Review of the Environmental Goods and Services Sector in Hertfordshire

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Executive Summary

This report summarizes the findings of a study funded by a **Vice Chancellor's Grant in the Social Sciences, Arts and Humanities**. The study focuses on the *Environmental Goods and Services* (EGS) Industry. This sector is very important both for its role in contributing to economic growth, and for its contribution in reducing the effects of economic activity on the environment, including for example global warming. Extensive secondary research has been carried out on the EGS sector; primary research has also been carried out. This consisted in surveying a sample of 32 Business Managers at EGS companies based in Hertfordshire. The EGS is estimated to have a World market value of $550 billion in 2001, up from $484 billion in 1998. This market was expected to reach a value of $620Bn by 2005. The market size for the UK was just above £25Bn in the UK in 2004, up from £16Bn in 2001, while the market size for the East of England was £7.2Bn in 2004. The sector is in rapid growth, with some estimates of the rate of growth as high as 20% pa. The sector employs around 400,000 people in the UK, of which 48,000 circa in the East of England, and is composed of circa 17,000 companies, of which 2,139 in the East of England, on a par with the aerospace and defence sectors. The problem in characterizing this industry is that it is very diverse, spanning numerous industrial classifications. Legislation, both national and EU, is set to play an important role to promote industry demand. Regulations need to be supported by a matching economic policy. This paper adopts a simplified segmentation model of the industry consisting of five broad segments: *Environmental engineering secto*r; Waste *collection, disposal and processing sector*; Pollution *equipment sector*; Renewable *energy sector*; and *Services, Training and Consulting sector*.

The HE sector has a unique role in the research and development of new sustainable processes, technologies and products, either through developing new technologies autonomously and then "spinning them off" by setting up new businesses or developing them in collaboration with businesses. This report suggests that the EGS sector has several gaps in performance which prevent it from developing further. These gaps in performance are in areas such as strategy, marketing, human resource management (HRM), International trade and IT.

Summary Recommendations

This report recommends that:

- Local Government Agencies, Authorities and Non Government Organizations (NGO) devise support packages for the industry including, for example, financial incentives, advice, training and other support to address the weaknesses identified in the sector;
- Business Schools, and in particular UHBS, seek opportunities for collaborations with companies in the EGS sector (of which the author has developed a database as part of this project) to support them with:
  - Business courses, in particular programmes such as MBA, MSc Management, MSc in Strategic marketing and MA in HRM. The sector can be approached to enrol employees on these courses and fill the gaps in performance identified by the research, which include strategic capabilities, international trade skills, general managerial competence, marketing, it and HRM skills;
  - Commercial collaborations including for example Knowledge Transfer Partnerships (KTP), to support these organizations to redesign their strategies, research and exploit international opportunities, improve their marketing and HRM processes and activities and build their ITC skills. It is worth mentioning at this point that UHBS is already collaborating with a Stevenage company, *Abbey Steel* Ltd. which specializes in sourcing surplus steel for reuse and recycle.
  - Collaboration projects with companies in the sector to develop integrate offering of environmental services and business strategies by supplying these companies with management and strategic skills, as well as supporting them in attracting human resources;
  - Identification and approach of partner companies that can work together with UHBS and UH to complement the overall offer of business, training and education services revolving around sustainability. These potential partners should be selected based on a detailed analysis of their capabilities so that relationships can be mutually beneficial.
- Engineering and technological schools seek opportunities for collaboration with companies in the EGS sector to complement their technical skills in order to jointly develop green technologies;
- Specialist environmental departments target the private sector for specialist training on best environmental practice;

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Contents

1. Introduction

This report Investigates the *Environmental Goods and Services* (EGS) sector, reviews existing research, offers a map and segmentation of this industry and maps what are perceived by operators as performance gaps and weaknesses of this sector. Ultimately the report suggests ways the Higher Education (HE) sector, and in particular the *University of Hertfordshire* (UH) and its Business School (UHBS) can support the growth and development of this important industry. The report suggests that there are considerable opportunities for UH and UHBS to support the industry with education, consultancy and training services, and even to enter collaboration agreements with operators in the sector. Indeed this report suggests that the HE sector and policymakers have a duty to support this industry, for example with targeted service provision or incentives, because of its importance as a growing industry and because of its role in providing goods and services that might help fight global warming. The report relates the findings of a project originally entitled "*Mapping of capabilities in the Sustainable Business Practices Services Industries*" which was granted support by the *Vice Chancellor's Grants in the Social Sciences, Arts and Humanities Scheme.* The study is set in the context of the Hertfordshire County, for two main reasons:

- The resource limitations to this project;

- The relevance of the Hertfordshire County to UH and UHBS, who can service this geographical area very well.

Because of the scale of the project, this report suggests directions for further research and recommendations for targeting the industry in Hertfordshire; however it is also a pilot project to inform the performance of wider scale projects.

The original objectives of the project were:

1. Identify the main sectors of the Sustainable Business Practices (SBP) services industry;
2. Map the industry supply structure and capability;
3. Identify trends and driving factors for the industry;
4. Identify gaps in the provision of SBP services;
5. Identify possible types of support the industry might require from the university sector (UH in particular).

Since the production of the proposal, it has been decided to refer to the SBP Services industry as EGS industry, which is the accepted term for this industry.

The EGS sector is defined by the Organization for Economic Cooperation and development (OECD, 1999) as the set of "activities which produce goods and services to measure,

prevent, limit, minimize or correct environmental damage to water, air and soil, as well as problems related to waste, noise and eco-systems. This includes cleaner technologies, products and services that reduce environmental risk and minimise pollution and resource use" (OECD, 1999, p.9). The European Commission defined the industry (1994) as "including firms producing goods and services capable of measuring, preventing, limiting or correcting environmental damage such as the pollution of water, soil, as well as waste and noise-related problems. They include technologies where pollution and raw material use is being minimised." Diener and Terkla (2000 P. 305) define the industry as the sector of activities "associated with compliance with environmental regulations, environmental assessment, analysis and protection; pollution control, waste management, and remediation of contaminated property; the provision and delivery of the environmental resources of water, recovered materials, and clean energy"; and the technologies and activities to deliver "energy and resource efficiency, higher productivity, and sustainable economic growth (enabling pollution prevention)". Demand for environmental technologies, defined as the technologies that provide improvements in environmental quality (Ramakrishnan, 2004) has always been significant, stimulated by widespread concern about the environmental impact of the economic activity. Many products of common use have long been known to produce harmful impacts on the environment in the course of their operation, for example the motor car produces harmful emissions from the exhaust; white goods such as fridges utilize CFC gases, which can damage the ozone layer; and the use of asbestos in various common use products has had very dangerous effects on people's health. More recently, the Stern Report (2006) and the increasing awareness generated by the media on the issue of global warming has generated greater interest in sustainable business practices in the business sector. Part of this interest is due to claims by academics and practitioners that being green generates competitive advantage (Porter and Linde, 1995; Stone and Wakefield, 2001; Maxwell and van der Vorst, 2002), although these claims have been disputed (Telle, 2006).

Plenty of research has been carried out on the *EGS* industry, and numerous reports are available, for example numerous OECD studies (1999, 2002 and 2004); Diener and Terkla's (2000) study; Mansfield and Thomas's (2005) study on behalf of the DTI and Defra, to mention but a few. This research identified the size, structure, trends and constraints to growth of this industry. However, little research (apart from Diener and Terkla's 2000 study) has been identified which focused on the micro characteristics of this industry, in particular its capabilities, performance gaps, direct constraints to growth, needs for support, etc. This information is very important both for policy makers and the HE sector, as this industry has an important role to play both in terms of contribution to wealth creation and economic growth and of its contribution to the research and design of new technologies, processes

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and business models to reduce the impact of business and consumption activities on the environment, for example global warming.

The purpose of this report is to investigate the features of this growing industry, including its segmentation, capabilities and capacity in the context of the Hertfordshire County. The main focus of the report is on the private sector industry as developer of new "cleaner" technologies, as it "will be the main driver for these new technologies" (Stern, 2006, p.360). The private sector may therefore represent a better opportunity than the public sector as a target market for support services supplied by the HE sector, and in particular by UH and UHBS. From the point of view of UH Green, the Interfaculty body which has as its focus sustainable business, this report also represents an evaluation of potential competitors to UH Green.

2. Contribution to knowledge and rationale

Under the pressure of environmental legislation and regulation, international standards, social pressures and changes in lifestyle, and stimulated by incentives, technological developments and public investment (OECD, 2002), businesses are increasingly demanding goods and services to support their implementation of sustainable business practices. This has made the *EGS* industry an increasingly important sector. The industry is strategically very important in delivering the changes necessary to address environmental issues, and this report contributes to this agenda by mapping and helping establish the capabilities and limitations of the industry in Hertfordshire, so that relevant organizations, such as UH, UHBS and local GOs and NGOs can aim relevant support at the sector. This exercise is difficult as the industry is very diverse and expected to go through rapid structural change, including the introduction of totally new activities (OECD, 1999). The study will hopefully offer an initial indication in aiding policy decisions on support interventions to this industry by the HE sector, as well as suggesting more avenues for research. One of the aims is to identify specific gaps in the sector provision and capabilities in order to decide what specific support this industry needs. This will add to current knowledge of the industry and point HE establishments towards attractive opportunities in the sector, in order to support the sustainability agenda.

3. The EGS industry - Overview

Encouraged by factors such as legislation, taxation and public opinion, Businesses have started to offer new "green" products to the market, sometimes with good intentions, sometimes in exploitative ways (Peattie and Crane, 2006). The establishment of international standards such as the ISO14001 environmental management standard has raised the stakes by creating a clear distinction between businesses that can demonstrate

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commitment to environmental management and those who cannot. To reduce their "environmental footprint", companies have looked for external help (Diener and Terkla, 2000) and this has given rise to a significant, diverse and developed industry (ibid), with an estimated World market value of $550 billion in 2001, up from $484 billion in 1998 (Kennett and Steenblik, 2005). This market was expected to reach a value of $620Bn by 2005 (Ibid). This is complemented by the size of the market for carbon permits: €22.5Bn worth of allowances was traded in 2006 (The Economist, 2006). The market size for the UK was just above £25Bn in the UK in 2004, up from £16Bn in 2001, while the market size for the East of England was £7.2Bn in 2004 (Mansfield and Thomas, 2005). The waste sector alone is worth £14.6Bn for the UK. The sector is in rapid growth, an estimate of the rate of growth in 2000 was about 8% pa (OECD, 2002), but other estimates are far higher, up to 20% pa (Mansfield and Thomas, 2005). New firms and technologies appear over time to fuel this growth (Ibid). The move towards renewable energy for example, although still very small, has created a market opportunity for small to medium scale technologies delivering renewable energies (Godfrey, 2006). The problem in characterizing this industry is that it is very diverse, spanning numerous industrial classifications, and including services and product technologies across sectors such as engineering, construction and many other industry sectors, so it is difficult to define a clear boundary (OECD, 1999; Mansfield and Thomas, 2005) and there is no consensus on its definition (OECD, 2002; Kennett and Steenblik, 2005). It is also a sector in rapid structural change (OECD, 1999).

The EGS sector attracts considerable human resources, directly or indirectly employed by the industry, and generates specific professional competences (Diener and Terkla, 2000; Godfrey, 2006). The sector employs around 400,000 people in the UK, of which 48,000 circa in the East of England, and is composed of circa 17,000 companies, of which 2,139 in the East of England, on a par with the aerospace and defence sectors (Mansfield and Thomas, 2005). At least 80% of the industry appears to be made up of SMEs, with a considerable number of start-up companies (Diener and Terkla, 2000). The average turnover per company for the UK is £1.4M, while in the East of England region this is nearly £3.4M, second only to the South East of England region where this average is over £3.8M. There are important exceptions, e.g. some of the waste management companies are very large, international players such as *Veolia Environmental Services*, a 5Bn operation with 82,700 employees in the UK only (www.veolia.co.uk/); *Onyx Environmental Group Plc*, part of *Vivendi Environment's* £16Bn operation, *SITA Holdings UK*, part of *SITA* of France and employing 7,000 people in the UK alone, and *Bramble Industries Plc*, a merger of *GKN Plc* and *Cleanaway* (Keynote, 2006). Size is important in waste management in particular because of the need to achieve economies of scale. The technology based firms are

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complemented by ancillary firms, e.g. financial services, insurance, accounting and law firms, in addition to training and educational institutions, that specialize in serving this industry. One of the features of this sector is the connection of some segments of the industry with the public services sector, for example waste management, refuse collection, recycling etc. are delivered by companies that are contracted out to environmental services by local authorities (Keynote, 2006). Around one half of the investment in the field comes from government expenditures, although the business sector has been increasing expenditure in EGS (OECD, 2002). The industry is also driven by other sectors, for example energy consumption, transport, economic activity, etc. and therefore is affected by the state of demand in these sectors.

4. Main Industry Trends

Some sectors of the EGS industry were defined as mature by the OECD in 1999; however, new developments mean that the sector is poised to continue its recent growth spurt. The emphasis of the industry has thus far been to "clean the mess" created by industrial processes, i.e. a remedial effort rather than a redesign of the processes to prevent the damage. This industry is expected to go through rapid structural change, including concentration and privatization (OECD, 1999). New technologies are expected to move the emphasis from remedial "end of pipe" clean up activities, which concentrate on individual industrial processes, to preventative models which are orientated to design whole industrial systems, where industrial processes are designed to achieve closed loop, "cradle to cradle" features (OECD, 1999; Diener and Terkla, 2000). One of the technologies forecasted to grow, for example, is that of air pollution control technologies, including products, systems and services to reduce and eliminate polluting gases and particulates.

The EGS sector has been urged by governments and environmental agencies to design products and services that integrate environmental management with other business strategies that contribute to core businesses (OECD, 1999; Diener and Terkla, 2000; Gutberlet, 2000). All these pressures are stimulating considerable research and investment in new technologies to "design waste out" of products and processes, with the participation of HE organizations. According to Mike Beard (2008), Corporate Affairs Advisor for Wastepack Ltd., a company supplying packaging management and recycling services, growth in many sectors of the EGS sector occurs in spurts, driven by new pieces of UK/EU regulation as they are introduced. Further growth is driven by increase of expenditure in EGS by the private business sector (OECD, 2002); not only to comply with regulation but also to gain economic benefits, e.g. reduce use of resources and waste.

Another important trend in the industry is its increasing globalization. Differences in environmental regulations from country to country and the small size and specialization of some of the operators have thus far limited the development of global trade (2002). The adoption of common standards, as well as privatization and de-regulation of utilities in many countries is expanding international markets. This means that many international opportunities are now available to EGS companies, in areas such as the East European countries, East and South East Asian countries, Italy and other South Europe countries (OECD, 2002), Brazil and other Latin American countries and some African countries (Kennett and Steenblik, 2005). These markets are expected to grow due to increasing public environmental awareness and legislation.

A very important trend is the coming to fruition of initiatives to "spin off" the intellectual property, in the form of technologies and patents, from universities and other research institutions into the commercial sector (Rutherford and Fulop, 2006). Life Cycle Assessment (LCA) features strategies to produce "cradle to cradle", closed loop processes, and sustainable approaches to product (service) design and manufacture, but maintains focus on these products' and services' performance to achieve customer satisfaction (Nuij, 2001; Maxwell and van der Vorst, 2002). Another trend, "precipitated" by the adoption of ISO14001 is the management of supply chains for the achievement of sustainable provisioning and supply chains. In terms of energy, hydropower seems an important growth area, with prospect revenues of $160Bn pa (Koch, 2002), and opportunities for small scale projects. Developing countries seem set to become an important market for any renewable energy project (Ibid). Education and training are sectors of activity that are set to grow, as both consumers and companies' employees need to be made aware of the ecological impact both of production and consumption (Gutberlet, 2000) and this may interest both the private and the public sector. The demand for environmental management systems (EMS) supported by information systems is likely to increase significantly, for example in the transport industry (Rondinelli and Berry, 2000). This opens opportunities for consulting services. Some of these services, such as energy audits, are supplied by industrial sector associations or utilities, but there is already evidence that the private sector, e.g. engineering firms, are more effective (Schleich, 2004). Finally, a disturbing trend consists of the rise of new specialized and organized eco- crime activities, including for example illegal hazardous waste trafficking (Massari and Monzini, 2004).

5. Driving Factors

From a low rate of growth through the 90s (OECD, 1999; Diener and Terkla, 2000), a renewed impetus has been given to this growth by scientific consensus on the gravity of

environmental problems such as global warming. This consensus has been amplified by media and by various government commissioned reports, such as the Stern Report (2006). This in turn puts social pressures on businesses to comply with environmental standards. The EGS industry is driven and influenced by various factors that shape the demand for its services and goods. The driving factors include governments' environmental policies implemented by taxation and penalties (the "polluter pays" principle), regulatory agencies, the action of pressure groups, customers' requirements, employees and public opinion. These industry drivers can prompt the rate of growth of this industry to accelerate further. The action of these driving factors is counterbalanced by the development costs of new technologies, which are more expensive than conventional technologies as economies of scale have not yet reduced the costs. Governments are expected to establish policies that stimulate the industry of generation of carbon neutral energy (Godfrey, 2006). These government policies include financial support in the form of grants to develop new technologies and the setting up of bodies that help shape the behaviour of businesses in researching and adopting these new technologies. Other forms of government intervention include targets, taxation and enforced regulation. In the UK for example the government set up specific recycling and composting targets – as opposed to other techniques to deal with waste such as landfill and incinerating (Keynote, 2006), and stated that renewable sources of energy will need to be developed (Keynote, 2006). However, the UK support for the EGS industry has been questioned, as grants provided to support domestic installation of solar panels and wind turbines, already administered in a very confusing way, have been slashed (The Guardian, 2007).

Legislation, both national and EU, is set to play an important role to promote industry demand. For example, the EU directive 94/62 EC will stimulate demand for biodegradable, recyclable packaging (Catulli, 2007); The EU Waste Water Treatment directive (Keynote, 2006) and the End-of- Life Vehicles directive will all stimulate demand for recycling services. In the UK and the EU, trends are driven by UK and EU legislation and regulation. A good example is the *Waste Electrical and Electronic Equipment* (WEEE) directive, which sets out the responsibility of manufacturers of said equipment for its recovery and recycling after the life cycle of the product. "Producers will be responsible for taking back and recycling electrical and electronic equipment. This will provide incentives to design electrical and electronic equipment in an environmentally more efficient way, which takes waste management aspects fully into account. Consumers will be able to return their equipment free of charge." (http://ec.europa.eu/environment/waste/weee/index_en.htm).   This development created opportunities for new ventures to be formed, such as the aforementioned *Wastepack, Weee Care Plc.*, *PCDisposals Ltd.* and *Valpack ltd.* amongst

many others. In the automotive market BMW was notable for being the first one to introduce (in fact, anticipate) the EU Directive on End of Life disposal and recycling, in the form of the End of Life Charter (bbc.co.uk, 2006). This piece of legislation will no doubt induce a new "growth spurt" in the EGS industry. According to Beard (2008) these drivers are extremely powerful because they set liability for both manufacturers and retailers of products in respect both of their products *and* packaging, so that a demand has been created for suppliers which are able to take this responsibility, and associated risk and liability, from their clients. This legislation also drives technology and research: "In order to prevent the generation of hazardous waste, Directive 2002/95/EC requires the substitution of various heavy metals (…) and brominated flame retardants (…) in new electrical and electronic equipment put on the market from 1 July 2006." ((http://ec.europa.eu/environment/waste/weee/index_en.htm). This opens the door to business (and Universities) to invest in the development of alternative materials.

Regulations need to be supported by a matching economic policy. Renewable energy sources will be made viable by the government's introduction of taxation and carbon tariffs, which will put the burden of the damage carbon does on the polluters (Duncan, 2007). If governments keep enforcing these economic measures big businesses will drive the industry further by creating demand for cleaner technologies. Further, economic incentives, such as subsidies for example, play a part in driving the market (OECD, 2002).

6. Constraints to the growth of the EGS sector

Many factors contribute to constrain the further development of this market, first of all a degree of uncertainty on what regulation and legislation will be introduced by governments, and the absence of universal technical standards – although these are being adopted. This uncertainty not only makes difficult for the EGS company managers to make decisions on investments, it also discourages investors from supporting the sector, and therefore makes it difficult for some EGS companies to raise finance. This is exacerbated by the fact that many of the operators in the industry are small, specialist companies (OECD, 2002).

The importance of the public sector as a receptor of EGS – as it was reported above often equal to 50% or more of the market value – means that operators need to be conversant with public procurement procedures. This factor also hinders international trade, as some governments tend to "buy local" (Ibid). There is also the dependence on the sector on technical innovation, which is often difficult to manage for smaller companies as is the acquisition of the necessary technical knowledge (Ibid). The industry has not been very proactive in trying to infuence or shape this regulation and legislation (OECD, 2002).

The recycling industry has constraints of its own. Some of the "image" problems that restricted the success of recycled products in some product categories, e.g. high technology,

would probably be not a problem today. However, companies involved in recycling and supplying recycled or reused products face problems such as irregularity of supply (i.e. out of stock positions when a buyer requires a recycled product and this is not available) and, expecially in after consumer recycling, labour intensiveness and high costs of disassembling products, sorting materials and stocking them (Vadde et al, 2007). Finally there is the cost of the recycling process itself, often requiring advanced technologies (e.g. as in the recycling of carbon fibre). This means that recycled products in some cases need to be priced at a premium, which can be difficult to accept by prospective buyers.

7. Industry Segmentation

The OECD (1999) offers a comprehensive approach to the segmentation of the EGS industry, summarized in Fig.2. The sector is divided into three main groups: the "pollution management" group; the "cleaner technologies and product groups" and the "resource management" group. These three groups are divided in three sectors of activities; these are "production of equipment and specific materials", "provision of services" and "construction and installation of facilities". A third level lists all the specific environmental activities, for example air pollution control, wastewater management, solid waste management, etc. (OECD, 1999). Diener and Terkla (2000) segment the EGS industry into three main sectors, *the environmental engineering and consulting secto*r, including environmental engineering, construction, remediation and consulting; the *waste collection and disposal sector*, which includes solid and hazardous waste and recycling services, and the *pollution equipment sector*, including monitoring instruments, information systems, and equipment for pollution prevention, control and remediation equipment. In reality the author feels that to these, other sectors of activity need to be added, for example the renewable energy sector, which competes against fossil fuel generated energy, and is segmented in sectors in competition between each other, such as wind power, solar cells, which have gone through three generations of technologies, solar tubes, another type of technology utilizing solar power. Geothermal technology is still in its infancy, as is wave technology (utilising the energy generated by waves along coastlines). Other technologies do not generate energy, but help preserve it, vacuum tubes are an example. Energy storage technologies are also very important to compensate the transient nature of some of the above technologies. To this sector we need to add other "specialist" sectors such as the training services sector and specialist advice, for example the marketing consulting sector aims at advising on how companies should position themselves in respect of the sustainability issue. This report adopts a segmentation strategy that takes into account both the OECD (1999) and Diener and Terkla's (2000) segmentation and the categories proposed by Ecodirectory

(http://www.ecodirectory.org/default.aspx), a government backed organization funded by Envirolink UK, the East of England Development Agency (EEDA) and ExDRA. The categories used by this organization are summarized in table 1.

Table I. EGS categories - Ecodirectory

Type of Service
Air pollution control
Cleaner technology & processes
Contaminated land remediation
Energy management
Environmental monitoring / instrumentation
Environmental services
Marine pollution control
Natural environment management
Natural environment science
Noise & Vibration control
Renewable energy
Renewable materials
Waste management
Water and wastewater treatment
Consultancy & advice
Training
Other

Source: Ecodirectory

Table 2. EGS categories – OECD

Main groups	Activities
Pollution management group Production of equipment and specific materials for, Provision of services for, Construction and installation for	Air pollution control
	Waste water management
	Solid waste management
	Remediation and clean up of soil, surface
	Noise and vibration abatement
	Environmental monitoring analysis and
	Environmental R&D
	Environmental contracting and engineering
	Analytical services. Data collection, analysis
	Education, training and information
	Other
Cleaner technologies and products Production of equipment, technology, specific materials or services for	Cleaner/resource efficient technologies and processes
	Cleaner / resource efficient products
Resource Management group	Indoor air pollution control
	Water supply

Production of equipment, technology, specific materials or services for	Recycled materials
	Renewable energy plant
	Heat/energy saving and management
	Sustainable agriculture and fisheries
	Sustainable forestry
	Natural risk management
	Eco-tourism
	Other

Source: OECD, 1999

For the purpose of this report, the Author proposes a simplified segmentation model consisting of five broad segments:

- *Environmental engineering secto*r, which includes environmental engineering, construction, remediation and cleaner technology and processes, contaminated land remediation and other;

- *Waste collection, disposal and processing sector*, which includes solid and hazardous waste management, recycling services, renewable materials and other;

- *Pollution equipment sector*, including monitoring instruments, information systems, and equipment for pollution prevention, control and remediation equipment, environmental monitoring and instrumentation, marine pollution control, noise & vibration control, and other;

- *Renewable energy sector*, which include renewable energy technologies, and energy management and other;

- *Services, Training and Consulting sector*, which includes environmental services, natural environment management, consultancy & advice and training and other.

8. The Public and not for profit sector

The environmental agenda was promoted initially by the not-for profit sector and Non Governmental Organizations (NGOs), such as for example *Friends of the Earth* and *Greenpeace*. Initially the relationship between these organizations and business, especially big business, was one of conflict. Recently though, as businesses gained awareness of the problem and its implications, the relationship has become one of collaboration (Deri, 2003; Esty and Winston, 2006). Companies started to develop strategies of seeking the support of these NGOs (Esty and Winston, 2006). The types of collaboration include advice and consultancy to businesses, and sponsorship to promote the sponsors' "environmentally friendly" image. Governments in various countries have sought to influence business behaviour in various ways, and these include various forms of support. This has given rise to

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a host of government backed or autonomous not for profit organizations which perform various roles. Businesses associate together to lobby governments, but also to join forces for researching new technologies and processes, which is essential to achieve results (Schmidt, 2001). Organizations that are linked to business and the professions include, for example, The *Chartered Institute of Waste Management* (CIWM), which promotes knowledge of, and training and education on, waste management; *The Environmental Services Association* (ESA), which includes the sector's operators and also supply training in order to raise standards; and *The Institute of Environmental Management and Assessment* (IEMA) which also aims at promoting best practice. The HE sector has a unique role in the research and development of new sustainable processes, technologies and products. These new technologies are either developed autonomously by HE institutions, and then "spun off" by setting up new businesses to exploit the intellectual property (Ramakrishnan, 2004; Rutherford and Fulop, 2006), or developed in collaboration between HE institutions and businesses (Maxwell and Van der Vorst, 2003; Ramakrishnan, 2004). New technologies and processes such as renewable energies are also developed in collaboration between HE institutions and utilities (Godfrey, 2006). There are numerous government and non-government organizations that support progress on the sustainability agenda as well as research and implementation of best practice by business, e.g. the *Department for Environment, Food and Rural Affairs* (DEFRA, http://www.defra.gov.uk/), and the *Environment Agency,* (http://www.environment-agency.gov.uk/) are responsible for the implementation of most of the legislation and regulations in matters of environment; government backed organizations such as the *National Industrial Symbiosis Program* (NISP, http://www.nisp.org.uk/) and the International Resources and Recycling Institute (IRRI, http://www.recycling-institute.info/)   facilitate the interaction and collaboration between businesses and businesses and universities, as well as promoting research on environmental practices. In the UK, local authorities take responsibility for supplying some environmental services, such as for example waste disposal, collection and management, domestic waste collection, and street cleaning. These activities are normally contracted out to specialized operators (Keynote, 2006). Overall, this sector and its competence are therefore heavily supported by government organizations and NGOS.

9. Gaps in provision and general weaknesses

Generally EGSs are constrained in their expansion by various factors, including the size and recent set up of some of the operators. For example, costs are a constraint to the diffusion of renewable energy technologies; these technologies are not competitive in respect to conventional technologies, especially because of their development costs (Keynote, 2006). This means that the success of these technologies in gaining market share depends on their

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costs and prices falling, which in turn depends on achieving economies of scale- a " catch 22" situation. Furthermore some of these technologies, for example solar power, are already very standardized (Diener and Terkla, 2000), which makes it difficult for any of the suppliers to differentiate themselves from other businesses. These limitations can represent an opportunity for suppliers to this industry, for example, for the development of technologies to reduce these costs (Keynote, 2004, 2006). One reported weakness of the sector is a poor ability to seek international opportunities, which is a problem as these are very attractive (Diener and Terkla, 2000; Keynote, 2006). Industry players also find it difficult to adapt their business strategy to changes in the market (Diener and Terkla, 2000). For example, it appears that the sector has not as yet implemented the required shift in emphasis from cleanup to pollution prevention the OECD (1999) and Diener and Terkla (2000) advocate. These limitations may be a consequence of the small size of many of the operators in these segments, for example those involved in the recycling of metals, where the majority of the operators are SMEs: they may not have the skills and resources to invest in the technical developments necessary for the above mentioned change of emphasis or in international trade activities, or the ability to attract funding, both because of their small size and because of the high level of uncertainty and dependence on regulatory frameworks beyond their control (OECD, 2002).

In many cases of start-up companies originated by the spin-off of technologies researched in HE establishments the "inventors" of these technologies, when starting to run the company concerned, lack the necessary managerial skills to succeed (Rutherford and Fulop, 2006). This in turn prevents these companies taking advantage of important opportunities, such as that represented by The East of Europe ad East and South East Asian countries, Italy and other South Europe countries (OECD, 2002), Brazil and other Latin American countries and some African countries and China for both recycled metals and renewable energy sources (Keynote, 2004; Godfrey, 2006). In addition UK based companies face intense competition from international operators (Keynote, 2004). Another reported weakness is the sector's poor ability to attract and retain high level human resources to the industry (Diener and Terkla, 2000). In the UK the waste management industry finds it difficult to attract and retain capable people, especially young people (Keynote 2006). The need for products and services that integrate environmental management with overall business strategies suggested by Diener and Terkla (2000) may put under resourced operators under pressure to quickly acquire additional competence and skills.

10. How are these weaknesses addressed at present?

Some effort has been made by the incumbent operators to identify new growth niches and geographical markets (Diener and Terkla, 2000). However, these new technologies need support by the government. In Australia for example, the Government and the renewable energy industry have set up an objective of achieving "a sustainable and internationally competitive renewable energy industry which has annual sales of $4Bn" (Godfrey, 2006, P. 98). The sector is also supported in the rest of the World, and in the UK public sector organizations and NGOs support this industry, for example grants are available to the development of new technologies and products from various regional, national as well as EU sources. Organizations such as NISP (see above) facilitate collaborations between business sector operators, and between these and the University sector. HE establishments have for a while been investing time and resources in collaborating with this industry, especially on the technical side (Maxwell and Van der Vorst, 2003; Ramakrishnan, 2004; Rutherford and Fulop, 2006). Government policies worked on two fronts to support the EGS supply side: stimulating the demand side through environmental regulations and standards, economic incentives and taxation; and directly promoting the supply side by promoting the industry with support of environmental R &D, financial support , export incentives, etc. (OECD, 2002). In general, some of the weaknesses of the industry have been addressed by the specific supply of business services by the government and HE sector.

11. Findings from the Survey of a sample of EGS Companies based in Hertfordshire

A survey was conducted on EGS companies based in the Hertfordshire County. The sample interviewed was made up of 32 companies, and these were administered a semi-structured questionnaire. The objective of the study was to assess what type of sectors the companies belonged to. The analysis of the sample reveals a very diverse sector. Table 3 summarizes the typologies of companies in our sample. The total adds up to more than 100% due to some companies being in more than one sector.

Table 3 – Typology of EGS sector companies

Typology		
Waste Management	2	6
Intermediation in fuels	1	3
Research and consultancy on buildings	2	6
Cleaning chemicals	1	3
Water Treatment / advice on hygiene	6	19
Monitoring equipment Sales & Rentals	4	13
Recycling / removal / disposal	5	16

Clean (renewable) energy brokers / providers	2	6
Laboratories of research and analysis	2	6
Environmental consulting	6	19
Wind farm development	1	3
Other	5	16
Total	37	106.25

Base: 32 Managers of EGS Companies in Hertfordshire - % adds more than 100 because of companies being in more than one sector

Fig. 1 - Typology of EGS sector companies
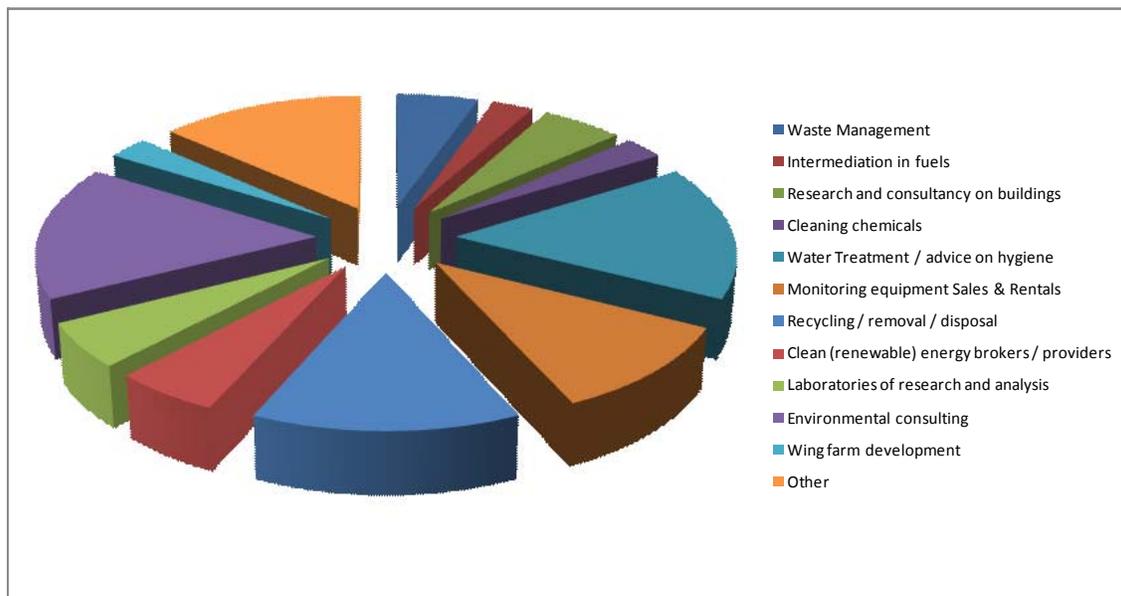
Base: 32 Managers of EGS Companies in Hertfordshire

The mix of companies broadly resembles the segmentation that has been described in section 7.

12. Characteristics of Companies in the Sample

The companies surveyed were predominantly SMEs – this seems to confirm what reported by secondary research. The database includes more companies but it appears the proportion of SMEs in this sample is similar. The average turnover of the companies is £22M circa, and the average number of employees is 97. These statistics, which are much higher than those in the Defra report cited in the study, are due to the presence of two large players

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in the relative small sample. These two statistics skew the statistic significantly. A summary of company's characteristics is shown in table 4 and 5 and Fig. 2 and 3.

Table   4 - Company Size: Turnover

Turnover ££		
<£100K	3	9
£100K - £250K	2	6
£250K - £500K	1	3
£500K - £1M	6	19
£1M - £5M	4	13
£5M - £10M	3	9
£10M - £25M	2	6
£50M - £100M	1	3
>100M	1	3
Not Known	9	28
Total	32	100

Base: 32 Managers of EGS Companies in Hertfordshire

Fig 2 - Company Size: Turnover
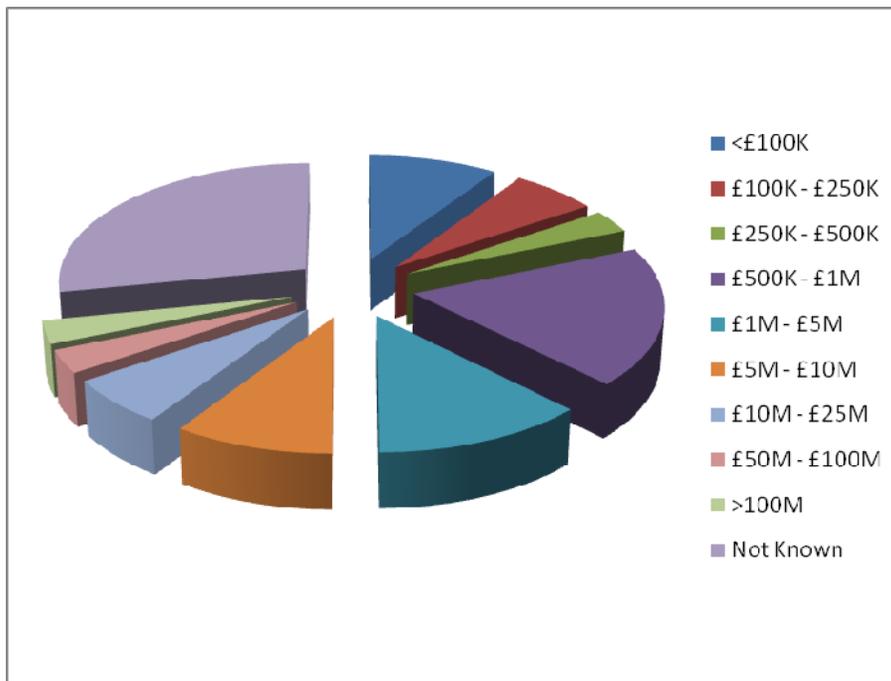
Base: 32 Managers of EGS Companies in Hertfordshire

Table 5 - Company Size: Number of employees

Size (employees)		
1 = 10	13	41
10 = 50	10	31
50 - 100	3	9
		20

100 - 500	3	9
500 - 1000	2	6
>1000	1	3
Total	**32**	100

Base: 32 Managers of EGS Companies in Hertfordshire

Overall the sample seems to be made of SMEs

Fig 3 - Company Size: Number of Employees
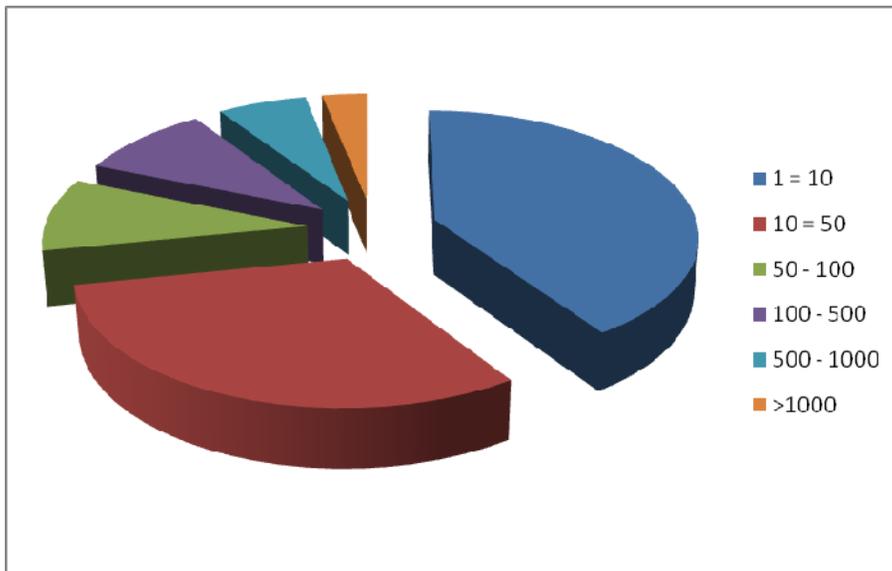
Base: 32 Managers of EGS Companies in Hertfordshire

13. Industry Sectors of Expertise

One of the questions that this research aimed to answer was around the industry sectors of expertise companies in the EGS sector had. This question is particularly relevant when considering the driving factors and trends of this industry, in particular legislation and regulation which is sector specific, for example the above mentioned WEEE directive aimed at the electric and electronic equipment manufacturers sector, the end of life directive aimed

at the car industry and the packaging regulation aimed at the packaging industry and, indirectly, to every industry sector. This question is not addressed by current research and reports available on the EGS sector, and the answer would assist in identifying further performance gaps as well as gaps in the industry. The primary research done with our sample seems to suggest that the companies in the sector supply a variety of business sectors, so it would appear most sectors of industry are supported. A summary of sectors of specialization is shown in table 6.

Table 6 - Target Sectors of Expertise

| Target sectors of expertise	Number of companies targeting sector
All industry	7
Manufacturing	3
Automotive	1
Aerospace	1
Commercial sector	3
Local authorities	8
Construction, property and other relative to built environment	6
Transport	1
Public and Private Utilities	4
Government e.g. Defra	3
Hotel, leisure and hospitality industry	4
Health care	1
Oil and gas industry	1
Pharmaceutical and bio-tech	2
Semiconductors, electric and electronic equipment	2
Banking and finance	2
Information technology, telecommunications and media broadcasting	1
Academic	1
Grocery, food manufacturing	2

14. Industry Drivers

Our sample's responses suggest that 44% of company managers believe that legislation is the main driver of the EGS sector. The second most cited driver is legislation and regulation combined (where regulation includes voluntary industry regulation as well as compliance with international standards). Our primary research seems therefore to confirm the importance of legislation as a market driver. The results are summarized in Fig. 4, below. The finding seems to confirm what identified by existing research as far as the main drivers are concerned. Security and risk are new suggested drivers, as well as awareness and moral obligation felt by managers, which is connected with the needs of preserving the reputation capital of a business.

The "other" category includes such factors as quality, price, trust, experience, reliability, reputation and customer needs – these are common drivers in all industries.

Figure 4 – EGS sectors drivers
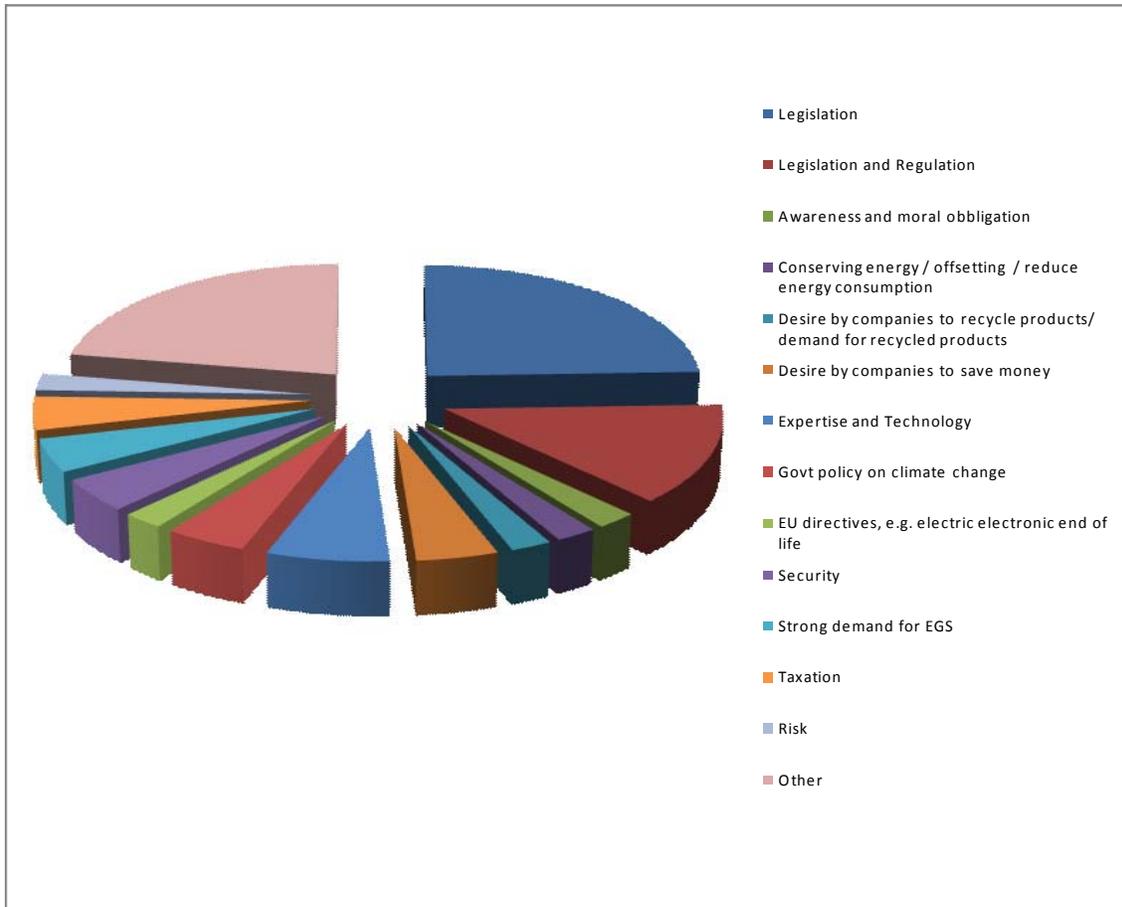
Base: 32 Managers of EGS Companies in Hertfordshire

15. Performance Gaps

Our findings from the sample survey confirm the gaps in performance identified by previous studies, in particular by Diener and Terkla (2000). In addition to these performance gaps, our study identified some more perceived performance gaps. The most significant new performance gap identified is in *marketing* and associated activities, such as *market research* and *sales strategy*. This need has been expressed by 15 of the respondents, which is nearly 50% or the sample. The second relevant gap is information technology (IT). These general performance gaps are summarized in Table 3 and Figure 3 below.

Table 7 – Perceived performance gaps

Performance gap – want improvement in / support with…	Frequencies	%
International business performance	13	41
Strategic capability	9	28
Management Competence	8	25
Ability to attract high value HRM	13	41

Base: 32 Managers of EGS Companies in Hertfordshire - % adds up to more than 100 due to some companies quoting more than one performance gap

Table 7 summarises the response to a set of questions designed to validate the suggestions from existing research, in particular that by Diener and Terkla (2000), who suggested the performance gaps above.
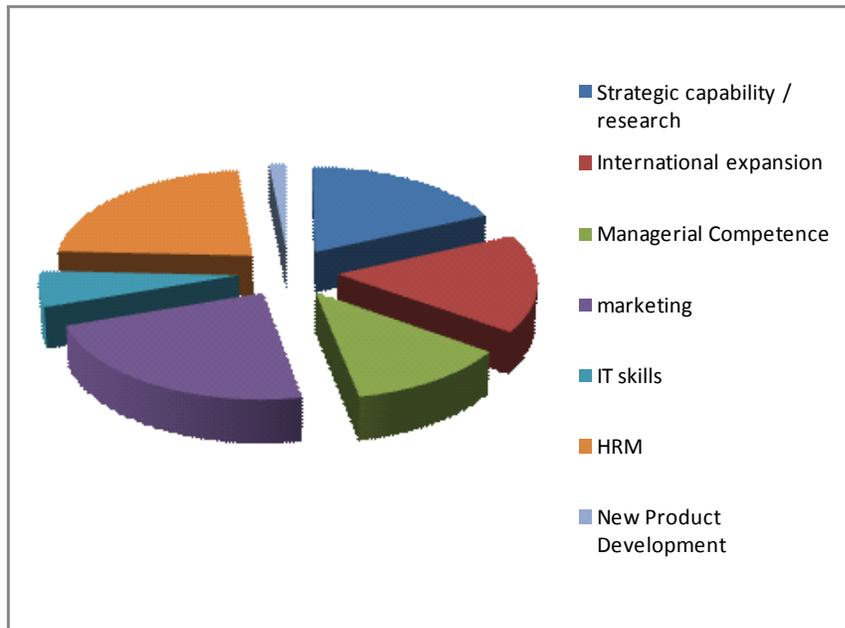
Table 8 – General areas for improvement

General areas for improvement	F	%
Strategic capability / research	12	38
International expansion	11	34
Managerial Competence	8	25
marketing	15	47
IT skills	4	13
HRM	15	47
New Product Development	1	3
Total	53	206

Base: 32 Managers of EGS Companies in Hertfordshire - % adds up to more than 100 due to some companies citing more than1 perceived weaknesses

Table 8 summarises the responses to a question designed to probe what other weaknesses the managers perceived their company to suffer from in addition to these performance areas identified by Diener and Terkla (2000). It is suggested that marketing and IT skills are significant areas of performance previous research appears to have overlooked – or perhaps the discrepancy is due to the different research context; for example Diener and Terkla's study was conducted in the USA. Several companies expressed rather specific needs. *STATS* Limited for example, a consultancy company part of the RDS group said "We need to improve at spotting opportunities", explaining their need is for improving marketing

research and analysis. *Aqualog Ltd.* explained that they "would like to work faster in terms of market penetration, e.g. we would like to find agents for Germany, France and Holland", and *Detek Systems Ltd.* would like "new breaks in international markets". *Applied Ionics Ltd.* declared they need "faster turnaround; responsiveness to orders and inquiries", suggesting some areas of improvement in their sales operations. On the issue of attracting high value human resources, *Cambridge Recycling Services Ltd.* said "We are not very successful in this task; we want to find better ways to target possible candidates more cost-effectively". *Tri Tec Environmental Services Ltd.* also suggests they have difficulties with HRM, as they find it "Difficult. We find it very expensive, and we would like to reduce costs of recruiting", while *STATS Ltd.* complained about the supply of good graduates by Universities: "It is a difficult fix, we feel we have been let down by the education sector". A summary of individual statements is summarized in the appendix.

Fig.5 - General areas for improvement

Legend:
- Strategic capability / research
- International expansion
- Managerial Competence
- marketing
- IT skills
- HRM
- New Product Development

Base: 32 Managers of EGS Companies in Hertfordshire

16. Capabilities for Partnering

This section addresses the issue of collaboration between the EGS sector and the HE sector in terms of research and commercial activities: in particular one of the objectives was to identify possible partners for UHBS and UH Green that, together with being recipient of support (Business courses, short courses, KTPs, consultancy, contract research, etc.) could also be suppliers or sources of knowledge and capability specifically associated with sustainability. Generally, the view taken by the author of this report is that the types of

companies more suitable for collaboration should include companies involved with research, consultancy and training. The database of companies surveyed includes a variety of capabilities, including the production of pollution monitoring software; laboratories and services of environmental analysis; built environment consultancy and research; research and consultancy on air pollution; planning advice on sustainable development; environmental and health and safety consultancy; advice on recycling of materials including compliance with legislation and risk management; and ISO14001 certifying bodies. Capabilities are summarized in table 9

Table 9 – Capabilities for partnering

Company	Capability	Positioning / competitive advantage	Sector of expertise
STATS Limited (part of RSK)	Advice on environmental impact of buildings	Prompt service	Building and construction industry; property development
Envirobods Ltd	Research and consultancy on air pollution	Very good and very well known	Government, Defra, local authorities, regulators, etc.
BRE	Built environment consulting and research	Unique research and consultancy organization originated by a privatized sector of Government; size; consultancy underpinned by strong research	Construction, product testing, automotive
ACL Engineering Ltd	Planning advice and training in sustainable development; sustainability appraisal	Environmental expertise	Public sector / academic
Aqualog Ltd	Electronic monitoring software	Flexibility, custom design	Leisure, health care, hospitality
Caswell Environmental Services Ltd	Specialist pharmaceutical laboratory for decontamination removal, decontamination and	Quality and experience	Public and commercial sectors – pharmaceutical and bio-

Company	Capability	Positioning / competitive advantage	Sector of expertise
	construction services		technology
Wastepack Ltd	Recycling of materials (packaging); service compliance; environmental advice	The company discharges their clients of their legal responsibility, therefore absorbing their risk	Supermarkets / grocers, food manufacturing, electronic fund recycling, end of life producer responsibility
RSK ENSR Group	Environmental health and safety consultancy and outsourcing of services	High level of customization; flexibility; response to clients' brief	Energy; property; water; waste for local government; transport; manufacturing
Mountainheath Services Ltd	Environmental reports	Very specialized	Environmental analysis to multi million pounds companies
Qualico	Survey services; environmental management, ISO14001 environmental audit, implementation with certifying body	Tailored and custom services	Automotive, aerospace, manufacturing, services, local authorities
Brightwater Engineering Ltd	Water treatment and sewage treatment consultants, sewage treatment plant equipment manufacturers	High quality technology	Specialist process plant contractor, acting as a main contractor on process-led industrial and municipal sector

Base: 32 Managers of EGS Companies in Hertfordshire

Our survey therefore suggests that there are companies in the EGS sectors UHBS and the University of Hertfordshire can partner with in order to transfer knowledge in both ways and run research and commercial projects driven by the sustainability agenda.

17. Future Prospects for the sector

This is the type of information which has been the hardest to gather. The reason for this may be that the primary interviewing technique used involved the telephone as a medium, and for such qualitative expert opinion it will be probably necessary to set up face-to-face interviews or workshops. There it is a consensus amongst the respondents that the industry is growing at a fast rate and has been doing so in the last 5 years. Estimates for this growth vary among respondents possibly depending on the sector they are in, the estimated rates of growth vary between 5% and 20%. Future outlook is upbeat, most respondents believe the market will continue its growth, with two respondents explaining this growth is due to buyers becoming more responsive to their marketing communication activities and growing concerns on sustainability; other two respondents believe that the growth rate is subject to the introduction of legislation and the impact of the introduction of international standards, e.g. ISO14001. Two respondents in the energy sector are sceptical of the international development of their business due to the heavy regulation of their market.

18. Access to market

One of the areas the research attempted to investigate is to what extent government support and incentives, e.g. grants, influence the market. 12 respondents (37%) claim GOs and NGOs support or act as brokers in the connection with potential buyers. These include *Business Link, Chambers of Commerce, NISP, EEDA* and Trade Associations. One respondents uses competitive tendering, the balance reaches their customers through various marketing activities. All the respondents cited client referral as an important market access route. Several respondents cited the importance of their reputation in getting them inquiries. As far as incentives and subsidies are concerned, only 4 companies out of 32 (circa 12%) cited these as important, one respondent cited research grants while 3 others claimed that their clients look for subsidies when they buy their products. These 3 companies are respectively an environmental management company, an energy adviser and broker and a water treatment and testing company. The fourth company, which benefits from research funding is a research and consultancy company.

19. Conclusions and recommendations for sector support

The EGS Industry is a major growth industry and it is strategically important so that it has attracted the attention and support of governments, the OECD, HE establishments and other bodies. The sector is diverse and well developed in terms of size of the economic activity, and its diversity makes it very arduous to research. For this reason, it is recommended that HE organizations, and in particular UH, research the sector further to better define its features and needs. From research so far, it appears that the industry has numerous

knowledge and competence gaps. These gaps may constrain the sector in its growth, and, more importantly, in its timely development of suitable technologies that can support energy and resource efficiency. The research also seems to suggest that this sector represents a major opportunity for the Higher Education sector and in particular UHBS and The University of Hertfordshire, especially in consideration of the growth of education and training services within the EGS sector, which could unlock opportunities for the University to deliver both training and education to the wider business community and students, and collaborate with EGS companies to deliver training and consultancy projects and education.

It is recommended that:

- Local Government Agencies, Authorities and Non Government Organizations (NGO) devise support packages for the industry including, for example, financial incentives, advice, training and other support to address the weaknesses identified in the sector;

- Business Schools, and in particular UHBS, seek opportunities for collaborations with companies in the EGS sector (of which the author has developed a database as part of this project) to support them with:

    o Business courses, in particular programmes such as MBA and MSc Management as well as MA in Marketing and MSc in Strategic marketing. The sector can be approached to enrol employees on these courses and fill the gaps in performance identified by the research, which include strategic capabilities, international trade skills, general managerial competence, marketing, it and HRM skills;

    o Approach companies in the sector to offer commercial collaborations including for example *Knowledge Transfer Partnerships (KTPs)* and *Knowledge East to England Partnership 3s* (KEEP3), to support these organizations to redesign their strategies, research and exploiting international opportunities, improve their marketing and HRM processes and activities and build their ITC skills. It is worth mentioning that UHBS is already collaborating with a Stevenage company, Abbey Steel Ltd. which specializes in sourcing and marketing surplus steel for reuse and recycle.

    o Collaborate with companies in the sector to develop integrate offering of environmental services and business strategies by supplying these companies with management and strategic skills, as well as supporting them in attracting human resources;

    o Identify and approach partner companies that can work together with UHBS and UH to complement the overall offer of business, training and education

services revolving around sustainability. These potential partners should be selected based on a detailed analysis of their capabilities so that the relationship can be mutually beneficial.

- Engineering and technological schools seek opportunities for collaboration with companies in the EGS sector to complement their technical skills in order to jointly develop green technologies;

- Specialist environmental departments target the private sector for specialist training on best environmental practice;

20. Next Steps – commercial and research

Further research will focus on developing the relationship with the sector, in particular:

- Seek contact with a selected number of organizations in the sample so to seek in depth information on their needs as well as more qualitative information on the EGS industry. This stage of the investigation will require face to face contact, using two complementary strategies:

    o Face –to-face in depth interviews;

    o Workshops (this would allow discussion and brainstorming amongst the participants EGS companies).

  This will give the author a deeper understanding of this important sector, in particular the objectives still to be achieved include a better feel for what the future prospect of the market are and to what extent the companies in the EGS industry benefit from government support and incentives;

- Repeat the study with a bigger sample, on a wider regional context. As explained, the study is a pilot and a larger sample is necessary to validate the findings.

21. Notes on Methodology

The methodology used to produce this report differs slightly from that outlined in the original proposal. It consisted of two stages, one of desk research and one of primary research, however telephone interviewing was opted instead of face –to face interviewing for reasons of speed of execution. The stages have been conducted as follows:

21.1.   Desk Research

21.1.1. Literature Review

SPRING REPORT: The EGS Industry – Maurizio Catulli

This consisted of researching and consulting a variety of sources, divided in two types: academic research papers on the industry and sustainability in general; and market reports from governmental and commercial organizations.

21.1.2. On Line search

This consisted of web research, in particular the database of EGS Hertfordshire companies was sourced from an on – line directory (Ecodirectory); some information on companies, GOs and NGOs has been sourced from these organizations' web sites.

21.1.3 Primary Research

This consisted of administering a telephone semi-structured interview to a sample of EGS managers. Telephone questionnaires have been administered to a sample of 32 respondents from a frame of 103 companies in the database. The questionnaire included a mix of quantitative and qualitative questions. The sampling frame was obtained by sourcing a list of companies based in Hertfordshire from *Ecodirectory* (http://www.ecodirectory.org.uk/), a resource funded by *Envirolink UK*, the *East of England Development Agency* and *ExDRA*. In order to be registered on this database, which is accessible on line, a company must elect to register with it – registration is free, and the total database includes over 2,000 companies.

21.1.4 Rationale and limitations

The choice of telephone interviewing was made to allow a survey of a larger sample than originally envisaged and at the same time reduce costs. The author believes that because the respondents are business managers and not consumers, the responses give a good indication of what the population should be like. However, there are considerable limitations in the study, in particular:

- The respondents were all recruited from an Association (Ecodirectory) directory – this exclude companies that are not members of that association;

- The respondents are all based in Hertfordshire, this may not be representative of the wider market;

- The sample size, 32 is too small to draw final conclusions.

The author is still planning to pursue the methodological approaches outlined in the original proposal, in particular, 10 respondents will be selected for in depth face to face interviews; and one or two workshops will be organised as soon as resources (funds) become available.

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