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Green startups: a new typology for sustainable entrepreneurship and innovation research Based on FinTech*

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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. Among the necessary tools to provide the necessary financial resources needed for the activities of green startups; The use of new financial technologies ("FinTech"). This technology is capable of providing green financial technologies such as blockchain, IoT and big data and their applications to achieve sustainable development goals. 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 startups. 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, Fintech.

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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 re- sources 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 organization 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 (Shep-herd 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 analyses 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.

1.1. Types of startups

Every day, different types of startups and startup companies are emerging around the world. Many startup ideas fail during their evolution. Some are good startup ideas and are known as successful startup companies in their own country or even globally. Startups can be categorized from two perspectives:

a. This category is related to the intellectual nature of startup ideas and their trustees.
b. The second category is mostly based on startup investment and income. Like small or traditional businesses whose startup idea is more about making money from its members and not growing high. Types of startups are either based on the personal capital of people who are at a good financial level or are created on the basis of foreign investment (Roodpaohti et.al,2019). One of the classes of startups are green startups, which will be described below.

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 environ- mental 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 re- sources 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 emphasizes 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) de- fines sustainable innovation as "the development and implementation of a radically new or significantly improved technical, organizational, 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 se- cure 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 practices, 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 be- come 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 analyses 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 con- sidered 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 organizations. 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 organizations (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 sustainabil- ity within a triple-bottom-line – especially as external actors may interfere with sustaina- bility-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: FinTech Roles

Green start-ups like any other start-ups are dependent on adequate resource acquisition. Finance is characterized as a central aspect of entrepreneurial success (Schaper, 2002). Sufficient initial capital may provide start-ups with a buffer that enables them to over- 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 Europe- an 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 focusing 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 plat-forms 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. Staroßom, 2013; Cosh et al., 2009; Kerr and Nanda, 2009; Megginson and Smart, 2006; von Nietzsch et al., 2005). However, a green start-up might experience further and other challenges due to their involvement in busi- ness 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 entrepreneur- ship 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).

One of the most important technological financial tools to provide the financial resources and capital needed by green startups is the use of fin-tech and blockchain technologies. FinTech, or financial technology, which is equivalent to the term "FinTech", means; "Innovative use of technology to provide financial services" and, of course, a step up, seeks to empower people as users of financial services. "FinTech" which some people also call "FinTech" or "FinTech"; With the development of the startup space in the world, it became popular, but; In general, it is not specific to startups and large companies in Iran and the world operate in this field. The future development and adoption of blockchain, IoT, big data and other related technologies offers the promise of systemic transformation: a radically different financial and capital allocation system geared toward inclusive and sustainable development. These new technologies are at an early stage of development and their future trajectories are difficult to predict with confidence. However, the net effect of applications of fintech and blockchain technology to the wide range of potential use-cases above will be to substantially improve reliability (such as identity and financial inclusion), increase access to services (such as energy, banking and property ownership) and importantly, lower overall system costs. The aggregate impact of lower costs in each individual organization or service-provider, and given sufficient competition and market dynamics, may have the positive effect of lowering the costs of achieving the goals connected to these services (Nassiry, 2018).

Financial instruments with the ability to mobilize public and private capital toward low-carbon, climate-resilient investment are therefore key to success. One of the most dynamic instruments in the area of sustainable finance comprises green bonds, which are fixed-income instruments whose proceeds are used by the issuer for environmental projects. Over the past decade, investor demand for these instruments has been growing in response to shifts in policy and capital allocation due to growing concerns about climate change and sustainability. Moody’s (2018) projects that the global issuance of green bonds will grow to between $175 billion and $200 billion in 2018, up from $155 billion of green bonds issued in 2017. In Europe, Nordic countries have pioneered the use of green bonds to mobilize capital for investment in sustainable infrastructure and related sectors. Beginning in the 1970s, Sweden, Norway, Denmark and Finland have demonstrated leadership in environmental policy, regulation and changes in behavior consistent with a sustainable economy (McCormick et al. 2015). Nordic countries have also pioneered the use of green bonds to mobilize capital for sustainability goals (Nassiry,2018).

2.5. Typologies in sustainable entrepreneurship research

There is a range of typologies distinguishing different types of sustainable entrepreneur- ship in the literature. We summaries a selection of these in Table1. 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 an- other. 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 analysis. They differentiate between four different types: innovative opportunists, visionary champions, ethical mavericks and ad hoc enviropreneurs.

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 entrepreneur- ship, 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 devel- op a new typology, which is suitable to properly analyse and explain the financial chal- lenges and opportunities of green start-ups.

Table 1. Characteristics of typologies in sustainable entrepreneurship literature

Author (Year)	Main characteristics of typology	Typology (actor types)	Type of organization	Central social unit	Main purpose of the typology
Isaak(1998) "green business"	Degree of environmental Orientation of a company's core business	-Green business -Green business	Startups And incumbents	Organizations	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	Startups	Mixture of organisations and individual	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 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-reluctan t start-ups	Startups	Mixture of organizations and individuals	Discovering opportunities For implementation of environmental management from the beginning of a company
Hockerts And Wüstenhagen, (2010) "Sustainable entrepreneurs"	Degree of environmental orientation of a company's core business and reach due to market presence	-David -Goliaths	Startups 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 mision" and type of revenue model	-Traditional NGO -Not-for profit social enterprise -Social hybrid social enterprise -Economic hybrid social enterprise -For profit social enterprise	Startups and incumbents	Organisations	Enabling empirical research of social enterprises at the macro-level

Source: Bergset & Fichter (2015), Journal of Innovation Management

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 over- arching categories: product/service-related characteristics, entrepreneur-related character- istics 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 important in early stage investment deals where uncertainty abounds (cf. Breuer and Breuer, 2005). These over- arching 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 so- cio-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 (Prahalad 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 (Prahalad 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 con-ventional business (York and Venkataraman, 2010). Altruistic tendencies might further-more facilitate an entrepreneur's recognition and creation of sustainable innovation (Pat-zelt and Shepherd, 2011). Environmental entrepreneurs, as opposed to social entrepre-neurs, 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 materi- als. This principle applies to approaches such as biomimicry (Fichter, 2005) and "cra- dle-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 pat- terns in society (cf. Fichter, 2005). All guiding principles are a potential source of inspira- tion for innovative business models and product-service-systems. Sustainable entrepre- neurs 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 qualifica- tion is considered of paramount importance in both general entrepreneurship and sustain- able 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 conse- quence 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, commu- nity 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 favor 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 sus- tainability (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.

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 analyzing 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 organizational 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 synthesized 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 de- scribed above.

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 timein 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 (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 skepticism 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" andthus 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 prioritizing 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.

Source: Bergset & Fichter (2015), Journal of Innovation Management

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

Main characteristics of typology	Typology (actor types)	Type of organization	Central social unit	Main purpose of the typology
- Product-related characteristics - Entrepreneur related characteristics - Strategy-related characteristics	- The alternative start-up - The visionary start-up - The inventive start-up - The ecopreneurial start-up - The unintentionally green 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

Source: Bergset & Fichter (2015), Journal of Innovation Management

- **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 alter- native 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 ev- er-increasing pace of modern life and economy. Some use underutilized 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 levels 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 comforta- ble 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 realization 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 environ- mental 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.

5. Subnational Pooled Financing Mechanisms in Green Startups

One of the key financial innovations at the institutional level for green startups has been the use of a structure known as subnational pooled financing mechanisms (SPFMs) as means of raising sustainability-oriented capital from financial markets. As International Institute for Sustainable Development (IISD) (2018) explains:

"Most SPFMs require the set-up of a Special Purpose Vehicle (SPV) that have transparent governance structure and processes. These SPVs, whose structure depends on national laws, are responsible for contracting debt and making debt service payments on this debt. They are usually owned by governments, though owners can also include the private sector, development partners, NGOs, etc. SPFMs must be structured in such a way as to have a high-level of creditworthiness. This can be achieved by using several levels of credit enhancements, which would be cost-prohibitive if applied to individual projects. These enhancements include reserve accounts, cash flow over-collateralization, intergovernmental financial transfers and intercepts, partial credit guarantees, first loss-facilities and subsidies".

According to the Global Fund for Cities Development (FMDV), SPFMs “have been successfully used since 1898 in securing finance for both large and small local projects, securing over $1 trillion in finance in the US and Europe, and over $2.6 billion in developing countries” (FMDV 2017, p. 6).In Europe, Nordic countries in particular have applied the SPFM model to meet subnational financing needs for green startups. Examples of Nordic PFAs include Kommuninvest (Sweden), an organization jointly owned by local government authorities and that acts as an aggregator and conduit issuer to Swedish local governments and uses proceeds from its green bond capital-raising for lending to Swedish municipalities in the form of green loans, which members then use to invest in environmental projects; KommuneKredit (Denmark), which serves as a municipal credit aggregation agency and is similar in function to Kommuninvest and Kommunalbanken; and MuniFin (Finland), which is the main financial services provider to Finland’s local governments and offers a discount margin to its borrowers to provide an incentive to propose projects depending on how ‘green’ the project is in terms of its environmental sustainability (Climate Bonds Initiative 2018).In addition, an important blockchain use-case has begun to take shape in monitoring green bonds proceeds in the form of the Green Asset Wallet initiative (Repinski, 2017). The project, led by Stockholm Green Digital Finance and backed by Norway’s Center for International Climate Research (CICERO), applies the concept of sustainability attribution to green financial investments. As CICERO (2018) explains:

"The project ... is designed to equip green investors with the technology to better deliver on the goals of the Paris Climate Agreement and the SDGs. ... The wallet is based on open-source technology tailored for capital market actors. The technology will offer a platform for validation of, as well as impact reporting on, green investments. The Green Assets Wallet will help to effectively channel private institutional capital to green projects globally, specifically supporting green emerging markets investments. In spite of the rapid growth in the green bond market, transparency remains a concern among investors. Continued momentum in the growth of the green bonds market and more broadly in the expansion of green finance will be contingent on transparency in the use of proceeds (Santibanez et al. 2015; Kyriakou 2017; Linsell 2017). In order to raise capital for the implementation of the Paris Agreement and, developing countries in Asia and other regions may expand the use of green bonds, adopt financing models such as SPFMs, and further develop and implement innovative fintech and

blockchain approaches to enhance and promote the growth and transparency of their growing green bonds markets.Adoption of innovative approaches, such as the Green Asset Wallet initiative described above, could provide additional means to boost investor confidence in the underlying quality of green financial instruments".

Major developing countries in Asia have recently begun to adopt and extend innovative approaches to promote green finance. The People's Republic of China (PRC) has identified the establishment of a green financial system as a goal in its Thirteenth Five-Year Plan (Central Committee of the Communist Party of China (CPC) 2016) and has taken the lead in creating new institutional frameworks and incentives for green finance and green bonds. The Guidelines for Establishing the Green Financial System, released in 2016 by the People's Bank of China (PBOC), the Ministries of Finance and Environmental Protection, the National Development and Reform Commission (NDRC), and the banking, insurance, and securities commissions, all emphasize the importance of establishing a green financial system, including "financial instruments such as green credit, green bonds, green stock indices and related products, green development funds, green insurance, and carbon finance, as well as relevant policy incentives to support the green transformation of the economy" (People's Bank of China, 2016). The PRC's growth in activity in the green bonds market has propelled the country into a leadership position, and green bond issuance from this country represents one of the largest sources of issuance in the global green bond market (Climate Bonds Initiative 2017).

6. Overview and discussion

Table 4 summarizes 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 synthesizes 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 skillfully 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	Medium-high
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

	The alternative start-up	The visionary start-up	The inventive start-up	The ecopreneurial start-up	The unintentionally Green start-up
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

Source: Bergset & Fichter (2015), Journal of Innovation Management

7. 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 be- tween 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.

8. 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.

The future development and adoption of blockchain, IoT, big data and other related technologies offers the promise of systemic

transformation: a radically different financial and capital allocation system geared toward inclusive and sustainable development. These new technologies are at an early stage of development and their future trajectories are difficult to predict with confidence. However, the net effect of applications of fintech and blockchain technology to the wide range of potential use-cases above will be to substantially improve reliability (such as identity and financial inclusion), increase access to services (such as energy, banking and property ownership) and importantly, lower overall system costs. The aggregate impact of lower costs in each individual organization or service-provider, and given sufficient competition and market dynamics, may have the positive effect of lowering the costs of achieving the goals connected to these services (Nassiry,2018).

Of course, there will be growing pains, particularly as the system takes shape. According to Tapscott (2016), "[t]he biggest problems...have to do with governance. Any controversy that you read about today is going to revolve around these governance issues. This new community is in its infancy. Unlike the Internet, which has a sophisticated governance ecosystem, the whole world of blockchain and digital currencies is the Wild West." The significant energy use of blockchain consensus algorithms relying on proof-of-work, as compared to the more efficient proof-of-stake approach, will also need to be resolved. However, even critics such as Roubini and Byrne (2018) who labeled blockchain "one of the most overhyped technologies ever" due to its inefficiency compared to existing databases and its superior demand for storage space and computing power, among other limitations, have conceded that blockchain could have "potentially far-reaching implications" if combined with "secure, remote automation of financial and machine processes" and in "specific, well-defined, and complex applications" such as in interaction with self-driving cars or drones.

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 skeptical of equity investment due to having to relinquish decision-making rights and control, un- less 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 organization, 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 startups find appropriate investors and vice versa. Information access and qualification programs 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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