmental innovation” and “eco-innovation” (Fussler, 1996; Rennings, 2000; Kemp and Pearson, 2007; OECD, 2009; Horbach et al., 2012), “sustainability innovation” (Fichter and Pfriem, 2007; Arnold and Hockerts, 2010), “sustainable innovation” (Wüstenhagen et al., 2008; Nill and Kemp, 2009; Hockerts and Wüstenhagen, 2010), “sustainability-oriented innovation” (Klewitz and Hansen, 2014), and “green innovation” (Schiederig et al., 2012). While a distinction between environmental and social issues related to innovation is often made, a clear line is rather difficult to draw. A recent analysis of 8,516 journal publications shows that “40.7% (3,469) apply the notion ‘environmental innovation’, 31.9% (2,716) the notion ‘sustainable innovation’, 17.6% (1,495) ‘eco-innovation’ and 9.8% (836) the notion ‘green innovation’. It appears that more than 80% of the publications use only one notion, indicating that the notions are used consistently within individual publications” (Schiederig et al., 2012, p. 183). The analysis further shows that three different concepts of green, ecological, and environmental innovation are used largely synonymously, while the notion of sustainable innovation broadens the concept and includes a social dimension.

There has been a rich debate in the economic literature about the distinctive features of environmental innovation and eco-innovation as opposed to general innovation (Rennings, 2000). One of the most referenced definitions is provided by Kemp and Pearson (2007, p. 7): "Eco-innovation is the production, application or exploitation of a good, service, production process, organizational structure, or management or business method that is novel to the firm or user and which results, throughout its life cycle, in a reduction of environmental risk, pollution and the negative impacts of resource use (including energy use) compared to relevant alternatives". The EU-funded Eco-Innovation Observatory (EIO) describes eco-innovation as "any innovation that reduces the use of natural resources and decreases the release of harmful substances across the whole life-cycle" (EIO, 2013, p. 10). This relatively broad definition builds on a dominant understanding of innovation and further emphasises types of inputs, outputs and full life-cycle impact as the key indicators of eco-innovation. Concepts of sustainable or sustainability innovation include these environmental aspects as a key feature, but also explicitly claim that radically new or significantly improved products (goods or services), processes or practices contribute to economic and social goals of sustainable development (Wüstenhagen et al., 2008). Rather than just focusing on short-term profits, stakeholders expect firms to meet a triple bottom line of economic, environmental, and social value creation (Elkington, 1999; Schaltegger and Wagner, 2011). Building on then existing literature, Fichter (2005) defines sustainable innovation as "the development and implementation of a radically new or significantly improved technical, organisational, business-related, institutional or social solution that meets a triple bottom line of economic, environmental and social value creation. Sustainable innovation contributes to production and consumption patterns that secure human activity within the earth's carrying capacities" (Fichter, 2005, p. 138, authors' translation). In this paper, we will adopt this concept of "sustainable innovation." Examples of existing sustainable innovation include organic and fair food production, electric and shared mobility, sustainable fashion, renewable energy technology, energy-efficient "smart homes" and eco-tourism.

2.2 Sustainable entrepreneurship

Sustainable entrepreneurship is "[...] an innovative, market-oriented and personality driven form of creating economic and societal value by means of break-through environmentally or socially beneficial market or institutional innovations" (Schaltegger and Wagner, 2011). It creates economic value through market activity and societal value through positive externalities or a reduction of negative externalities. Unlike public, charitable or NGO activity with a societal impact, sustainable entrepreneurship – as it takes place in a business context – needs to be financially self-sustaining in the middle to long-term (cf. Shepherd and Patzelt, 2011; Thompson et al., 2011).

Using the above definition of sustainable entrepreneurship as a starting point, it can be argued that research on it overlaps with a wide range of theory and research on sustainable business practises, such as e.g. environmental management, business ethics, stakeholder theory and CSR (Corporate Social Responsibility). The distinction of sustainable entrepreneurship from other similar types of entrepreneurship such as social entrepreneurship and environmental entrepreneurship (/ecopreneurship) is still an issue of contention (cf. Schaltegger and Wagner, 2011; Thompson et al., 2011). Here, we see sustainable entrepreneurship as a specific form of entrepreneurship that meets a triple bottom line of economic, environmental and social value creation by means of sustainable innovation.

Sustainable entrepreneurship is a relatively new research area within the larger field of

entrepreneurship research (Thompson et al., 2011; Cohen and Winn, 2007) and a great deal of research on it to date has been conceptual. Several studies attempt to define sustainable entrepreneurship (Schaltegger and Wagner, 2011; Shepherd and Patzelt, 2011; Thompson et al., 2011) or broaden the understanding of wealth creation (Di Domenico et al. 2010; Tilley and Young, 2009) and opportunity development (Doyle Corner and Ho, 2010). Others explore the entrepreneurial opportunities and challenges arising through the existence of externalities and market inefficiencies (Pacheco et al., 2010; Patzelt and Shepherd, 2011; York and Venkataraman, 2010; Cohen and Winn, 2007; Dean and McMullen, 2007) or evaluate the potential societal impact of the resulting innovation (Cohen et al., 2008; Schaltegger, 2002). A few studies focus on strategic issues, such as the entrepreneurial process (Belz and Binder, 2015), the competitive strategy of the entrepreneurs (Petersen, 2003) or the potential necessity of sustainable entrepreneurs to become institutional entrepreneurs in order to achieve their goals (Pinkse and Groot, 2013; Dean and McMullen, 2007). A range of studies look at the actors involved, focusing on the motivation or intention of the entrepreneurs (Kuckertz and Wagner, 2010; Parrish, 2010; Gray and Balmer, 2004; Schaltegger, 2002), the influences within the institutional context (Meek et al., 2010; Pacheco et al., 2010; O'Neill et al., 2009; Parrish and Foxon, 2009; Isaak, 1998) or the relationship between different actors, such as incumbents and start-ups (Hockerts and Wüstenhagen, 2010).

2.3 Green start-ups and their specific characteristics and challenges

Sustainable entrepreneurship can unfold in established companies (incumbents) as well as in emerging and young companies (start-ups). While well-established, incumbent firms often improve on radical innovation by investing in incremental innovation processes, radical innovation disproportionately often originates in smaller and entrepreneurial new firms (cf. Baumol 2010). Similar findings have also already been established for sustainable innovation (Fichter and Weiß, 2013), implying a stronger impact of start-ups in the transition towards a sustainable or green economy. In this article, we therefore focus specifically on green start-ups. They have to meet a triple bottom line; the focus of their business activity, though, is on products or services that have a positive environmental impact and contribute to the environmental goals of a Green Economy. That is why they are labelled “green”.

The “green” characteristics of start-ups may relate in particular to three aspects of their business:

- **Product-related characteristics** – Are the products (goods or services) of the start-up green or not? While researchers and practitioners like to speak of a “green” or “cleantech” sector (e.g. Eurostat 2009), we argue that green goods and services can be offered in most, if not all, sectors. Therefore it is sensible to look at the (potential) environmental impact of the products and analyse the extent of greenness based on these credentials. One sector classification that is helpful in this regard, is the “Environmental Goods and Services Sector” classification developed by the EU statistical office Eurostat (2009), which focuses both on end-of-pipe solutions (CEPA – classification of environmental protection activities) as well as resource management approaches (CReMA – classification of resource management activities). These classifications cover all business-related activities, which contribute to seven overarching environmental goals: renewable energy, energy efficiency, renewable resources, resource efficiency, circular economy, waste management, emission reduction and climate protection as well as biodiversity and ecosystems.

Product-related characteristics of the start-ups give an indication of how well these goals can be achieved.

- **Entrepreneur-related characteristics** – How do entrepreneurs contribute to the greenness of their start-ups' activities? Many authors in the sustainable entrepreneurship literature focus on the impact of the motivation (e.g. Gray and Balmer, 2004; Schlange, 2006; Schaltegger and Wagner, 2011), values (e.g. Parrish, 2010) and attitudes (e.g. Kuckertz and Wagner, 2010) of the entrepreneurs on sustainability-related issues in the company. Additionally, the technical, business-related and sustainability-related qualification and knowledge of the entrepreneur can be considered relevant (e.g. Choi and Gray 2008; Nicholls and Pharoah, 2008; Patzelt and Shepherd, 2011). These have an impact on how the start-up is run and developed over time.
- **Strategy-related characteristics** – How can strategy strengthen or weaken the sustainability of the company? While these characteristics are obviously linked to the entrepreneur, the start-up's strategy is decided by more factors than "just" the founder's values and wishes. Rather strategy is developed through continuous interaction between the founders and managers of a company and the external stakeholders, such as investors, suppliers and customers.

While their significance and impact have been identified, research has yet to explore the full range of potential additional challenges and new opportunities that green start-ups may experience compared to that of other start-ups and how these may impact their dealings with investors and other market actors such as customers, employees, suppliers, competitors, and support organisations. When start-ups develop green goods or services, they attempt to find market-based solutions to environmental problems that up to recently have been mainly considered the domain of politics and non-profit organisations (cf. York and Venkataraman, 2010), which may take considerable effort and time (Freimann, 2005). As the types of entrepreneurial motivation, knowledge and backgrounds observed are more diverse and often less business-oriented than in typical start-ups (e.g. Patzelt and Shepherd, 2011), they may have challenge looking for support and money from more conventionally business-minded actors (cf. Linnanen 2002). In company strategy, critical trade-offs may arise between the goals of environmental, social and economic sustainability within a triple-bottom-line – especially as external actors may interfere with sustainability-related strategic goals (Freimann et al. 2010).

Research on sustainable business often emphasises the existence of a business case for sustainable business practice (e.g. Schaltegger et al., 2012; York and Venkataraman, 2010; Porter and Kramer, 2006). Making this connection is helpful in overcoming the earlier existing dichotomy between economic (consumption oriented, individualist) and societal (collectivist) values (cf. Walley and Taylor, 2002). However, in order to assess potential challenges green start-ups experience in their day-to-day operations as well as strategic considerations, it is important also to be aware of difficulties in trade-offs and decision-making that might potentially arise from existing, dominating market structures and the sustainability-related aspects of entrepreneurship (cf. Shepherd and Patzelt 2011).

2.4 Financing green start-ups

Green start-ups like any other start-ups are dependent on adequate resource acquisition. Finance is characterised as a central aspect of entrepreneurial success (Schaper, 2002). Sufficient initial capital may provide start-ups with a buffer that enables them to over-

come low performance and liquidity difficulties in the early phases (Gimeno et al., 1997). Conversely, insufficient financial means have been cited as a main reason for the failure of start-ups in the first years of their existence (cf. Carter and Van Auken, 1990). There is a range of investment options involved in entrepreneurial finance that depend, amongst others, on stage of company development, size of investment and characteristics of the company. More “informal” sources of finance are found in business angels as well as friends and family of the entrepreneurs who invest at early stages and small-medium large sums of money (e.g. Börner, 2005; Brettel, 2005; Steier, 2003). Formal institutions such as banks and venture capital firms are among the most prominent sources at later stages and for larger sums (e.g. Börner, 2005; Kollmann, 2005). Entrepreneurs themselves often provide a substantial sum of the money needed for company development (cf. Bygrave and Quill, 2007; Bhide, 1992; Carter and Van Auken, 1990). Additionally, in the European context, public funding programmes for small, entrepreneurial companies are fairly widespread.

Green start-ups and sustainable entrepreneurs may be able to find some sources that target them specifically. These providers include “sustainable” business angels who invest in a value-oriented manner (cf. Brettel, 2005), green/social venture capital firms focussing specifically on cleantech or social innovation respectively (e.g. Randjelovic et al., 2003), venture philanthropists seeking to increase the societal impact of the entrepreneur (John, 2006; Nicholls and Paton, 2009), a handful of social banks (Weber, 2011; Cowton and Thompson, 2001) and microfinance as well as, more recently arising, crowdfunding platforms where informal investors invest for a range of reasons (cf. Lehner, 2012).

Any start-up may indeed experience difficulty initially when looking for money due to its lack of collateral/revenues, unknown/inexistent credit history and/or radical innovation with no market history or benchmark (cf. Starobom, 2013; Cosh et al., 2009; Kerr and Nanda, 2009; Megginson and Smart, 2006; von Nietzsche et al., 2005). However, a green start-up might experience further and other challenges due to their involvement in business activities where markets generally do not work well (Patzelt and Shepherd, 2011; Di Domenico et al., 2010; York and Venkataraman, 2010) and the attempted mobilisation of resources occurring in institutional environments that are not very supportive (Desa, 2012). Radical sustainable innovation can take considerable time and effort (cf. Freimann, 2005), which does not necessarily correspond well with expectations of short investment horizons (cf. Randjelovic et al., 2003). The potential conflict between short-term profits and a triple bottom line of economic, environmental, and social value creation may create difficulties related to entrepreneur-investor relations and a potential “mission-drift” of the company. Financing green start-ups may thus very well differ substantially from financing other start-ups (cf. Shepherd and Patzelt, 2011).

In research on sustainable entrepreneurship – including literature on social entrepreneurship and on environmental entrepreneurship – finance as a topic has thus far been explored fairly narrowly (cf. Moore et al., 2012). Existing research related to environmental entrepreneurship has looked primarily at cleantech companies with high capital demands (e.g. renewable energy technology) that are funded by venture capital funds (cf. Caprotti, 2011; Hargadon and Kenney, 2011; Bürer and Wüstenhagen, 2008; O’Rourke, 2005; Wüstenhagen and Teppo, 2006; Randjelovic et al., 2003). As opposed to research on environmental entrepreneurship, the variety of financial instruments assessed in research on social entrepreneurship is greater. However, demand-side focus lies mainly on social businesses (and social investors) that are “sustainability driven” and often have zero or negative expected returns (e.g. Nicholls and Paton, 2009; Achleitner et al., 2007; John,

2007), with some (partial) exceptions (McWade, 2012; Moore et al., 2012; Emerson and Spitzer, 2007). There have been calls for more research in this area (Shepherd and Patzelt, 2011; Nicholls and Pharoah, 2008).

2.5 Typologies in sustainable entrepreneurship research

There is a range of typologies distinguishing different types of sustainable entrepreneurship in the literature. We summarise a selection of these in Table 1. A typology must identify crucial characteristics relevant to the issue at hand - here challenges in financial access. The suitability of the typologies above therefore depends on their goal and usage. When the focus is, on the one hand, on sustainable entrepreneurship in start-ups and, on the other hand, on finance, there are two main characteristics that may be considered crucial in a typology: Societal impact and level of profitability. The typologies of Hockerts and Wüstenhagen (2010) as well as Isaak (1998) are somewhat limited in scope as they focus on a comparison of start-ups as one big group with established incumbents as another. The typology of Freimann et al. (2010) is similarly limited as only one of the groups involves start-ups with green products and services and the start-ups in the other two either focus on environmental management or have no environmental focus. While the typology of Zahra et al. (2009) is interesting in terms of the scope and level of societal impact it explores, they focus primarily on companies that are not-for-profit. The typology that Lepoutre et al. (2013) develop for a study on social entrepreneurship in the Global Entrepreneurship Monitor is also of interest. However, here the scope is not only on such companies that work in a market context, rather also such that are not and will not become financially self-sustaining. Their other types can be captured by the remaining typologies presented below.

This reduces the list of typologies to a smaller set of those focusing on core business in a market context, impact and level of profit-orientation (as estimated by type of motivation). Three of the listed typologies, which focus on environmental entrepreneurship, thus come closer than the others to describing the broader spectrum of sustainable entrepreneurship from less profit-oriented to more profit-oriented with lower to higher levels of societal impact. These typologies – Linnanen's (2002) typology for environmental entrepreneurs, Schaltegger's framework for ecopreneurship (2002) and Walley and Taylor's typology of green entrepreneurs (2002) – complement each other in describing types with different kinds of intention (profit/sustainability) driving the entrepreneurs as well as the market and societal impact their start-ups have.

Linnanen (2002) describes four types of environmental entrepreneurs across two dimensions (wish to change the world and desire to make money), which indicate motivation as well as intended societal impact: self-employers, non-profit businesses, opportunists and successful idealists. Schaltegger (2002) differentiates between three main types of entrepreneurial actors: alternative actors, bioneers and ecopreneurs. For Schaltegger, all of these actors have environmental performance as a core business goal and can thus be seen as sustainable entrepreneurs. Yet, he places a particular emphasis on the "substantial contribution" that is achieved through a "significant market influence", which can be measured by a large market share or an influence on competitors to take similar action: i.e. by ecopreneurs (Schaltegger, 2002). He does, however, make a point of the fluidity of boundaries between the different types of actors: alternative actors sometimes turn into bioneers with an interest in a higher turnover, and may bioneers increase their market share and turn into ecopreneurs. Walley and Taylor (2002), on the other hand, consider each contribution that different sustainable entrepreneurs make as equally worthy of anal-

ysis. They differentiate between four different types: innovative opportunists, visionary champions, ethical mavericks and ad hoc enviropreneurs.

Table 1. Characteristics of typologies in sustainable entrepreneurship literature

Author (year)	Main characteristics of typology	Typology (actor types)	Type of organisation	Central social unit	Main purpose of the typology
Isaak (1998) “green-green business”	Degree of environmental orientation of a company’s core business	-Green business -Green-green business	Start-ups and incumbents	Organisations	Development of strategies for promotion of ecopreneurship within private-sector initiatives
Linnanen (2002) “Environmental entrepreneurs”	Internal motivation: the desire to change the world and the desire to make money and grow the business	-Self-employer -Non-profit business -Opportunist -Successful idealist	Start-ups	Mixture of organisations and individuals	Unspecified
Schaltegger (2002) “Ecopreneurs”	Degree of environmental orientation of a company’s core business and the market impact of the company	-Alternative actors, -Bioneers, -Ecopreneurs	Unspecified	Individuals and their role in a company	Framework provides a reference for managers to introduce ecopreneurship
Walley and Taylor (2002) “Green entrepreneurs”	Internal motivation and external (hard and soft) structural influences	-Innovative opportunists, -Visionary champions, -Ethical mavericks, -Ad hoc enviropreneurs	Unspecified	Interrelation between persons and external structures	Contribute to further research into ways of fostering green entrepreneurship
Zahra et al. (2009) “Social entrepreneurs”	Type of market and societal impact	-Social bricoleur, -Social constructionist, -Social engineer	Unspecified	Individuals	Assess the level (local vs. global) and type of (small-scale, institutional, “revolutionary”) impact
Freimann et al. (2010) “Ecopreneurs”	Type and amount of environmentally friendly business measures implemented at the start	-Eco-dedicated start-ups -Eco-open start-ups -Eco-reluctant start-ups	Start-ups	Mixture of organisations and individuals	Discovering opportunities for implementation of environmental management from the beginning of a company

Author (year)	Main characteristics of typology	Typology (actor types)	Type of organisation	Central social unit	Main purpose of the typology
Hockerts and Wüstenhagen, (2010) “Sustainable entrepreneurs”	Degree of environmental orientation of a company’s core business and reach due to market presence	-David -Goliaths	Start-ups and incumbents	Organisations	Demonstrate the different, but complementing roles of incumbents and new ventures in sustainable entrepreneurship
Lepoutre et al. (2013) “Social entrepreneurs”	Presence of “social mission” and type of revenue model	-Traditional NGO -Not-for profit social enterprise -Social hybrid social enterprise -Economic hybrid social enterprise -For profit social enterprise	Start-ups and incumbents	Organisations	Enabling empirical research of social enterprises at the macro-level

2.6 Conclusion: Need for a new typology of green start-ups

While the three described typologies are helpful in considering the motivation, societal impact and level of profitability of the companies involved in sustainable entrepreneurship, neither is focusing explicitly on start-ups nor financial challenges. There is thus a clear need to go beyond existing typologies of sustainable entrepreneurship and to develop a new typology, which is suitable to properly analyse and explain the financial challenges and opportunities of green start-ups.

3 Methodology

In order to empirically assess different types of green start-ups according to aspects that are of relevance to sustainable entrepreneurship in green start-ups (core business with a positive environmental impact) as well as in finance (e.g. profitability, risk, time-horizon, size/growth, investment needs), a typology can prove helpful. While the existing typologies presented in section 2 provide a good foundation, they neither focus on start-ups nor on challenges or financial access specifically. In section 4 we therefore suggest an elaborated typology building on these existing ones by addressing issues related to the green start-up: its products/services, the founder/founding team and the company strategy. This exploration is informed by the research on sustainable entrepreneurship as well as further

literature on sustainable business (e.g. environmental management, CSR and business ethics) and start-up financing. Having explored these issues in general, we then attempt to describe the green start-up types considering such issues specifically and then address the potential consequences for financial access. Thus, we follow a deductive method, which constructs types of green start-ups by deducing them systematically from existing concepts of sustainable entrepreneurship and theoretical considerations based on research results on sustainable entrepreneurship and start-up financing.

4 Conceptual development

What issues are of relevance in explaining the characteristics and challenges of green start-ups? A range of issues arise in the sustainable entrepreneurship and sustainable business literature. In the following part we focus on characteristics that allow for a distinction of different types of green start-ups. In order to systematically assess the characteristics distinguishing different types of green start-ups, we assign these to three overarching categories: product/service-related characteristics, entrepreneur-related characteristics as well as strategy-related characteristics, as described in section 2.3. Not only do these three categories cover the most important aspects of young companies, they are also the ones that are of central importance to investors deciding whether or not to invest in such companies (cf. Wüstenhagen and Teppo, 2006).

A division into these categories helps us understand how sustainability-related and environmental issues have an impact on the factors that are decisive to investors: required size of investment, risk, expected return and time-horizon of investment (cf. Emerson and Spitzer, 2007; McWade, 2012). The product/service characteristics have an impact on the value proposition and thus all these aspects. Furthermore, the entrepreneur/team as well as the strategy are of crucial importance as these give investors an indication of whether the entrepreneur(s) are considered competent and are seen to have the same goals and strategies as that of the investor, which is considered to be of utmost importance in early stage investment deals where uncertainty abounds (cf. Breuer and Breuer, 2005). These overarching categories are certainly interconnected. Nonetheless, distinguishing the characteristics along these lines facilitate an analysis of the concrete factors that influence investors' decision-making, instead of having one black box of reasons ("the company").

4.1 Product/service-related characteristics

Product/service quality. Mass-market production often demands highly competitive (i.e. low) prices that may in turn require low-quality inputs. Low product quality leads to a more frequent disposal of products and higher consumption of new products and thus resources. Planned obsolescence has been described as a deliberate, unsustainable strategy to lower the quality of products in order to shorten the product lifespan and induce new purchases and increased consumption (Cooper, 2010; Guiltinan, 2008; Giaretta, 2005) and is partially caused by capital market and profit orientation (Schridde and Kreis, 2013). Other consequences of low-quality material input may include health deterioration and toxic waste in landfills.

Environmentally friendly products or services are such that reduce environmental impact by, amongst others, making use of renewable resources (materials and energy) and eco-design, while avoiding toxic materials and ensuring health safety. Green products and services are thus in general such that have a higher quality in a holistic sense and are often

labelled and certified as such. One consequence of such high product/service quality is that a frequent disposal of old products becomes less likely. Also, a high quality is perceived by leading sustainable companies to give them a competitive advantage in reputation – something which is difficult to imitate (Petersen, 2003).

Long-term focus. Like in most processes of post-industrial society, the tempo in innovation cycles is increasing (Fichter, 2005), amongst others due to globalisation, information technology and increased competition (cf. Giaretta, 2005). Similarly, product lifespan are decreasing, which makes the time to compensate investment in R&D limited (Baumol, 2010). Sustainable innovation processes involve finding solutions to complex problems, which may require a long-term focus. The phase of the market launch is in the case of innovative, sustainable products often longer than for more conventional products, which may cause comparatively higher costs even before any earnings has been made (cf. Freimann, 2005). Additionally, current technical and market infrastructures may not be suitable for future sustainable solutions and path dependencies may hinder and slow down the diffusion of radical innovation (cf. Rennings, 2000).

Need-orientation. The starting point for sustainable innovation can be said to be the fulfilment of actual and, largely, already existing needs (cf. Pfriem, 2011). Many sustainable entrepreneurs seek solutions to the “wicked” societal problems of the world and are concerned with fulfilling needs of the base-of-the-pyramid (the largest and poorest socio-economic population group) as opposed to catering to ever-increasing consumer demands in the industrial world (cf. Pfriem, 2011; Cohen and Winn, 2007; Fichter, 2005; Prahalad and Hammond, 2002). Globally, poorer population segments have often been observed to pay higher prices for goods/services due to e.g. poor infrastructure and a prevalence of the informal economy (Pralhad and Hammond, 2002). In specific cases, sustainable entrepreneurs offer products at lower prices, while remaining profitable, e.g. by focusing on the aggregated purchasing power of communities or developing pay-per-use or sharing models (Pralhad and Hammond, 2002).

4.2 Entrepreneur-related characteristics

Sustainability-related motivation. Sustainable entrepreneurs’ motivation may be a mix of sustainability-related and profit-oriented (cf. Schaltegger and Wagner, 2011), but can also be predominantly either one or the other (cf. Parrish, 2010; Shepherd and Patzelt, 2011). Sustainability-driven entrepreneurs are seen as having the potential to create more radical innovation, as these entrepreneurs often wish to challenge the legitimacy of conventional business (York and Venkataraman, 2010). Altruistic tendencies might furthermore facilitate an entrepreneur’s recognition and creation of sustainable innovation (Patzelt and Shepherd, 2011). Environmental entrepreneurs, as opposed to social entrepreneurs, are often described as profit oriented (Thompson et al., 2011), but as they often also have a sustainability-related motivation (cf. Schlange, 2006; Gray and Balmer, 2004), the level of profit aspired to can vary considerably from one entrepreneur/team to the next. A sustainability-related motivation in some cases opens up to a collaborative approach and open innovation (cf. Vickers and Lyon, 2012; McPhedran Waitzer and Paul, 2011; Doyle Corner and Ho, 2010; Pacheco et al., 2010; Petersen, 2003), which in turn may have an impact on the levels of externalities and profit.

The use of guiding sustainability principles. While consumption, any consumption, from a conventional economic perspective is always desirable (Pfriem, 2011), sustainable business is linked to the guiding principles of efficiency, consistency and sufficiency (cf. Young and Tilley, 2006). Efficient resource use through reduction, reuse and recycling

indicate a more sustainable approach to production and can be a source of cost efficiency (cf. Cohen and Winn, 2007; Porter and Kramer, 2006; Horbach et al., 2000). Consistency, on the other hand, relates to the environmental compatibility and recyclability of materials. This principle applies to approaches such as biomimicry (Fichter, 2005) and “cradle-to-cradle” or upcycling (Braungart and McDonough, 2002). Lastly, sufficiency relates to finding the suitable measure of consumption and indicates a conscious contribution by business towards more (globally and inter-generationally) sustainable consumption patterns in society (cf. Fichter, 2005). All guiding principles are a potential source of inspiration for innovative business models and product-service-systems. Sustainable entrepreneurs are observed to value frugality, reuse/re-purpose materials (Gagnon, 2012) and practice “resource perpetuation”, i.e. enhance and maintain resources as long as possible (Parrish, 2010).

Business qualification of the entrepreneur/entrepreneurial team. Business qualification is considered of paramount importance in both general entrepreneurship and sustainable entrepreneurship. While sustainable entrepreneurs/teams who are more motivated by their contribution towards sustainability than by earnings may have thorough knowledge of social or environmental issues (Patzelt and Shepherd, 2011), a very pertinent academic background and may be highly qualified (Nicholls and Pharoah, 2008), they may lack business qualification (cf. Choi and Gray 2008; Nicholls and Pharoah, 2008). One consequence of this may be that aspects like marketing strategy and financial plan are given too little prominence in investment proposals and business plans (cf. Randjelovic et al., 2003).

4.3 Strategy-related characteristics

Level of market-orientation. Many green start-ups effectively use market mechanisms to offer their sustainable products/services. Others may lack market-orientation and be more principally against the workings of the current market economy and work towards a more radical transformation of both the economy and society (cf. Vickers and Lyon, 2012; York and Venkataraman, 2010). They may have and develop a very different organisational logic than conventional start-ups (Gibbs, 2009). Their strategy may thus involve engaging in “alternative” economic approaches (Schaltegger, 2002) that diverge from that of the market economy at a local or regional level, such as bartering, sharing and local, community currencies, or at the global level through open source development (cf. Vickers and Lyon, 2012)

Growth willingness. Even if growth is still seen as a “must” for most conventional and also sustainable businesses (cf. Vinturella and Erickson, 2004), a reassessment of this strategy is becoming visible (cf. Nazarkina, 2012; Linnanen 2002). Even in conventional business, growth research finds that small businesses may intentionally refrain from opportunities to grow (Wiklund et al., 2003; Davidsson, 1989). In sustainable companies, this scepticism can be explained by a fear of having to compromise on sustainability issues (cf. Howard and Jaffee, 2013; Vickers and Lyon, 2012) and high product quality (Hockerts and Wüstenhagen, 2010), or diminishing product exclusivity (Petersen, 2003). Increasing demands for local products may favour multiple, small companies based regionally, close to the markets (York and Venkataraman, 2010). On the one hand, a large number of small companies can be said to contribute to “eco-growth” (Clausen, 2004). On the other hand, growth is sometimes seen as a strategy of “creative destruction” (cf. Schumpeter, 1947) by “sustainable champions” (Petersen, 2003), forcing other, more unsustainable businesses out of the market (cf. Nazarkina, 2012; Parrish, 2010; Clausen, 2004).

Control and decision-making rights. Sustainable entrepreneurs who are motivated by their contribution to sustainability may be wary of sharing decision-making powers with external actors due to a fear of conflict of interest or “mission drift”, i.e. economic concerns becoming a more important goal than the sustainability impact (cf. Vickers and Lyon, 2012; Nicholls and Paton, 2009; Nicholls and Pharoah, 2008; Choi and Gray, 2008; Gray and Balmer, 2004). At the same time, cooperative company forms are described as particularly sustainable despite, or perhaps rather because of, their ability to integrate a large range of opinions and decision-makers (cf. Ridley-Duff, 2009).

4.4 Overview of characteristics and potential impact on financial access

Not only different types of sustainable entrepreneurs, also investor types can be distinguished (cf. Wüstenhagen and Menichetti, 2012). These may differ both in terms of their preferences with regard to risk-return-levels and regarding attitudes and exposure to sustainability (cf. McWade, 2012). Taking the different types of investors into account, Table 2 explores the relevance of the different characteristics of green start-ups with regard to a possible impact on their financial access.

Table 2. Overview of characteristics and potential impact on financial access

Characteristic	Relevance to finance
Product/service-related characteristics	
Product/service quality	Investors may see high quality as both a challenge (if they target mass-market segments) and opportunity (if they target exclusive niche markets of high quality or are interested in the environmental impact).
Long-term focus	Research on venture capital (VC) assert the need for longer investment periods in green start-ups and that this can lead to a lack of interest in many VC funds (Linnanen 2002; Randjelovic et al. 2003), but also observes a longer average engagement time in actual VC investment for green start-ups (Randjelovic et al. 2003).
Need-orientation	Investors might expect lower returns from the base-of-the-pyramid and thus perceive need orientation as a challenge. It might also impact the time-horizon of the investment as “wicked” problems are rarely solved by a quick fix. However, sustainability-oriented investors sometimes explicitly target companies that focus on the base of the pyramid, e.g. through impact investing or microfinance institutions.
Entrepreneur-related characteristics	
Sustainability-related motivation	A sustainability orientation (cf. Randjelovic et al. 2003; Schick et al. 2002; Linnanen 2002), “green image” (Wüstenhagen & Teppo 2006) or business plan with information on sustainability impact (Randjelovic et al. 2003) can cause a negative reaction from financial advisors and investors. On the other hand, so-called high net worth individuals with a sustainability orientation are the primary source in sustainable VC funding

Characteristic	Relevance to finance
	(Randjelovic et al. 2003). Motivation may have an impact on decision-making and, therefore, the level of profitability of the venture. Sustainable entrepreneurs may thus experience a challenge in finding conventional investors willing to invest. Sustainability-oriented investors may see entrepreneurs with a sustainability-related motivation as an opportunity and a safer bet in reaching their extra-financial goals.
Use of guiding sustainability principles	Efficiency and consistency leading to reduced financial needs, and possibly increased return can be seen as an opportunity for investors. Sufficiency may be seen as a challenge by most investors as it can lead to reduced consumption.
Level of business qualification	A lack of business qualification may be perceived as a lack of professionalism or needed skills by investors (cf. McWade 2012; Nicholls and Pharoah 2008), creating a reluctance or scepticism on their part.
Strategy-related characteristics	
Level of market-orientation	Most investors are unlikely to be interested in sustainable start-ups that lack a market-orientation. Some informal investors who operate at a low-funding level such as individuals on crowdfunding platforms and microfinance institutions may be open to funding such start-ups.
Level of growth	Low or organic growth will have a comparable influence on the level of profitability and the ability to repay investors. High-growth green start-ups are often more "business-like" and thus more easily find interested investors (cf. Hockerts and Wüstenhagen 2010). Especially equity finance has been found to be conducive to growth and efficiency, amongst others in the context of cooperative social enterprises (Ridley-Duff 2009). Green VC firms will also expect high growth. Microfinance institutions or alternative banks will only seek repayment of the (generally speaking low-sum) debt.
Control & decision-making rights	External equity investment involves control, oversight and participation in decision-making by investors. Involving investors in decision-making may cause a prioritising of financial aspects over sustainability-related ones in cases of trade-off (cf. Linnanen 2002). Some sustainable entrepreneurs may seek investors with a similar perspective (Hasenhüttl 2008), i.e. sustainability-oriented investors.

4.5 Relevance and implications for different types of green start-ups

As can be deduced from the discussion, not all green start-ups can be considered to have the same product/service qualities, entrepreneurial character and company strategies. While we build on the three described typologies of sustainable entrepreneurs (Linnanen (2002), Schaltegger (2002) and Walley and Taylor (2002)), which in combination de-

scribe a spectrum of types, we elaborate on these and offer a broadened typology. This broader typology involves not focusing only on the entrepreneurs, but rather also on the product/service they offer and the strategy of the new/young company. In research on sustainable entrepreneurship, there has been a strong emphasis on analysing the entrepreneur and their intentions and motivation. This focus on the person behind the start-up goes back to early theory on conventional entrepreneurship (cf. Kirzner, 1973; Schumpeter, 1947). We argue that a broader perspective is needed in order to thoroughly and effectively evaluate the extent to which the above mentioned characteristics, which differ in types of green start-ups, have an impact on their everyday business operations, on financial challenges and opportunities as well as success in the longer term. With regard to the investigation and explanation of financial challenges and opportunities of green start-ups, it is appropriate to develop a typology, which explores the start-up as a whole (and adopts an organisational perspective). Of course investors are interested in the entrepreneurs as the key individuals of a start-ups, but banks, venture capitalist, business angels and other investors are also interested in the products and services of the start-up and in its strategy and business model. Furthermore, a narrow focus on the entrepreneur might moreover not always be appropriate for sustainable entrepreneurship. In the context of social entrepreneurship, Doyle Corner and Ho (2010) speak of the “collective entrepreneur” as sustainability-related ventures are observed to often require a shared effort.

Table 3 below describes the synthesised and elaborated typology in a comparable fashion to the description of other typologies in Table 1. The usage of the types developed by Linnanen (2002), Schaltegger (2002) and Walley and Taylor (2002) becomes clear in the below description of the individual start-up types with relation to the characteristics described above.

Table 3. Characteristics of the elaborated typology of green start-ups

Main characteristics of typology	Typology (actor types)	Type of organisation	Central social unit	Main purpose of the typology
- Product-related characteristics	- The alternative start-up	Start-ups	Interrelation between key individuals (entrepreneurs) and key organisational characteristics (products, strategy)	Framework for empirical research on financial challenges and opportunities of green start-ups
- Entrepreneur-related characteristics	- The visionary start-up			
- Strategy-related characteristics	- The inventive start-up			
	- The ecopreneurial start-up			
	- The unintentionally green start-up			

Type 1: The alternative start-up. The self-employer (Linnanen 2002), the non-profit business (Linnanen 2002), the ethical maverick (Walley and Taylor, 2002) and the alternative actor (Schaltegger, 2002) can all be found in alternative start-ups. The entrepreneurs/teams are motivated by making a contribution to sustainability (or, in the case of the self-employer, avoiding the mistakes of large corporations). Their background experience and knowledge often comes from a social or environmental movement and not formal business education or practice. Their personal motivation may be influenced by their wish to limit their own negative impact (e.g. ecological footprint). They therefore apply the

principles of consistency and sufficiency while attempting to fulfil actual needs, in order to avoid rebound effects and reduce absolute usage of natural resources. These start-ups are a form of “revenue-generating social enterprises” (Nicholls and Pharoah, 2008, p. 18), that operate on the boundary to the market economy. They strive for an independent local or regional economy through autarchy and closed-loop production and consumption. Due to this and their wish not to integrate with the conventional market place, the (implicit) company strategy is one of no or low growth as well as no or low profit. According to Schaltegger (2002), these companies produce solid goods through craftsmanship, and not through arguably more efficient industrial processes. The alternative start-up can also be seen as part of the “slow movement” trying to reclaim time and slow down the ever-increasing pace of modern life and economy. Some use underutilised and undervalued work power, such as seniors, disabled individuals and the “unemployable”, in order to both use their skills and knowledge as well as provide a contribution towards community integration. In this type of entrepreneurship, there is an inclination towards open innovation and open source, as positive externalities are explicitly wanted.

Conventional investors are likely to be uninterested in alternative start-ups due to their small funding needs, higher perceived risk level, long time-horizons and low profit-levels. Conversely, such start-ups may be sceptical towards external funding in general due to their political views and/or wish to retain all decision-making power, and therefore seek funding (if at all) through their private networks and in the local community - possibly via crowdfunding. For those who have reached a stage of activity in which income is fairly stable, a loan from the local bank might be an option.

Type 2: The visionary start-up. In visionary start-ups, Walley and Taylor’s visionary champion as well as Linnanen’s successful idealist can be found. They have a “change the world” mentality and perceive business to be the best means to this end, which means they often have a business-related education. Due to their sustainability-related motivation, entrepreneurs/teams in visionary start-ups may allow for or intentionally create positive externalities. The business focus of visionary start-ups is more global than local and they aim at a mass-market customer base. Growth is a primary goal in order to contribute to creating a more sustainable market. They are however not ready to grow at any price, if this means yielding control or compromising their sustainability principles. The fulfilment of actual needs, e.g. in the base-of-the-pyramid, often in collaboration with other actors, and a high product/service quality are likely to be part of their business model.

These characteristics imply a possibly lower level of return (albeit possibly also high if the mass-market strategy is successful), a high level of risk and a longer time-horizon for investments. While conventional investors may in certain cases be interested in funding visionary start-ups (e.g. in growth phases), the entrepreneurs may feel more comfortable with investors with a similar orientation. Depending on the start-up phase, all types of sustainability-oriented investors may be of interest for the visionary start-ups.

Type 3: The inventive start-up. The motivation of Schaltegger’s bioneers operating in inventive start-ups is the most balanced between an economic and a sustainability-related orientation (cf. Schaltegger, 2002). The entrepreneurs/teams behind inventive start-ups are highly inventive, very technically skilled and often socially involved in their community. The entrepreneurs’ potential lack of business education or experience can be explained by their technical education and/or inventor background. These start-ups are “socially driven businesses” that yield a financial return (Nicholls and Pharoah, 2008, p. 18). For their prime-quality and sometimes exclusive goods/services, premium prices are charged from their sustainability-oriented target group customers, both to cover above-market cost lev-

els and increase profit (cf. Schaltegger, 2002). Growth is not necessarily a goal, unless the start-up strives towards becoming an ecopreneurial start-up (cf. Schaltegger, 2002). Like in the case of the ecopreneurial start-ups, their business model often lies in high risk high-tech development.

Inventive start-ups may have substantial capital needs and potentially yield high profits, but they may experience considerable difficulty accessing money due to their lower initial scale of operation, higher level of risks and niche strategy. While they might be able to convince certain conventional venture capital firms, they are likely to feel more comfortable with sustainability-oriented investors, such as green/social venture capital firms or social banks. Other types of investors are unlikely to provide them with the amount of capital they require to build prototypes, or at later stages, grow.

Type 4: The ecopreneurial start-up. Linnanen's opportunist, Schaltegger's ecopreneurs and Walley and Taylor's innovative opportunists in ecopreneurial start-ups are primarily economically motivated and highly market oriented. They identify opportunities, which are likely to be scalable and try to achieve high growth in a short period of time. As the entrepreneurs are often not inventors themselves, they rely heavily on other people and possibly a larger network for the realisation of their idea. The start-ups may have considerable environmental impact and have a high level of positive environmental externalities. Due to their highly market-adapted strategy, trade-offs between different sustainability aspects or between environmental sustainability and economic sustainability are more likely to be prevalent in this type of start-up, than in the others described. This increases the level of risk with regard to the sustainability outcome.

These are probably the green start-ups that are most viable for venture capital investment due to their high growth potential and potentially high profitability, and also likely to be interesting to other conventional investors. Their method of working does not deviate considerably from that of current, conventional market logic. This does not necessarily mean that they have the same mind-set as investors, but the "cultural clash" might be considerably smaller.

Type 5: The unintentionally green start-up. Walley and Taylor's ad hoc enviropreneurs are small business owners who "happen" to be involved in a niche business activity that can be considered sustainable. Being primarily oriented by an economic motivation, these entrepreneurs/teams are likely to have some kind of background in business, whether it is through their education, business experience or both. Their implicit contribution to sustainability (as observable in e.g. product quality and long-term focus) can be assumed to originate from their traditionalist values as influenced by their personal networks (cf. Walley and Taylor, 2002). The entrepreneurs unintentionally contribute to sustainability through their start-up and are often not aware that there are or can be positive environmental and social effects resulting from their products or services. We label this type of new and young companies „the unintentionally green start-up“. This category of sustainable entrepreneurship matches findings that some sustainable innovation is a chance occurrence (Fichter and Arnold, 2004).

The unintentionally green start-ups may not be seen as a high-risk investment, but indeed one of rather low return. This type of sustainable start-up is likely to be traditional in their financial sourcing and seek a loan from the local bank.

4.6 Overview and discussion

Table 4 summarises the above findings on the characteristics of different types of green

start-ups, which on the whole may be said to indicate their level of sustainability-orientation. In order to make the overall picture clearer, we synthesises the findings and label the extent of a characteristic with the values “low”, “medium” and “high”. The more sustainability-related the motivation of the entrepreneur/team is (i.e. the more sustainability-driven these are), the more they seem to be sustainability-oriented, i.e. also be affected by other characteristics that may complicate dealings with other market based actors and especially investors. The ecopreneurial and the unintentionally green start-ups are thus likely to have less difficulty in this regard. While the visionary start-up skilfully and deliberately uses the market logic and business strategies to contribute to more sustainability, which opens some new opportunities for them, they will still encounter a range of challenges. The inventive start-ups with their balance of sustainability concerns and economic orientation might similarly struggle, albeit for other, primarily product-related reasons. The alternative start-ups will have most difficulty in interacting with investors, but may not necessarily be worried too much about this due to their inward and small-scale orientation.

Table 4. Matching characteristics with types of green start-ups

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

4 Limitations & further research

A conceptually developed typology is likely to be fuzzy at best. There is thus a need for empirical investigation to assess its validity. Indeed, the stated aim of this paper was to develop a foundation for future empirical work on green start-ups in the context of finance. The value range indicated in table 4 (low-medium-high) can be seen as a starting point for an ordinal scale to be used in quantitative analysis. The characteristics can be used as items along the dimensions of “sustainability-orientation in product/service development”, “entrepreneurial sustainability-orientation” and “sustainability-orientation in start-up company strategy”. These dimensions might then capture sustainability-orientation in start-up companies more comprehensively than has been achieved up until now in empirical research. Linking such sustainability-orientation with the usage of financial instruments and sources as well as challenges in a quantitative study-design will enable a more differentiated analysis of financial access in green start-ups.

In addition to an empirical analysis of the actual usage of finance in different types of green start-ups, there is clearly a need for more focused, context-specific research in a range of areas. It has amongst others become clear that the perception, attitudes and orientation of investors may have an impact on how they assess and evaluate the quality of an investment opportunity in a green start-up. The rather simplistic distinction between conventional and sustainability-oriented investor needs further research and more differentiation should be achieved in empirical work. Also the impact of the interaction between the green start-up and the innovation system in which they operate on financial access merits a thorough empirical analysis in future. Neither the interaction between green start-ups and investors nor the financial assessment of risk and future profitability are automatic, straight-forward processes. Rather they are heavily impacted by amongst others institutional logic, asymmetrical information, transaction costs and regulatory conditions.

5 Conclusion & implications

Up until now research on sustainable entrepreneurship has only begun to explore the issue of finance. In this conceptual paper, we have explored why and how different types of green start-ups may have additional challenges and some new opportunities in terms of access and usage of finance to fund their early activities. A range of characteristics related to the product/service, the entrepreneur/team and company strategy may have an impact on investors' assessment and the start-ups' perception of external investors. While we embarked on this paper wanting to point out the differences between sustainable entrepreneurship and conventional entrepreneurship, it has become clear in the exploration of different characteristics that it is likely that there are more differences between the green start-up types themselves than between such types and other start-ups in general. The implication for entrepreneurship research includes a widening of the focus in order to explore the whole potential range of financial usage and needs in green start-ups.

Start-ups are considered illiquid, high-risk investments that have a potentially high return, but in practice often deliver a rather low return. This adverse risk/return situation is likely to be exacerbated for many green start-ups. Entrepreneurs/teams of start-ups that are motivated by their contribution to sustainability (i.e. sustainability-driven start-ups, like the visionary, the alternative and, sometimes, the inventive start-ups) are likely to be sceptical

of equity investment due to having to relinquish decision-making rights and control, unless the investor has a similar orientation. Business angels often accept lower return-levels when they have additional sources of motivation. Sustainability-oriented business angels are thus an interesting finance source for such start-ups to tap into. However, there's a challenge identifying these due to such investors' informal organisation, low-key profile and dispersion. VC firms are increasingly investing in cleantech. However, they are primarily interested in the later company development stages and not so much in the early stage of start-ups and require a high level of return in a relatively short timeframe (making them mostly relevant for ecopreneurial and in certain cases inventive start-ups). While VC firms that focus primarily on cleantech have a somewhat longer time horizon than others, this may not suffice for some radical sustainable innovation processes that require a much longer perseverance and patience. Many green start-ups are thus in need of so-called "patient capital".

We have also seen that, especially for sustainability-driven start-ups, there is a need for continued professionalization; although there is a worry about "mission drift" in such cases. This could be another indication that sustainability-driven start-ups would be well-advised to seek out likeminded investors. Looking at current numbers for "sustainable and responsible investment" (SRI) and impact investment, however, it is clear that these are still marginal compared to conventional investment (even if growing). It would therefore be sensible to tap into the conventional investment markets where possible (e.g. for those start-ups where motivation is more mixed or leaning towards the economic side). On the policy-side, efforts to mainstream relevant investment instruments, such as a "blended value" approach, might be helpful in this respect. Another area where policy and intermediaries could support the development towards a better matching of supply with demand, could be to develop matching instruments that take into account strategies, goals, motivation etc., in order to help start-ups find appropriate investors and vice versa. Information access and qualification programmes for both investors and green start-ups may also enable an improved matching. On the investment side, informal investors who are interested in green start-ups may not be able to alone fulfil the needs (nor shoulder the risks) of such start-ups, in which case both the formation of investor syndicates and investor networks might be beneficial to achieve higher sums and create portfolio effects. The creation of an enabling environment for such strategies is also something that could be offered by intermediaries and supported by incentives in relevant policies.

Green start-ups have the potential of developing and spreading radical, sustainable innovation in all sectors of the economy and contribute to a transformation towards a sustainable, green economy, but may need better access to finance in order to achieve this potential.

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Article

The Rationality and Irrationality of Financing Green Start-Ups

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Abstract: Green start-ups contribute towards a transition to a more sustainable economy by developing sustainable and environmentally friendly innovation and bringing it to the market. Due to specific product/service characteristics, entrepreneurial motivation and company strategies that might differ from that of other start-ups, these companies might struggle even more than usual with access to finance in the early stages. This conceptual paper seeks to explain these challenges through the theoretical lenses of entrepreneurial finance and behavioural finance. While entrepreneurial finance theory contributes to a partial understanding of green start-up finance, behavioural finance is able to solve a remaining explanatory deficit produced by entrepreneurial finance theory. Although some behavioural finance theorists are suggesting that the current understanding of economic rationality underlying behavioural finance research is inadequate, most scholars have not yet challenged these assumptions, which constrict a comprehensive and realistic description of the reality of entrepreneurial finance in green start-ups. The aim of the paper is thus, first, to explore the specifics of entrepreneurial finance in green start-ups and, second, to demonstrate the need for a more up-to-date conception of rationality in behavioural finance theory in order to enable realistic empirical research in this field.

Keywords: green; environmental; sustainable; entrepreneurship; start-up; entrepreneurial finance; behavioural/behavioral finance; rationality; venture capital; business angels

1. Introduction

Theory and empirical work in entrepreneurial finance have made significant strides in the last decades in explaining particularly the supply-side perspective of investors but also attempting to illustrate the demand-side challenges involved when new and young companies seek external finance. One emerging field of entrepreneurship study, sustainable entrepreneurship, has thus far not received much research attention in the context of finance. “Green” start-ups constitute one actor type within sustainable entrepreneurship whose potential difficulty of financial access is currently a loose hypothesis, which has really neither been described exhaustively by theory nor been explored thoroughly by empirical work thus far. While entrepreneurial finance theory can provide some insight into investment in green start-ups, there are some aspects of it that are more challenging to illuminate within the existing theoretical framework—such as motivation beyond profit and strategic considerations arising from sustainability-related goals. Although the behavioural finance literature is still in its early years, it has some crucial contributions to make here. It can especially help explain why investors’ decision-making criteria include other aspects beyond such conventionally considered criteria as risk, return, liquidity and time-horizon.

The main question raised by this theoretical paper is: Why may green start-ups experience challenges in accessing finance to fund their early-stage activities beyond what other start-ups experience? From a supply-side perspective, investors may be wary of such start-ups. Why is this the case? From a demand-side perspective, green start-ups and their entrepreneurs may similarly be wary of (certain types of) investors, which, at first glance, might be somewhat more perplexing. While, as is shown in this paper, we can come a long way in explaining these questions by using entrepreneurial finance theory, its theoretical framework largely holds the implicit (and sometimes explicit) assumption of rationality in investment decision-making. The notion of rationality that the research field relies on is, however, rather constricted. The contribution of behavioural finance theory may help overcome entrepreneurial finance theory’s deficit in explaining green start-up finance. However, while some theorists in behavioural finance object to the prevalent conception of rationality, most rely on the idea of a “bounded rationality” as they see revealing itself in empirical evidence. That is why this paper, in conclusion, draws specifically on theory of rationality in economic behaviour to suggest how behavioural finance theory can evolve into a more realistic and holistic framework for exploring the topic of investment in green start-ups in particular as well as in start-ups in general.

2. Methodological Approach and Structure of Paper

A comprehensive literature review was carried out in several steps for this theoretical paper. First, a broad review of the literature was made for green start-ups, sustainable entrepreneurship and green start-up finance looking at the characteristics of such companies described in the literature as well as the challenges (including financial ones) that such companies experience, also by building on previous work by the author [1]. Second, for the more elaborated parts on entrepreneurial finance theory and behavioural finance, a similar pattern of search was adopted. For entrepreneurial finance theory, a range of pertinent and high-ranking journals were specifically searched using combinations of keywords such as “‘entrepreneurial finance’ and theory” (these were: *Venture Capital*, *Journal of*

Entrepreneurial Finance, Strategic Change: Briefings in Entrepreneurial Finance, Entrepreneurship Theory and Practice, Journal of Business Venturing and Journal of Finance). This search was supplemented by a more general Google Scholar search for the same keywords, to broaden the literature base. Due to the more fragmented contributions expected in the behavioural finance literature, Google Scholar searches were used bringing behavioural finance together with entrepreneurial finance by entering combinations of keywords such as “‘behavioral finance’ or ‘behavioural finance’ and entrepreneurship” or “‘behavioral finance’ or ‘behavioural finance’ and start-up” in addition to “behavioural finance theory or behavioral finance theory”. Primarily, theoretical and conceptual studies were analysed and used in the paper, in addition to some empirical work supporting the line of argumentation (e.g., on return levels of investments). The papers were clustered according to topics or the overarching theories used in the respective papers. An emphasis was placed on using existing literature reviews as well as identifying landmark or classic studies and theorists in both fields. Due to the effect the interaction between investor and entrepreneur has on investment behaviour, both investor and entrepreneurial behaviour are seen as units of analysis. Both explicit decision-making and the underlying rationality are seen as pertaining to this behaviour, as more or less visible features thereof.

The paper is structured as follows: First, green start-ups are defined by drawing on the growing literature on sustainable entrepreneurship. Here, their particular characteristics and potential related challenges in seeking external finance are emphasised. Second, the paper explores central theoretical concepts in entrepreneurial finance and their relevance for green start-ups. Both the explanatory value and the deficit of theory in helping to understand the financing of green start-ups are investigated by drawing on findings from the literature on sustainable entrepreneurship. Third, behavioural finance is defined and its relevance to entrepreneurial finance explored. Subsequently, its contribution towards overcoming the explanatory deficit in entrepreneurial finance regarding the finance of green start-ups is made evident. Fourth, evidence on the shortcomings in the assumptions and theoretical underpinnings of entrepreneurial finance (and to some extent behavioural finance) in explaining certain realities of entrepreneurial finance are presented. Fifth, in order to arrive at a theoretical basis that is more comprehensively able to explain green start-up finance, the paper takes a closer look at two theorists, Kent D. Miller and Amartya Sen, who contribute to broadening the concept of rationality in economic theory.

3. What are Green Start-Ups?

Sustainable entrepreneurship has been described as “[...] an innovative, market-oriented and personality driven form of creating economic and societal value by means of break-through environmentally or socially beneficial market or institutional innovations” ([2], p. 6). In this context, green start-ups can be understood as such new and young companies that develop and sell products or services that have a positive environmental impact and contribute to a greening of the economy (e.g., through reduced emissions of greenhouse gases, improved energy efficiency, application of a circular economy, “cradle-to-cradle” approach, *etc.*), while striving to meet a triple-bottom-line [1]. These companies have certain characteristics that distinguish them both amongst each other and from other, more “conventional” start-ups. In terms of products and services, such companies provide a high

product quality by amongst others applying eco-design, avoiding toxic materials and using renewable resources [1]. Their products and services often involve radically innovative solutions [3], which may require a long development period before they are market-ready [4]. Some focus on developing and emerging markets where the needs for sustainable solutions may be particularly urgent and business model innovation may be necessary in order to be successful [5]. The entrepreneurs themselves may have different types of motivations ranging from strongly sustainability-orientated via a mix to purely profit-orientated, which is likely to have an impact on how they run their companies [6]. Such entrepreneurs who are particularly sustainability-driven and (also) have non-pecuniary goals have for instance been observed to lack business qualification [7,8]. They may, to different extents, apply sustainability principles such as efficiency, consistency (recyclability and environmental compatibility of materials) and even sufficiency (call for reductions in consumption) [1]. In terms of strategy, the level of market-orientation varies (e.g., use of bartering, sharing, community currencies and open source development has been observed [9]), business growth may in some cases be curbed for fear of having to compromise on sustainability-related issues [9,10] and control may be retained within the company for fear of “mission drift” (*i.e.*, compromising environmental goals) [7–9,11,12]. Further influences include the environment that the start-ups operate in (regulation, sector and market competition), which may be more or less conducive to green business models.

4. Exploration of the Relevance of Theoretical Concepts in Entrepreneurial Finance for Green Start-Ups

4.1. What is Entrepreneurial Finance?

Entrepreneurial finance is a field of finance study that has developed strongly in the last two to three decades, with only a few exceptions dating from before the early 1990s [13,14]. In most cases, the objects of study are new, innovative firms that exhibit other characteristics in finance than more established firms and large corporations. While the latter are more often publicly traded and thus fund themselves primarily via stock exchanges or have easier access to debt finance due to their longer track record and available collateral, new and (mostly) small entrepreneurial companies may struggle more to access finance and thus struggle more with survival in early years. There are a range of theoretical explanations for this more limited access (as explored below). It should be noted, however, that not only access to finance explains (the lack of) survival of new companies: the “liability of newness” theory in the realm of organisational ecology research on why new companies may generally struggle more with survival than established companies [15] furthermore provides an elaborate explanatory framework beyond that of purely financial issues.

While focus on venture capital (VC) in the academic literature is dominant, there are a range of other sources of entrepreneurial capital that are of equal practical importance to entrepreneurs and start-ups. Banks play a central role. Not only in bank-based economies such as Germany, Japan and the Scandinavian countries is debt financing the most important external source for entrepreneurial and small companies [16,17]. These two types make up the largest providers of formal entrepreneurial finance, but there is a multitude of more informal (or “alternative”) sources of finance that play a crucial role for new companies [13]. High net worth individuals who often have years of business and

entrepreneurial experience themselves act as business angels (also called angel investors) and are among the most prominent “informal” investors. Moreover, the company founder(s), their friends and family may also be central money providers. Indeed, family investment into new ventures has been called “likely the single largest source of start-up capital in the world” ([18], p. 598). Crowdfunding (also called crowd investment) has recently also emerged as a practical option for start-ups [19]. Albeit so-called “bootstrapping”—a creative manner of making existing money last longer as well as of making use of unconventional sources of money and thereby avoiding external inflows of money [20]—does not involve formal or informal investment, it is considered a legitimate and most practiced form of strategy in the entrepreneurial finance literature [21]. In this context, the importance of trade credit—the deliberate usage of postponed payment to suppliers—has been emphasised [17].

All these different sources of investment are, however, not equally prominent at all stages of entrepreneurial development. The early phases—also coined pre-seed, seed and start-up stages—are generally financed by the more informal sources of investment such as business angels, the founders’ own funding, family and friends, in addition to the more formal short-term bank loans [13,17,22]. These early times are also classical bootstrapping phases. In some countries, especially in Europe, they are also characterised by the usage of public funding instruments [22]. Access to venture capital increases in the start-up and expansion/growth stages and overlaps at the beginning with business angel investment [22]. Long-term banking generally becomes a viable option only at later phases [23].

4.2. Existing Literature on Green Start-Up Finance

Green start-ups and sustainable entrepreneurs may in certain cases find “socially responsible investors” or “impact investors” who target their types of companies specifically and are interested in achieving a societal impact with their investments by adopting a so-called blended value approach [24,25]. Certain business angels have been noted to invest in a value-orientated manner [26]. A limited, but growing number of venture capital firms have a specific focus of cleantech [27,28]. Some venture philanthropists target start-ups in order to strengthen their ability to have a societal impact [11,29]. In some countries, there are social banks that only fund companies with a sustainability-related area of operation [30,31]. Some crowdfunding platforms explicitly target green start-ups and environmental projects, and the informal investors involved are often motivated by other goals than making a profit [32,33].

As explored further above, green start-ups are in certain aspects different to other start-ups. On account of their (indirect) environmental protection activities, green start-ups are involved in markets where market failure can be especially strong [34–36]. Even though green start-ups generally are for-profit or at the very least strive to be financially self-sufficient [1], their (different levels of) environmental externalities may impact the company’s profit levels. Green start-up finance may thus be assumed to be rather different compared to more “conventional” entrepreneurial finance [37]. These differences are indeed likely to have an impact on investment conditions in terms of risk, return and time-horizon of the investment. It is therefore assumed that green start-ups may experience more—or other—challenges than other start-ups [1].

The issue of green entrepreneurial finance has yet to be thoroughly explored in the context of sustainable entrepreneurship research [1,38] and is only slowly receiving more attention [27]. A recent

qualitative study of sustainable venture capital coin the involved investors “pragmatic idealists” as they not only seek financial return but also a social return on investment [27] and can be said to adopt a “blended value” approach [24]. In addition to their investment, these sustainable venture capitalists are catering specifically to sustainable entrepreneurs by providing both sustainability-related business advice and related network support. Interviews with stakeholders in the field further revealed an understanding of the longer time-frame needed for investments in sustainable entrepreneurship as well as the acknowledgment of potentially reduced profits in return for an increased social or environmental “return”. While it is clear that the proportion of sustainable venture capital firms is rather small, investor syndication is seen as a potential method for diversifying and reducing risks [27].

Environmental entrepreneurship research, a precursor to sustainable entrepreneurship research, has also investigated some financial issues by looking primarily at cleantech companies with high capital demand, funded by venture capital [28,39–44]. An early study on green venture capital estimated that 4.5% of all venture capital firms could be considered to be “green” VC firms [28]. These were found to have a somewhat longer investment time-horizon than other VC firms, make on average much smaller investments in early-stage companies (\$1.1 million vs. \$120 million) and raise their money from high net worth individuals rather than the pension funds and banks found in other VC funds. Start-ups interviewed in the study confirmed a need for “patient” capital due to their long product development periods. The study identifies a range of barriers to investment in green start-ups: lack of networks in which demand finds supply and vice versa, a prevalence of “bad” business plans (focusing too much on environmental issues and too little on financial planning) and a lack of investor understanding for green business models. A gap in investment is found particularly at the early stage, as green VC firms are wary of the high risks involved here [28]. Another study looking specifically at renewable energy technology finds that there are a range of risks involved that are higher than in other sectors favoured by VC firms: technology risk (due to high capital demands and long R&D periods), exit risk (more conservative incumbents with little interest in taking over new technology through mergers and acquisitions), people risk (due to the “green” image) and regulatory risk [44]. Specialised VC firms are, however, theorised to be able to mitigate these risks and increase expected returns with their better knowledge on environmental technology [44]. Yet another study focuses on venture capital investments in clean energy in the US and similarly emphasises the need for longer time-horizon of individual VC funds and a need for syndication across VC firms in order to arrive at the high investment sums often needed in cleantech. Furthermore, the authors also maintain that the terms of contracts need to be adapted to the specifics of cleantech, which requires intermediaries with special knowledge [41]. Finally, a study estimating the potential of VC for cleantech innovation in the US comes to the conclusion that the success criteria for VC investment—large and growing markets, fast return on investment through high revenue streams and a large earning potential (through exist or mergers and acquisitions (M&A)—are unlikely to be met by such innovation [42]. The authors consider entrepreneurial self-financing and family and friends as more realistic and even more sensible money sources.

Some empirical work thus exists on the phenomenon of entrepreneurial finance in green start-ups. Currently, this literature is not comprehensively grounded in existing or new theory linked to entrepreneurial finance.

4.3. Central Theories in the Entrepreneurial Finance Literature

Although a range of different theories are applied in the entrepreneurial finance literature in individual cases (e.g., the prisoner's dilemma [45], the resource-based view [46], feminist theory [47], knowledge-based theory, procedural justice theory, organisational learning theory and social exchange theory [48], network theory and social and human capital theory [22,49,50]), it is information economics and contract theory that influence the bulk of conceptual work. A central premise of information economics is that informational asymmetries, *i.e.*, that the different parties involved in an economic transaction do not have equal information, are present in almost all market situations [51]. There is therefore no such thing as a perfect market, and Pareto efficiency is difficult to attain even in competitive market settings. Asymmetrical information benefits the economic party with the information advantage regarding availability, quality and prices of products, services or companies, which they can use to disclose advantageous information and hide more detrimental information before, during or after transactions or contracts have been agreed upon. The relevance of information economics might be said to be even more acute for entrepreneurial finance than it is for corporate finance due to the low availability of reliable, publicly accessible information on small and/or new companies, also causing higher transaction costs for such companies [16,52,53]. Companies are said to become "less informationally opaque" over their life-time [17].

Some seminal papers on asymmetrical information illustrate the underpinnings of information economics and explore the main effects of asymmetrical information. They have been used extensively as a foundation in the literature on entrepreneurial finance [13,16,46,54–62]. These papers include that of Akerlof's theory of "lemons" [63], Jensen and Meckling's exploration of the principal-agent-problem in investor-investee relationships [64], Leland and Pyle's paper on the role of signalling in the IPO/share-issuing process [65], as well as Stiglitz and Weiss' model of "credit rationing" [66].

Akerlof [63] illustrates customers' difficulty of knowing product quality before purchase with the example of "lemons" (low-quality cars). Because potential purchasers have less information about the car than the sellers, they are likely to ask for a lower price not knowing whether they are buying a prime-quality car or a "lemon". This will, however, force the higher quality-car sellers out of the market, as they are not willing to sell at lower prices, leaving a market full of lemons and, thus, afflicted with adverse selection. Solutions to the problem are for Akerlof found in "counteracting institutions" such as guarantees, brands and licences (*i.e.*, reputation building, which in turn generates trust). Adverse selection in the context of finance implies that investors' evaluation criteria and processes are not sufficient to distinguish good projects and companies (*i.e.*, likely to be profitable) from the bad ones. This situation has been described for venture capital, whereby many "good" companies (*i.e.*, those with prospective high return and a lack of risk-loving behaviour) will be uninterested in the conditions offered, leaving more "lemons" in the market interested in VC [49].

Jensen and Meckling [64] define investors (debt and shareholders) as principals and entrepreneurs and company managers as agents in principal-agent-relationships. In such a relationship, the principal delegates responsibilities for a job to the agent. The crux of the agency-problem involved here is that "there is good reason to believe that the agent will not always act in the best interests of the principal" ([64], p. 1976) due to different goals or perceptions of risk in the principal and the agent [48]. Once the money has been delivered, there is an incentive for the entrepreneurs or managers to take on

projects that are riskier than the ones originally agreed upon, which is particularly likely in the case of more intangible company assets [16,59]. Not only risk is a potential problem, the entrepreneur may invest insufficient effort or may indulge in expenses or make decisions that are not otherwise aligned with investor preferences [13,17,49,55]. This situation, described as moral hazard, is thus a central part of the principal-agent problem and is likely to increase with the amount of external funds needed [17] as well as with particularly low or high levels of entrepreneurial wealth [59].

It should be noted here that, while there is some contention in the literature about who has the best information about a new company—the entrepreneurs or the external investors—[16,48], it is generally assumed that it is indeed the entrepreneurs who have the most internal information about the company and thus have the upper hand [56,65,67]. Empirical evidence does, however, not generally support the implicit assumption of opportunism on the part of the entrepreneur [48].

As a consequence of these considerations, contracts and monitoring established themselves as sensible solutions to the problems of moral hazard and adverse selection in entrepreneurial finance. In equity finance, especially in venture capital, contracts are formulated that both provide incentives to the entrepreneurs and leave a significant chunk of control and decision-making rights to the investors [13]. Monitoring is also a central feature of the investor-entrepreneur relationship in venture capital, and some other forms of investment, creating high transaction costs for such investors [13,67], who thus require a high return prospect as a potential payoff for efforts (in addition to other reasons such as level of risk, illiquidity of funds and relatively low diversification due to on average large sums [13,22]). These high transaction costs may not be deemed justifiable in the case of small companies with smaller funding needs. This is one explanation for the frequently observed use of internal financing common at the beginning of new ventures [23].

As an alternative to venture capital, “relationship lending” or in Germany the use of a so-called “Hausbank” is seen as another solution for asymmetrical information [17]. Banks that develop extensive knowledge about the entrepreneur, or friends and family having access to non-public and more personal information, are more able to assess the intentions, goals and efforts of new companies [16].

Leland and Pyle [65] consider the solution to the problem of asymmetrical information, which they observe to especially pervade the financial markets, to be the entrepreneur’s own or an intermediary’s willingness to invest in the company/project and thereby signalling the quality of it. The authors see asymmetrical information as a primary reason for the existence of intermediaries.

The pecking order theory established in Myers and Majluf’s [67] as well as Myers’ [68] work suggests a way for entrepreneurial companies of signalling quality in order to overcome asymmetrical information. Myers and Majluf [67] theorise that potential investors will be sceptical of companies issuing equity due to the reluctance of already existing investors and owners to issuing new equity in a situation where new, under-priced equity would lower the overall value of the company. Thus, for outside investors without inside information, no new shares being issued indicate “good news” about the company. A logical consequence of this situation is a pecking-order of financial instruments, that indicates that firms prefer to first finance their activities internally (e.g., through company profits or founder equity), and, if this is not possible, only second by debt and at the very last with external equity [68]. The pecking order theory thus directly refutes the Modigliani-Miller theorem on capital structure. This development supported earlier observations of a similar kind [69] and is found to

generally apply to small and medium-sized companies (SMEs) [16], while depending on the level of personal wealth of the entrepreneur [60].

In the case of debt finance where potential lenders have information about their companies or projects that banks do not possess, Stiglitz and Weiss [66] show how credit rationing must take place as there is difficulty in identifying which are the “good” investment projects. If supply were to meet demand, the interest rates would have to be very high, and “bad” or excessively risky projects would be the only ones interested in paying such a high price of capital. The authors thus provided a theory-based explanation for access constraints in debt finance for small and new companies.

4.4. Explanatory Value of Entrepreneurial Finance Theory for Green Start-Up Finance

The information economics theory used in the entrepreneurial finance literature has substantial explanatory value also for green-start-ups. Asymmetrical information is potentially widespread in relationships between green start-ups and investors. Information and knowledge about specific industries, technologies and types of business activities are not spread out evenly across investors. Indeed this type of knowledge constitutes one of their competitive advantages over other investors. Entrepreneurs in green start-ups are therefore also limited, perhaps more so than other start-ups operating in more established fields of business activity, in their choice of investor to such that are sufficiently informed and open to their business activities [48]. Similarly, credit rationing is likely to take place in banks, because these are not fully able to assess and assimilate the information that green start-ups are providing them with.

While the entrepreneurial finance literature focuses on the monitoring of companies to overcome situations of informational asymmetries [13], there might be other reasons for such asymmetries that lie outside agency problems, and rather are linked to an inability to assess the market itself, preventing a deal in the first place. There is some anecdotal evidence to suggest that investors and public funding institutions are not equipped to assess and evaluate certain types of green start-ups and their business models due, first, to the fact that they are not trained in these new fields of business activity and, second, to a lack of established benchmarks in these early times of many types of such green market activity [70]. Similarly, investors have been observed not to understand and not to accept the legal and organisational structures of social enterprises, as these may diverge from conventional legal forms [6,70]. If this is true on a larger scale, it may indicate the existence of asymmetrical information due to the overlapping of market activity with environmental protection activity, which up until recently was not seen as part of the market remit. The entrepreneurs have here developed knowledge and information in areas that have not been considered as relevant by investors and/or are largely not (yet) accessible to these. Good cooperation between investor and entrepreneur presupposes a common understanding and agreement on how an industry or market works in addition to specialised knowledge to complement one another [48]. This may help to explain some of the difficulty certain green start-ups have when approaching investors, as they are bringing “non-market” elements to the market context and may therefore have a lower level of information and knowledge “overlaps” with the investors.

This situation may have a considerable impact on many of the problems that arise through informational asymmetries, that have been discussed above. For one, transaction costs in reducing asymmetrical information barriers are likely to be substantially higher for (at least some) green start-ups

than for start-ups in more established fields of business activity, as specialised investors are likely to be few and far between. Related to this effect is an increase in required expected return due to a higher need for information acquisition and monitoring on part of the relatively less-informed investor. Although there are some areas of activity in which green start-ups may be expected to earn a high profit (e.g., cleantech), for many green start-ups a high return level cannot be expected due to their mix of social and economic return. The resulting lower rate of financial return arises due to the so-called double externality problem. The phenomenon of double externality refers to two distinct types of externalities. First, externalities arise through conventional spillover effects to other firms from investment in innovation, which is found in entrepreneurial companies in general. Second, they arise when prices fail to sufficiently reflect any positive externalities, *i.e.*, social and environmental impact, created (and often intended) by the company, which particularly holds true for green start-ups, and any negative environmental or social impact created by competing companies [71–74]. As a consequence, some research considers private investment less likely in this area and sees public-partnerships as a possible solution for sustainability-oriented companies with a reduced economic return [33].

When an investor evaluates the investment proposal of a green start-up, their expectation of how a business plan should look—“simple, including all relevant information while keeping extraneous information to a minimum” ([50], p. 40)—is often likely to impact their impression of the green start-up’s proposal negatively. Business plans including information on the company’s sustainability impact, which is more likely to be integrated by green start-ups, have been found to cause a negative reaction in investors [28]. The green start-up and its entrepreneurial team may consider sustainability-related information central to the market in which they operate, even if it is not recognised as such by the investor. Not only will seemingly superfluous information be included, but, according to the investor, some information might lack. While entrepreneurs in green start-ups may be highly knowledgeable on environmental issues related to their business [35], a lack of business qualification has been observed in such entrepreneurs [7,8]. This shortcoming is likely to be perceived as a lack of professionalism or needed skills by most investors [8,75].

Cases of adverse selection might arise where it is not clear in advance that the product/service or business model of the green start-up might cause a double externality problem and result in lower financial return. Furthermore, agency problems may arise that are even more severe than in many other cases. Moral hazard may arise regardless of the entrepreneurs’ level of disclosure regarding environmental goals before signing the contract: conflicts of interest and diverging goals between the investor and entrepreneurial team may become obvious only later on. From the perspective of the investor, a green start-up, in which the entrepreneurs are strongly motivated by a potential contribution to environmental goals, may upon transferral of the investment use the money in a manner that strengthens this ‘mission’ while potentially compromising the current or future profitability of the company in cases where trade-offs arise. One specific goal that disagreement may frequently arise on is the level of growth of the company. Green companies have been observed to sometimes be wary of growth due to a fear of having to compromise on sustainability issues [9,10] and high product quality [76], or diminishing product exclusivity [77].

A partial solution to this potential mismatch between many green start-ups and investors lies in the use of intermediaries with specialised knowledge, as intermediaries have a prime purpose in reducing informational asymmetries [65] and risk [44]. This seems to also be perceived as a solution in practice

as there is evidence of an increase in VC companies that specialise in environment-related sectors (e.g., energy) or cleantech, even if these are still a rather marginal part of the industry [27]. Similarly, green start-ups may meet with more understanding when engaging in relationship building where they develop a longer lasting relationship with a bank (e.g., a growing number of “social” banks), as well as when approaching more informal investors such as family and friends who may be better informed about the entrepreneurs’ motivation and capabilities.

4.5. Explanatory Deficit of Entrepreneurial Finance Theory for Green Start-Up Finance

There are also a few questions in green start-up finance, which are not so easily explainable by using existing entrepreneurial finance theory. For one, there is evidence that investors do invest in such companies—like impact investors or socially responsible investors—even if the return is not always comparable to other start-ups [27,28]. The inability to explain a willingness to invest in such companies may, however, also to some extent be explained by the larger research focus on formal investment in entrepreneurial finance and its relative lack of exploration of informal investment. Business angels have for instance been found to also enjoy non-pecuniary benefits from their investments (see below) and non-professional investors in crowdfunding seen to be picking their projects with a more non-economic, value-based approach [32,33].

If it is true that investors might have other goals than purely financial return, which seems to be the case in socially responsible investment and impact investment, the concept of adverse selection might take on another meaning than it currently does in entrepreneurial finance theory. It is considered that a “good” company or investment prospect is one that will be financially profitable. For investors with a blended-value approach, “good” and “bad” might mean something else. “Bad” might indeed mean that environmental goals are not achieved as planned and the sustainability outcome or impact of the company is smaller than initially projected.

While the literature explores the perspective of the investor in moral hazard situations, in which the entrepreneur decides to spend the money invested in other ways than agreed or deemed necessary by the investor, the perspective of the entrepreneur is not fully accounted for by this concept. The potential conflict of interest as observed by the outside investor may lead to the designing of a contract that limits the options of the start-up with concrete targets related to e.g., output or profits [13]. This contract—whether foreseeable or not—may cause a “mission drift” in such companies that are sustainability- or mission-driven. When decisions have to be made, in which the entrepreneur face a trade-off between their company’s financial and sustainability-related goals, a predefined contract may “force” them to prioritise financial goals, overlooking or explicitly weakening any sustainability-related goals. Additionally, decision-making rights may be defined in a way that transfers a considerable amount of control to the investor (through board or management roles), potentially creating a shift in the “goal structure” of the company. Empirical evidence shows that the higher the discrepancy between investor and management/founder goals is, the more intense the interaction and investor control becomes [78]. Related to this issue, is the assumption that entrepreneurs (as agents) act in a self-interested manner. While this is marginally contested in the entrepreneurial finance literature [48], in the literature on social business, the trust in social entrepreneurs has been found to be higher than in

other entrepreneurs due to the existence of a social aim [6]. Moral hazard could therefore be assumed to be perceived by (some) investors as being lower in (some) green start-ups.

Similarly, there are some types of behaviour in start-ups that may be perceived as “signalling”, which, however, when carried out by green start-ups, may mean something different. Some examples can be found in the use of internal funds or collateral, which is considered a way for entrepreneurs of signalling the quality of their firms [16]. If by quality, however, the level of (future) return and growth intentions are assumed and implied, this may not always be the case for companies that have extra-financial/non-pecuniary goals, which applies to a range of green start-ups. Furthermore, for “socially responsible” or “impact” investors, sustainability-oriented green start-ups can signal their adherence to environmental goals by making their lower monetary motivation evident in the form of reduced dividend pay-outs and similar actions [6]. There is thus a need to look closer at the underlying assumptions of the entrepreneurial finance literature, which are not always made explicit.

Table 1. Explanatory value and deficits of entrepreneurial finance theory for green start-ups.

Overarching theory and concepts	Explanatory value		Explanatory deficit
	Specification	Potential consequences	
Asymmetrical information	<ul style="list-style-type: none"> -Investor knowledge about specific new, green industries, technologies and types of business activities is largely still lacking -Lower levels of knowledge “overlaps” between investor and entrepreneur -Differing understanding of what is central company information -Benchmarks are lacking 	<ul style="list-style-type: none"> -Higher transaction costs -Increased required expected return -Complicated or impossible to conclude the deal 	<ul style="list-style-type: none"> -Existing willingness of some (informal) investors to invest despite of lower expected returns
Adverse selection	<ul style="list-style-type: none"> -High level of externalities 	<ul style="list-style-type: none"> -Lower future profitability 	<ul style="list-style-type: none"> -Other meanings of “good” and “bad” investment prospects -Potential consequence of “mission drift” due to contract design
Moral hazard	<ul style="list-style-type: none"> -Conflict of interest -Differing goals between entrepreneur and investor 	<ul style="list-style-type: none"> -Conflictual interaction 	<ul style="list-style-type: none"> -Potentially higher trust in green start-ups due to “selfless” goals
Potential solutions	<ul style="list-style-type: none"> -Improving information exchange and investor knowledge 	<ul style="list-style-type: none"> -Intermediaries with specialised knowledge -Use of relationship banking 	<ul style="list-style-type: none"> -Misconstrued significance of “signaling” due to differing goals

5. Going beyond the Entrepreneurial Finance Framework: Behavioural Finance

5.1. What is Behavioural Finance?

Behavioural finance as an explicit branch of finance research is a relatively recent phenomenon of the last two decades. Its establishment as a separate study can be said to have happened organically based on mounting empirical evidence gathered in studies on financial markets that contributed to contesting the “efficient markets hypothesis” underlying modern finance theory, which has cemented the notion of the market as an efficient, “near-perfect allocational device” ([79], p. 377). Such evidence includes amongst others observations of investors practicing satisficing rather than optimising [80], the use of intuition and emotions in investment decision making [81], an impact of investor mood on stock markets [82] as well as an underestimation of risk and excessive trading [83], which also leads to a lack of diversification [84] and herding behaviour [85].

In more established finance theory, it is conceded that some individuals can have biases and be irrational, but it is maintained that these do not provide any systematic distortions [86]. Behavioural finance advocates, on the other hand, suggest that this distortion is significant and systematic [83,86,87]. The “distortion” is argued to lie in human nature: “Mindsets are influenced by individual and collective learning processes, which may be highly specific and path dependent. [...] Knowledge gained from new information is sometimes very different from one person to another, depending on education and personal experience” ([54], pp. 45–46).

The main foci of behavioural finance are (the limitations of) cognitive ability, the role of emotions in and the impact of social/group psychology on investors. As behavioural models are based mainly on empirical and experimental evidence and not primarily theory, they are said to better explain evidence from financial research than traditional models [82]. Central concepts from psychology that are used as a foundation in behavioural finance literature include a range of heuristics (rules of thumb developing through experience) as well as the more formal prospect theory as developed by psychologists Daniel Kahneman and Amos Tversky in the 1970s [86]. Alluding to moral hazard in agency theory, the sum of behavioural biases and their impact on cognitive ability and analysis have been coined “intellectual hazard” [88]. The consequence of the use of heuristics is an increased level of (systematic) biases in investment decisions.

5.2. Behavioural Finance Theory’s Contribution to Explaining Entrepreneurial Finance

A majority of studies in behavioural finance focus on investment in stock markets, which corresponds to its evolution as a field of study. Some also focus on entrepreneurial finance [54,56,89–91], but this is a rather recent phenomenon. Particularly, the difference between business angels and venture capital investors is emphasised. While business angels are observed to primarily evaluate the entrepreneur and make decisions based on own experience, intuition and gut feeling, VC investors are noted to use a more systematic and analytical due diligence approach looking at the entrepreneur(s), technology, market, potential competition and financial planning [54]. Fairchild [89] combines the dominant asymmetrical information theory from entrepreneurial finance with elements from behavioural finance and develops a “behavioural game-theoretic model” to explain entrepreneurs’ choice of VC investors or business angels: VC firms are modelled to add greater value to the start-ups,

while business angels are better able to overcome agency problems through trust and empathy based relationships with the entrepreneurs. The entrepreneurs end up choosing business angels based on a “warm-glow” feeling, even if choosing venture capital is argued to lead to maximised firm value. Dissenting voices, however, argue that VC investors are also limited in their insights regardless of available formal tools and thus are similarly affected by systematic biases [92]. In addition, other authors in behavioural finance looking at entrepreneurial finance issues introduce counter-theories to asymmetrical information. Yazdipour [56] emphasises that asymmetrical information theory is unable to incorporate complex entrepreneurial realities in which entrepreneurs often are the principal (*i.e.*, investor) and an outside investor may additionally be the agent. In order to complement deficits in entrepreneurial finance theory, salient behavioural manifestations in the entrepreneurial field have thus been coined “perception asymmetry” [91] or “cognitive asymmetry” [54] between investor and entrepreneur. Bonnet and Wirtz [54] argue that such cognitive asymmetry arises through different mind-sets and manifests itself either in conflicts that can lead to increased costs or constructive clashes of heterogeneous experience and knowledge, which may increase the value of the company. Entrepreneurs are described more as using intuition and effectuation, and thus not using the same “language” and logic as investors. Due to the investor differences described above, they hypothesise that this cognitive distance is smaller between business angels, who themselves often have entrepreneurial experience, and entrepreneurs than between venture capital investors and entrepreneurs. As conflicts arising from cognitive asymmetry do not arise (solely) from deviating interests, they cannot be solved through interest alignment in contracts, such as agency theory suggests. Solutions may lie elsewhere according to the authors. Mentoring may be more productive than monitoring (as it helps reduce knowledge asymmetry) and entrepreneurs help themselves when they externalise tacit knowledge so as to communicate company and product quality to the investors [54].

Some heuristics have been used to describe entrepreneurial finance behaviour: The affect heuristic suggests that an inability to assimilate evidence or data arises in cases where investors develop “feelings” or affect for a company or technology [56]. The consequence may be that investors are swayed by the attractiveness of a proposal or idea rather than the more objective financial data presented [56]. In other words, investors may make decisions for other reasons than the return and risk characteristics considered rational in traditional financial theory. The representativeness (similarity) heuristic describes humans’ tendency of “overreliance on stereotypes” and has been identified in empirical research where VC investors favour entrepreneurs who have a similar background in education and business experience [93]. The unrealistic expectations and optimism observed in entrepreneurs have been found in experiments to create investor scepticism towards the company information that is given by start-ups [58].

5.3. Overcoming Entrepreneurial Finance’s Deficit in Explaining Green Start-Up Finance

There is a range of heuristics and biases, which may help in explaining mismatches between investors and green start-ups. One example is the time-delay trap, which keeps investors from placing as great an importance on the future as they do on the present (materialised by discount rates) and which may dissuade them from investing in start-ups that provide partial solutions to complex, long-term challenges such as climate change or biodiversity loss. These complex challenges often

require radically new solutions that are likely to involve a long R&D phase and whose fruits (and profits) can only be reaped after a substantially longer “incubation” period [4,28,41,44]. A further example includes the observance of herd-behaviour, which may help to explain why a niche such as investment in green start-ups is likely to remain a niche and why the “average” investor is likely to be sceptical of it: it might feel more risky to invest in a business area (environmental protection) that up until recently was only marginally perceived as an investment opportunity. Herd behaviour could, however, also explain why cleantech investment has become an increasingly popular area of investment for private equity over the last few years: if others profit from it, then why should not I? Similarly, the status-quo bias reveals why it is easier for investors to stay with the sectors and technologies they already know well and have built up networks in and not venture into the new, relatively unknown field of green start-ups. Finally, the representative (similarity) heuristic explains why investors may reject the business-models of green start-ups that do not act (fully) consistently with conventional entrepreneurial behaviour, due to their own world-view rather than the actual merits of that business model. Different mind-sets generally separating entrepreneurs and investors [54] are likely to become even more pronounced in the case of green entrepreneurs. Business angels may be more able to overcome investor-entrepreneurial differences, depending on an affinity on the part of the business angel for a “green business” approach. Profitable cleantech start-ups behaving like “conventional” start-ups may, again, be an exception in this regard.

The deficits encountered in entrepreneurial finance theory when trying to explain green start-up finance may be dissolved fairly easily when applying a behavioural finance lens. The perhaps biggest contribution of behavioural finance to the question of green start-up finance may indeed be its admittance that investors in practice (often) may choose companies to invest in based on something other than the conventionally theorised criteria of risk and return. These reasons may include affect towards the company based on similarity or for other reasons, perceived “coolness” of the potential investee, societal impact or even moral considerations. Behavioural finance thus explains why investors actually may invest in green start-ups. It may explain why some investors adopt a “blended value proposition” whereby both financial and societal returns are considered in investment-decisions [24]. There is fairly clear empirical evidence for this type of investment behaviour: business angels for instance invest for emotional reasons, in order to help entrepreneurs (not all investor-entrepreneur relationships are adversarial [48,94]), with the intention of stimulating local development or due to interest in new technology [49,54]. One specific source of start-up finance can be considered particularly likely to have altruistic motives beyond any economic motives: money that comes from family [18] and friends. In investment, altruism, however, also extends beyond the family—sometimes even to strangers [95]. These inclinations can be indirectly corroborated by aggregated figures as well: investors in private equity do on average not achieve much higher returns than public equity investors [96]. One likely reason why these investors choose an unfavourable risk-return profile in their investments is that, in addition to being less risk-adverse, they see non-pecuniary benefits to investing in entrepreneurial companies [96].

When it is accepted that investors among themselves have different goals and that the goals of entrepreneurs may deviate from those of investors, this is likely to further inform theory building and future investor behaviour. The possibility of “mission drift” in sustainability-driven start-ups may become more obvious and explicit. This awareness may indeed make it more complex to construct

contracts that are acceptable to both sides in those cases where goals deviate. The realisation that entrepreneurial “signalling” may have other meanings than a high financial company quality, may make investors more inclined to examine companies into which the founders’ pour their own money more carefully. If goals then deviate, they might be more reluctant to invest.

6. Questioning the Underlying, Implicit Assumptions of Entrepreneurial Finance Theory

The understanding of rationality implicit in entrepreneurial finance theory leads to the above explanatory deficit when it comes to green start-up finance. Neoclassical economics informs the assumptions in entrepreneurial finance theory: economic actors are rational “homo economicus” who maximise their utility. Utility maximisation, perhaps even more so than in other economic theory, is here characterised as the single goal of maximising profit while minimising risk. Decision-making that does not conform to this logic can therefore be characterised as irrational. As discussed above, externalities may in some cases lead to a lower return rate for green start-ups. Thus, investing in such firms may, from an entrepreneurial finance theory perspective, be characterised as irrational. Indeed, investing in start-ups in general could be described as irrational from the standpoint of mainstream economic theory due to the potentially high risk coupled with average low return [96].

While behavioural finance provides empirical evidence that investors may not behave in the above described manner as is “expected” of them, behavioural finance theory also, to a large extent, holds on to these factors as being the rational ideal [79,97], even if up-to-date evidence from psychology maintains that emotions help organise rather than prevent rational thought [98]. According to Kent D. Miller, in behavioural finance “‘heuristics and biases’ make up a residual category for deviations from rationality as defined by expected utility theory” ([99], p. 60). Bounded rationality is therefore described as the “starting point” for behavioural finance [83]. According to some behavioural finance theory, financing green start-ups could thus also be described as an “irrational” act arising from e.g., affect or reliance on emotions in decision making.

There are, however, also some contributions in behavioural finance that indicate the need for rethinking the concept of rationality in finance theory. Risk has been noted not to be of an objective magnitude [79,91,99,100]. Both statistically assessable risk and non-calculable uncertainty (which is often part of entrepreneurial processes) involve personal judgement and subjectivity [99]. It is therefore difficult to judge what a “rational” handling of risk looks like in the entrepreneurial (finance) context, and it can likely only be attributed *ex post* when success or failure has already manifested itself. Furthermore, behavioural finance explanations for the tendency to integrate other goals than return in investment decisions point to an understanding of broader rationales underlying investor behaviour. These explanations include amongst others the affect heuristic [56], personal preferences [79], a wish to express personal characteristics such as values, taste and social class in investment [101] and so on. As such, not all behavioural finance theorists accept the terms of rationality from modern finance theory and neoclassical economics as used in the entrepreneurial finance literature. Frankfurt and McGoun [79] in a humorous fashion object to the dominant paradigm’s attempt to assimilate behavioural finance by labelling it the “anomalies literature” and advocate a more radical version of behavioural finance that goes beyond current conceptions of rationality.

7. Future Directions

7.1. Behavioural Finance's Need for a More Substantial Departure from Modern Finance Theory

While some theorists within behavioural finance theory object to the predominant, limited notion of rationality, it might be sensible to draw on further theoretical work from outside of behavioural finance in order to further broaden the understanding of the concept of rationality. Here, the works of Kent D. Miller [99] and Amartya Sen [102] will be particularly instructive. In the context of entrepreneurship theory, Miller champions a more comprehensive concept of rationality, which builds on other theorists' ideas (e.g., that of Alasdair MacIntyre and Nicholas Rescher) about the existence of multiple rationalities such as cognitive, practical and evaluative rationality, which correspond to beliefs, action and normative evaluation:

“Processes of opportunity discovery and opportunity creation [in entrepreneurship] evidence other, often neglected, aspects of rationality. Both processes require action, not just decision making. These processes give rise to an understanding of rationality as performative, not simply cognitive. Rather than being universal, rationality is situational; it responds contingently and creatively to the perceived exigencies of particular situations. Rational individuals pursue what is feasible, given their finite cognitive and physical capacities. Rationality is dynamic, rather than static; it is amenable to learning over time. Rationality includes critical reflection on values and learned preferences, rather than treating values and preferences as exogenously given and fixed. Rationality is subjective, not objective; only through personal *commitment* does it become normative. Norms of rationality emerge within communities of practitioners.” ([99], p. 67, emphasis added)

Miller further emphasises the relevance of feelings in entrepreneurial assessments and maintains that rationalities emerge from and are embedded in social contexts.

A seminal paper by Amartya Sen, from as early as 1977, entitled “Rational fools: A critique of the behavioural foundations of economic theory” [102] argues that economics' “first principle”—*i.e.*, self-interest—is a problematic conception of humans. Sen is harsh in his judgement of the concept of homo economicus: “The purely economic man is indeed close to being a social moron” ([102], p. 336). The treatise is written as a plea for another conception of rationality. He fiercely argues that there are a range of interests that lie between one's own and that of others (e.g., family's, friends', local communities', peer groups' and social classes') and that rationality in economic theory has been diminished to meaning the same as consistency in decision-making, within the framework of utility theory. Sen introduces “sympathy” and “commitment” as further drivers of behaviour. If sympathy is an “egotistic” driver, as it also makes the decision-maker feel good when others are better off; commitment, which induces someone to act on someone else's behalf, is a rather selfless type of reasoning behind decision-making. Commitment is a “counterpreferential choice, destroying the crucial assumption that a chosen alternative must be better than [...] the others for the person choosing it” ([102], p. 328). While Sen argues that commitment is unlikely to be important in a lot of economic behaviour, he argues that it will be of importance for public goods, where individuals share usage. This is a central claim, which makes it particularly relevant for the argument of this paper, as green start-ups

(partially) turn public goods (environmental protection) into private goods (e.g., reduced CO₂ emissions through the use of electric vehicles). The importance of commitment in the rationality underlying decision-making in the sphere of private goods may thus be expanding.

While at Sen's time of writing there had been "very few systematic attempts at testing the consistency of people's day-to-day behaviour" ([102], p. 326), behavioural economics and behavioural finance can be seen to prove him right in his argument that people are more likely to be inconsistent for reasons not directly observed or postulated. Sen, nonetheless, mentioned the contradiction between mainstream economic theory and the casual observation that people often act altruistically or in other people's interest. In his opinion, admitting that commitment may steer behaviour was not a concession of irrational decision-making. He argued that its acknowledgement would have monumental implications for economic models.

It has been argued, amongst others by behavioural finance champions, that modern finance theory is strongly normative [82,84,87] and may thus influence how research is currently carried out:

"[...] both the ontology and the epistemology of financial economics are decidedly value-impregnated, however well the methodology masquerades as perfectly objective [...] what we believe *ought to be there* leads to what we believe *is there*. And what we believe *is there* leads to how we can prove that it is, indeed, *there*, whether it is really *there* or not." ([103], pp. 159–160, emphasis in original)

Similarly, it has been argued that economic theory can influence actual market behaviour for instance by corrupting the values of those active in financial markets as well as stimulating unethically acting individuals to self-select into them [104]. Perceptions of what "rational behaviour"—or even just "common" economic behaviour—might be, may therefore limit investors' investment scopes in a way, which is inconsistent with a long-term survival of both the economy and society—*i.e.*, in the long-term irrational.

The importance of accuracy and realism in economic theories and models thus becomes clear on several levels. And a stronger departure of behavioural finance theory—including its endeavours to explain entrepreneurial finance—from modern finance theory seems warranted and necessary.

7.2. Future Research on Green Start-Up Finance

Based on the above considerations, a more comprehensive framework for studying green start-up finance can be developed (see Figure 1 below).

Some first hypotheses are here suggested:

1. Taking different forms of rationality into account will help reduce informational, cognitive and knowledge-based asymmetries between investors and green start-ups.
2. Intermediaries can help mitigate the risks involved in green start-up finance by applying specialised knowledge and networks.
3. Intermediaries can help reduce/avoid adverse selection and moral hazard through optimised matching between suitable investors and green start-ups.

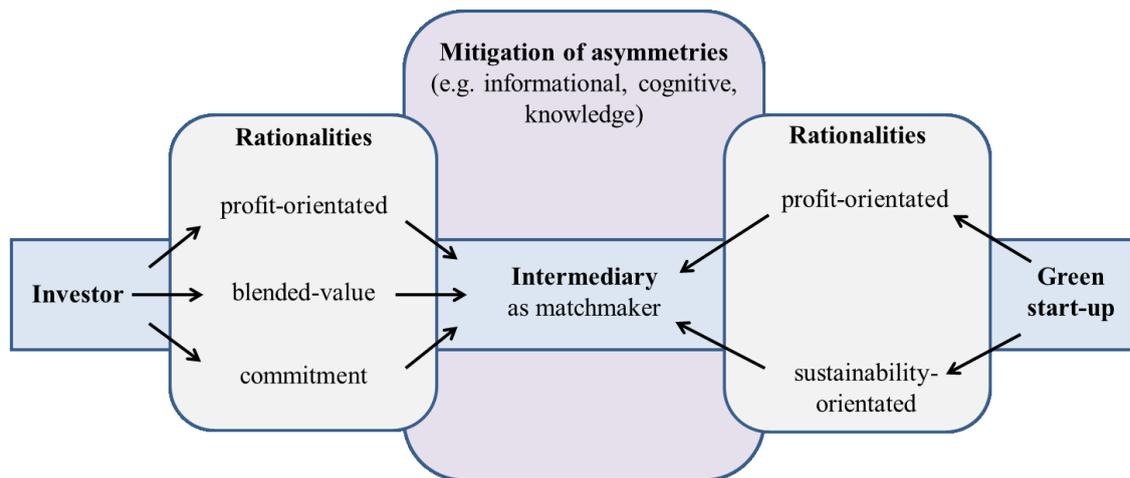


Figure 1. Framework for future research on green start-up finance with a broad conception of rationality.

A range of interesting research questions arise in light of these theoretical considerations that can be explored in future qualitative and quantitative empirical research. A few are mentioned here: How do contracts need to be drafted in order to preserve both investor and green start-up interests? What kind of impact does a blended-value approach have on investor strategy and behaviour in entrepreneurial finance? How can commitment inform an early stage investor's investment strategy? What is the impact of a longer investment time-horizon on profit levels in green start-up finance? How can intermediaries serve as a bridge between supply and demand by optimising matching in green start-up finance? In what cases do more "alternative" sources of green start-up finance (e.g., business angels, crowdfunding, family and friends) play a critical role?

8. Conclusions

Green start-ups offer products and services that provide environmental protection or substantially reduce environmental impact compared to other existing products and services. They thus, in a sense, convert (parts of) a public good into private goods. This makes them an odd case in entrepreneurial finance and one that has yet to be comprehensively explored. Using the concepts developed within the entrepreneurial finance literature, we can certainly explain some challenges in such companies: asymmetrical information problems may increase due to the relative novelty involved in introducing previous non-market elements into existing sectors or the creation of entirely new sectors. Investor inability to assess and comprehend the relevance of certain product elements or even the possibility of customer demand existing for green products and services may be the result. Investors may thus be more sceptical of green start-ups as an investment category *per se*. Furthermore, this situation may cause transaction costs to increase thus making profit expectations high in cases where this might not be realistic. Moral hazard between investor and entrepreneur may arise due to differing goals. Intermediaries may therefore be a more relevant solution than the optimisation of contracts in order to enable a better match between investor and start-up.

Some elements are more difficult to explain with the current understanding and usage of theoretical concepts in the entrepreneurial finance literature. Some concepts take on a new meaning or can be misinterpreted when not adapted to the context. For instance, when profit is not the central (or only)

goal, signalling may get distorted as the actions interpreted as “signals” mean something entirely different to the entrepreneurs than they do to the investors. Additionally, an unforeseeable or (for the company) unfortunate consequence of contracts may be a “mission drift” of company strategies arising from a shift in the goal structure when external investors gain significant decision-making rights in certain green start-ups.

Behavioural finance contributes to bridging the explanatory deficit that arises in entrepreneurial finance theory. It helps us understand the prevalence of other types of goals than profit-maximisation and risk-minimisation in actual investor behaviour—also in the context of entrepreneurial finance. Other factors may be relevant in the decision-making process such as emotion, intuition, satisficing—as opposed to optimising—as well as moral considerations or values. Therefore non-pecuniary benefits resulting from investments may also matter to the investors. On the other hand, a range of heuristics and biases are likely to fortify more conventional mind-sets (and portfolios) of many investors. These broadened decision-making criteria or influences observed in the behavioural finance literature suggest that green start-ups may also experience additional opportunities in niches—not only difficulties in the mainstream. While the possible existence of “cognitive asymmetry” between investor and entrepreneur is seen to be either costly or constructive, it may suggest that an optimised matching between likeminded investors and entrepreneurs may be the path of least resistance and most fruitful cooperation. The potential existence of “mission drift” caused by investment contracts and misconstrued “signals” from entrepreneurs regarding company quality can be used to inform further theory building in behavioural finance and direct future investor behaviour.

Behavioural finance provides a good extended framework for studying entrepreneurial finance in green start-ups. However, while some theorists already advocate another conception of rationality, there is still generally a need for a more radical departure from current notions of rationality. Cognitive asymmetry does not alone arise from differing goals, rather also from values and perceptions of the world, which, in turn, influence an individual’s rationality. There is a range of empirical indications (also arising from the case of green start-ups) that suggests that a fundamental reconsideration of this main, implicit assumption of behavioural finance—rationality based on utility maximisation, risk and return, which humans in their bounded rationality in practice often fail to attain—may be overdue.

Going beyond the two theoretical frameworks of entrepreneurial finance and behavioural finance, economic theorists Kent D. Miller and Amartya Sen instruct us towards a more comprehensive understanding of rationality and the goals and criteria behind economic decision-making, including commitment, which corresponds better to the realities of investment behaviour as observed in the behavioural finance literature. An updating of the theoretical framework of behavioural finance along these lines would lead to more realistic assessment of investment decisions related to (not only green) start-ups. An expanded concept of rationality illustrates why investing in green start-ups may be perfectly rational.

Conflicts of Interest

The author declares no conflict of interest.

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Financing innovation in sustainable start-ups – an exploration of financial access, challenges and opportunities

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Abstract: The issue of how start-ups finance their sustainable innovation processes has not yet been explored exhaustively. In this paper, empirical “work-in-progress” on access to finance and public funding for sustainable start-ups is presented. In a two-stage research process, exploratory interviews with start-ups in Finland, Germany and Sweden are first carried out – and presented in this paper – before a large-scale survey is distributed in the three countries. It is expected that there are differences between conventional and sustainable start-ups as well as between types of sustainable start-ups that are of relevance to entrepreneurial finance. Such differences may have an impact on access to and use of financial instruments and investor types in addition to leading to specific challenges and opportunities in start-ups’ financial sourcing. Building on relevant existing evidence, this research aims at exploring the whole potential range of financial usage, needs and gaps in innovative sustainable start-ups.

Keywords: Sustainable; innovation; start-ups; entrepreneurship; entrepreneurial finance; exploratory interviews; survey.

1 Introduction

Access to finance is crucial for innovation processes in both “conventional” and sustainable start-ups. There are, however, differences between conventional and sustainable start-ups as well as between types of sustainable start-ups relevant to the innovation process. Characteristics related to product/service, the entrepreneur/entrepreneurial team and the strategy of the start-up are likely to have an impact on the start-ups’ needs and requirements as well as investors’ perception of them as investment opportunities. Differences arising from such characteristics might lead to additional challenges and opportunities in start-ups’ financial sourcing. The topic of how start-ups finance their sustainable innovation processes has not yet been explored and understood well enough. More empirical work is thus needed and the goal of this work is to contribute to overcome this deficit.

2 Theoretical background

Sustainable start-ups can be defined as young companies (up to 8 years of age) that develop and launch innovative, sustainable products/services. Sustainable innovations are

“the development and successful establishment of such technical, organisational, systemic, institutional or social inventions that contribute to the conservation of critical natural resources and to global and long-term transferable production and consumption patterns and levels” (Fichter, 2005: 138, author’s translation).

Innovative start-ups’ “liability of newness and smallness” (e.g. Schaltegger & Wagner 2011: 232) can impact their access to finance (cf. Cosh et al. 2009). Banks and other financial institutions have difficulty accurately assessing risks in start-ups with radical innovations lacking a market history/benchmark and entrepreneurs who have an unknown/inexistent credit history (cf. Starobom 2013; Kerr & Nanda 2009; Megginson & Smart 2006; von Nietzsch et al. 2005). Entrepreneurs may lack collateral and the start-up may not have reached a stage in which revenues can help pay back loans (cf. Cosh et al. 2009). Some theories explore the difficulty innovative entrepreneurs experience in accessing finance: Especially agency theory and asymmetrical information situations between investors and entrepreneurs are prominent in pertinent literature (e.g. Kerr & Nanda 2009; Grichnik & Schwärzel 2005; Stiglitz & Weiss 1981; Leland & Pyle 1977).

In sustainable entrepreneurship research – both social entrepreneurship and environmental entrepreneurship – finance has yet to be explored broadly (cf. Moore et al. 2012). More research is thus still needed on the topic, due to the potential differences to conventional entrepreneurial finance (cf. Shepherd & Patzelt 2011; Nicholls & Pharoah 2008). One small-sample study finds that bootstrapping is not uncommon among sustainable entrepreneurs (cf. Choi & Gray 2008). Research related to environmental entrepreneurship focuses primarily on cleantech companies that have high capital demands (especially developing renewable energy technology) and are funded by venture capital funds (cf. Caprotti 2011; Hargadon & Kenney 2011; Bürer & Wüstenhagen 2008; O’Rourke 2005; Wüstenhagen & Teppo 2006; Randjelovic et al. 2003). In research on social entrepreneurship the variety of investor types and financial instruments assessed is greater. Still, focus lies primarily on social businesses (and social or “impact” investors) with zero or negative expected returns, which are “sustainability driven” (e.g. Nicholls & Paton 2009; Achleitner et al. 2007; John 2007), with a few exceptions (McWade 2012; Moore et al. 2012; Emerson & Spitzer 2007).

Differences can be assumed to exist both between conventional and sustainable start-ups as well as between types of sustainable start-ups that are relevant to the innovation process and entrepreneurial finance. The author has elsewhere explored such distinguishing characteristics related to a) product/service (product/service quality, level of long-term focus and level of need orientation); b) entrepreneur/team (sustainability-related motivation, use of guiding sustainability principles and level of business qualification); and c) company strategy (growth willingness, level of market orientation and insistence on retaining control and decision-making rights) and accordingly defined different types of sustainable start-ups (Bergset & Fichter, forthcoming).

3 Research design

This ARDS paper is based on work carried out in the European research project “Support Systems for Sustainable Entrepreneurship and Transformation” (SHIFT). SHIFT investigates barriers and strategies for supporting eco-innovation and sustainable entrepreneurship in Finland, Germany and Sweden. Building on previous conceptual work carried out by the author (Bergset & Fichter, forthcoming), the financial usage, needs and challenges of different types of start-ups will be empirically examined in a two-stage process. The research question can be stated as follows: How and to what extent are the needs of different types of sustainable start-ups in different phases met by financial institutions (both conventional and sustainability-oriented ones) and public funding programmes?

In the first stage, 24 short, exploratory interviews have been carried out with start-ups in Finland, Germany and Sweden. The search for companies was carried out in talks with experts, in pertinent publications as well as on the Internet. The companies were then selected based on the following criteria: a) the company was founded 2006 or later (or not yet founded); b) the company provides an innovative green product/technology or service/product-service system; c) the companies have a range of *estimated* financial needs and capital intensities (low-medium-high). Questions were asked about the type of investment/funding instruments used and their sources as well as broader questions about challenges, gaps and positive experiences. The goal of this first phase is to generate background information on the areas of relevance that should be covered in a survey as well as knowledge of the language used by the entrepreneurs in start-ups. In the second stage, these results will thus feed into a survey, which explores different types of sustainable start-ups’ actual use of financial instruments, investor types and funding programmes in different phases as well as their needs, requirements, challenges and opportunities in all three countries. Using categories of different sustainable start-ups developed in an earlier paper (Bergset & Fichter, forthcoming), we will operationalise the sustainability-related characteristics associated with product/service, entrepreneur/team and company strategy mentioned above. A comparison will be made to a control group of “conventional” start-ups. The survey will be distributed to start-ups through incubators in the project countries.

The results from the first stage of the empirical research process have been analysed in a qualitative (and semi-quantitative) content analysis. As categories for analysis we used the phases in the “Entrepreneurial lifecycle” model by Price (2004) as well as the stages commonly observed in entrepreneurial finance: early-stage (including pre-seed, seed and start-up stages) as well as expansion stage (cf. Kollmann, 2005).¹ Figure 1 shows the approximate overlaps between these different representations.

¹ We will not explore the later stage of entrepreneurial finance here as it is beyond our scope.

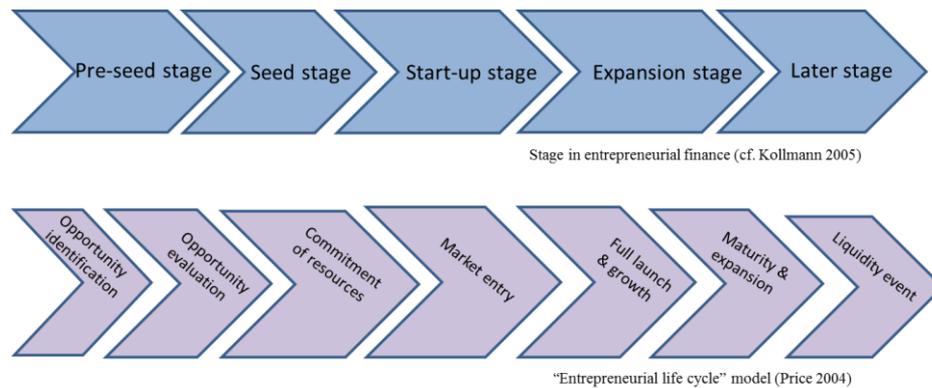


Figure 1 Comparison of stages in entrepreneurial finance and the “entrepreneurial life-cycle” model.

4 Results and discussion

Description of the companies interviewed

8 start-up companies were interviewed in each country. These interviews were on average 25 minutes long. In most cases (20), interviews were carried out with (one of) the founder(s) or the inventor (in one case no company has yet been founded), but in three cases later employed CEOs and in one case an internal consultant were interviewed instead. 7 of the 24 companies were founded by only one person, while the majority had a team of founders. 5 companies had female (co)founders. The average age of the companies was 3.8 years.¹ *Table 1* shows an overview of company characteristics.

¹ However, this is measured calculating the time passed since founding the company. Most companies spent a considerable time (up to several years) working on the idea, business plan, technology etc. in the pre-seed and seed stages before actually founding the company.

Table 1 Overview of interviewed start-ups (number of companies in brackets)

Industries	Type of offering	Phase of entrepreneurial lifecycle	Legal forms
Automotive supplier (1)	Product (12)	1. Opportunity identification (0)	Finnish Oy (8)
Biotechnology (1)	Service (9)	2. Opportunity evaluation (0)	German GmbH (4)
Business consultancy (2)	Product-Service-System (3)	3. Commitment of resources (5)	German GbR (1)
Chemicals (2)		4. Market entry (10)	German UG (1)
E-commerce (1)		5. Full launch and growth (5)	German VvaG (1)
Ecosystem services (1)		6. Maturity and expansion (1)	Swedish AB (8)
Electronics (1)		7. Liquidity event (3)	No company founded (1)
Heating/energy efficiency (1)			
Information services (2)			
Insurance (1)			
Mobility (2)			
Packaging (1)			
Renewable energy (7)			
Textiles (1)			

Sources of investment and funding

When identifying the sources of investment mentioned by the interviewees, what becomes apparent is the diversity of sources used in the early phases of company development (i.e. pre-seed and seed stages) compared to that of the start-up stage and the expansion stage. While this to a considerable extent is likely to be due to the focus being on companies under 8 years of age (most have not even reached the expansion stage (cf. Kollmann, 2005), i.e. the “full launch & growth” phase (cf. Price, 2004)), it is still an indication of the need to be more “creative” in finding sources of money in the early phases of company development. This becomes evident in funding arising from e.g. a cooperative founded for investment purposes or using paid parental leave for company development.

3 companies had so far not accessed any external public or private sources of finance/funding (one from each country, all approx. 2 years old, 1 company had relinquished by choice). Own funding, which is used by most start-ups to a larger or smaller extent (explicitly mentioned by 12 (50%)), arises through e.g. personal loans, exit

money from earlier own companies, in-kind work/no salary and cross-subsidisation with other jobs that run parallel to start-up activities. As the start-ups chosen were knowledge-based companies it comes as no surprise that 5 of the 24 companies arose from academic research projects and initially were funded as such (2 in Germany and 3 in Sweden). 2 companies in Sweden also started as spin-offs from existing companies and thus received their initial (and longer-lasting) finance from the original company. Bank loans are, as expected, not quite common in the early stages of company development: Only three of the 24 companies have been able to access debt funding due to guarantees from public funding institutions or long-term established personal contact with the bank as well as in connection with a business plan competition.

Main similarities between the countries

- Public funding for innovation and business development is used by the majority.
- Business angels are the main type of private actor that is used (7 companies (29%)).
- Public-private partnership (PPP) funding seems to be quite common; it however also often falls through due to only public and no private commitment (no private matching found in time).
- Sustainability-oriented investment or impact investment for start-ups seems still to be in development (only small sums are accessible and total volumes are still small).

Main differences between the countries

- Crowdfunding and crowd-investment seem to have spread faster in Germany, where several portals already are established. While two companies there had used crowd-investment (and one of them also crowdfunding), none had used such portals in Finland and Sweden.
- While in all countries public funding for innovation and business development is used, the range of earmarked, specific instruments used in public funding in Germany was conspicuous. Whether this echoes the broader diversity of public funding programmes in Germany compared to the landscapes in Sweden and Finland would have to be evaluated in the survey.
- While in all countries some start-ups had reached the “expansion stage” (Kollmann, 2005) or “full launch & growth” phase (cf. Price, 2004), only in Germany two companies had found external funding or finance so far in this phase.
- In Sweden, a large number of companies (6) had achieved internal funding through revenue. In Finland and Germany only 2 companies respectively were in this situation. The companies are primarily service-based companies or such product-based companies that are cross-subsidising their innovation development with consultancy for other companies (one exception existed in a technology-based company).

General challenges and gaps

Table 2 shows the type of challenges mentioned by the companies according to frequency and subsequently bundled in categories.

Table 2 Overview of general challenges in access to funding and finance as perceived by start-ups

GENERAL CHALLENGES	Finland	Germany	Sweden	Total count
Complications in application process				
Long / complex application processes for public funding	2	1	4	7
Difficult access to public money due to (private) matching need	2	4		6
Diverging evaluations within one organisation/blocking decision-makers	2	1		3
Long application processes for private investment		1		1
Investors' / funders' requirements not fulfilled				
Need for first revenues			2	2
Need for customers/proven demand			2	2
VC firms lack interest at early stage		2		2
Public funding institutions' focus is too specific (e.g. high-tech)	1		1	2
Majority of public funding goes to larger corporations	1			1
Access to investors difficult for 1-person team	1			1
Access to investors difficult when too many owners in company			1	1
Time-horizon of investment				
Time-horizon of company longer than that of investors (in general)		3	3	6
VC firms have too short time-horizons		1	2	3
Level of investment				
Early stage financial needs too high (e.g. for prototype)		2		2
High level of investment needed when going international	1			1
Risk level				
Risk averseness in public funders	1			1
Risk averseness in banks	1			1
Start-up internal issues				
Lack of information about suitable investors	2			2
Terms perceived as unacceptable (e.g. high share of company demanded)	1			1
Fear of losing control to investors			1	1

There is a broad range of challenges, most of these common for all start-ups, not only sustainable start-ups. Several start-ups described public funding processes as too long and complex. Many were not able to access public funding due to a lacking private matching.

The time-horizon of investors (and especially VC firms) was considered to be too short for knowledge-based companies developing innovation.

Gaps according to size of funding/investment as well as the phase are perceived very differently by the interviewed start-ups, indicating a need to relate this question to type of company in the future survey.

Sustainability-related opportunities and challenges

Only a few companies (3 German, 1 Swedish) had received finance from “sustainability-oriented” investors (providing a specific opportunity to such start-ups), as identified by the companies themselves due to investor motivation or the type of investments they made, e.g. renewable energy. Equity was received in the pre-seed/seed stages from one business angel with renewable energy experience, one venture capital provider with a strict Cleantech portfolio and one family office. In the start-up stage, another sustainability-oriented family office acquired 80% of one company.

Table 3 Overview of sustainability-related challenges in access to funding and finance as perceived by start-ups

SUSTAINABILITY-RELATED CHALLENGES	Finland	Germany	Sweden	Total count
External issues				
Hindering / uncertain regulation	1	1	2	4
Start-up internal issues				
Important to company that investors have similar values		1	1	2
Issues related to investors / funders				
Lack of understanding of legal form/type of business		1	1	2
Lack knowledge due to lack of established benchmarks for sustainable services	1			1
Scepticism that customers will pay for "green solutions"	1			1
Company's sustainability approach makes investors lack interest		1		1
Legal form of cooperatives is suspicious to investors due to spread of control		1		1
Profit opportunities in company too low for investors		1		1
Lack of understanding of underlying environmental issues impacting ability to assess the potential market			1	1

Although challenges were not divided specifically into general and sustainability in the interviews, some challenges were blatantly related to the sustainability aspects of the start-up and its innovation. *Table 3* shows these sustainability-related challenges in accessing funding and finance. While some companies had several challenges in this category, revealingly, as many as 10 of 24 companies (42%) experienced at least one challenge explicitly related to the sustainability of their company or product/service. Interestingly, the possibility that investors would not be interested in sustainable start-ups

was not considered likely by most interviewees. Rather, the main concern among the start-ups was the lack of investor understanding and knowledge about sustainability-related issues that may have an impact on product, possible market or business model. It is possible that some of the reasons listed above as “general” reasons (i.e. reasons that are relevant for all start-ups) are also somehow sustainability-related (e.g. a long time-horizon may arise due to the type of radical sustainable innovation that the start-up is developing). This possibility should be taken into account in the survey design.

5 Conclusion

This ARDS has delivered a preliminary impression of financial access and challenges of sustainable start-ups seeking money in Finland, Germany and Sweden. Phase 1 of the empirical research has provided useful information that will be used in developing the survey in phase 2. Amongst others the survey design will have to allow for an explicit exploration of sustainability-related challenges (and distinguish these from “general” challenges in entrepreneurial finance), look more thoroughly at the national differences in the project countries as well as develop appropriate questions on perceived gaps in finance and funding for sustainable start-ups.

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ARDS - Feedback

First, feedback is requested on how the findings from the interviews should feed into the survey at second stage of quantitative empirical research. Second, feedback is requested on the survey design itself.

SHIFT Workshop with Investors, Intermediaries and Start-ups in Berlin 5.11.2015

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1 Goal and setting of the workshop

In the empirical work of Work Package 6 in the SHIFT project – exploratory interviews and a survey – a strong focus lay on the demand side of green start-ups and their challenges, difficulties and opportunities in accessing finance and funding. In order to also explore the perceptions and realities of the supply side, a workshop was carried out with investors, public funding organisations, intermediaries as well as a few start-ups. In this workshop key findings from the interviews and survey were presented and discussed. The perspective of start-ups was also directly presented by two start-ups: one service-based company offering a green and sustainable household insurance and one high-tech renewable wind energy company. In reply to the SHIFT presentation, a representative of the venture capital industry, the *German Private Equity and Venture Capital Association (BVK e.V.)*, presented his viewpoint on the situation of venture capital generally in Germany and specifically for young Clean-tech companies. Furthermore, representatives for both early stage investors – *Business Angels Netzwerk Deutschland (BAND)* – and sustainability-oriented investors – *Forum Nachhaltige Geldanlagen (FNG)* – presented key figures and the rationales of their respective investor groups. Subsequently, the results and presentations were discussed in a group of approximately 30 invited experts.

2 Input from the investor representatives

- *Martin Bolits, German Private Equity and Venture Capital Association (BVK e.V.)*

Martin Bolits does not observe particular challenges for Cleantech or green companies, but agreed that new and young companies, particularly those that are high-tech and highly innovative, may struggle with expansion stage finance in Germany. The seed and start-up phases are, relatively speaking, easier in terms of finance. The so-called „valley of death” makes it difficult also for companies with environmental technology to scale-up their activities. There is relatively little venture capital being invested in Germany compared to other European countries (below average investment per GDP). There is also no strong venture capital “culture” in Germany, compared to e.g. the US. There is, however, a strong trend of foreign investors in early stage finance in Germany. Venture capital funds increasingly seek investors abroad, not only in Germany. A further challenge is the lack of exit channels for early stage investors in Germany.

At the same time, green technologies are seen as forward-looking and particularly innovative among equity investors, particularly institutional investors. ESG (Environment, Social, and Governance) criteria are growing in importance. Blackstone was mentioned as one example of an investment firm that integrates ESG issues in their portfolio and seeks savings potentials (i.e. win-win situations) through applying green criteria. Furthermore, it is seen as an important signal from the political side, that the issues of environment and entrepreneurship are increasingly seen together: e.g. the new Juncker investment plan (i.e. The European Fund for Strategic Investments (EFSI)) at EU level seeks to target green start-ups with investment.

As possible solutions to current challenges for young companies, the BVK suggests amongst others the following: “research bonus” to provide incentives to young companies with a high level of research and development (R&D) that are still at a non-profitable stage; a “patent box” that provides tax incentives for revenue from the utilisation of intellectual property and EU conform treatment of loss carryforward taxation. Further measures for venture capital funds and investors include legally enshrined tax transparency for funds and rollover options for investors in venture capital without tax disadvantages.

There are no official statistics at national level specifically in the area of Cleantech, but unofficial counts yield approximately 60 venture capital / growth finance deals in the last three years. While green start-ups are not seen to suffer more challenges in financial access than other start-ups, Bolits concedes that there are few German venture capital firms that specialise in the area of Cleantech and mentioned a few examples: eCapital, Munich Venture Partners and Sirius Venture Partners. Nonetheless, all venture capital firms that invest in innovation and IT are also open to financing innovative green companies.

- *Roland Kirchhof, Business Angels Netzwerk Deutschland*

Business angels as investor/mentors provide both money and know-how to the companies they invest in. They generally invest between ca. €50.000 and 500.000 and have a profit expectation of ap-

proximately +/- 10%. Smaller investments are generally too costly due to the involved transaction costs. Most business angels are not organised in networks, so the number of business angels in Germany is difficult to assess with certainty: approximately 7.500 business angels are active in Germany, 1.400 are organised in networks. Although individual sums may be small, they jointly invest approximately €650 million each year, which compares well to the €590 million invested yearly in venture capital (cf. numbers from ZEW). In the regular surveys conducted by BAND called "Business Angels Panel", environment and energy have been one of the most popular categories of investees alongside IT and medicine in the last three years. Also in the High-Tech Gründerfonds, there is a substantial proportion of green start-ups being funded (8-10% of whole portfolio). There is thus a financing niche for green start-ups: they are even quite popular.

Still, there might be a few barriers, as in practice there is some reservation with regard to engaging with green start-ups. The sheer broadness of the category and the heterogeneity of green start-ups make it more difficult for business angels to specialise in the area. Also, either the number of potential investees is too small or they are not identified by the investors. There might be a gap here for a business angel network, which is specialised on green start-ups, as can be found in the US.

Investors are generally market-oriented and welcome the "green" element. It is however not a deciding factor for them and it does not necessarily provide a decisive distinguishing characteristic compared to other business areas. Mission-orientation in green start-ups is something which is hard to digest for investors. As can be seen in other technology-based companies, green technology-based companies are sometimes too little market-oriented and focus too exclusively on their technology development. There might thus be a need to provide qualification measures to green start-ups to make them investment-ready. On the other hand, it might be helpful to provide better information on green start-ups for investors and provide fora or networks for "green angels". It would also be sensible to target both sides with specific matching formats and maybe a public seed fund and a growth fund.

Investors are receptive to the general tendency towards sustainability-orientation in society and politics and will likely consider sustainability criteria for their investments increasingly in future.

- *Volker Weber, Forum Nachhaltige Geldanlagen*

In Germany, €127.3 billion were invested in sustainable investment last year. These investors analyse their potential investees according to, first, the sustainability criteria and, second, the financial aspects.

Based on our work we would segment sustainable investors into the following categories:

- (1) The idealists (18%) – high-sustainability investors
- (2) The profit-focused investors (36%) – concerned with new developments where there is a chance of very high profitability
- (3) The profit-interested investors with ethical orientation (9%) – high stable profits
- (4) The risk-averse investors (27%) – secure preservation of capital in each phase

- (5) The responsibility-aware investors with an expectation of profitability (10%) – focus on generational equity

Start-ups in general, not only green or sustainability-oriented start-ups, have to increasingly adapt to the general trend of ESG-assessment in investment and prepare a sustainability strategy early on. This can also save money when done early and not developed only at a later stage with consultants as an “add-on”. They can integrate sustainability in their DNA, by dealing with codices such as the RNE Nachhaltigkeitskodex, the UN Global Compact or the ISO 26000 Guidance of Social Responsibility.

3 Main discussion points of the workshop

- **Specificity of green start-ups and consequences for access to finance**

There was a rather general consensus on the need to distinguish between different types of green start-ups and that these cannot be merged into one category. Due to the level of heterogeneity and the number of green sectors, there is a need to cluster or categories these. The need to define what is meant by “green” and what types of companies we are talking about was also mentioned as crucial by one intermediary. Two general strands that were mentioned by several participants were, one the one hand, the “Cleantech cluster” of profit-oriented, and, on the other hand, the social and sustainability-oriented category of companies. The latter were seen as being more “mission-driven”, but were noted to also have the potential to become big and also be profitable (to some extent). It was mentioned that there is need to set straight the record on „mission-driven” companies: These do not per se offer an unprofitable proposition. The “good-to-great” approach in the US was also mentioned – sometimes the growth and performance of mission-driven companies (such as e.g. Patagonia) is stronger due to their authentic, sustainable approach, not despite of it.

The consequences for finance were also discussed in the context of different types of start-ups. For investors, it is difficult to specialise on green start-ups as the category encompasses so many diverse types of business activities. A start-up representative maintained that green start-ups may be different to other start-ups, but that they have similar financial access problems.

A category that was seen to have specific challenges was that of the disruptive or radical innovations in the areas of energy and infrastructure: These have a high capital need and experience barriers due to the number of licences and permits that are needed for their activities, even just to get started on pilots and testing. The level of risk is therefore also very high for these companies. A suggestion was made that policy and intermediaries should enable protected economic zones for such companies where the red-tape is reduced substantially and experimentation is encouraged. This was seen as an area where public involvement and public incubators have a clear role to get involved. Another idea was to bring in strategic investors from abroad to invest in such larger projects.

- **Mobilisation of money**

According to one start-up representative, the lack of money is not really an issue in the German Economy; the question is rather how it can be mobilised for risk investment. One possible solution was seen in lead investors who act as pioneers and mobilisers of other investors. Some investors claimed that they are not convinced of green start-ups’ significance in terms of numbers. Here, the suggestion was made that green start-ups, which are estimated to make up 14% of all new companies (cf. Green Economy Startup Monitor), should be made more publicly visible.

- **Level of profitability and investment time-horizon**

While there was a concession on the investor side, both from venture capital representative and business angel representative that profitability and growth potential are crucial aspects for most investors, it was maintained that German venture capital firms are less “aggressive” than the American ones. German VC firms are generally involved longer (4-6 years, some even up to 10 years). One start-up representative argued that for many green start-ups the investment horizon is fairly long and that many investors do not have the courage to “think big”. Related to this issue of mobilisation the issue of exit was discussed. An investor maintained that early stage investment is an “exit-driven” business, which however is complicated in Germany due to the lack of and uncertainty of exit options. This makes it even more important to be patient and involved in specific companies for a longer time period.

- **Need for appropriate matching**

There is currently a lack of appropriate matching between green start-ups and investors who are open to such start-ups. There are no specialised business angels networks for green start-ups. One investor stated the need for green start-ups to find the appropriate investment team, which would be patient enough to wait for an exit down the road. A start-up representative mentioned the need for (investment) partners who understand green business model and the importance of the sustainability characteristics that are essential for some green start-ups. At the same time, pitch events were seen as less helpful than personal connections, indicating a need for other network formats than those currently used.

- **National vs. international perspective**

Due to the relative lack of risk investments in Germany, the issue of international investors was touched upon by several participants. One investor representative mentioned the need for a pan-European strategy (e.g. a European stock exchange segment or by bundling different technology fields). A start-up representative mentioned the option of seeking investors from the US or China who are often more globally oriented.

- **Political and legal conditions**

Several investor representatives berated the lack of policy stability for investments in green start-ups. Renewable energy legislation has been bold, but rather instable in Germany over the past few years. This is something which makes green start-ups an even riskier area of investments at the early stage.

The role of public money was also mentioned several times: There should be specific grants and green investment funds targeting green start-ups. Those funding programmes that currently are available are often difficult to access due to high levels of bureaucracy and long waiting times, which need to be simplified and improved.

- **Need for more research**

An investor representative argued that early stage investment is an area that it is difficult to get good, representative data for. There is a definite need for more research here. Not only quantitative data is needed, interested was also expressed for case studies on successful investment in green start-up as well as cases of investment histories and follow-on investment stories.

4 Correspondence with findings from empirical work in SHIFT

The need to further categorise types of green start-ups, which was mentioned several times in the workshop, was also made apparent by the results of the survey in the SHIFT project. While there was some disagreement with regard to specific challenges for green start-ups, Martin Bolits' presentation about difficulties for innovative and expansion phase funding correspond to findings of the survey.

The finding in the survey that green start-ups' teams often lack a business background was acknowledged and verified by the participants of the workshop. In this context, the need to make green start-ups "investment ready" was maintained.

Similarly, there was an acknowledgement of investors' lack of information and knowledge about green business models. It was argued that more information should be made available in order to enable better investor assessment in this area. However, there was a level of disagreement regarding the existence of investors who might be willing to forego some profits in order to achieve a societal impact. One intermediary also mentioned the different "languages" spoken by investors and start-ups and the challenge in overcoming this linguistic gap.

Finally, the need for optimised and adapted matching seemed to be a consensus in the group.

5 11 key propositions resulting from the workshop

- (1) There is disagreement regarding the existence of particular challenges in financial access for green start-ups. It is nonetheless maintained that certain characteristics – such as a sustainability-orientation, a high level of innovativeness and a high level of technology – can lead to a large amount of barriers and challenges in early stage finance for such companies.
- (2) As early stage finance in the green economy impacts both potentially highly profitable Cleantech companies as well as social businesses and social entrepreneurs, a clear differentiation of the different types of start-ups and investors is helpful for an optimised matching of green start-ups with investors. It should, however, be noted that “mission-driven” does not mean incompatibility with market activity.
- (3) ESG (Environment, Social & Governance) issues play a growing role for investors. Even if sustainability-oriented investors still play a relatively limited role in early stage company finance, it can be assumed that sustainability criteria will become increasingly important also for early stage investors in general due to current societal developments and trends (climate change, energy transitions etc.).
- (4) Venture capital is relatively limited in Germany. Early stage investment is thus a general challenge – not only for green start-ups. Private capital, which is abundantly available in Germany, should therefore, if needed with public support, be mobilised for risk capital.
- (5) It would be sensible to consider the lifelong investment cycle of companies as a whole and build a network, which helps facilitate and enable exit strategies and future investment rounds from early stage to more mature company stages.
- (6) In order to strengthen the investment culture in Germany it might be sensible to encourage the current trend of foreign investors’ activity in early stage investment in Germany. Such a strategy would also benefit green start-ups. A pan-European strategy (such as e.g. INNEON) might be particularly advantageous.
- (7) Patience is necessary in the financing of many green start-ups: „Patient capital“ – a more long-term oriented investment strategy is thus necessary.
- (8) Investors who are interested in green business models should be sensitised to the relevance of sustainability issues for the investment. Green start-ups, on the other hand, should be offered adapted “investment readiness” programmes to help them prepare for investor interaction.
- (9) Specialised investor networks and pioneer investors could act as role models in start-up investment in the Green Economy and could thus help mobilise other interested investors.
- (10) Radical innovation with high capital demands and regulatory barriers might benefit from the development of innovation parks with infrastructure for testing and experimentation as well as regulatory exemptions and special provisions at the early stages.

(11) More research and diffusion of knowledge is needed in the field of early stage finance for the Green Economy, both in terms of quantitative data as well as more qualitative success stories and best practice.