



Why do they do it? Corporate venture capital investments in cleantech startups



Puck D. Hegeman^{*}, Roger Sørheim

Department of Industrial Economics and Technology Management, Norwegian University of Science and Technology (NTNU), Alfred Getz Veg 3, 7491, Trondheim, Norway

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ABSTRACT

Sustainable startups commercializing a clean technology provide an opportunity for a greener future. Despite their high investment risks, cleantech startups increasingly attract corporate venture capital. This paper explores which companies invest venture capital in cleantech startups and why they do it. It includes 26 cases of established companies that invested in cleantech startups founded in Norway between 1999 and 2012. This study broadens the scope of corporate venture capital research. The findings show that corporate venture capital investors are more heterogeneous than assumed in the literature thus far. Firstly, it finds that small and medium enterprises are active corporate venture capital investors. Secondly, it reveals that the motivations to invest are more diverse than hitherto assumed. The study adds to the sustainability literature by empirically revealing that large companies invest corporate venture capital to promote corporate greening to maintain competitiveness.

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1. Introduction

Investment in sustainable startups drives the transition to cleaner production (Bocken, 2015; De Lange, 2019). This is eminent in environmentally sustainable startups commercializing a clean technology (cleantech). Consequentially, research has increasingly focused on the involvement of different providers of entrepreneurial finance (De Lange, 2019). Venture capitalists have been identified as potential contributors to sustainable enterprises (Bocken, 2015; Bento et al., 2019). Previous studies have also focused on the difficulties facing investors in cleantech startups. Venture capital fund investors typically shy away from the long development times and capital-intensive nature of cleantech commercialization (Gaddy et al., 2017). Investors are also deterred by exposure to unstable government regulations and an unfavorable track record (Ghosh and Nanda, 2010). Furthermore, contributions to reduced environmental degradation do not translate into financial returns (Beise and Rennings, 2005). These factors have

diminished investor interest in cleantech startups (De Lange, 2016, 2017, 2019; Cumming et al., 2016). In contrast, corporate venture capital investors (CVCIs) are increasingly investing in cleantech startups (Cleantech Group, 2015).

There is limited knowledge about CVCIs' involvement in the financing of green startups (Hockerts and Wüstenhagen, 2010; Bjørgum and Sørheim, 2015; De Lange and Valliere, 2020b). In general, CVCIs invest for more than purely financial gain, as companies are known to invest for strategic reasons as well (Gompers and Lerner, 1998). A strategic goal can be to gain insights into new markets or novel technologies or to support the development of complementary products (Dushnitsky and Lenox, 2006). Previous research has focused on large firms investing corporate venture capital (CVC), while other types of investors have been overlooked (Van De Vrande and Vanhaverbeke, 2013). It is also unknown whether these investments are in any way motivated by the environmental innovations the commercialized technology features (Hockerts and Wüstenhagen, 2010). Therefore, this present study focuses on companies that provided equity to environmentally sustainable startups. To explore whether the investments are motivated by the green profile of the startups, this paper combines Bansal and Roth (2000) framework on why companies "go green" with insights from CVC literature on the motivations of CVCIs.

^{*} Corresponding author.

E-mail addresses: puck.hegeman@ntnu.no (P.D. Hegeman), Roger.sorheim@ntnu.no (R. Sørheim).

This study questions who the CVCI in environmentally sustainable startups are and why they invest. To answer the research questions, an exploratory case study was carried out with 26 established companies that invested capital in cleantech startups. Pernick and Wilder (2007, p.2) define cleantech as “any product, service, or process that delivers value using limited or zero nonrenewable resources and/or creates significantly less waste than conventional offerings.” Thus, cleantech refers to four main sectors: energy (including renewable energy, energy efficiency, fuel cells and hydrogen), transportation, water, and materials (Cumming et al., 2016). The startups were founded in an academic setting in Norway between 1999 and 2012. This study established 14 of the companies’ motivations to invest by using case documents and conducting in-depth interviews with seven of the corporate investors.

This paper makes several contributions to literature and practice. First, it broadens the scope of the traditional CVC literature by examining all corporations that invest CVC in cleantech startups. Prior CVC studies have overlooked small and medium enterprises (SMEs) because of limited data availability (Van De Vrande and Vanhaverbeke, 2013; Titus et al., 2017) and the assumption that large firms are more active CVCI (Dushnitsky and Lenox, 2005a; Keil et al., 2008). This study includes SMEs, revealing them as comprising a group of active CVCI. Similarly, the majority of CVC studies have focused on investments made via CVC units. CVC can also be invested directly, with operating business units managing CVC activities (Dushnitsky and Shaver, 2009; Dushnitsky, 2006; Miles and Covin, 2002). This study includes investments made directly and via CVC units. Second, this study adds to the sustainability literature by empirically confirming that CVC investment can be an action of companies’ green responsiveness (Hockerts and Wüstenhagen, 2010; Bocken, 2015). At the same time, the heterogeneity of CVCI and of their motivations for investing is pointed out. This study confirms that on one hand, large CVCI are motivated by the strategic value of green opportunities presented by the startups. On the other hand, SMEs are mostly unaware of the green profile. Third, this study has policy implications. Increased investments in environmentally sustainable startups can contribute to the transformation to a more sustainable economic system, which is referred to as a “green revolution” (Mazzucato, 2013) and has been conceptualized as a “sustainability transition” (Markard et al., 2012; Wannags and Gold, 2020). This idea is shaping government agendas worldwide, aiming to encourage patient capital investment in environmentally sustainable startups (Mazzucato, 2013). To create an effective policy mix, it is pertinent for policy-makers to understand who the different investors in sustainable startups are and what motivates them to invest (Wüstenhagen and Menichetti, 2012). This study shows that CVCI should be included in the policy mix as they represent a relevant investor segment.

The remainder of this paper is organized as follows. Section 2 presents a frame of reference focusing on key research strands on investments in cleantech startups and the role of and the rationale for CVC investment. The methods and the dataset on which this study is based are covered in Section 3. Section 4 presents the results of the empirical analysis and introduces four types of CVCI in cleantech startups. In Section 5, the findings are discussed, conclusions are drawn, and suggestions for future research are offered.

2. Literature

This section discusses the financing of cleantech startups. It then presents the reasons for making CVC investments that are identified in the literature, as well as explains the known drivers and motivations for “going green”.

2.1. Financing cleantech startups

The typical investment model of startups follows several steps in line with technology development (Siegel et al., 2003; Balachandra et al., 2010; Zahra and Nielsen, 2002), as depicted in Fig. 1. The first step is the discovery and research and development (R&D) stage. This stage is followed by the demonstration of the technology, which includes product conception and prototyping. In these phases, investments tend to come from an entrepreneur’s own capital, government subsidies and the so-called friends, family and fools. Additionally, business angels can be involved, offering advice to the new venture, as well as providing early-stage financing (Landström and Mason, 2016). After a successful demonstration phase, the product advances to the commercialization phase. Full commercialization is reached when the product is introduced on the market and a self-sufficient business has been developed. At this stage, the venture can be financed through its own revenues and may be able to attract external financing via bank loans and private equity players. The transition from the demonstration phase to full commercialization is especially challenging.

(Balachandra et al., 2010). Production costs are high, while market penetration is still low, as the startup prepares for the challenging market introduction. This phase is aptly referred to as the “valley of death,” and many startups commercializing a technology never emerge from it. This is also the phase where venture capital investors typically focus their investments (Bürer and Wüstenhagen, 2009).

Particular characteristics of cleantech startups have an impact on the venture capital investment opportunity, making it deviate from that of the typical high-tech startup. Table 1 summarizes the major differences between venture capital investment opportunities in cleantech versus other high-tech startups. The green aspect of cleantech startups is the main differentiator. Cleantech startups commercialize environmental innovations and are therefore subject to a “double externality problem” (Beise and Rennings, 2005, p.6). This problem comprises two spillover effects; the first applies to all technological innovations, and the second applies specifically to environmental innovations. The first externality concerns the risk of an innovation’s benefits spilling over to others, in which the innovator does not fully appreciate its investment’s value. The second externality concerns the issue of the startup providing a public good in the form of reduced environmental degradation, a value that is not allocated to the startup (Stucki and Woerter, 2019; Hall and Helmers, 2013). Whereas property rights are often well defined for other high-tech ventures, leading to the accumulation of benefits for the firm and its investors, there is no return for the green impact made by cleantech startups. Recent literature indicates that while investors are increasingly valuing sustainability (Durand et al., 2019; Hawn et al., 2018), the potential to capture value that leads to a financial return remains a major consideration (De Lange and Valliere, 2020a).

The second differentiator relates to government involvement in the cleantech environment. This involvement is high and likely to remain that way (Doblinger et al., 2019), affecting commercialization from the R&D phase until after full commercialization. Policies, including the establishment of carbon credit markets, subsidies and feed-in tariffs, have been far from consistent (Bento et al., 2020; Marcus et al., 2013). The development of cleantech is furthermore characterized by long development times and high capital intensity (Gaddy et al., 2017; D’orazio and Valente, 2019). The sector’s capital intensity is exemplified by Solyndra, a US company that manufactures solar photovoltaic systems using thin-film technology. This firm had to raise USD 970 million in equity finance before its planned listing (Ghosh and Nanda, 2010), which was subsequently

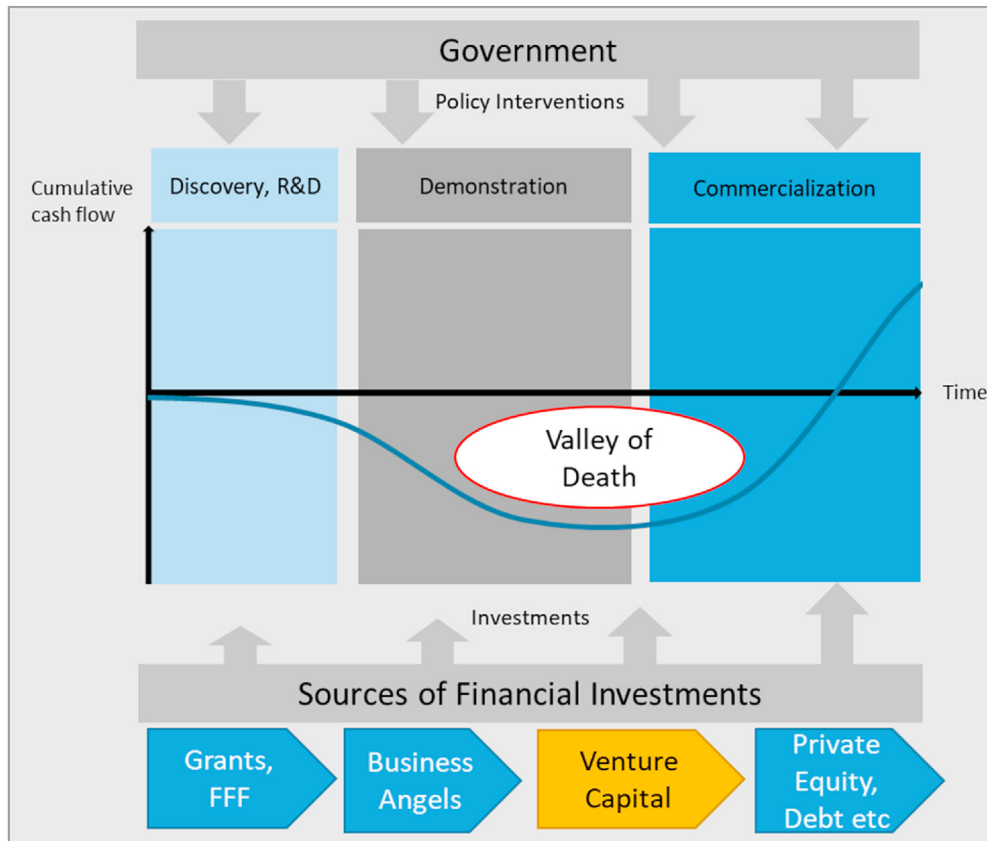


Fig. 1. Commercialization of cleantech, including sources of investment (adapted from Bürer and Wüstenhagen (2009)).

Table 1
Cleantech as venture capital opportunity compared with other high-tech startups.

	Cleantech venture capital investment opportunity	High-tech/Biotech venture capital investment opportunity
Accumulation of benefits	Benefits to society, hard to appropriate	Private benefits predominate as property rights are well defined
Markets	Substituting for an infrastructure in place, operating on production side of economy, inconsistent government regulation	Substitution problem is lower/not applicable, operating on consumption side of economy
Deal characteristics	Riskier investments: capital intensive, long time horizon, high technology risks, and scalability uncertainty	Risky investments: lower capital intensity, easier to evaluate risks, returns and market growth opportunities
Exit and track record	Lacks attractive track record, no proven exit route via incumbents	Track record including high-profile exit, incumbents proven to provide viable exit route

(Adapted from Cumming et al. (2016)).

withdrawn. Lastly, it is difficult to exit from cleantech startups. Although the sale to incumbents is a proven exit route for other high-tech ventures, such as biotechnology and information technology startups, this route is not logically available for cleantech startups (Ghosh and Nanda, 2010; Gaddy et al., 2017).

2.2. Corporate venture capital investors

Given the characteristics of cleantech investing, it is remarkable that CVC investments in cleantech startups are on the rise (Cleantech Group, 2015). CVC refers to equity investments by non-financial established corporations in privately held entrepreneurial ventures (Dushnitsky and Lenox, 2006). The existing literature focuses on investments by large companies that have separate entities in place to manage their investment activities (Röhm, 2018), while SMEs and companies that invest without such a specific CVC body are largely neglected (Schildt et al., 2005). Data availability partly explains the focus on large companies investing via separate

units, but smaller companies are also reasoned to be less active CVCIs because of resource constraints (Keil et al., 2008; Van De Vrande and Vanhaverbeke, 2013).

CVCIs prefer to invest in startups with a related technology and thus are able to provide valuable resources for the technology of a particular startup and the industry in which it is active (Maula et al., 2009; Titus and Anderson, 2018). However, CVC investees run the risk of the investing firms' appropriation of their technology (Hellmann and Puri, 2002), which is why accepting investments from companies has been compared to "swimming with sharks" (Katila et al., 2008).

Companies' reasons to invest in new ventures are generally divided into financial and strategic motives (Gompers and Lerner, 1998; Chesbrough, 2002; Dushnitsky and Shaver, 2009; Sykes, 1990; Siegel et al., 1988; Wadhwa and Kotha, 2006). In financially oriented investments, the goal of CVC investments is to earn superior returns. Companies investing for financial gain believe that their proximity to the market and the technology, balance sheet

strength, and long-term investment horizon enable them to make better investment decisions than other venture capital investors (Chesbrough, 2002; Maula et al., 2003; Gompers and Lerner, 1998). Although there is often a mix of financial and strategic objectives at play in CVC investment, strategic objectives are at least as important as the financial return on investment (Dushnitsky and Lenox, 2006; Röhm et al., 2018). The goal of strategic investments is to benefit the companies' own businesses, which can take different forms. Investing in a startup can provide the CVC with insights into new technologies and practices (Siegel et al., 1988; Maula et al., 2009; Sahaym et al., 2010; Wadhwa et al., 2016; Rossi et al., 2020). Companies can also invest because of the early window on new markets or on government development that these investments provide (Rind, 1981). In all these cases, CVC is associated with explorative learning (March 1991), which requires the investment target to have a certain distance from the investor's existing knowledge base (Schildt et al., 2005). However, the intended meaning of CVCs can also be to learn about potential acquisition targets (Sykes, 1990). In other cases, a CVC contributes to a startup that is developing a complementary product, as it may increase the demand for the CVC's own products (Sykes, 1990; Dushnitsky and Lenox, 2006). By making CVC investments, a company will also be exposed to entrepreneurial knowledge, culture and thinking, which may again enhance its innovative capabilities (Dushnitsky and Lenox, 2005b; Basu et al., 2011). Even if the investment fails, the learning provided to the investing firm can be such that the endeavor is still regarded as a success because of strategic returns (Keil et al., 2010; Titus and Anderson, 2018).

To explain the adoption of CVC, studies have also focused on social mechanisms. Gaba and Meyer (2008) describe how the success of the venture capital fund model has led to the emergence of CVC and how the adoption of CVC has subsequently spread across the corporate population. They find that CVC is more likely to be pursued by companies that are active in an industry where CVC is popular, witness prominent companies invest CVC, and are geographically close to previous adopters. CVCs have been compared to the "lemming's march towards financial immolation" (Edelson, 2001). DiMaggio and Powell (1983, p.149) explain such homogeneity of organizational practices by mimetic isomorphism, a "constraining process that forces one unit in a population to resemble other units that face the same set of environmental conditions." Thus, a company's environment plays a role in the adoption of CVC and can grant legitimacy to CVC investing. Legitimacy refers to "a generalized perception or assumption that the actions of an entity are desirable, proper, or appropriate within some socially constructed system of norms, values, beliefs, and definitions" (Suchman, 1995, p.574). Practical legitimacy pertains to the "self-interested calculations of an organization's most immediate audiences" (Suchman, 1995, p.578). Moral legitimacy is concerned with "a positive normative evaluation of the organization and its activities" (Suchman, 1995, p.579).

2.3. Drivers of and motivations for corporate greening

Can existing companies' wish to go green further explain CVC investments in cleantech startups? Green growth in the economy is known to be promoted by new entrants and incumbents, but their interaction remains to be explored (Hockerts and Wüstenhagen, 2010). Although Hockerts and Wüstenhagen (2010) identify CVC as a greening opportunity, they add that CVC thus far has been neglected as a potential action of companies' green responsiveness. Numerous internal and external drivers influence the type and the degree of environmental responsiveness of incumbents (Jiang et al., 2018; Cai and Zhou, 2014). Mostly, firms have been observed to engage in ecological responsive activities as a result of legislation

(Paulraj, 2009), but stakeholders may also pressure companies to act in an ecologically responsible way (Delmas and Toffel, 2004; Porter and Kramer, 2002; Baah et al., 2020). Acting more proactively, incumbents may recognize the strategic value (Engert et al., 2016) brought about by the (financial) opportunities presented by the deployment of greening activities (Molina-Azorín et al., 2009). Firms can also be driven by ethical reasons. In line with the above arguments, Bansal and Roth (2000) identify three reasons why companies go green: competitiveness, legitimation, and ecological responsibility. Competitiveness refers to increases in the company's long-term profitability. Legitimation entails going green as a requirement to keep meeting shareholders' expectations and thus maintain legitimacy. Firms motivated by an ecological responsibility to go green act out of an ethical inclination, instead of acting out of self-interest.

To summarize, investments in cleantech startups present several issues for investors, especially those focusing on financial returns. CVCs are known to invest not only for financial returns but also for strategic advantage. Bansal and Roth (2000) describe three drivers for going green; corporations can be driven by legitimacy, propelled by the strategic value offered by greening activities, or be motivated by a sense of ecological responsibility. However, the link between these drivers and corporations investing CVC has yet to be explored.

3. Methods

Because of the limited knowledge of who the corporate investors in cleantech startups are and the insufficient understanding of their motivations, this paper is an exploratory study based on a multiple case study design (Eisenhardt, 1989; Yin, 2014).

3.1. Sample

The first step in this research is to identify the companies that invest CVC in cleantech startups. A group of cleantech startups was identified, and all CVC investors were extracted from it. This approach ensures that all the various types of companies investing CVC are acknowledged. This implies that all governance modes through which CVC has been identified to be invested (Dushnitsky, 2006) are included in the analysis. The analysis thereby includes both tightly structured settings, where operating units manage the investment process, and looser structures, where investments are made via separate CVC units (Dushnitsky and Shaver, 2009; Miles and Covin, 2002). As a result, the sample comprises a larger variety of CVCs than do the samples in some previous studies, which have focused solely on large firms investing via CVC units (Keil et al., 2008; Van De Vrande and Vanhaverbeke, 2013).

The group of cleantech startups was derived from a database maintained by the Research Council of Norway's FORNY program on academic spin-offs (Borlaug et al., 2009). The database contains descriptions of all startups, the technologies they commercialize, and their financial information. It also holds newspaper articles featuring the startups. The startups commercializing cleantech were selected using a three-step process. First, the authors went through all the 370 startups in the database and selected the cleantech firms based on their descriptions. Second, to ensure that no firms were missed, all startups that were named in the newspaper articles (included in the database) that commented on environmental impacts were reviewed. After this process, any uncertainties (which all related to technologies beyond the grasp of the authors) were discussed with a cleantech entrepreneur who had a degree in nanotechnology and material sciences. This person validated all the startups labeled as cleantech. The database provided this study with 25 cleantech startups (founded between 1999

and 2012), of which 13 received CVC investments from 26 established companies. Table 2 lists the 26 investors, their activities, and the activities of the startups in which they invested.

The selection of interviewees followed a replication design (Yin, 2014, p.57). The authors interviewed representatives of different corporate investors based on the distinguishing features observed when the various CVCI were identified (industry and technology, size, ownership, location, investment experience, with and without a separate CVC unit). Large companies and SMEs were labeled based on the OECD definition for Norway using the number of employees. Companies with more than 100 employees are identified as large, and those with fewer than 100 employees are called SMEs (Oecd, 2018). The number of employees at the time of investing was determined through annual reports and/or financial statements. Although CVC is a sensitive and confidential topic in many organizations, seven firms agreed to an interview.

3.2. Data collection and analysis

In the first step, the cases were summarized, using annual reports and financial statements accessed via the Norwegian Register of Company Accounts that provides ownership and investment data for investor and investee, data from technology transfer offices, newspaper articles, and web pages. These case descriptions included information on the investors, their investments, and the startup(s) in which they invested. The descriptions provided a rich depiction of the different corporate investors in cleantech startups, allowing the authors to become “intimately familiar with each case

Table 2
Characteristics and activities of CVCI and activities of investees.

Investor	Size	Ownership	Activity of investee
1 Engineering consulting firm	Large	Private	Environmental IT systems surveying and simulating air quality
2 Environmentally responsible manufacturer of materials	Large	Private	Crucibles for production of silicon wafers
3 Metal processing and hydropower producer	Large	Private	Turbines for small hydropower plants
4 Energy utility company ^a	Large	Private	Hydraulic drivetrain solution for wind turbines
5 Fish farming company	Large	Private	Photobioreactor based on the use of captured CO ₂ and algae for bio-based omega-3 production
6 Fish farming company	Large	Private	Photobioreactor based on the use of captured CO ₂ and algae for bio-based omega-3 production
7 Producer and seller of fish feed	Large	Private	Photobioreactor based on the use of captured CO ₂ and algae for bio-based omega-3 production
8 Fish farming company	Large	Private	Photobioreactor based on the use of captured CO ₂ and algae for bio-based omega-3 production
9 Oil company ^a	Large	Private	Hydraulic drivetrain solution for wind turbines
10 Energy utility company	Large	Government	Floating offshore platform with hybrid wind and wave energy converters
11 Energy utility company ^a	Large	Government	Production of silicon for solar panels
12 Energy utility company ^a	Large	Government	Turbines for water containing gravel
13 Energy utility company	Large	Government	Fuel cell based on natural gas
14 Hydropower producer ^a	Large	Government	Turbines for small hydropower plants
15 Mechanics and plumbing company	SME	Private	Crucibles for production of silicon wafers
16 Plastics and injection molding company	SME	Private	High-temperature hybrid heat pump for industrial customers
17 Owner and operator of thermal processes	SME	Private	Grey water cleaning systems for households and biogas production for farmers
18 Fish farmer network	SME	Private	Floating offshore platform with hybrid wind and wave energy converters
19 Business consultancy	SME	Private	Production of silicon for solar panels
20 Business consultancy	SME	Private	Photobioreactor based on the use of captured CO ₂ and algae for bio-based omega-3 production
21 Metal processing company	SME	Private	Grey water cleaning systems for households and biogas production for farmers
22 Hydrogen fuel cell developer	SME	Government	Grey water cleaning systems for households and biogas production for farmers
23 Hydropower producer	SME	Government	Turbines for water containing gravel
24 Energy utility company	SME	Government	Turbines for small hydropower plants
25 Hydro and geothermal power producer	SME	Government	Production of hydrogen from renewable energy sources, including biogas
26 Energy utility company	SME	Government	Turbines for small hydropower plants
			Turbines for small hydropower plants
			Production of hydrogen from renewable energy sources, including biogas
			High-temperature hybrid heat pump for industrial customers
			Turbines for small hydropower plants
			Turbines for small hydropower plants
			Planning, development and refurbishment of small hydropower plants

^a Investors with separate CVC units.

Table 3
Sample of interviewees and sample of cases for which documents were used to establish the motivation to invest.

Cases - interviewed	Investor characteristics		Type of interview
3	Large	Private	Skype
10	Large	Public	Face-to-face
12	Large	Public	Face-to-face
16	SME	Private	Phone
21	SME	Private	Face-to-face
25	SME	Public	Face-to-face
26	SME	Public	Skype
Cases - documents used	Investor characteristics		
4	Large	Private	Private
5	Large	Private	Private
9	Large	Private	Private
11	Large	Public	Public
13	Large	Public	Public
14	Large	Public	Public
24	SME	Public	Public

as a stand-alone entity” (Eisenhardt, 1989, p.540).

Second, annual reports were used to determine the companies’ motivations for investing, but the data were used only when an investment and its goal were mentioned explicitly in a document. This was the case for 10 companies, mostly large firms with detailed annual reports, as expected (Table 3).

Third, semi-structured interviews with representatives of seven

corporate investors were conducted to deepen the authors' knowledge of these corporate investors' motivations (Table 3). The questions focused on the governance of CVC investments, the goals of the investment, the investment process, the management of the investment, and the outcome. The interviewees had all been involved from the start until the end of the investment or were still involved if the investment was active. The interviews were held between October 2017 and January 2018 and lasted 50 min on average, ranging between 35 min and 1 h and 40 min. The interview data were then added to the case data.

The interviews and the motivations described in the annual reports were coded using NVivo 11.¹ The coding began by identifying measures that were subsequently linked to more abstract constructs (Eisenhardt and Graebner, 2007). Some linking of measures to constructs was straightforward, such as when an investor stated that financial return was the main goal when investing CVC, which was linked to a financial motivation. Some conceptual constructs were revised during the process. For instance, the authors started with the interviewees who were motivated to invest by the location of the startup, which was linked to the "geographical proximity" construct (Boschma, 2005). However, these cases where "location" was mentioned were not associated with investing in targets that were easier to identify and where lower transaction costs might apply (Langeland, 2007). Instead, the investment was linked to shareholders requesting the promotion of regional development. Therefore, this construct was changed to "legitimacy." Finally, this analysis resulted in five main motivations for corporate investors to invest in cleantech startups.

After the data on motivations were added to the cases, the authors looked for cross-case patterns to find out whether different investor types could be identified. This cross-case analysis was carried out by selecting different categories; subsequently, within-group similarities and intergroup differences were established (Eisenhardt, 1989). Various categories were suggested to explain the findings, including first-time versus experienced investor, and investors with and without a separate CVC unit, but no clear distinctions were revealed in this way. Ownership and size proved to be distinctive categories leading to four investor types.

4. Results

4.1. Who invests in cleantech startups?

CVCs in cleantech startups are remarkably diverse, including large companies and SMEs. A further distinction can be made between government-owned and privately owned CVCs.

4.1.1. Privately owned SMEs (seven investors)

The investments of privately owned SMEs are distinctive in terms of industry and technology relatedness vis-à-vis the startups. These companies invest in startups that are unrelated to their industry, which creates contextual issues, as the investor–investee relatedness typical in a CVC relationship is absent. Instead, the investors are related to the startups only by the opportunity to exploit their current capabilities when they become involved in the startups' activities. For instance, an SME providing mechanically engineered components to the oil sector in Norway invested in a startup

that might have a use for the SME's production facilities for components that would be used in hydropower in emerging markets. This group of SMEs invests in startups at a very early stage. The investors have diverse investment experiences—some investing for the first time, others with multiple CVC investments. None of the investments made by this group is organized via a separate unit.

4.1.2. Large privately owned companies (nine investors)

The investments of large privately owned companies give them exposure to new and clean technologies that have a certain distance from their existing markets and technologies. This distance creates the environment to form the typical CVC relationship, which can enhance innovation in the investing company. Some investors are vertically related downstream to the investee. This is the case with fish farming companies investing in the green production of fish food. Others invest in a different industry, such as the oil company investing in wind energy-related technology. However, what all investments share is that the new and cleantech will not likely be exploited by the investment firm in the short term but offers insight into a technology or industry, providing knowledge that may be useful in the longer term. Similar to the other groups, large privately owned companies tend to invest close to home. Furthermore, this group of investors typically does not invest via a CVC unit (only two out of nine do), although most are active CVCs.

4.1.3. Government-owned SMEs (five investors)

This group of investors consists of energy utilities and energy producers. Given the Norwegian context, where 98% of electricity comes from hydropower, these firms have historically been active in renewable energy (hydropower) production and thus, have always used cleantech in their core business. There is closer industrial and technological relatedness between the investors in this group and their investees, with most startups commercializing a hydropower technology, thus providing fewer opportunities for an explorative relationship. Operating units make and manage the investments, so no CVC units are involved.

4.1.4. Large government-owned companies (five investors)

Large government-owned companies (again, mostly energy utilities and hydropower energy producers) are active CVC investors and tend to invest close to home. Compared to their SME counterparts, the investments they make are more explorative, focusing on new technologies in their existing industry. These include an energy utility investing in a wave energy converting technology, as well as one investing in fuel cells based on natural gas. The group of large government-owned companies invests most often via a separate CVC unit; three out of five investors do so. Nonetheless, having a CVC unit does not automatically mean that dedicated managers are in place to oversee the investments. For example, one of the investors has an "empty" CVC unit that functions solely as an investment vehicle, while the investments are managed elsewhere in the parent organization.

4.2. Why invest in cleantech startups?

The interviews were conducted with investors of different sizes (SMEs and large companies) and with different ownership structures (government and privately owned). Additionally, the investors' communications concerning their CVC activities were analyzed via annual reports, financial statements, web pages, and press releases. The four different groups of investors (described in Section 4.1) have made CVC investments based on different motivations. Table 4 presents illustrative quotes to exemplify the motivations of the different investor types. An overview of the

¹ NVivo was used to efficiently manage and organize the data obtained from the annual reports and the interviews. It was also a useful tool for coding the data of this exploratory study. In the initial stages of the analysis, NVivo allowed flexible coding of node classifications (measures and constructs) and constant reviewing of the nodes' content. In the cross-case analysis, NVivo enabled efficient and detailed analysis of patterns between cases, for instance by allowing a visual exploration relating different combinations of constructs.

Table 4
Illustrative quotes that emphasize the investment motivations of different investor types.

Privately owned SMEs	Government-owned SMEs
<p>“We would be able to become a worldwide supplier ... together with [the startup]. We could expand and become great.”</p> <p>Large privately owned companies “We were sure that sooner or later, [we] would have to pay for their CO₂ emissions.”</p>	<p>“If this has been an initiative from another part of Norway, we would not have done it.”</p> <p>“We were very concerned about our role as a local company.”</p> <p>“We wanted to maintain the technological knowledge related to turbine production. It was disappearing. It was a matter close to our hearts.”</p> <p>Large government-owned companies “It was a part of a strategy to look into new possibilities in the renewable sector.”</p> <p>“The basis for building more cleantech here is clear.”</p> <p>“Of course, the goal was to earn a return.”</p> <p>“To try to get business into this region was very important to us.”</p>

Table 5
Investment motivations of different investor types.

Case	Investor characteristics		Financial	Window new technology/industry	Green opportunity	Legitimacy	Supply to startup
3	Large	Private			V		
4	Large	Private	V				
5	Large	Private		V	V		
9	Large	Private		V	V		
10	Large	Public		V	V	V	
11	Large	Public		V	V		
12	Large	Public	V		V	V	
13	Large	Public	V		V	V	
14	Large	Public	V		V		
16	SME	Private					V
21	SME	Private					V
24	SME	Public	V		V	V	
25	SME	Public				V	
26	SME	Public				V	

motivations per investor is given in Table 5.

4.2.1. Privately owned SME investors

The interview findings reinforce the idea that privately owned SMEs form a distinct group of investors, as this group tends to invest in startups unrelated to their actual industry. The interviews emphasize that companies in this group invest for the potential to widen their client base and supply to the startup. As a result, official investment criteria are limited, as is the due diligence performed. The management team orally discusses the startup potential and the link with the operations of the SME, which form the basis for the investment. The management team also needs to be genuinely interested in the technology in order to commit to the startup. These investors relate the potential financial return on their investment to an increase in their own sales and services, not to a future sale of their shares in the startup. The green aspect of investing in a novel cleantech plays no role in the motivation for investing.

4.2.2. Large privately owned investors

Large privately owned investors behave largely as described in the literature. They invest for strategic and financial returns. As they seek a strategic return, they ensure that there are learning opportunities by investing in a promising new technology or industry. However, an additional reason of these investors lies in the green attributes of their investments. The perceived opportunity of “going green” is explored by investing in a cleantech startup, which is viewed as a way of positioning the company for the sustainability transition of the economy and their industry (Dyllick, 1999). Investing offers the opportunity to be exposed to innovative clean technologies that can be used for what is deemed inevitable internal green innovation. To illustrate, a large privately owned investor took a stake in a cleantech startup to orient itself concerning possibilities in the hydropower industry. The investment

was made because of a perceived opportunity to build up a green energy portfolio. The company’s main activity emitted a high level of greenhouse gases. By building up a green energy portfolio, the management hoped to secure its own power, as well as be awarded carbon credits to offset the future carbon tax owed by the company’s other activities. To determine the return potential, these investors perform due diligence. The extensiveness of the due diligence and the investment criteria that apply vary. For one company, the decision to invest was predominantly based on the green aspect of the commercialized technology, with minimal due diligence on other aspects of the startup. The other companies describe a full-fledged process where the technology, the team, the market, the valuation, and potential exit routes are included in the analysis.

4.2.3. Government-owned SME investors

Government-owned SMEs are motivated by pragmatic legitimacy. In the Norwegian context, the shareholders of government-owned utilities are the municipalities where the utilities are active. The SMEs have decided to invest in cleantech startups in an effort to contribute to local entrepreneurship and local knowledge creation, as well as to maintain certain technological knowledge in the community. The investments have been made to indicate to their shareholders and clients—residents of the municipalities—that “their” utilities function for their benefit by pursuing local development. Geographic proximity is therefore the most important condition when making the investment decision. The goal to create local development is not only instigated by legitimacy building toward their shareholders and clients. The managers of the investing companies share the moral belief that local development is a just and important objective. It is this belief that has subsequently led to a CVC investment in a cleantech startup. It is striking that many of the government-owned investors in the sample have acted similarly in their perception about making a CVC investment in a high-risk startup as a way to foster local development. CVC

investments by government-owned companies are furthermore a consequence of isomorphism. In multiple instances, the investments are based on the actions and the beliefs of similar organizations in their network. Thus, the investment decision is not necessarily a rational economic action, as shown by the lack of proper due diligence by the investors. In one instance, there was no due diligence at all. The investing firm chose to invest based on a phone call from a consultant who conveyed the message that more organizations similar to that one had been invited to become involved. For government-owned SME investors, green motivation plays no role when making investments in cleantech startups.

4.2.4. Large government-owned investors

Many motivations are at play when large government-owned companies invest in cleantech startups. First, the companies seek to invest for traditional reasons—for financial or strategic returns by exploring a new technology in their industry. Second, these companies want to invest in locally owned startups to build their legitimacy for their stakeholders. Third, the green profile of cleantech startups plays a major role. These companies believe that the investment helps them in being prepared for the sustainability transition of the economy. They recognize that greening of the economy is inevitable, and they want to be strategically prepared by learning about innovative new cleantech that may be deployed in their companies at a later stage. For some investors in this group, their investment criteria specify the sole focus on cleantech startups. Others are open to investing in non-cleantech startups as well but emphasize the desirability of a green profile to maximize appropriate learning benefits. This group performs elaborate due diligence before investing to ensure that the complex set of investment criteria is met.

5. Discussion and conclusions

This study explores who the corporate investors in cleantech startups are and why they invest in these startups. One of the most intriguing findings is the heterogeneity of corporate investors in the cleantech industry. The investors are diverse in size, ownership, and managing their investments. Such diversity shows that the current focus of CVC literature on separately managed entities of large listed companies leaves out many other types of active corporate investors.

The characteristics of cleantech startups lead to a disadvantageous financial return profile for investors. Therefore, it is not surprising that the motivations for investing in these startups are not purely financial. The motivations are more varied than the traditionally cited motivations of seeking financial and strategic returns. Furthermore, the reasons for investing differ between large investors and SMEs and between government-owned and privately owned corporate investors.

For large corporate investors, the green aspect of the investment is one of the principal reasons to commit to a startup commercializing a new cleantech. These large companies recognize the role played by environmental performance now and in the future, and they prepare strategically by investing CVC. Thus, CVC investment is indeed an action of companies' green responsiveness, as posited by [Hockerts and Wüstenhagen \(2010\)](#). In contrast, the double externality problem is not perceived as such. The large companies in this study's sample do not share the idea that the value of reduced environmental degradation is not allocated to the startup and is thus lost to them as investors. Instead, they learn from their exposure to innovative cleantech. This prepares them for a sustainability transition of the economy in which they expect to be compensated for the green value created. Clean technologies will become financially beneficial, with non-clean technologies facing

costs such as carbon taxation. Therefore, CVC investments motivated by the perceived opportunity of going green show that the motivations laid out by [Bansal and Roth \(2000\)](#) also apply to corporate investing, as it aligns with their notion of competitiveness.

However, small and medium investing companies are unaware of the green features of their investments, the opportunities that these may present, and the specific risks when investing in cleantech startups. The reason may lie in the companies' relative lack of sophistication in making CVC investments, but other motivations also seem more important for them. The fact remains that by investing in cleantech startups, SMEs are actually contributing to a greener economy. The lack of appreciation shows the possibility to raise SMEs' awareness of their potential to contribute to and promote green development.

Government-owned and privately owned companies also differ in their motivations for making CVC investments in cleantech startups. The motivation of government-owned CVC investors in this study illustrates the major role that institutions play in the decision to make CVC investments. Government-owned investors, especially SMEs, have taken actions that are not in line with traditional investment criteria but are aimed to maintain legitimacy of their stakeholders. Moreover, sometimes they simply replicate what their peers have done, thus following their social network in what is deemed the just action. The finding that traditional investment criteria are not key to their decision-making process may explain why government-owned SME investors are not aware of the characteristics of cleantech investments.

Private SME investors form a separate group in the sense that they view these investments as offering possibilities for business development and increased revenues. They regard CVC as a move to acquire customers of their products based on their existing core competencies, although these will have to be developed to cater to these new customers. For them, CVC is a purely exploitative activity at the outset, and they are involved at an early stage. In several of the cases, these SMEs can be viewed as co-founders of the new cleantech company. Whereas the large companies in this study behave largely as described in the CVC literature, with a dual focus on financial returns and organizational learning, privately owned SMEs behave quite differently.

Overall, this paper enhances the knowledge base of who the corporate investors in cleantech are and why they choose to invest in this complex industry. Thereby, it contributes to the traditional CVC literature by emphasizing the heterogeneity of CVC investors. It shows that SMEs, large companies, and government-owned companies are active corporate investors. Previous CVC literature has focused on investments made to financially benefit the incumbent or allow the investor to explore new technologies and markets ([Röhm, 2018](#)). This work establishes that CVC investors can additionally pursue exploitative learning, aim to build legitimacy, explore a green opportunity, or may simply repeat an activity undertaken by their competitors. Earlier research has established how the financial versus the strategic orientation of CVC investments influences the value creation in the investor firm ([Dushnitsky and Lenox, 2006](#)). The greater variety of motivations identified in this study can similarly be expected to have an impact on the degree to which incumbents benefit from their investments. The value added by the investing firm to the startup is likely affected as well.

This work also adds to the literature on sustainability by empirically confirming CVC is pursued with the aim to promote corporate greening. However, it shows that in this regard CVC investors do not form a homogeneous group. For large investors, the sustainable opportunity presented by cleantech investments seems directly related to value capturing as the companies are motivated by the opportunity to advance their competitiveness. As large CVC

investors want to learn from their investments, the findings show that the opportunities presented by an exposure to innovative clean technologies override the drawbacks of cleantech investments. This explains why these investors do not recognize the double-externality problem. In contrast, SMEs neither recognize the part that they play in commercializing cleantech, nor are they aware of the risk profile of cleantech startups.

Several practical implications can be derived from this study. In general, CVC investment has been ignored by policy makers when designing support measures for clean tech startups. This study confirms that these investors could play a key role in closing the equity gap for these new cleantech startups. Policy makers can consider launching tax credit schemes targeting CVCs. An important finding of this study is that these schemes should not solely be focused on large firms with CVC units but also SMEs. Such a measure could include upfront tax relief when the investment is made, as well as lower taxes on capital gains from investments in cleantech startups. This study has shown that government-owned companies make cleantech investments. Governments could put up such investments as part of the mission of these companies to stimulate the birth and growth of cleantech startups, thus contributing to the technology advancements needed to develop more sustainable solutions for society. Moreover, this study indicates the lack of a thoroughly contemplated investment strategy among the CVCs. A more diligent strategy that takes into account the cleantech context will result in better investment decisions, leading to more beneficial outcomes from these investments for the CVC parent and the startups. Specifically, applying environmental, social, and governance criteria can help CVCs in guiding their due diligence and investment decisions, taking into account the risks of and opportunities presented by cleantech investments.

This study also has limitations. As the decisions to invest were made between 2 and 11 years ago, the interviews might have been affected by recollection bias. The authors tried to minimize this bias by bringing details about the cases to the interviews in order to fill in the gaps. Additionally, many of the interviewees checked their own files during the interviews. The authors also used investment memoranda, shareholder agreements, and meeting notes, as well as the information provided via the prepared case studies. The cleantech startups in this study are all university spin-offs and based in Norway. As university spin-offs, they may have certain characteristics that influence investors' decisions. Although the interviewees were asked how important this aspect was and how they viewed it, and it was deemed to have minor importance, it still might have an implication for the results.

This study opens up promising research opportunities. First, the scope of CVC research can be broadened by diverging from its current focus on large companies and investments taking place via CVC units. A particular unexplored avenue is that of SMEs investing in entrepreneurial ventures. The SMEs' role and position as CVC investors deserve to be corroborated and further explored. In line with what is known about large firms, the value that SMEs can add to entrepreneurial ventures could be examined. The organizational learning gained by SMEs from CVC investing is another promising extension to current CVC research. On a different note, future research could examine the implications of the various motivations for the development of cleantech startups. CVC can add value to startups in many ways (Maula et al., 2005), and research on legitimizing effects suggests that added value by CVCs to sustainable startups differs from those to other ventures (De Lange and Valliere, 2020b). In addition, future research can explore the effects on investing firms. Large CVCs seek to learn from their cleantech investments, so their learning and green innovation stemming from these investments needs to be examined. Ultimately, these investments could have a double green impact if CVC investing leads

to the successful development of green startups and at the same time results in green innovation in the investing firm.

CRediT authorship contribution statement

Puck D. Hegeman: Conceptualization, Investigation, Formal analysis, Writing - original draft. **Roger Sørheim:** Investigation, Validation, Writing - review & editing.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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