

THE EMERGENCE OF *GREEN* VENTURE CAPITAL



Jelena Randjelovic,^{1*} Anastasia R. O'Rourke² and Renato J. Orsato³

¹ Sustainable Northern Ireland Programme, Belfast, UK

² Yale School of Forestry and Environmental Studies, USA

³ IIIIEE, Lund University, Sweden

Innovative financing mechanisms are needed to facilitate sustainable development. In the past few years, socially responsible investments have emerged as a successful type of financing scheme but many eco-oriented start-up companies remain under-funded.

Apparently, environmental innovations have only recently caught the attention of an important financial sector: venture capital (VC). The article describes the emerging phenomenon of environment-related VC (or *green* VC) and provides an overview of the current market for this type of investment. The paper delves into this industry, revealing its characteristics, processes and mechanisms. The study also uncovers the main problems faced by eco-entrepreneurs as well as venture capitalists interested in this type of venture. Finally, it analyses the drivers for green VC and attempts to identify the

sources of innovation and the uniqueness of these emerging financial products. Based on the analysis, the paper also derives a definition of green VC.

Copyright © 2003 John Wiley & Sons, Ltd and ERP Environment.

Received 19 February 2003

Revised 28 March 2003

Accepted 9 April 2003

INTRODUCTION

One of the main mechanisms for financing innovative start-up companies is *venture capital* (VC)¹. Increasingly, VC is being directed towards entrepreneurial ventures that demonstrate various aspects of sustainability (be it eco-improvements and/or social benefits). This recent interest in sustainable solutions may be an indirect result of the successes and popularity of *socially responsible investments* (SRIs), which have so far been mainly channelled into mutual funds. Indeed, there has been a phenomenal growth of such

* Correspondence to: Jelena Randjelovic, 89 Loopland Drive, Belfast BT6 9DW, Northern Ireland, UK.
E-mail: Jelena@sniponline.org

¹ Venture capital is used in this paper to refer to *venture capital funds* that do not encompass *individual* private investors.



funds and the amounts invested, and a rapid proliferation of investment and analytical products catering to this segment. According to the *social investment forum* (SIF), the total assets under management in professionally managed portfolios utilizing one or more of the three strategies of screening, shareholder advocacy and/or community investing in the USA climbed from €36.4 billion in 1994 to €2.13 trillion in 2001 (representing some 12% of all professionally managed investments in the USA in 2001, estimated at €18.13 trillion). Due to the sustained market downturn, the assets of socially screened mutual funds were flat: €140 billion in 1999 compared with €139.4 billion in 2001 (SIF, 2001). This trend is not confined to the USA. The universe of retail ethical funds doubled in size every three years in the UK during the 1990s, from €517.9 million in 1990 to €5.15 billion in 1999² (UBS Warburg, 2001). Of similar (though less media-friendly) success has been a growing inclusion of environmental and social criteria to credit and risk assessments undertaken by banks (Barannik, 2001).

The relative weight that environmental factors take in SRI screens and activism also varies widely. We contend that eco-entrepreneurship, as it generates benefits to sustainable development, might be best created by smaller, faster moving firms usually characterized by start-up businesses. However, despite the successes of SRI, eco-oriented start-up businesses have not yet caught the attention of most venture capitalists (Diefendorf, 2000). Hence, what drivers would help eco-oriented start-up companies get the flow of capital and expertise to make their businesses grow at a faster rate?

This paper addresses this question by delving into a new stream of emerging VC,

which we label *green VC*: 'a high-risk financial capital provision for eco-innovative ventures, which offers the potential for financial returns, as well as contributing to sustainable development'. Such a definition emerged from the research we present in the following sections, which dealt mainly with product-oriented ventures.

We argue that green VC shares some features of other types of VC and yet it also demonstrates some unique features and innovations of its own. The paper's objective is thus to propose and explain the (above) definition for green VC and to explore its current size, scope, drivers and possible limiting factors for growth of the sector in the future. The paper should be situated within the ongoing debate over the sources of profitability of green firms (King and Lenox, 2001), on profitable eco-innovation (Rennings, 2000) and the ongoing concern of many practitioners to make the 'business case' for sustainability (Dyllick and Hockerts, 2002).

BACKGROUND AND METHODS

The paper stems from discussions with a number of specialists in the VC field in Europe³. Initially, a search on the topic of 'green venture capital' (and related nomenclature) in VC practitioners' databases was undertaken. We soon found that currently no such category exists. Many firms use the words 'ecological' or 'environmental' as a way of promoting some of their eco-related activities. Curiously, others firms purposely do *not* market themselves this way because they assume it would be more difficult for them to secure funding. Overall, although substantial literature review was undertaken, we found

² Note: All values presented in this article have been converted from United States Dollars (\$) and British Pounds (£) to Euro (€) based on the average currency rate for 13 March 2002, according to the Universal Currency Converter Website, <http://www.xe.com/ucc/convert.cgi> [13 March 2002]. Since the numbers intend to give an idea of magnitude, precision is not a key element. Therefore, the numbers represent an approximate value of the original currency.

³ The data presented here has been drawn from a research undertaken for a Master's thesis at the IIIIEE, Lund University (Randjelovic, 2001), and represents part of an ongoing research programme on forms of innovative finance for sustainability at INSEAD Business School's Center for the Management of Environmental Resources (CMER).



very little academic and popular literature that makes an explicit link between environment (or sustainability) and VC. Despite this gap, we found many VC practitioners who were investing in start-ups that had an environmental benefit or theme, and many eco-entrepreneurs who had launched their companies using VC.

The research was exploratory in its nature. Data was compiled through websites, company material and interviews. It is thus subject to bias and we must be somewhat careful with results. The main sources of information on 'green' venture capitalists were the internet⁴ and documentation on participants at the Sustainable Private Equity conference held on 19 January 2000 in Switzerland.

Before searching for interview targets, it was necessary to identify the main players in the industry among investors, VC firms and eco-entrepreneurs (i.e. entrepreneurs who are keen to commercialize their eco-innovative product or service). It was necessary to identify what problems eco-entrepreneurs face when they seek funding, and eventually how they get the financial support. More specifically, it was necessary to identify the following. What are the targets and features of the green VC industry? How do eco-entrepreneurs get funding? What are the possible opportunities for venture capitalists in this emerging sector? These questions broadly orientated 33 semi-structured interviews with European green and mainstream VC firms and managers, as well as with specialists and practitioners in VC. Many of these interviewees preferred to remain anonymous – explaining why some of their quotes included in this paper are not assigned.

We limited our study to 'environmental' or 'eco' innovations rather than attempting to

discuss 'sustainability' innovations, which would necessarily include *social* issues. From our preliminary reading on the topic, we found that socio-oriented start-ups tend to face different issues and problems than environmental start-ups; not least because most of them have their main market based in developing countries, and or obtain their funding from philanthropic sources. Many of these ventures are funded by a kind of 'venture philanthropy' (i.e. sponsorship and foundation based funding that uses some VC processes), which moves the discussion away from profitability and mainstream take-up of eco-innovation. Thus this paper is limited to studying VC financing originating from and destined for developed countries only and is focused only on eco-innovations and eco-entrepreneurs.

THE EMERGING PHENOMENON OF GREEN VC

VC is often thought of as a 'neutral' way of financing start-up companies, independently of kind of business, normally having a short-term perspective. Sustainable development, on the other hand, is concerned with the direction and the actual content of companies' products, services and practices, having a commitment to long term orientation (Rennings, 2000).

A business-oriented understanding of sustainable development, however, tries to find the link between environmental and social activities performed by firms and their financial performance. Under the rubric of the 'triple bottom line' of sustainability, investing in eco-innovations is expected to create shareholder value. For example, the Swiss group *Sustainable Asset Management* (SAM) defines sustainability as 'a business approach to create long-term shareholder value by embracing opportunities and managing risks deriving from economic, environmental and social developments' (SAM, 2001).

So far, most capital with a sustainable development mantra has been invested in

⁴The key words in internet searches were 'venture capital', 'sustainability' and 'ecological'. These resulted in finding a database entitled 'sustainable business' that specifically compiles information on sustainability finance, including sustainability VC. Some European VC companies whose focuses were 'environmental' investments (i.e. environmental technologies or renewable energies) were discovered in this database and were approached for an interview. It should be noted that these numbers are approximate.



*large-cap*⁵ companies, via the inclusion of (positive and negative) screening criteria by mutual and pension fund analysts and rating agencies (so-called *socially responsible investment* (SRI) funds). Here analysts try to identify profitable corporations that also strive to minimize the 'environmental footprint' of their operations, while contributing to the economic and social development of the communities in which they operate (UBS Warburg, 2001).

The screening methods employed by European SRIs increasingly apply a 'best in class' approach to their selection of stocks based on environmental and social criteria, rather than using only negative criteria, which would, for example, avoid nuclear and tobacco industries. Companies are judged in relation to others in their sector, against criteria such as their environmental policies and programmes, the use of environmental management systems, renewable resources, conditions placed on suppliers, quality of stakeholder relations and the quality of environmental reports and communications, among other criteria.

Although green VC can be considered a type of SRI, it could not easily use the same criteria for the selection of investments. This is because, in their initial phase, start-up firms often consist of only two or three people and *the idea* for the innovative product or service, which, in most cases, has not yet reached the manufacturing and/or commercialization phase. Start-ups could thus be considered '*concept firms*'; they normally do not have management systems, supply chain issues or environmental/social reports. The evaluation of the environmental aspects of the business must thus be based on different grounds – more to do with the expected, rather than the actual (environmental, social and financial) performance of the company.

⁵ 'Cap' is short for capitalization. This is a market value for the company's stocks, which is calculated as the number of stocks multiplied by the stock price. There are small-, mid- and large-cap companies. Large-cap companies usually have market value of greater than €3 billion.

Therefore it would appear that a green VC's environmental orientation depends on the content, direction or effects of the start-up company that it decides to support. How then do we decide whether a start-up company is indeed 'green'? One approach is to look at the concept of eco-innovation to see the future environmental implications of the products and services that a firm will eventually generate. According to Rennings (2000, p. 322), *eco-innovations* can be defined as 'measures of relevant actors (firms, politicians, unions, associations, churches, private households), which: (i) develop new ideas, behaviour, products and processes, apply or introduce them, and; (ii) contribute to a reduction of environmental burdens or to ecologically specified sustainability targets'. In our research we focused mainly on product-based eco-innovations developed by start-up firms.

A typical example of eco-innovation financed by VC is the manufacturing of wind turbines for the generation of electricity. Wind energy can be considered a type of green VC investment because it is an emerging business sector, often led by start-up companies, with the obvious benefits of using renewable energy and zero emissions during the use phase of turbines. Of all the new renewable energy technologies, wind power has made the most significant commercial progress. Today, wind energy is much cheaper than nuclear power and competitive with all forms of fossil fuel based power generation. More importantly, it is estimated that costs will decrease by up to 45% within the next 15 years (UNDP, 2000).

In October 1999, the *European Wind Energy Association*, the *Forum for Energy and Development* and *Greenpeace International* jointly released a study (*Windforce 10*), which contends that wind energy could meet 10% of the world's electricity demand by the year 2020 (EWEA *et al.*, 1999). Clearly, this represents a significant opportunity for green VC financing. The recent growth in the use of energy from wind power was partially supported by governments such as Denmark and Germany via

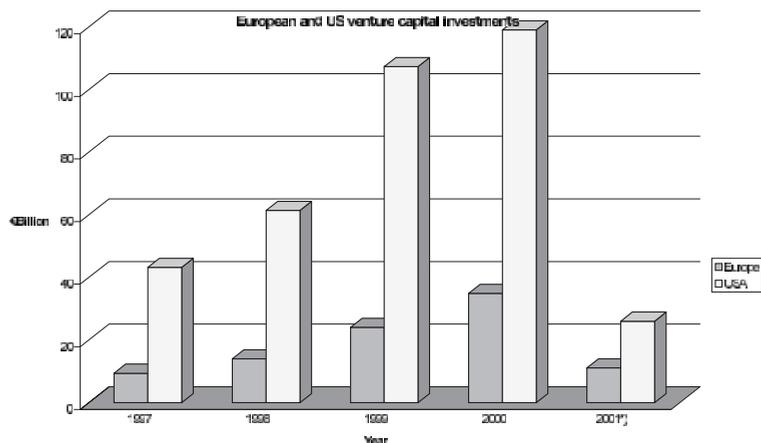


Figure 1. European and USA VC investments during a five-year period (* This is valid for the first half of the year 2001. Source: Compiled data from (i) PriceWaterHouseCoopers and 3i Group plc, (ii) Venture Economics and (iii) EVCA 2000. The USD currency was converted into Euros by using Universal Currency Converter at <http://www.xe.com/ucc/convert.cgi> [3 January 2002].)

legislation and financial mechanisms (EEA, 2001). However, future profitability of such investments and other renewable energy innovations certainly depends on the existence of what Porter and van der Linde (1995) call 'environmentally friendly regulation'.

State of the Art in green VC

A growing number of venture capitalists invest in eco-oriented start-up companies. As an emerging phenomenon, both the number and variety of green VC fund-types are expected to change in coming years. For a number of sub-categories, we compare the current features of green VC with conventional or mainstream (non-green) VC companies. This comparison makes possible a discussion on the unique qualities of green VC. One of the most explicit differences is in the size of the industry. In 2000, mainstream VC investment in Europe and the USA totalled €154 billion. This figure dropped substantially in the first half of 2001, when *private equity*⁶ and VC investment reduced by 13% in the USA and Europe (EVCA, 2002). Two

main reasons account for such a decrease: the downward momentum of the *initial public offerings* (IPOs)⁷ of venture-backed companies – particularly in the information technology (IT) industry – and the lack of innovative projects in Europe that could eventually be targeted by venture capitalists (Gompers, 1998; EC, 2001). Figure 1 presents VC investments in the USA and EU during this period.

The figure also shows that VC investments in both the USA and Europe have increased over the past five years. The total amount invested in the last five years was around €540 billion. To give a sense of scale, this is equivalent to the aggregated GDP of Denmark, Norway, Sweden and Finland (World Fact Book, 2001). Compared with this figure, green VC is in its infancy – we estimate that in 2000 green VC accounted for approximately €33 million in Europe and €67 million in the USA, which represents only 0.08% of the total amount invested by the VC industry⁸.

⁷ *Initial public offering* (IPO) is the process of launching a company for the first time by inviting the public to subscribe to its shares on the stock market.

⁸ This data was gathered from various sources such as interviews and websites. Because some VC companies did not want to disclose information, it is possible that the real amount invested is higher than the one presented here.

⁶ In contrast to the USA, in Europe *private equity* and *venture capital* investment are often used interchangeably. For details on the data provided here, see: <http://www.evca.com/>

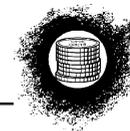


Table 1. Differences between mainstream and green VC firms

VC in Europe and USA	Mainstream	Green VC
a) Investment size (see Figure 1)	€154 billion	€100 million (0.08% of the size of the mainstream)
b) Number of VCs	Around 1600	Around 45 (4.5% of the number of mainstream)
c) Average amount of investments	€120 million	€1.1 million
d) Duration of investment	2–3 years	3–5 years
e) Environmental prerogatives	Environmental risks and liabilities	Environmental screening
f) Sources of financing	Pension funds and banks	High net-worth individuals
g) Investors' orientation	Typical return on investment (ROI)	ROI plus ecological orientation
h) Current targets for investments	Communications, software, information technology	Renewable energy, water and cleaner technology equipment

Source: Data for mainstream VC was mainly gathered from websites and publications of EVCA and Venture Economics. Data for green VCs was gathered from interviews with green venture capitalists and public information in www.sustainablebusiness.com

Besides size, there are other quantitative and qualitative differences between mainstream and green VC. Table 1 summarizes the main differences found in these two types of investment and the following paragraphs explore these differences, selectively taken from the table (except the size, which was previously explained with Figure 1).

The total number of active mainstream VC companies in Europe and the USA is around 1600, with more than 850 active firms in Europe⁹ (row 'b' in Table 1). Compared with mainstream VC, the number of green VC firms in Europe and the USA is much smaller. We found 20 European and around 25 US companies dealing with green VC.¹⁰ For example, when searching in the member list of the European Venture Capital Association (EVCA), we found 17 VC companies that have 'environment' as an investment category, which represents only 2% of the total number

of EVCA members.¹¹ Conversely, some mainstream VC companies actually invest in eco-oriented start-ups, such as in fuel cell technologies, but they do not claim such orientation. Our research included the first category only. The average amount invested is very small compared with that invested by the mainstream Private Equity (PE) industry¹² (row 'c' in Table 1). While the average amount of mainstream VC invested was about €120 million,¹³ some sources interviewed estimated that approximately €1.1 million is usually invested in eco-oriented start-ups in Europe.¹⁴

Both the USA and European mainstream PE firms provided a similar portion of financing to *early stage* enterprises (start-ups), which accounted for around 14% of all VC investments (EVCA, 2000; Venture Economics, 2002). However, this portion is fairly small, compared with *later stage* financing. As a consequence,

⁹ Number of companies listed as members of European Venture Capital Association (EVCA) and National Venture Capital Association (NVCA). Since there are companies that are not members of these associations, this number is expected to be higher.

¹⁰ The number of companies was identified by compiling data provided by participants in the *Sustainable Private Equity Conference*, held on 19 January 2000 in Switzerland. Additionally, data was also collected from various websites that provide information for eco-entrepreneurs, such as <http://www.sustainablebusiness.com> [10 July 2001].

¹¹ Data from the EVCA website section created for helping entrepreneurs that seek financing. Using 'environment' as a searching criterion in each industry sector, 17 start-up companies could be identified [15 August 2001].

¹² These figures represent only a small part of total PE investments; compared with conventional investments it represents 0.15% of European and 0.06% of USA PE investment.

¹³ Data were taken from the member list of EVCA (2002), because it has data on all participative VC companies, size of the investments they have and sectors they invest in.

¹⁴ Interview with anonymous VC firm.



nowadays the time to exit the mainstream VC investment is around 1–2 years – an investment period may not be enough for eco-innovations to become commercially viable. Indeed, our research indicated that the time to exit averages five years for most green VC investments (a difference represented in row 'd' in Table 1). Many of the eco-entrepreneurs interviewed by us expressed the need for a longer period of product development to reach a market breakthrough. These start-ups are often product-based and the product cycle is longer than service-oriented innovations such as 'dotcoms'.

Environment prerogatives are – as one could expect – the core difference between mainstream and green VCs (row 'e' in Table 1). Mainstream VCs usually include environmental issues in their investment decision procedure as a risk factor only. Environmental issues are seen as a risk carrier or a potential liability to the start-up. Often, external consultants are hired to assess environmental risks related to the specific potential investee company in due-diligence procedures. Green VCs, on the other hand, consider the capacity eco-innovations have to add value to an enterprise, besides the risk reduction factor. Hence, it can be said that green VCs have the potential to generate 'double dividends' – the creation of both low environmental impacts or risks and financial returns (see Porter and van der Linde, 1995). After targeting eco-innovations, the decision investment procedure is basically the same as in the mainstream VC industry.

Mainstream and green VCs have somewhat different sources of financing (see row 'f' in Table 1). The main source of financing for mainstream VC is provided by institutional investors, which are composed by pension funds and banks. In 2000, pension funds accounted for 24% of the total investors in VC funds, while banks accounted for 22% (EVCA, 2002). For green VC funds 'high net worth' individuals represent almost 50% of their investors, which have often chosen green VC funds because of their environmental beliefs

and/or the understanding of the potential double dividends of sustainability related investments. This, in fact, constitutes the fundamental difference between the typical orientation of investors (or drivers for investing) of mainstream and green VCs (shown in row 'g' of Table 1).

The main difference between mainstream VC and green VC is found in the type of target investment (row 'h' of Table 1). Mainstream VC managers tend to invest in fast growing sectors, such as IT or communications, which account for 23% of total invested amount in Europe (EVCA, 2002). Our data shows that green VC firms currently invest in the following groups of technologies: (i) wind, solar and wave energy; (ii) desalination and water recycling; (iii) organic agriculture; (iv) fuel cells and (v) industrial process technologies.

Wavegen, a start-up funded by green VC, provides a good example of an eco-oriented start-up. The company was established in 1992 in Scotland to research innovative technologies and manufacture equipment for wave energy production (Ross, 2001). In 2000, the company secured a 15-year contract with the Scottish electricity utility to supply wave energy to the grid (Wavegen, 2002). The expressed commitment of the UK Government to reduce carbon dioxide emissions by 20% by the year 2010 under the United Nations Framework Convention on Climate Change (CEPS, 2000), and to have 10% of the energy supplied by the grid coming from renewable energy sources is expected to facilitate the adoption of wave technology. In other words, there are many grounds to believe that in the near future wave energy technology could repeat the success wind energy had in the 1990s. Considering the projected unit cost of electricity generated by wave technology¹⁵ or the first decades of the

¹⁵ The projected unit cost of electricity generated by wave technology is around €0.08, while the cost for wind energy is estimated to be €0.06. Wave generated electricity has the potential to achieve substantial cost advantages in the next 20 years and, eventually, transform fossil fuel generated electricity into an anti-economic activity. For more details see UNDP (2000).



21st century, it is reasonable to expect that this technology could become an attractive investment for green VC.

Companies such as Wavegen have the potential to be targeted by green VC funds, such as Sustainable Asset Management (SAM). This green VC firm established two funds in the year 2000 with a total amount of €86 million (SAM, 2001). Approximately 40% of the investors in the fund are high net worth individuals, with particular interest in sustainability-oriented firms. SAM-PE (private equity), for instance, invests in three main areas: emerging energy, resource productivity and healthy nutrition.¹⁶ When screening for eco-innovations in which to invest, SAM-PE assesses social, economic and macro-societal environmental trends. The commitment to investing in more environmentally sound companies makes SAM-PE a didactic example of a green VC enterprise. In this respect, Wavegen could eventually create value to VC financiers, such as SAM. However, not all eco-innovations obtain the necessary funding and not all green VC managers find appropriate eco-innovations to invest in. The following section explains why such situations happen; it provides an overview of the current problems faced by both 'sides' of green VC industry.

ECO-ENTREPRENEURS AND GREEN VC: A PROBLEMATIC RELATIONSHIP

Many eco-entrepreneurs and green VCs alike consider the words 'sustainability' or 'environment' problematic for the promotion of the enterprise. Often, start-up companies and VCs are reluctant to use these words even if sustainability principles are somehow embedded in their products. As one green venture capitalist stated, 'Our name often makes investors think that we just ride bicycles and eat vegetables'.¹⁷ Although such a type of interpretation

constitutes an important barrier to be overcome within the industry, it is certainly not the only one faced by green VC managers and eco-entrepreneurs. Below we have selected the most prominent barriers identified in our research.

- (i) *Lack of a proper network.* Since entrepreneurs and VC firms normally 'find each other' via active networks, the lack of a good network can certainly represent an impediment for the start of such relationships. In Europe, for instance, there is no formal network for eco-entrepreneurs and green VC firms. Nor are there enough conferences, trade fairs and information platforms for information and knowledge sharing about green VC, such as the *Investors Circle*¹⁸ in the USA. Some initiatives have emerged recently in the UK. There, a network has been formed¹⁹ to match investors with entrepreneurs in the field of digital technologies that contribute to social and environmental change. Although this represents a step forward, such type of network still needs to be extended to other members of the European Union.
- (ii) *Different meanings for 'sustainability' and 'environment'.* Many eco-entrepreneurs and green VC firms mentioned that environment and/or sustainability is perceived as less profitable (and even as a costly burden), which hampers the chances of getting funding. Indeed, many eco-entrepreneurs have eliminated the environmental perspective from their business plans so they could access mainstream funds more easily. For green VC firms, there are also some differences in perception as to what constitutes 'sustainability' or 'environmentally responsible' behaviour, and what will be a profitable investment.

¹⁶ For more details see <http://www.sam-group.com/>

¹⁷ Anonymous interview (4 July 2001).

¹⁸ See <http://www.investorscircle.net/>

¹⁹ See <http://www.vitamin-e.net/>



- (iii) *Lack of a 'good' business plan.* According to some venture capitalists, funding for start-ups is often refused because entrepreneurs submit a 'bad' business plan. For venture capitalists, a 'bad' plan reflects an incomplete or inconsistent business concept, a lack of essential data (e.g. expected revenues), or too much irrelevant data (such as an overemphasis on world environmental problems). For instance, a green VC firm representative²⁰ told us that an eco-entrepreneur submitted a business plan with ten pages on the science of climate change, and only four on the business concept. Apparently, 'bad' business plans are not unique to eco-entrepreneurs but rather a pervasive problem in the industry.
- (iv) *VC finance timing.* Many eco-entrepreneurs have their requests for financing refused simply because of the stage of development of the start-up. From the point of view of venture capitalists, start-ups in a very early stage of development represent too high a risk. As many of the green VC firms are themselves quite new, they have so far tended to favour businesses that are relatively 'mature', if compared with 'good' business ideas that still need to be 'incubated'. Such a situation generates a gap in financing, which is not totally filled by other types of investor, such as *angel investors* – private investors who provide capital directly to start-up companies in the very early stage of development.
- (v) *Lack of expertise and skills.* Lack of skills and expertise is a problem on both 'sides' of green VC investment. On one side, the research showed that VC firms or managers refused to finance eco-innovations because they did not understand a particular technology or the particular industry the eco-entrepreneurs wanted to enter. On the other side, venture capitalists have

the opinion that eco-entrepreneurs lack the business skills, such as marketing, management or financial competences, which are necessary to run their businesses. Thus, eco-entrepreneurs may need proper contexts, such as 'technological incubators', to be properly developed. In such places, eco-entrepreneurs who tend to have a technical orientation learn the managerial competences necessary to make their ideas to succeed in market terms.

- (vi) *Lack of potential market breakthrough.* Many eco-entrepreneurs are refused financing because their technology seems not to have the potential to be commercially viable within the lead-time expected by investors. Financing may also be refused for start-ups that are expected to compete in a mature industrial sector (automotive industry, for instance), or they think that the technology – and the team behind it – will simply not attract enough attention on the market in the short-term.

Having described existing problems of the relationship between green VC managers and eco-entrepreneurs, it is now appropriate to discuss the potential green VC funds have to expand. The following section summarizes the peculiarities of the green VC market by looking at the drivers for eco-innovations, as well as the sources of innovation in the green VCs themselves.

THE POTENTIAL OF GREEN VC TO EXPAND

According to the arguments presented in the previous sections, when compared with the broader categories of VC, green VC is expected to have some intrinsic uniqueness. Obviously, there are also many common issues faced by both types of investment. Because green VC is, in essence, a niche market in the broad area of

²⁰ Who prefers to remain anonymous (25 July 2001).



VC investment, it inherits many problems from its 'parent' investment segment.

Many of the problems faced by green VC can expect to be resolved in time as the field becomes more sophisticated and as the market 'learns' about the business opportunities within sustainable development. Apparently, what is now needed are some 'big successes' in green VC to draw attention and capital towards earlier stages of financing start-ups. The VC industry needs to learn about eco-innovations and, similarly, eco-entrepreneurs – whether they be start-ups or other environmental professionals – need to learn about green VC and other innovative finance mechanisms such as venture philanthropy. Venture capitalists operate in one of the riskiest zones of investment and they expect to be compensated for this risk by high returns on their investments.

The point at which a VC (whether green or not) would describe the relative 'success' of a venture would be at the stage wherein equity shares of the investee company are sold to other shareholders, preferably as an initial public offering (IPO). Of course, many ventures do not make it this far. The primary aim of venture capitalists is to gain sufficient return on investment in order to repay their investors, as well as to keep a percentage of the profit as income for themselves. Thus, the success of the venture is judged by the way in which the market considers the potential for the business to create value in the future. For green VC managers, this means that *what* they are funding is innovative and subject to particular market and non-market drivers (regulation, in particular), and *how* they are funding it (i.e. how they manage their investments and bring the eco-innovation to the market) requires a unique approach. These two aspects are covered in the following sections, schematically represented in Figure 2.

The main drivers for eco-innovations and subsequently green VC expansion, represented in Figure 2, are regulatory and technology push, and market pull (Rennings, 2000). Technology and regulatory push can motivate

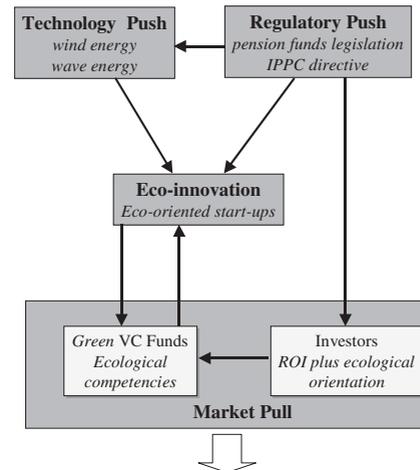


Figure 2. Determinants of eco-innovation expansion (Source: Adapted from Rennings (2000, p. 326).)

eco-entrepreneurs to start companies with environmentally beneficial new products (such as wave energy), while market pull, based on the investors' demand and competencies of green VC managers, can also influence the development of eco-innovations. These drivers and competencies are further discussed below.

Drivers for Value Creation

Traditionally, environmental 'externalities' are not adequately priced or valued by the market. Rennings (2000) reminds us of market imperfections – long debated by economists – that can hinder eco-innovations: 'As long as markets do not punish environmentally harmful impacts, competition between environmental and non-environmental innovation is distorted'. One way of curbing such imperfections is via environmental regulatory regulations, such as the IPPC directive.²¹ Regulatory guidelines

²¹ The IPPC directive stands for Integrated Pollution Prevention and Control and was issued in 1996 on the EU level. The IPPC directive would drive emerging start-ups to be able to fit into existing supply chain of companies already following IPPC directive; in other words, the IPPC directive could become an eco-innovation driver.



such as IPPC have the potential to trigger the development of 'cleaner' technology, such as wave and wind energy, discussed in the previous sections.

Green VCs' success rests firmly on how well the market – in our case translated into the view of green VC managers – perceives the potential value-creation of the start-up and/or the eco-innovation of existing businesses. This is especially true of new green VC funds, which only have a small number of investments and thus cannot easily spread their risk as larger VC funds. As can be observed in Figure 2, the *regulatory push* is a relevant factor influencing both the development of new technologies and the willingness of investors to fund eco-entrepreneurs. The regulatory push also influences the eco-entrepreneurs: by direct governmental measures (such as the IPPC) that have a direct impact on the development of eco-innovations and their commercialization. Thus, because of the 'triple' influence, the relevance of regulations is maybe the most important in development of eco-innovations and their ability to attract VC funds.

Changes in the pension fund laws in Europe consist of a special type of regulatory push that can induce investors to fund eco-oriented start-ups. Germany, for instance, has recently issued a law for pension funds to disclose information about ecological, ethical and social characteristics in their investments (Article 115 of the German Pension Legislation Act, 2002). The UK has a similar law that obliges pension funds to declare the extension in which social, environmental or ethical considerations are taken into account. According to EIRIS (2002), this regulatory approach is expected to be broadened and made more stringent in the future – eventually covering all EU countries. Since pension funds are currently the main investors in VC funds (24% in Europe, EVCA, 2002), such changes have the potential to significantly affect the investment market for green VC. As a result, one can expect that the amount of capital available to eco-innovations

via green VC firms and managers could significantly increase in the near future.

Without the backing of VC many eco-innovations will not be able to grow at the rate needed to reach the commercialization stage. This means that the perception of investors in the potential profitability of eco-innovations is of crucial importance to lifting many of these businesses off the ground. The perception of investors and green VC managers of the commercial viability of eco-innovations together with green VC managers' internal competencies represent part of the market pull explained next.

Competences of Green VCs: Nurturing and Managing Start-Ups

As discussed previously, regulatory push in some cases (e.g. pension legislation) influences investors to seek more environmentally and socially responsible funds, such as green VC funds to provide capital to eco-entrepreneurs (see Figure 2). Once the actual investment is selected and capital raised, the success of the investment is, to a certain extent, reliant on how well the start-up is managed and how 'well' the financier exits the investment. Hence, a particular competitive advantage of green VCs may be located here. If the VC (whether green or not) firm or manager has particular competence in techniques of corporate environmental management, they will be in a position to help investee companies to grow 'right' from the start. This would mean screening, assessing, stipulating and assisting entrepreneurs in ensuring that their businesses processes and products are managed in a way that have low environmental impact and social burden. They would thus be able to assist start-up companies in avoiding many environmental problems and costs in the future. This is one area wherein green VCs could lead other VCs, creating positive environmental outcomes in the process.



Furthermore, after a green VC firm successfully sells the shares of eco-oriented start-up in the stock market (technically, 'exiting' the investment), it certainly will be in a better position to justify the investment in eco-innovation, as well as to attract more investors. In this respect, a 'cleaner company' would be a selling argument for investors – it lowers costs and liability risks, as well as demonstrating an interest in creating value over the long term. With an increasing number of investors searching for sustainability attributes in companies (such as the SRI-oriented mutual funds), this could result in a profitable venture for green VC.

FINAL CONSIDERATIONS AND DIRECTIONS FOR FUTURE RESEARCH

In this paper we have explored an emerging phenomenon within the VC industry: environment-oriented VC or 'green' VC, as we named it. We initially described the characteristics, market and processes of VC and, in order to demonstrate the unique aspects of green VC, we compared it to the so-called mainstream VC. We also discussed the main barriers and drivers currently faced by green VC firms and managers and the eco-innovations supported by them. By doing so, our article arranged dispersed data, which allowed us to systematically describe and analyse this emerging phenomenon.

We emphasized that, as a unique thriving type of financing, the development of green VC seems to depend on the implementation of some specific types of regulation. This would positively influence the general conditions for green VC, such as changes in the rules that facilitate funding for eco-entrepreneurs (the ones guiding pension funds, for instance). On the other hand, green VC managers, eco-entrepreneurs and investors need to develop competences on environment-related strate-

gies and practices, which can create economic value *and* reduce environmental impacts/risks.

According to our study, comparing the financial performance of green VC funds with mainstream VC is fundamental for further development of the research area of VC financing. This is why we endeavoured in this exploratory research. By providing some (anecdotal) success stories of green VC, we expect to have persuaded academics to follow up on our research. In the *organization and environment*²² front, for instance, future research could assess governmental measures and mechanisms that improve the general climate for the development of eco-innovations in existing businesses, as well as the emergence of eco-oriented start-ups. In *studies of technology*, it seems essential to identify (alternative) technologies that are not only technically feasible to materialize in the coming years (such as wave energy technology, mentioned in this article) but are also able to become candidates to receiving green VC funding. In fact, such demand suggests that technology and management studies have to be brought together in future VC financing research. In order to facilitate such a process (in particular, research design), as well as a general discussion on the topic, based on the article, we propose the following *definition for green VC*: *green VC is a high-risk financial capital provision for eco-innovative ventures, which offers the potential for financial returns, as well as contributing to sustainable development.*

This definition – and the study in general – also have important implications for practice. Based on the research presented here we hope to have convinced practitioners in financing – in particular, mainstream VC managers – to pay more attention to the potential value-creation of green VC. We have demonstrated that there is a growing market for investment in eco-innovations, but so far only those who see sustainable development

²² For an overview of the *organization and environment* field, see Orssatto (2001).



and eco-innovation as vehicles for value-creation have targeted it. We wonder how long it will take for other VC firms to catch up with these visionaries.

REFERENCES

- Article 115 of the German Pension Legislation. 2002. In *Stiftung Zukunftsfähigkeit* [Foundation for Sustainability] http://www.stiftungzukunft.de/berichtspflicht_en.htm [18 February 2002].
- Barannik AJ. 2001. Providers of financial services and environmental risk management: current experience. In *Sustainable Banking*, Bouma JJ, Jeucken M, Klinkers L (eds). Greenleaf: Sheffield; 247–267.
- Centre for European Policy Studies (CEPS). 2000. *Carbon Emissions Trading Briefing Note by the UK Emissions Trading Group* <http://www.ceps.be/Research/Workparty/cop6/carbemistrade.htm> [10 January 2002].
- Commission of the European Communities (EC). 2001. *Communication from the Commission to the Council and the European Parliament on Implementation of the Risk Capital Action Plan*. EC: Brussels.
- Council Directive 96/61/EC of 24 September 1996 Concerning Integrated Pollution Prevention and Control (IPPC). *Official Journal L* 257: 0026–0040.
- Diefendorf S. 2000. The venture capital & environmental industry. *Corporate Environmental Strategy* 7: 388–399.
- Dyllick T, Hockerts K. 2002. Beyond the business case for corporate sustainability. *Business Strategy and the Environment* 11 (2): 130–141.
- Ethical Investment Research Service Website (EIRIS). 2000. *Changing World of Pensions: Guide for Pension Scheme Members*. <http://www.eiris.org> [16 December 2001].
- European Environment Agency (EEA). 2001. *Renewable Energy: Success Stories*, Environmental Issue Report 27. EEA: Copenhagen.
- European Private Equity and Venture Capital Association. 2000. *Yearbook 2000*. Vanden Broek: Bruges.
- European Venture Capital Association (EVCA). 2002. <http://www.evca.com/> [10 January 2002].
- European Wind Energy Association (EWEA), Forum for Energy and Development, Greenpeace International. 1999. *Windforce 10*. <http://www.greenpeace.org.au/> [10 January 2001].
- Gompers AP. 1998. Venture capital growing pains: should the market diet. *Journal of Banking & Finance* 22: 1089–1104.
- King AA, Lenox MJ. 2001. Does it really pay to be green. *Journal of Industrial Ecology* 5: 105–117.
- Orssatto RJ. 2001. Environmental challenges in organizations. In *International Encyclopedia of the Social and Behavioral Sciences*, Vol. 7, Smelser N, Baltes P (eds). Elsevier: Oxford; 4590–4592.
- Porter M, van der Linde C. 1995. Green and competitive. *Harvard Business Review* September–October: 120–134.
- Price Water House Coopers. 2000. *Global Private Equity 2000*. <http://www.pwcglobal.com/extweb/ncsurvres.nsf/DocID/> [10 June 2001].
- Randjelovic J. 2001. *Toward Sustainability Venture Capital: How Venture Capitalists Can Realize Benefits from Investing in Sustainability-Oriented Start-Up Businesses*. International Institute for Industrial Environmental Economics: Lund.
- Rennings K. 2000. Redefining innovation: eco-innovation research and the contribution from ecological economics. *Ecological Economics* 32: 319–332.
- Ross D. 2001. Give us a wave. *Our Planet Magazine*. <http://www.ourplanet.com> [15 January 2002].
- Social Investment Forum (SIF). 2001. *Report on Socially Responsible Investing Trends in the United States*. <http://www.socialinvest.org/areas/research/trends/2001-Trends.htm> [12 January 2001].
- Sustainable Asset Management (SAM). 2001. <http://www.sam-group.com> [20 September 2002].
- UBS Warburg. 2001. *Sustainability Investment*. <http://www.ubswarburg.com/researchweb> [20 February 2002].
- United Nations Development Programme (UNDP). 2000. Renewable energy technologies. In *World Energy Assessment: Energy and the Challenge of Sustainability*, Turkenburg WC (ed.). UNDP: New York; 219–272.
- Venture Economics. 2002. <http://www.ventureeconomics.com/> [20 February 2002].
- Wavegen. 2002. <http://www.wavegen.com/> [24 February 2002].
- World Fact Book. 2001. <http://www.cia.gov/cia/publications/factbook/> [15 January 2002].

BIOGRAPHY

Jelena Randjelovic (corresponding author) holds a Master's degree in Environmental Management and Policy at Lund University in Sweden. She is currently working for the Sustainable Northern Ireland Programme. She can be contacted at 75a Cregagh Road, Belfast BT6 8PY, Northern Ireland, UK.
Tel.: +44 28 9050 7850
Fax: +44 28 9094 2151
E-mail address: Jelena@sniponline.org



Anastasia O'Rourke is currently a PhD candidate at the Yale School of Forestry and Environmental Studies. Prior to Yale, she worked as a Research Associate for INSEAD's Centre for the Management of Environmental Resources.

Dr. Renato J. Orsato is an Associate Professor at the International Institute for Industrial Environmental Economics (IIIEE), Lund University, Sweden. He received his Ph.D. in Business Administration from the University of Technology, Sydney (Australia).