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Development and Commercialisation of Eco-Innovations by New Ventures

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1 Introduction

> *'Under a … BAU [Business As Usual] … scenario, the stock of greenhouse gasses could more than treble by the end of the century, giving at least a 50% risk of exceeding 5℃ global average temperature change during the following decades … Such changes would transform the physical geography of the world … [with] … powerful implications for the human geography – where people live, and how they live their lives' (Stern, 2006, p.iv).*

Since the dawn of the Industrial Revolution, the economies of the industrialised world have been founded on a carbon-intensive production paradigm. Economically valuable energy resources have been obtained from stores of coal, oil and natural gas. Established companies that produce these energy resources, along with products reliant on these resources, are central to this system, their market position founded on this paradigm in a manner that is not easily modified or abandoned. Prior developments limit what established firms can do on the basis of the experience and competence they have built up and what they have to lose. Thus while many existing companies are aware of pressures from changing environmental conditions, they are constrained in their capacity to generate novelty of organisation and output. The result of such constraints is that established companies have a poor track record of addressing environmental issues:

'*…less than one in five European utility companies has a strategy in place to address the implications of climate change and emissions trading. Two-fifths of those surveyed are still developing their strategies and one in five has no strategy at all'* (Wiegand and Gledhill, 2004, p.7).

Generations of established companies have failed to recognise or develop radical new innovations beyond their horizons (Utterback, 1994). While they occasionally introduce breakthroughs that build on their competences to extend their markets (Tushman and Anderson, 1997), the majority of innovations by established companies are incremental ; they are unlikely to undertake innovations which undermine their hard-earned competences. Penrose was one of the first to identify the limits to innovation experienced by individual companies and her observations anticipated those of many writers on innovation since her time (Penrose, 1959). Each company 'will be guided in its expansion programmes as much by the nature of its own resources as by market demand, for every firm is … a more or less specialised collection of resources and cannot move with equal ease in every direction' (Penrose, 1995, p.224). Moreover their past experience shapes the extent to which existing companies are even able to perceive new opportunities: '… the expected profitability of

expansion is controlled by the ability of the firm to see opportunities for the use of its own resources' (Penrose, 1995, p.216).

Penrose had pointed out why it may not be economic or viable for established firms to realise all the opportunities that arise for meeting customers' needs and it has since been observed that radical innovations which disrupt markets typically come from outsiders (Christensen, 1997). This leaves scope for new enterprises which have no stake in prevailing forms of activity, indeed entrepreneurship has been defined as '… the pursuit of opportunity without regard to resources currently controlled…' (Stevenson, 1999, p.10). Such new ventures are ready to take risks in pursuing opportunities with a minimum of resources and thrive on emerging opportunities; their forte is in finding and creating niches for production and exchange, some of which grow into mainstream activities. It is these characteristics that make new ventures potential agents of environmental innovation.

It is not enough, however, for new companies to innovate. They are much more likely to have an impact if they grow their customer base and diffuse their technology. While the opportunities for new activity meeting environmental needs are in principle extensive, there are many obstacles in the way of expansion for new ventures of this kind. This chapter investigates both opportunities and obstacles facing new environmental ventures, first through a review of prior work on the growth of new ventures, then through an examination of new empirical research from the UK. Evidence from a database of 73 micro-SMEs allows a comparison between different environmental sectors and identifies obstacles particular to each sector which affect the ability of new ventures to create and capture value. Richer detail is gained through nine case-profiles. These investigate the role of access to finance and business support in venture growth, along with how new ventures perceive opportunities and obstacles in the innovation process. By way of conclusion we identify some of the implications for environmental innovation policy that emerge from analysis of this data.

2 Establishment and Growth of New Ventures

The recent entrepreneurship literature has raised questions about the source of entrepreneurial opportunities, asking whether they are discovered or created by the entrepreneur, and the means by which they are exploited (Shane and Venkataraman, 2000). Two contrasting p erspectives on entrepreneurial opportunities are offered by Kirzner and Schumpeter. While Kirzner assumed that entrepreneurs are alert to and able to exploit already existing opportunities, Schumpeter held that entrepreneurs create new opportunities (Kirzner, 1997; Schumpeter, 1928). It is in an attempt to reconcile these viewpoints and discover an integrative framework for entrepreneurship that recent scholars have pursued a focus on entrepreneurial opportunity:

> 'Perception of an opportunity to create value triggers the process of new firm formation. The recognition of such an opportunity is determined by the imagination of the entrepreneur. This opportunity can be developed with the resources entrepreneurs have direct access to, with the resource they can acquire outside the firm or those they can create internally…' (Stam and Garnsey, 2005, p.3).

However, for a venture to survive and grow it must create value for customers and capture value in the form of profits. This can be particularly problematic when the new venture needs to demonstrate the potential for value creation so as to access resources that enable productive activity, prior to reaching customers. The barriers to growth that the new venture must overcome in order to achieve financial sustainability can be classified into three main categories: (1) financial factors, (2) management and organisational factors, and (3) product and market factors. Unfavourable factors edamined below are exacerbated when a venture operates in sectors that are capital intensive, concentrated and conservative. These are attributes of carbon intensive heavy industry, energy, utilities and transport sectors to a much greater extent than, for example ICT industries or the biotechnology sector where there is also greater opportunity for niche construction, favourable to new entrants .

(1) Typical barriers to finance for new ventures include the following. When risk capital funds have short time horizons they do not allow for the development time required by new ventures to achieve returns for investors. The development time is particularly uncertain for environmental technology firms and when managers have short time horizons this results in poor financial planning (Feldman & Klofsten, 2000). For a number of reasons there is an information asymmetry between the entrepreneurs' and investors' knowledge of a new technology and venture. There may also be some divergence of interests between the two parties, as where investors seek and entrepreneurs resist control. In addition, even where interests are shared, entrepreneurs may be unwilling to divulge information which they believe could endanger their competitive position.

(2) The survival of the majority of small firms is heavily dependent on the entrepreneurial and managerial abilities of their founders. The centrality of the owner-manager to the venture's initial business strategy, organisational structure, and access to resources means that her/his talents, skills, values and social networks are often critical factors in the start-up period (Chrisman *et al.*, 1998).

The "personal characteristics" of the entrepreneur include attributes such as education and previous experience, along with more technical and managerial skills, such as knowledge of the market. Moreover, the demands on the entrepreneur's skills shift as the company grows and this may present problems: the single-mindedness which ensured the company's birth

may be a liability when reacting to a changing market. The individual founder is particularly vulnerable here, whereas the existence of a founding team may offer a greater range of skills as well as alternative perspectives and strategies:

> '… growth usually leads to an extensive division of labour with functional specialists having different responsibilities … through specialization key managerial, innovative and sales functions become divided' (Feldman and Klofsten, 2000, p.634).

Coordinating these different functions becomes more difficult with growth, requiring an increase in the management of human resources. Growth can also increase bureaucracy and create communication blocks which stifle coordination. As new employees are brought into the firm, communication can be further complicated as the new recruits lack specialised knowledge specific to the firm (Garnsey, 1998).

(3) Successful innovation arises when a firm offers a product or service that is both technically viable and commercially marketable (Freeman and Soete, 1997). Nevertheless, many new ventures are launched without adequate understanding of either the demands of producing goods or of the market into which they will be sold. Many small firms originate as 'one-product' (or service) firms and are thus heavily dependent on a specific market. An overestimation of the size of this market, or the failure to respond to its development, are common causes of business failure. For production-based companies, development times and costs are frequently underestimated and, even if the initial product is successful, follow-up products are often harder to identify and develop.

Increased competition can make innovation-based rents obsolete. New and small firms are particularly vulnerable to an increased competitiveness in their niche market (Roure & Maidique, 1986). The initial success of a new firm in a market will attract new competitors, driving the need for efficient production to reduce costs and maintain competitive prices. If a new venture manages to capture temporary rents from an innovation, these can result in an over emphasis on profit-oriented behaviour at the expense of knowledge generation, with this creating organisational inertia potentially fatal to the new venture in the face of increased competition (Feldman and Klofsten, 2000).

The literature reviewing the growth of new environmental ventures is still limited, with recent contributions focusing on the role of market failures in the creation of opportunities for environmental entrepreneurship (Cohen and Winn, 2007; Dean and McMullen, 2007). We will show that as with new companies in other sectors, firms aiming to grow in the environmental sector face obstacles in the pursuit of opportunities. In addition, there are also many regulatory requirements in the environmental sector that create both opportunities and

obstacles to new firms. In this chapter our focus is on the new venture as a vehicle for exploiting opportunities both discovered and created. In the analysis which follows, we investigate the various obstacles that prevent environmental ventures from innovating successfully and achieving growth, despite the presence of potential business opportunities.

3 The Empirical Study

During 2004-5, the Environmental Innovation Unit (EIU) of the UK Government's Department of Trade and Industry (DTI) compiled a cross-sectoral database of UK firms pursuing innovations in the environmental domain. This investigation analyses a subset of 73 micro-SMEs from this database. The selection of these particular firms was made on two accounts. In the first case, micro-SMEs are resource constrained, a factor that is less operative in larger firms, and we wish to investigate how this constraint affects the development and commercialisation process. In the second case, we wish to gain insight into some of the common challenges faced by firms within particular environmental sectors. To this end, the firms in this analysis are disaggregated into five categories, based on the Joint Environmental Markets Unit (JEMU) classification:

- Cleaner Technologies and Processes
- Renewable and Low Carbon Energy – Stationary
- Renewable and Low Carbon Energy – Transport
- Recovery and Recycling
- Water and Wastewater Treatment

This classification scheme categorises according to technology rather than target markets. Some of the technologies, particularly 'Renewable and Low Carbon Energy', are generic technologies which can be applied to a variety of markets. Figure 1 shows the numerical breakdown of this categorisation process.

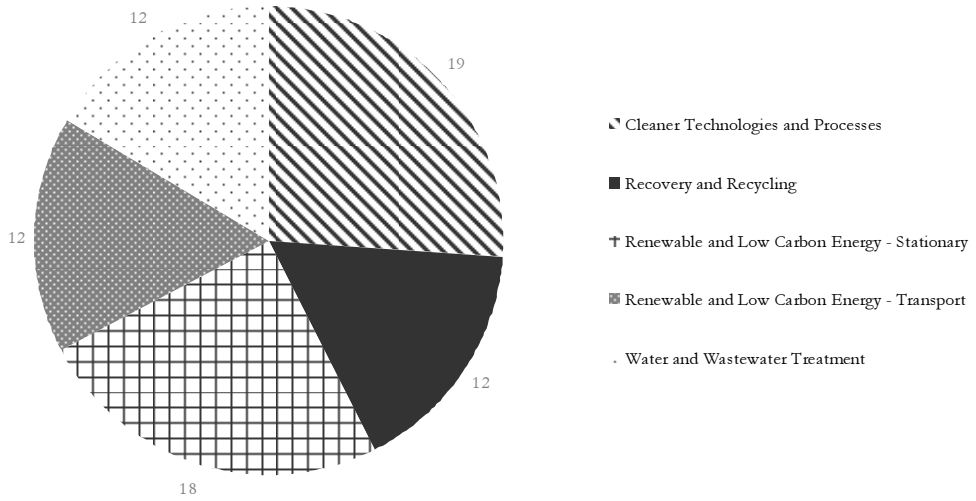

Figure 1 The selection of firms by DTI categorisation (N=73)

3.1 Stage I: Barriers to Growth: Categorisation

A problem with the notion of barriers to growth is that there is co-dependence and interconnection between a broad range of barriers to successful technological development and commercialisation rather than a discrete set of obstacles. Growth and development problems, and business opportunities, were identified based on self-reported factors, as in many studies of 'obstacles to growth'. Some reported external obstacles differ between companies facing similar conditions. This occurs because self-reported problems reflect the perceptions and aspirations of respondents. Firms that do not seek to expand on a scale that requires external finance do not cite its absence as an obstacle. A major US study showed that firms lacking growth aspirations reported fewer problems that more ambitious firms (Reynolds and White, 1997). Nevertheless, the study reported here reveals the relative magnitude of difficulties which new ventures must overcome to develop and grow, and how these vary according to sector.

While obtaining finance was a prevalent theme, the context in which the funds were required varied greatly. A distinction was drawn between the need for external finance and the reason for that need. These needs, in combination with the other factors affecting the firms in the development and commercialisation of environmental technologies, led to ten 'barriers' being selected for investigation. For simplicity of analysis these are organised initially as seven barriers internal to the firm and three barriers external to the firm, as in Table 1 below. Factors external to the firm all relate to features of the 'selection regime' facing these firms. In evolutionary theory these are the conditions that determine which firms are selected for allocation of resources in an economy (that is, demonstrate "fitness" for that environment).

Only operating costs are internal to the firms when viewed as open systems, since the other 'internal' factors refer to the firms' relations with other parties in their business environment[1]. Moreover, where the technologies are generic they can be applied in diverse markets with a variety of external conditions.

Table 1 Internal and external factors reported as affecting the financial position of the firm

Internal factors	External factors
Contacts with customers/partners	Lack of national standards
Funding for certification	Lack of public procurement
Funding for commercialisation	Regulatory uncertainty
Funding for R&D	
High capital costs	
Operating costs	
Proof of product	

The result of this analysis across the ten factors is presented in Figure 2. Only 16 out of 119 reported problems (13.4%) concern factors entirely external to the firm (related to their selection environment). Among 'internal' factors, *Contact with customers/partners*, *Funding for R&D*, and *Proof of product* emerge as the dominant challenges facing those firms in the data set.

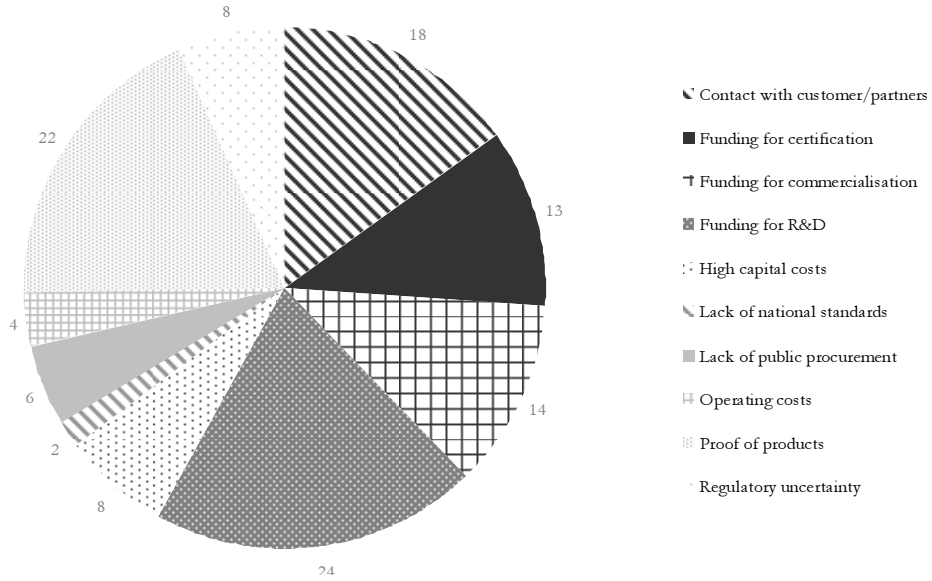

Figure 2 The aggregate set of factors facing firms (N=73), (legend details in clockwise direction)

However, while this aggregate analysis highlights these problem areas as ones in which firms could be offered capacity building assistance, it disguises those challenges that are of greater importance in particular sectors. Using the DTI categorisation previously described yields the results displayed in Table 2. These figures reveal that, for firms in this sample, the factors affecting the ability to develop and commercialise environmental innovations differs significantly between sector categories. For the firms developing cleaner technologies and

[1] However operating costs are influenced by supply costs, another external factor.

processes, *Contacts with customers/partners*, *Funding for certification* and *High capital costs* emerge as the key challenges. It is significant that for this category, *Funding for R&D* is of little concern. In this sample, firms in this sector have market or near-market ready technologies but experience difficulties in the early-stages of the commercialisation process.

In the recovery and recycling category, establishing *Proof of product* is the dominant challenge. For firms in this sector, demonstrable working prototypes or pilot plants appear necessary to convince prospective customers, partners and funding bodies of the value of the technology. This is evidenced by the other significant emergent obstacles, *Contacts with customers/partners* and *Funding for R&D*.

The profiles for firms in the renewable and low carbon energy categories (both stationary and transport) are very similar. In each, *Funding for R&D* is of primary concern. Other significant challenges, *Contacts with customers/partners*, *Funding for commercialisation* and *Proof of product*, highlight the need for firms to establish capabilities across a much broader range of skills and that resources might be stretched tighter as a result. The difference in attitudes towards *Regulatory uncertainty* provides the main distinction between the stationary and transport categories, as it is revealed to be of higher concern to those developing stationary technologies.

In the final category, water and wastewater treatment, *Proof of product* emerges as the most common challenge, with *Funding for R&D*, *Contacts with customers/partners* and *Funding for certification* also highly represented. The main challenge for firms in this sector appears to be achieving a demonstrable technology that convinces conservative customers of the value of their technology.

This analysis of a sample of 73 firms according to their JEMU classification reveals that entrepreneurial firms in the environmental industry face significantly different challenges according to the sector in which they operate. This points to the salience of conditions enabling supply and relating to demand in the various sectors and the need for environmental innovation policy to reflect these differences.

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Table 2 Analysis of the challenges facing firms developing and commercialising environmental innovation (N=73)

	Cleaner Technologies and Processes (%)	Recovery and Recycling (%)	Renewable and Low Carbon Energy – Stationary (%)	Renewable and Low Carbon Energy – Transport (%)	Water and Wastewater Treatment (%)
1. Funding for R&D	2.8	14.3	40	33.3	20
2. High capital costs	19.4	0	0	5.6	0
3. Funding for commercialisation	11.1	9.5	12	16.7	10
4. Proof of product	11.1	33.3	12	11.1	30
5. Funding for certification	16.7	9.5	4	5.6	15
6. Contacts with customers/partners	19.4	14.3	12	16.7	15
7. Operating costs	5.6	4.8	4	0	0
8. Lack of national standards	0	4.8	0	5.6	0
9. Lack of public procurement	11.1	4.8	4	0	0
10. Regulatory uncertainty	2.8	4.8	12	5.6	10
Total Internal factors Σ (1-7)	86.1	85.6	84	88.8	90
Total External factors Σ(8-10)	13.9	14.4	16	11.2	10

	Sample %
	25+
	20-24.9
	15.0-19.9
	10.0-14.9
	5.0-9.9
	0-4.9

3.2 Stage II: Case-Profiles

Following the analysis of 73 micro-SMEs, a number of firms were selected from this sample to be investigated in more detail, with focus on how they pursued raising finance and accessing business support. Early stage companies were chosen that had been founded between 1999 and 2003, across a variety of U.K. regions. Nine companies still in operation in 2006 were selected from four sectors:

1. Renewable and Low Carbon Energy - Stationary: Viridian, HelioDynamics, Voller Energy
2. Water and Wastewater Treatment: Gentronix, Advanced Oxidation Limited, EEC
3. Cleaner Technologies and Processes: Natural Building Technologies, Salvtech
4. Environmental Monitoring: Neptune Oceanographics

3.2.1 Data collection protocol

Case-profiles were issued with a questionnaire comprising a series of open and closed questions that enabled an in-depth inquiry into each case-profile. This facilitated a comparative analysis between case-profiles, focusing on issues associated with raising finance and accessing business support. A summary of these case-profiles is shown in Table 3.

Table 3 Introductory summaries for case-profiles

Case number	Company name	Sector	Formed	Region	Full time employees	Part time employees	Profit 2004/2005	Manufacturing capabilities	Description
E0217	Natural Building Technologies	Cleaner Technologies and Processes	Late 1999	Buckinghamshire	12	3	-£500k	Sub-contracted manufacturing	Pavatex boards Natilin Insulation Warmcell Insulation Thermofleece Insulation Baumit Bayosan plasters and renders Claytec plasters and boards Ziegel Blocks NBT Trade Paints Beeck Silicate Paints NBT Unfired clay blocks (in development)
ESM011	Salvtech	Cleaner Technologies and Processes	2002	Taunton, Somerset	2	0	-£2000	In-house and sub-contracted	Environmental board and moulded products from Wastepaper Recycling plant Residues. WRAP and Blink Kent
ESM059	Voller Energy	Low carbon-stationary	2002 March	Basingstoke, Hampshire	15	5	N/A	In-house manufacturing	Manufacturer of portable fuel cell systems, battery chargers and generators.
ESM004	Viridian Concepts	Low carbon-stationary	2003 Jan	Cambridgeshire	2 (soon to be 3)	3	£100k	Sub-contracted	Cost optimised solar hot water system for inclusion into new build dwellings.
ESM002	HelioDynamics Ltd	Low carbon-stationary	2001 October	Cambridgeshire	5	3	0	Some in-house and sub-contracted	Solar concentrator which can provide heat and power.
E0106	Advanced Oxidation Ltd.	Water and waste water treatment	2002	Penryn, Cornwall	4	1	0	Sub-contracted	Electrochemical treatment of wastewater (Finance Cornwall invested July 2005)
E0220	Gentronix	Water and waste water treatment	1999	Manchester	7	3	N/A	In-house manufacturing	Gentronix' core technology is GreenScreen, a living yeast biosensor which can be used to detect toxic and specifically genotoxic chemicals
ESM001	EEC	Water and waste water treatment	2002 Sept	South Yorkshire	1	As and when needed	Small net loss	Sub-license manufacturing agreements with company in Doncaster, South Yorkshire and company in Bucharest Romania.	"High-Speed Bio Tech" Environmental Equipment Wastewater Treatment.
	Neptune Oceanographics Ltd	Environmental monitoring	1999	Charlbury, Oxfordshire	2	0	N/A	N/A	Services to the offshore oil and gas industry, mainly subsea pipelines leak detection.

3.2.2 Access to Finance

All of the companies contacted required finance from outside their firms to develop their business. A summary of finance gained and not gained is shown in Figure 3. The case-profiles have all accessed government grants with success. In addition, two of the Cambridge-based companies have accessed Angel finance. In the case of Viridian, some private investment came from the company founders themselves, who had raised money from the sale of a previously successful venture. Natural Building Technologies, Advanced Oxidation and Gentronix have all successfully raised venture capital finance.

The companies were asked questions to determine whether their awareness of different sources of finances was a limiting factor for accessing finance. All case-profiles had full awareness of their options for raising finance from external sources, including funds specific to environmental technology e.g. Carbon Trust (Figure 3).

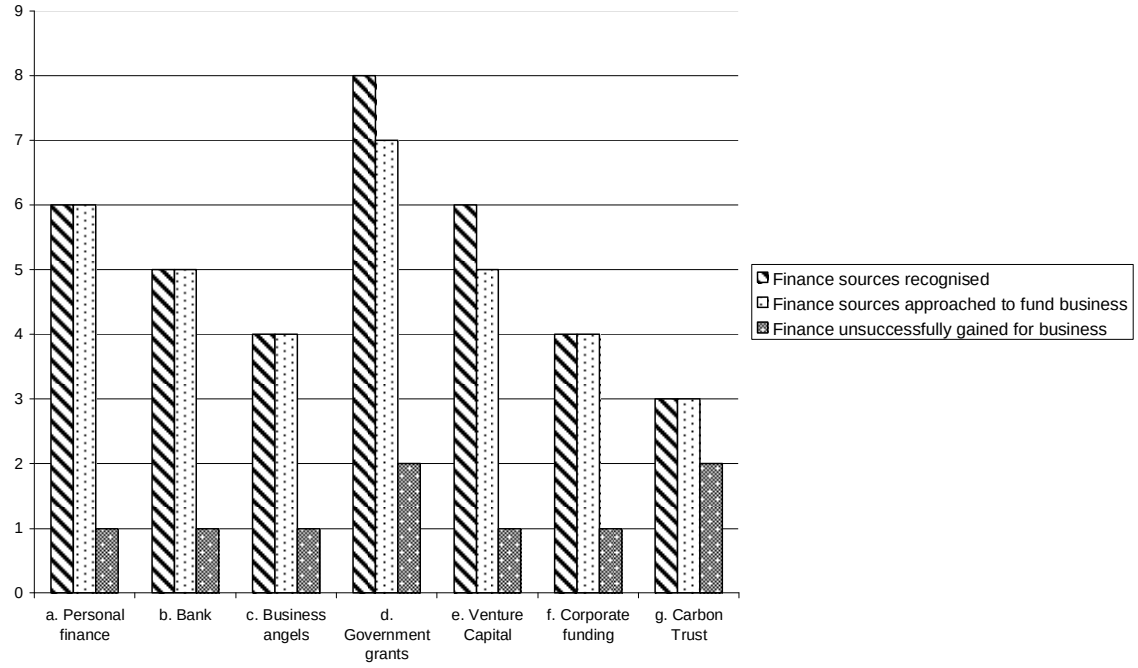

Figure 3 A comparison of sources of finance of which businesses are aware, which have been approached, and which have been unsuccessful gained (8/9 respondents)

Problems in raising finance stemmed from a mixture of internal and external factors. Internal factors reported included criticisms of company management, a sub-standard Business Plan, insufficient processes to exploit IPR and being an early-stage firm. External factors reported included the opinion that engineering businesses are 'no longer in fashion' with investors, that investors lack the knowledge to understand some types of environmental businesses, along with a comment regarding the difficulty of accessing bank finance due to the reluctance of banks to

provide finance to companies lacking an income stream or assets to secure against borrowing (e.g. if the entrepreneur is not a house owner). All firms had accessed government grants which played a critical role in the early development of their businesses. Some firms had also raised finance from a variety of other sources, including venture capital finance, Carbon Trust R&D funding and business angels. There were concerns regarding Venture Capital finance, including equity dilution, early exit pressures and a loss of control by founders over their companies.

These findings show that environmental entrepreneurs share some generic problems with entrepreneurs operating in other industries, but also indicate a sector specific issue regarding investor's knowledge of environmental technologies. This exacerbates the information asymmetry gap between entrepreneurs and investors. One entrepreneur makes a comment typical of the sector:

> *'To date any difficulties [raising finance] centred on too early stage, modest revenues and difficulty of some potential investors in supporting technology they don't understand.'* (Gentronix 2006)

Although the number of investors in clean technology has increased over the last few years, investment in clean technology is still dwarfed by investment in other sectors (Makower *et al.,* 2006). In 2005, energy technology investments formed 4.2% of total venture capital investments in U.S. based companies (Makower *et al.,* 2006). A recent U.K. report found similar findings, showing that few venture capital investors have made repeat investments in clean technology, with only eleven investors making three or more different clean technology investments (Library House, 2005). Investors may be deterred from repeat investments for a variety or reasons; investments may not have performed as expected, investment opportunities may be lacking, investors may lack the experience to identify investment opportunities, or the experience of investing may highlight the utility of sector specific competences to fulfil clean technology investments. Three out of nine of the DTI case-profiles identified financial barriers as the biggest obstacle they faced in 2006.

3.2.3 Business Support Needs

For new ventures to access customers and secure sales, they need to build confidence in their products and services. The analysis of 73 micro-SMEs showed that achieving proof of product and certification were significant barriers faced by companies in various environmental sectors (Figure 2). Without certification, demonstration of a product can build consumer confidence, but in some industries this is also problematic:

> *'…no one builds "prototype" houses, all experimentation is done on real products. NHBC has so far not been especially supportive to our demonstrating new products. Big companies can stand behind their innovative products and give housebuilders confidence. Housebuilders will not try out a product if it means their house doesn't qualify for NHBC or Zurich insurance.'* (Viridian Concepts 2006)

Building customer confidence is especially challenging when operating in industries unreceptive to new technologies:

> *'The conservatism of the construction industry, leads to resistance to change and a very long and tortuous process between product specification and actual sales.'* (Neil May, Natural Building Technologies, February 2006)

Another company operating in the waste industry faced a similar problem, commenting on an *'industry lack of interest in step change technology and modest risk taking'* (Gentronix 2006)**.** Five of the nine DTI case-studies identified problems associated with accessing customers as the main obstacle they faced in 2006. In addition to customer conservatism, one company found the transition from identifying customers to securing sales a particular challenge, and another was concerned about maintaining customer confidence during the lengthy development of production processes.

Setting up partnerships and making contact with customers created difficulties for companies in all the environmental sectors in this study. However the DTI case-studies identified that the business support need least readily met by existing services was help accessing potential customers. Public sector procurement can provide revenues and endorsement for new products. However, a lack of innovative public sector purchasing was only cited as an issue by six firms; the remaining companies in the study do not seem to have considered the public sector as a realistic revenue source. Government sector organisations rarely source innovative products from new companies in the UK.

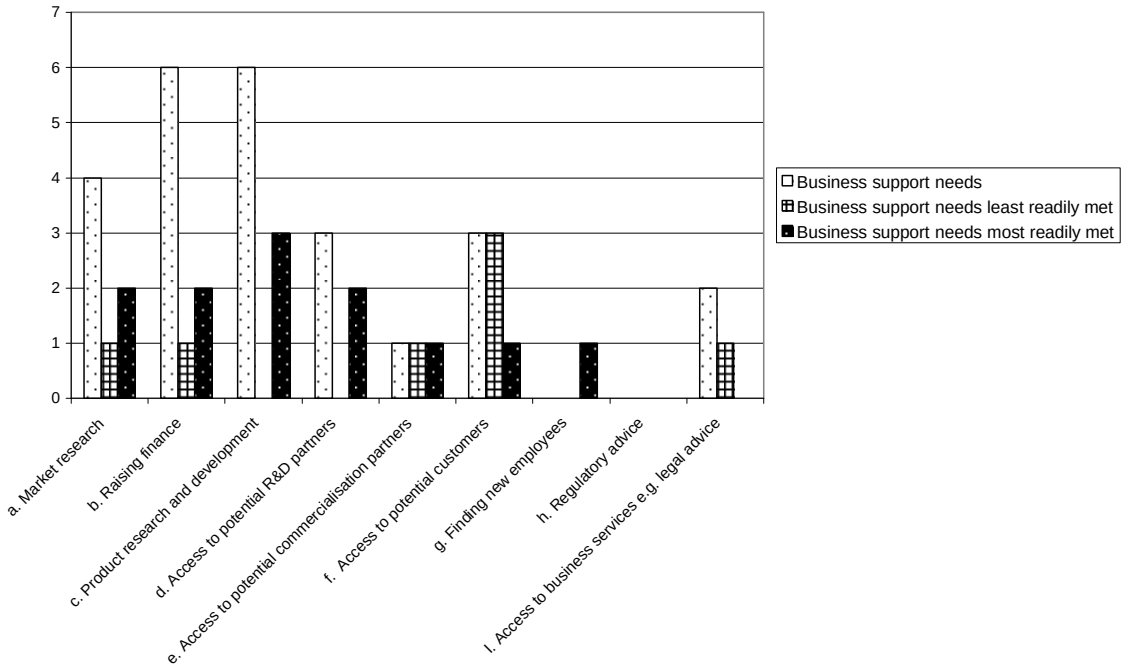

Figure 4 Comparison between business support sought (9/9 respondents), business support which was difficult to obtain (6/9 respondents), and most readily available business support (6/9 respondents)

Government regulation can have a vital role enabling the creation of value by environmental ventures, for their customers and other stakeholders. Two of the nine companies cited regulatory factors as their biggest business opportunity in 2006:

> *'Implementation of the EU Water Framework Directive and REACH legislation and expansion of Integrated Pollution Prevention and Control legislation which all highlight 'mutagens and carcinogens' as key pollutants of concern, yet very few methods to analyse these species are readily accessible to industrial laboratories and regulators.'* (Gentronix, waste)

> *'The legislative drive towards more ecological building combined with increased consumer demand and awareness are leading to huge large scale opportunities across the board. Large projects in new housing and schools are probably the biggest immediate opportunity.'* (Neil May, Natural Building Technologies, construction)

Although regulation has a direct affect on many environmental businesses, the case-profiles did not identify it as a business support need, but neither was it identified as a readily or not readily available business support service. This discrepancy needs to be further explored, but may be because regulatory support is not viewed as a business support service at the present time. The

areas of business activity for which firms sought business support can be seen in Figure 4. This shows the companies' main needs for business support are 'raising finance' and 'product research and development'. This is perhaps of little surprise when considering that the case-profiles are all early-stage companies that were contacted prior to sustainable revenue generation. Following the results from the analysis of the 73 micro-SMEs in the EIU database, it appears that the needs for business support are influenced by differences in sector and maturity.

3.2.4 Business Support Services

The case-profile companies were asked for their awareness and opinions of business support services available to them. All respondents were aware of Business Link as a source of business support but there was mixed awareness of other types of business support. It can be seen that companies were generally aware of more business support services than they accessed (Figure 5).

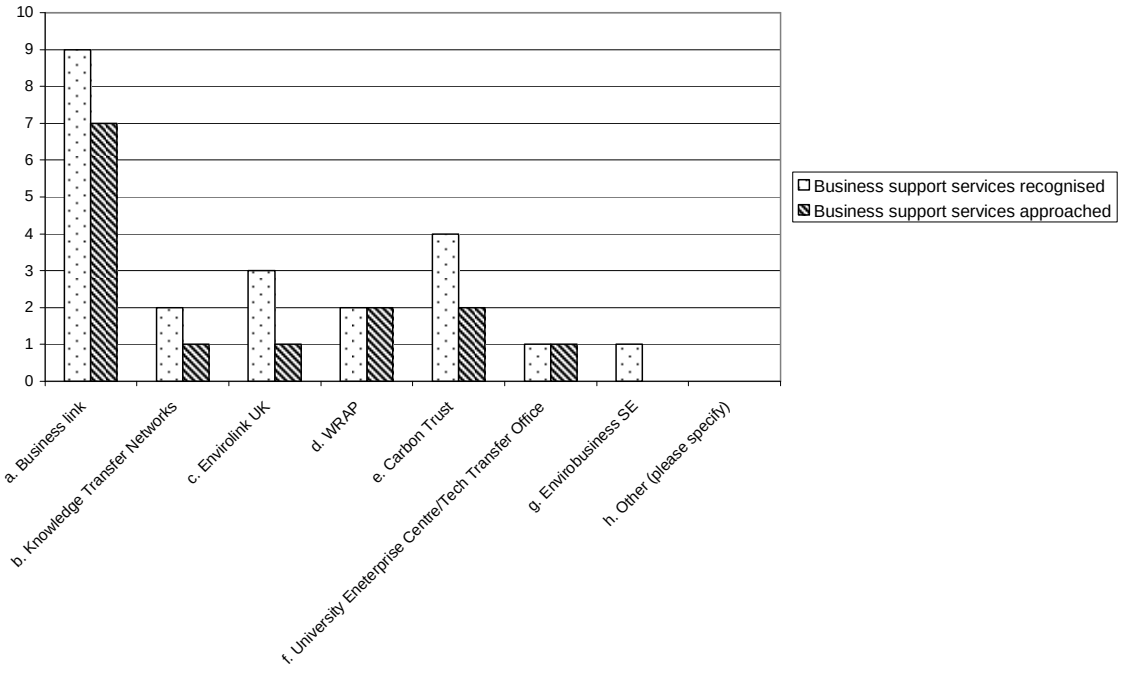

Figure 5 Comparison of business support services of which respondents are aware (9/9 respondents), and which people approached (9/9 respondents)

A variety of responses were obtained when the companies were asked about their opinions of the best sources of business advice they had received. Despite the different sources of business advice, Voller, Gentronix, Natural Building Technologies and EEC all mentioned the value of receiving advice from individuals with business and/or industry experience. Companies reported very favourably on the value of business support received from experienced individuals who have the capacity to take on a mentoring role. However, there was no apparent pattern in the

organisations from which these individuals were accessed e.g. incubators, investors, company networks, universities.

As regards business support organisations, the government support offices of Business Link received variable responses, not on the whole favourable, although there were regional variations. Some business support organisations were even described as a hindrance (WRAP) but again comments ranged depending on the individuals contacted within these organisations. Working with universities was reported to have been ‘very fruitful’. HelioDynamics found the incubator Life-IC in Sheffield to be of value even though the incubation period was terminated prematurely. Neptune Oceanographics remarked that passport and export support for overseas exhibitions had been valued business support.

4 Conclusion and policy implications

Current global environmental conditions call for a reduction in the collective time to market of innovations which benefit society. Yet despite the attempts of the innovative firms in this study to provide a supply of environmental goods and services, they faced a lack of innovative response and uptake in the customer supply chain. While tax incentives have been suggested as one means to encourage the uptake of alternative energy technologies, these could leave companies vulnerable to changes in fiscal measures. More could be done to encourage public sector procurement so that new entrants could use endorsement from public sector customers in extending demand for their innovative products and services. Government procurement[2] could provide a channel through which small firms could gain their first customers, improving the visibility and demonstrability of their products (Connell, 2004). In an age of privatised national industries there is also a role for industry regulators to require well placed established incumbents to act as customers to the new environmental firms[3].

One of the main problems faced by firms involved in the development and commercialisation of innovative environmental products and services is the problem of selling innovative new products into uncertain markets. These firms have difficulty persuading customers that they will benefit from the value provided by these innovations. Such difficulties include persuading customers that the product does something better than the competition (functions more effectively, has an improved performance-price ratio) or does something new: solves a customer problem that no other current product or service can solve. But an information asymmetry problem arises between eco-enterprises and potential customers. It may be difficult for these eco-enterprises to reach customers with these potential solutions, even when new environmental regulations have come into effect. It may also prove problematic to persuade customers that the information is reliable even if they are reached. These difficulties are amplified when selling into highly regulated, conservative industries such as those of construction and water.

All the companies studied in the case-profiles faced difficulties in achieving the transition between product development and product sales. Technological and market development need to occur concurrently to prevent barriers to commercialisation; unfortunately this can take a long time and be problematic for generic technologies[4] (Garnsey and Maine, 2005). The areas of business support that companies had difficulty obtaining related to this

[2] The U.S. Small Business Innovation Research (SBIR) Programme is an example of a system which requires procurement of innovative products and services which has been more effective than the U.K. optional equivalent.
[3] The U.K. has the Renewables Obligation Certificates (ROCs) which require all licensed electricity suppliers in England and Wales to supply a specific proportion of their electricity from renewables, but there is no requirement governing what types of companies should provide these renewables.
[4] Many sustainable energy technologies are generic which means they can be applied to a variety of markets which complicates the technological and market development matching process.

commercialisation process (Figure 4). For example, selling novel environmental products to the builders of new housing has proven to be particularly difficult for eco-entrepreneurs. Among other reasons, there are few opportunities to test products on 'prototype' houses since most experimentation is done on 'real' housing developments. Studies of innovation diffusion have revealed the benefits of observability and trialability for a new product seeking customer adoption (Rogers, 2003). Despite the potential for these new products to have a relative advantage over existing technologies or to meet as yet unmet user requirements, it is difficult for customers to test products. This low trialability gives rise to the low observability of the innovation's effectiveness. That the technology might be difficult for the customer to understand or incompatible with the organisational culture of the customer also contributes to the eco-entrepreneur's difficulties in diffusing the innovation.

However, a particularly interesting business model adopted in an effort to reduce the problems in the commercialisation process was that of Viridian. From the outset of their product development, Viridian created a consortium of potential customers and worked with them to define the product specifications. Through engaging with their potential customers throughout the process, they ensured that these customers would be informed of the value offered by their innovation, thus reducing the possibility that the benefits of their novel product would go unrecognised. As this example illustrates, the adoption of an appropriate business model is crucial to the growth of a new venture; its importance should not be underestimated as an effective business model can reduce problems and overcome barriers in the commercialisation process.

In this study, certification and standards were found to be a specific sectoral problem that made it difficult for firms to gain customer confidence in their new products. Certification services are required for all new products, whether from independent or government bodies. Government authorised and funded certification could be used more effectively to assure potential customers of the credibility and benefits of new environmental products.

Financial sources and business support available to eco-enterprise are rapidly changing in response to renewed interest in the commercial potential of innovative environmental technology products and services. However, there is a contrast between the business support which companies actively seek and the areas of business support which they have difficulty obtaining. Companies do not seek types of business support which are not readily available. Our study highlights the considerable value that firms receive in business support from experienced individuals. Such individuals have the capacity to take on a proactive mentoring role, with these mentors coming from a variety of organisations e.g. incubator, investor, company networks. The DTI is currently re-examining the role of Business Links and how to provide early stage companies with better links to prospective mentors.[5] The rise of advanced

[5] An earlier version of this report was used to support this recommendation to government.

information and communication technologies means that it is generally easier to seek out those individuals who would possess specialist scientific or technical knowledge. As the environmental industry has emerged relatively recently, few people have experience of forming new ventures in this sector. Alternative business support can however be provided by mentors with transferable skills from experience in other start-up companies or who have considerable experience and contacts in a company's target markets. There is much scope for improving the involvement of knowledgeable individuals in the creation of the next generation of environmental firms.

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