Emerging Markets In the Environmental Sector November 2006

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Abstract

This report has three purposes:

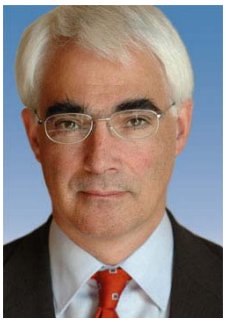
1. To estimate the size of the UK and global markets
2. To give a précis of UK supply-base strengths and weaknesses in the sub-sectors listed in Annex 1
3. To identify and analyse a number of promising areas in the EGS sector where new opportunities are likely to occur as a result of forthcoming market influences

The research for the report was undertaken by the UK Centre for Economic and Environmental Development (UK CEED) on behalf of the Environment Industries Unit (EIU). The EIU is a joint DTI and DEFRA unit that promotes innovation and productivity in the UK environmental goods and services (EGS) sector. The report is required to provide officials with an overview of the competitive environment of the UK EGS sector and provide new market intelligence in specific markets to help in securing the future competitiveness of the UK EGS sector.

Environmental Goods and Services Sub-sectors cover:

- Air Pollution Control
- Cleaner Technologies & Processes
- Decommissioning/Decontamination of Nuclear Sites
- Environmental Consultancy
- Environmental Monitoring, Instrumentation and Analysis
- Energy Management/Efficiency
- Marine Pollution Control
- Noise and Vibration Control
- Remediation and Reclamation of Land
- Renewable Energy
- Waste Management, Recovery and Recycling
- Water Supply and Wastewater Treatment

Forewords



The challenge of moving to a "one planet economy" offers a huge opportunity for business – both to save costs and to lead in the markets of the future.

New innovative environmental technologies and research can bring new business opportunities. They can open up markets and enhance the competitiveness of UK companies while improving the environment. Because as we know, good economic policy is also good environmental policy.

Their potential to contribute to a sustainable economy and be a driver for new business and jobs is increasingly being recognised around the world.

The UK environmental industry is already a dynamic and growing sector. Latest figures for 2004 show the sector had a turnover of £25 billion, and employed around 400,000 and this report predicts that turnover is likely to grow to £46 billion by 2015.

This latest report builds on earlier work and clearly sets out the opportunities for businesses. I want the UK to be a leading player in this significant and rapidly growing market.

Alistair Darling
Secretary of State, DTI



I am very grateful to have the opportunity to write a foreword to this report.

As the Prime Minister has made clear, the environment is a cornerstone of this Government's policies; only through sustainable development can the UK and other economies continue to make progress without continuing to damage our planet.

We must continue to separate economic growth from environmental degradation. I therefore believe we need a new environmental contract between Government, consumers and business. Regulation alone is not enough: we must work with business if we are to achieve our goals. We need to develop better ways to produce goods, using new, more efficient technologies, while encouraging more eco-innovation and design.

Developing a thriving UK Environmental Goods and Services sector is essential if we are to achieve our goals. I therefore welcome the conclusions in this report and hope both businesses and policy makers will take note of the opportunities.

David Miliband
Secretary of State, Defra

Executive Summary

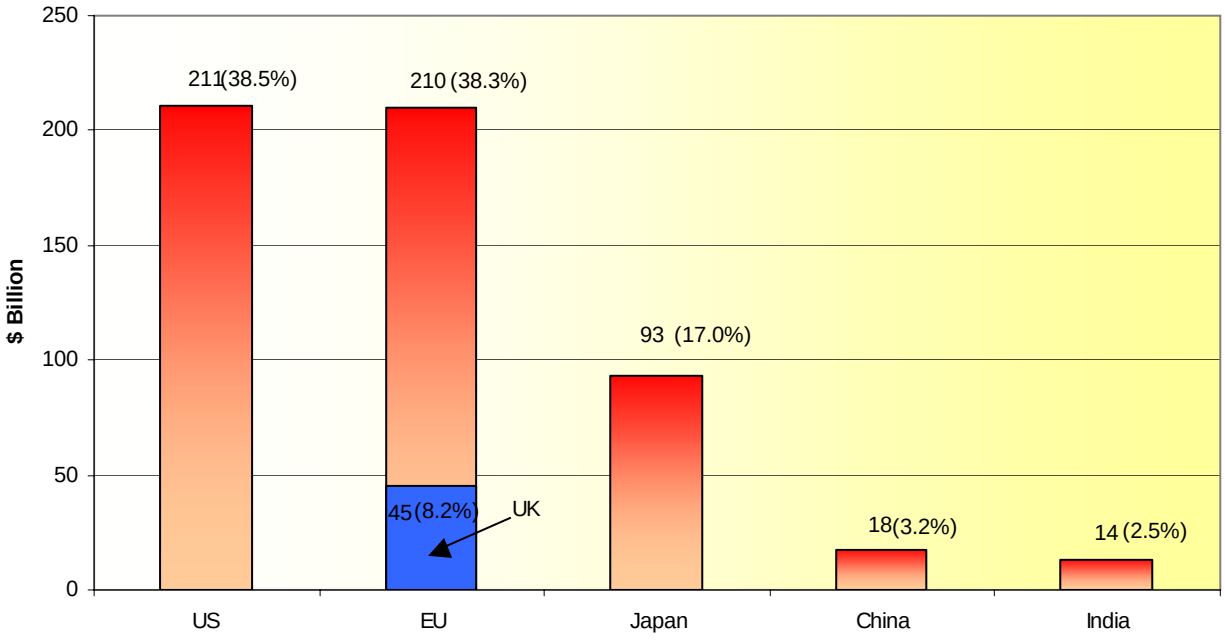
This report represents an on-going story of British success. The environmental goods and services (EGS) industry is hugely diverse, dynamic and growing rapidly year on year. It covers vital, long established industries such as drinking water supply, waste water treatment and solid waste management; sectors where Britain has long been a global player. At the same time, it encompasses newer industries at the leading edge of technological innovation, such as environmental monitoring, renewable energy and clean technologies. These sectors are all playing their part in delivering the solutions to both our global and more local environmental challenges as well as enabling us to meet out climate change obligations. With the right support and investment, the UK can become a world leader in the supply of these goods and services.

This report puts into a national and global context the strengths of the UK's EGS sector. It highlights both the challenges and the opportunities; and it provides a 'roadmap' of opportunities for growth in key industries.

A Significant Global Business

The global EGS sector was estimated to be worth $548 billion[1] in 2004, with the EU, US and Japan accounting for around 94% of the total as shown in Chart 1.

Chart 1: Environmental Goods and Services Market by Country 2004



In the EU, many member states, largely in the East, require substantial investment in basic environmental infrastructure, such as water supply and waste management. This is opening up exciting opportunities for UK EGS companies, although competition is already strong notably from German and Scandinavian companies.

1. EBI 2004a.

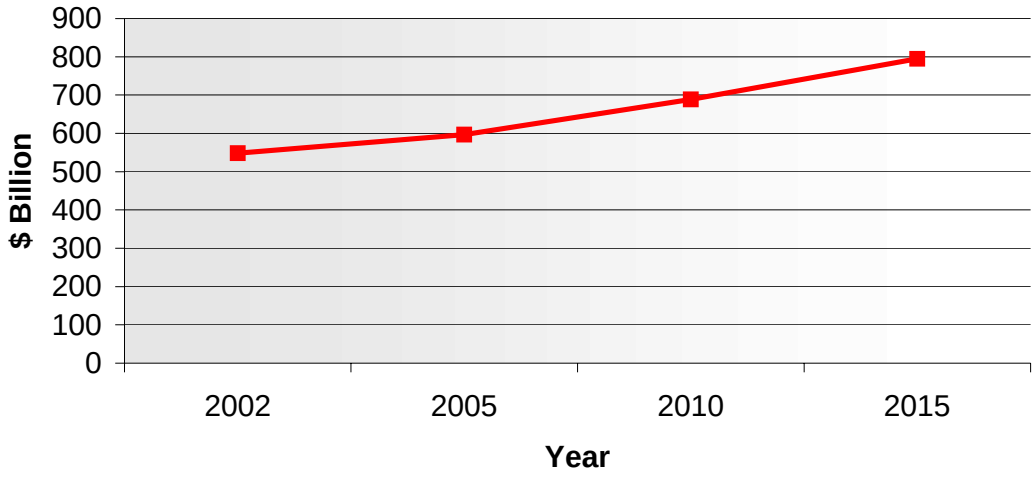
In the developing economies of Asia, South America and non-EU countries of the former Eastern Bloc, the potential is even greater. Many of these markets will require considerable investment in primary environmental services - clean air, water and land - over the next 10 years, as they continue to industrialise or clean up the legacy of earlier industrialisation.

But without doubt, some of the greatest potential opportunities are likely to be found in China and India. The size of the countries and the scale of the challenges mean that these two markets are predicted to have the fastest growing EGS markets. At the same time, the speed at which China and India are developing – and the resources they have available – means that they are already looking to move beyond basic service demand and are looking to invest in cleaner technologies, renewable energy and more sophisticated approaches to environmental management – some of the key strengths of the UK's EGS sector.

The competition is fierce, though, both from other developed nations and from within the countries themselves. Indigenous environmental sectors are growing quickly in these countries, with large numbers of graduate engineers working on new environmental technologies. Indeed, technologies from China and India, particularly in the renewable energy sector, are already appearing as imports into Europe, North America and Japan. The success of Chinese companies in particular is captured in the latest 'Rich List' report on China where leading entrepreneurs are just as likely to be from the EGS sector as they are from more traditional industries.

The global EGS sector is expected to grow by 45% by 2015 (see Chart 2). Using current world market size data and annual JEMU compound growth figures, growth forecasts can be extrapolated to provide an indication of world EGS market growth to 2015. Using this methodology, the forecasts suggest **world markets growing to $688 billion by 2010 (matching the JEMU forecasts) and just under $800 billion by 2015.**

Chart 2: World EGS Markets to 2015



The UK Industry

The UK environmental industry is well established, vibrant and diverse. This report shows annual turnover in the sector of around £25 billion[2] in 2005 - roughly the same as the pharmaceuticals and aerospace sectors. It employs approximately 400,000 people in 17,000 companies.

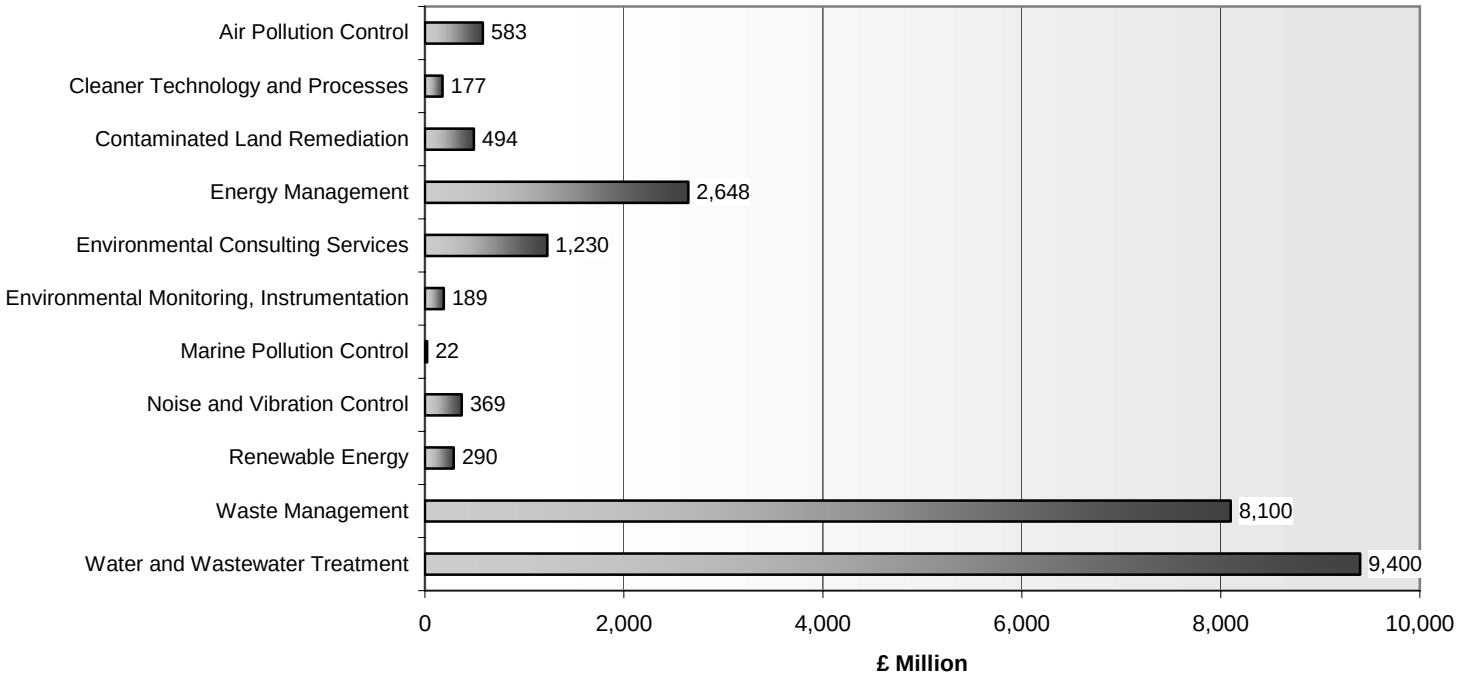
[2] Defra, 2005, corroborated by UK CEED's aggregated figures.

The dynamism of the sector is illustrated by UK CEED's Envirodaq index[3] of UK-listed EGS companies. The index covers both established and newly listed companies on FTSE and AIM which derive at least 60% of their value from EGS activities. Between January and August 2006, the index grew from 42 companies to 76 as new companies listed and existing companies increased their exposure to the EGS market. During the period June 2005 to end of May 2006, the index grew by 40% in value, compared to the FTSE 100's growth of 17% over the same period.

Although industry strengths vary from region to region, the EGS market is particularly strong in the East of England, the South East, London and the North West. Nationally, water/wastewater treatment and waste management sub-sectors are by far the largest, representing 39% and 34% of the industry respectively (see Chart 3). This reflects the global picture, where demand for waste management and water and wastewater treatment services accounts for 72% of the market.

These sectors, with their associated expertise in engineering, consulting and laboratory services, have already spawned a number of market-leading multinational companies in the UK. Other fields where the UK has a strong international reputation include noise abatement technologies, hydro power, metal recycling, energy management and marine pollution control.

Chart 3: UK Environmental Goods & Services Market by Sub Sector 2005



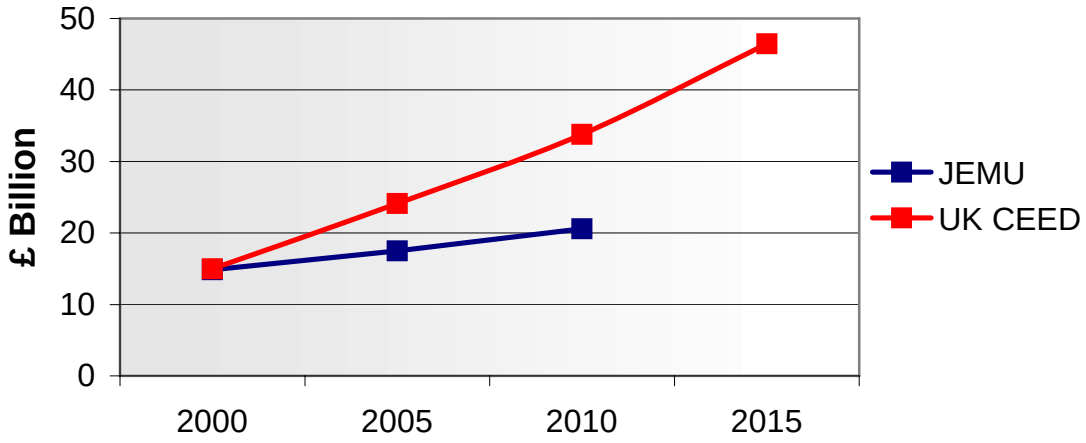
UK Market Growth

The 2002 study by DTI's Joint Environmental Markets Unit (JEMU)[4] forecast market growth in the UK to 2010. However, UK CEED's research has shown that, if anything, the JEMU forecasts are on the conservative side. By comparing the JEMU market size forecasts for 2005 with the actual position for the same year, it shows that UK market growth has outstripped JEMU predictions.

[3] The daily updated index can be found at www.envirodaq.com
[4] Now superseded by the joint DTI, Defra sponsored Environmental Industries Unit and the Environmental Industries Support Unit.

Using these figures as a starting point, and integrating more up to date forecasts of growth in individual sub-sectors where these exist (e.g. renewable energy, water and waste water treatment), growth forecasts can then be projected forward to 2015. **These projections suggest that the UK EGS market will grow from £25 billion in 2005 to £34 billion in 2010 (42% growth from 2005) and on to £46 billion by 2015.** The 2010 projection is significantly higher than the JEMU forecast of £21 billion. It also represents a near doubling of the market size between 2005 and 2015 as illustrated in Chart 4.

Chart 4: Projected Growth for UK EGS Sector 2000-2015



UK Sector Strengths

Chart 5 (see overleaf) provides a breakdown of UK EGS growth by sub-sector for the period 2005-2015. It shows that waste management and water/wastewater treatment remain the largest sectors, but that some of the greatest growth potential is in smaller, but fast growing sectors such as energy management, renewable energy, environmental consulting services, and contaminated land remediation.

Undoubtedly, the most concerted policy activity centres on responses to the challenge of climate change. Consequently, the **energy management** sector is expected to grow at double digit rates over the next five to ten years, spurred on by policy drivers such as: the Energy Review 2006; high fuel prices; public R&D funding; grants programmes; and industry/consumer demand.

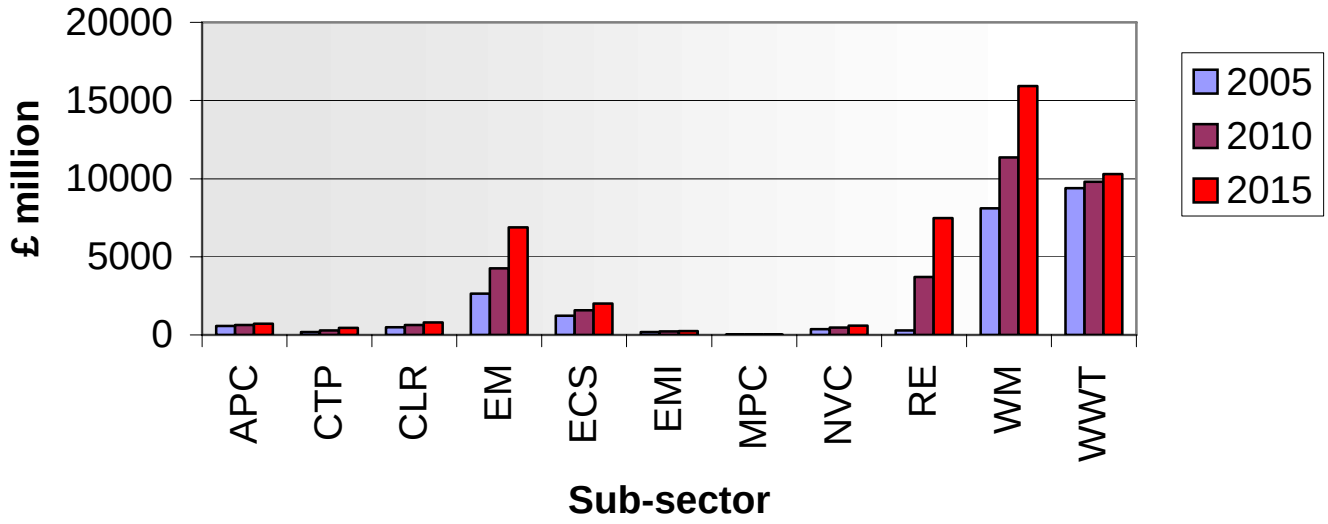
Renewable energy offers both large domestic and global market opportunities with estimates of over $1 trillion to be invested in non-hydro renewable technologies worldwide by 2030[5]. In the UK, it is forecast that £15-19bn of capital expenditure will be required to meet 2020 targets for renewables[6]. UK businesses are also taking a leading global role in the development of carbon markets and carbon financing, although these services are not traditionally considered part of the EGS sector.

The UK has a rapidly growing skills base for wind, wave and tidal power project management although the technologies themselves tend to be imported. The UK is also strong in areas such as hydro engineering, landfill gas utilisation, biofuel/biomass development. A growing number of investment vehicles, both private and public/private joint ventures, are being

[5] World Energy Council, 2006.
[6] DTI, 2004

established to invest in the UK renewable energy sector, something which is likely to spur growth in start-up activity.

Chart 5: Growth by Sub-sector 2005-2015



Key: *APC: air pollution control; CTP: cleaner technology and processes; CLR: contaminated land remediation; EM: energy management; ECS: environmental consulting services; EMI: environmental monitoring and instrumentation; MPC: marine pollution control; NVC: noise vibration control; RE: renewable energy; WM: waste management; WWT: water/wastewater treatment.*

The **environmental consultancy** sector has also seen double digit growth rates since 2000, with significant overseas activity by the bigger players. With the enforcement of stricter regulation in the developed and developing economies, the UK sector is well placed for further growth at home and abroad.

The market for **contaminated land remediation** is strong and growing in the UK, with prices for brownfield sites rising steadily. At the same time, a number of large scale regeneration projects are gathering pace, such as the London Olympics, Thames Gateway, and Growth Corridors; while in the North, markets are boosted by the ongoing renaissance of major northern cities such as Liverpool, Manchester, Leeds and Newcastle. These provide clear opportunities at home. In overseas markets, there is strong competition from more established US and EU companies.

Increasing commodity prices and tightening regulations are continuing to provide opportunities in the **waste management** sector, particularly in the area of recycling. In the latter area, there are challenging targets to be met to bring the UK up to the level of many of its EU neighbours and this continues to provide opportunities not just for the large vertically integrated companies that dominate the sector but also from smaller companies introducing innovative technologies. Forecasts suggest that £20bn of investment is required in the sector to meet legislative requirements by 2010[7]. This scale of investment and the opportunities for sector growth is spurring increasing investor and M&A activity in the sector.

The global **water and wastewater treatment** market is forecast to grow by 33% to 2025. The major opportunities over the next five to ten years are likely to be in the developing economies, where the priority is the supply of basic waster and wastewater treatment infrastructure. Nevertheless, capital investment of £18.9bn is forecast for England and Wales

[7] Institution of Civil Engineers, 2004

between 2005 and 2010 and a further £2.25bn for Scotland between 2006 and 2010. The UK market for consultancy and engineering activities, particularly in project management and network replacement, is also showing strong growth prospects, largely reflecting strong EU and UK policy drivers and also increasing incidents of water shortages.

Market Drivers and Way Forward

Globally, market growth is driven primarily by legislation, whether at the international or national level, particularly in the more mature markets of the US, EU and Japan. In recent years, rapidly rising resource and commodity prices, exemplified by the recent hikes in oil and gas prices, as well as the growing scarcity of resources like clean water and energy, have also become increasingly critical growth catalysts.

As well as stricter regulation, growth in the US, Japan and Western Europe is driven by innovation in existing technologies and the development of new step-change technologies. But the rate of development within these markets is far from uniform.

Growing the strength and capabilities of the EGS industry, both nationally and internationally, is the key to the UK maintaining and enhancing its position in worldwide environmental markets, whilst at the same time helping meet increasing domestic and international environmental challenges.

In the UK, the environmental policy framework driving demand for the EGS sector originates both from the EU and from national strategies and policies, which nevertheless reflect international agreements and EU policy. By ensuring that the most appropriate policy framework is in place, the government has a vital role to play in helping UK companies to thrive at home and abroad.

By adopting EU legislation early, the government can help give UK companies a competitive advantage. Countries which transpose directives in a timely, robust manner put their domestic EGS industries in a good position to export to those countries which lag behind. For example, in terms of waste management, Austria set up an industry agreement for car take back before the End of Life Vehicles (ELV) Directive was even proposed. As a result, Austrian companies have a sizeable portion of the UK vehicle ‘depollution’ equipment market.

Equally, delays in implementing regulations can have the opposite effect. In the ongoing debate on transposition of the Waste Electrical and Electronic Equipment (WEEE) Directive, the UK IT recycling industry has asked that certification to ISO14001 or an equivalent environmental management system is a requirement for licensing WEEE recycling operators. Such a requirement, it is argued, would make the sector more transparent, thus discouraging bulk export of waste and stimulating innovation in the supply chain. It has not yet been made clear that this will happen.

Central and local government can also help stimulate growth in the EGS sector through: leading by example in procurement; introducing supporting fiscal measures; providing regional support through RDAs; and stimulating investment in R&D. In procurement, the government and its agencies could set more stringent sustainability criteria governing central and local purchasing which would stimulate the supply side. Examples of fiscal measures may include increasing the proportion of taxation on environmental impacts, through mechanisms such as the landfill tax or extension of enhanced capital allowances.

Government can facilitate R&D investment by promoting increased coordination between funding programmes; improving industry participation in agenda-setting; simplifying existing funding application procedures and eligibility criteria; and facilitating access to information about all relevant R&D funding sources.

Key Role of Public Sector Procurement

The public sector is the largest procurement agency in the UK, accounting for 13% of GDP. In recent years, the government has begun to set out criteria for seeking to buy products and services with lower environmental impact. Regional Development Agencies, Devolved Administrations and Local Authorities can also use their procurement more intelligently to stimulate and support innovation. This again provides opportunity for EGS companies on the supply side.

In product categories where the cleaner alternative doesn't yet exist or is prohibitively expensive, it is unlikely that private enterprise will demand it, and equally unlikely that innovators will undertake the investment necessary to bring it to commercial production. In these cases, public procurement can supply the certainty of a large enough market. The recently launched National Action Plan on Sustainable Procurement[8] suggests how the government and its agencies can build on this vital role and become the lead sustainable procurement body in the EU.

Changes in purchasing practices among public as well as private sector organisations also reflect a gradual change in consumer purchasing, with certain products, such as organic food, sustainable timber and lower energy appliances, exemplifying a shift in demand towards products with a lower environmental impact.

[8] Chaired by Sir Neville Simms, Defra, 2006.

Chapter 1: Introduction

1.1 Context and Aims

The environmental goods and services (EGS) industry is hugely diverse, comprising a number of sub-sectors, some of which have their roots in some long established sectors, notably in the areas of drinking water supply, waste water treatment, and solid waste management. The sector has expanded significantly as the need for more sustainable products and services has grown and now encompasses high growth activities such as environmental monitoring, renewable energy and clean technologies.

Whilst large multinational companies are highly visible in areas such as waste, water and renewable energy, a number of the sub-sectors are notable for the prevalence of smaller companies. Start-up activity is increasing in certain sub-sectors such as renewable energy and recycling and investor awareness and funding mechanisms are growing to cater for this activity.

Globally, market growth has tended to be driven primarily by legislation, whether at the international or national level, particularly in the more mature markets of the US, EU and Japan. In recent years, rapidly rising resource and commodity prices, exemplified by the volatility in oil and gas prices and the growing scarcity of resources like clean water and energy, have also become increasingly important influences on the sector. Rising consumer demand for 'greener' goods and the response of companies and public sector agencies, often through corporate social responsibility activities, is also beginning to exert a pull in the market place.

This study aims to estimate the size of the UK and global Environmental Goods and Services markets and to provide an overview of the strengths and weaknesses of the UK supply-base for those sub-sectors listed in Annex 1. In addition the study also aims to identify and analyse a number of promising areas in the EGS sector where new opportunities are likely to occur as a result of forthcoming market influences.

This project was undertaken using a mixture of desk research, engagement with key industry and government agencies through telephone and face to face interviews and through the use of 4 technology roadmapping workshops. It uses as its starting point the 2002 report commissioned by the then Joint DTI/Defra Environmental Markets Unit (JEMU)[9]. The forecasts for global and UK environment markets contained in that report are compared with updated information where available and the forecasts are then projected forward to 2015.

The project was overseen by a small steering group consisting of representatives from the Environmental Industries Unit and UK CEED.

1.2 Structure of the Report

The report is structured as follows:

- Chapter 2 estimates the size of the UK and global environment markets and looks at the key drivers of market growth.
- Chapter 3 provides an overview of the sub-sectors within the UK's EGS sector. For each sub-sector, the size of the UK industry is estimated, the market drivers are pinpointed, and the strengths and weaknesses of the subsector are described.

[9] Global Environmental Markets and the UK Environmental Industry, Opportunities to 2010 (JEMU 2002)

- Annex 1 provides more detailed definitions of the sector
- Annex 2 reports on the outcomes of two scenario planning processes used to examine potential new opportunities in two sectors of relevance to the EGS sector: Contaminated Land Remediation and ICT – Enabled Environmentally Smart Buildings
- Annex 3 provides an overview, in the form of a matrix, of overseas market information by country and subsector.

1.3 Defining the Environmental Goods and Services Industry

The Environmental Goods and Services sector is diverse in nature and does not fit easily within existing classifications and definitions. It is particularly ill-suited to consideration under Standard Industrial Classification (SIC) codes. Most importantly, there is no universally accepted, clearly explicit definition of terms such as "environmental" or associated terms such as "waste". Many definitions have been used in the past and few studies have used the same definition, interpreted in the same way.

The environmental industry is multifaceted, and inextricably interwoven with mainstream industry. The environmental industry supplies, services and works alongside, or shares technology with every sector of mainstream industry. In many cases EGS companies are owned by, or spun off from, mainstream companies, or are indeed divisions or departments of them. Many people in the organisations covered by this study would not consider themselves to be in the environmental industry. The line between good business management and good resource management is thin, and in for instance metals recycling and certain parts of the energy management sector, there are strong commercial incentives pushing in the same direction as environmental considerations.

Environmental Business International (EBI) uses a definition comprising 14 subsectors grouped into three divisions: services, equipment, and resources. The OECD, with Eurostat, published a definition in 1999 that is very similar to the EBI definition, but includes construction/engineering costs of environmental plants, and adds several categories: sustainable agriculture, fisheries and forestry, natural risk management, and eco-tourism. It also makes research and development, cleaner technologies and cleaner products into separate categories.

The OECD/Eurostat definition is summarised as follows:

The environmental goods and services industry consists of activities which produce goods and services to measure, prevent, limit, minimise 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.

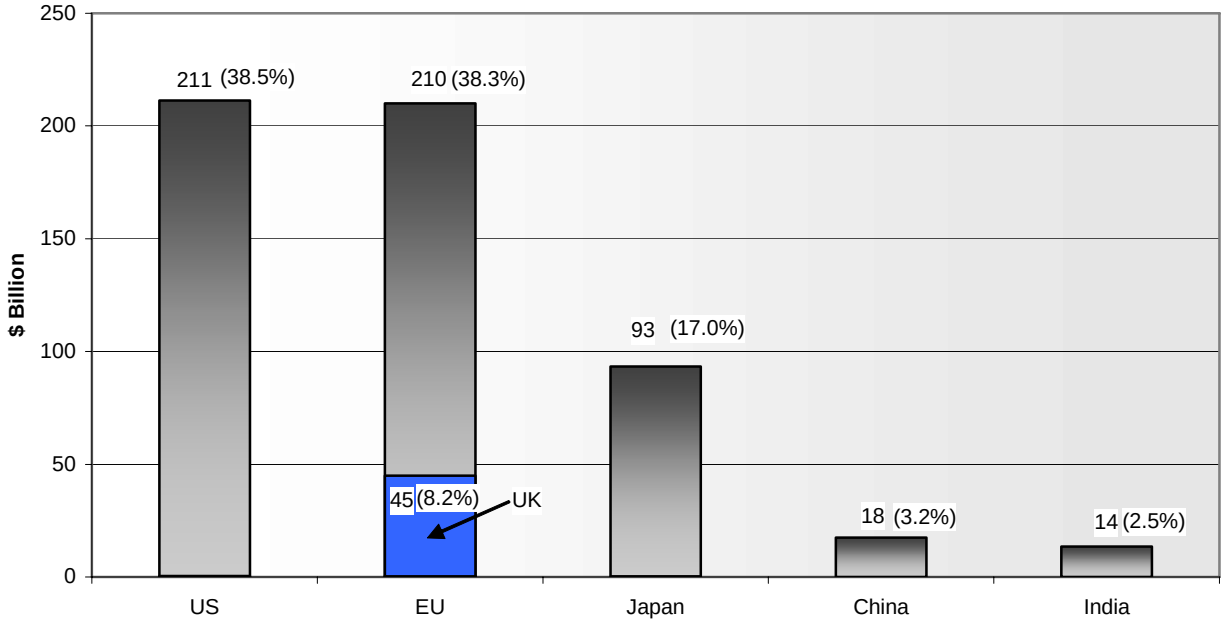
The JEMU list, which has been used for the UK analysis in this study, is itself a modified form of the OECD/Eurostat definition. It has been used by regional bodies to map the EGS sector, but has been subject to varied interpretation. The report authors in this study were asked to provide an assessment of these definitions and the resulting briefing was then fed into the Mapping Group of the Environmental Industries Federation for a definitive analysis.

Further explanation on definitions can be found in Annex 1.

Chapter 2: Global and UK Environment Markets

The global EGS sector has been estimated to be worth $548 billion (EBI 2004a) and is forecast to grow by up to 30% by 2010. The chart below indicates that the US and Japanese markets are by far the largest individual markets in terms of EGS sector turnover[10]. However, the total market for the EGS sector in the 25 countries of the EU has been estimated to be of a similar size to that of the US. These markets account for over 94% of world markets. The UK has an 8.2% share of world markets.

Chart 2.1: Environmental Goods and Services Market by Country 2004



UK CEED 2006 Aggregated Figures

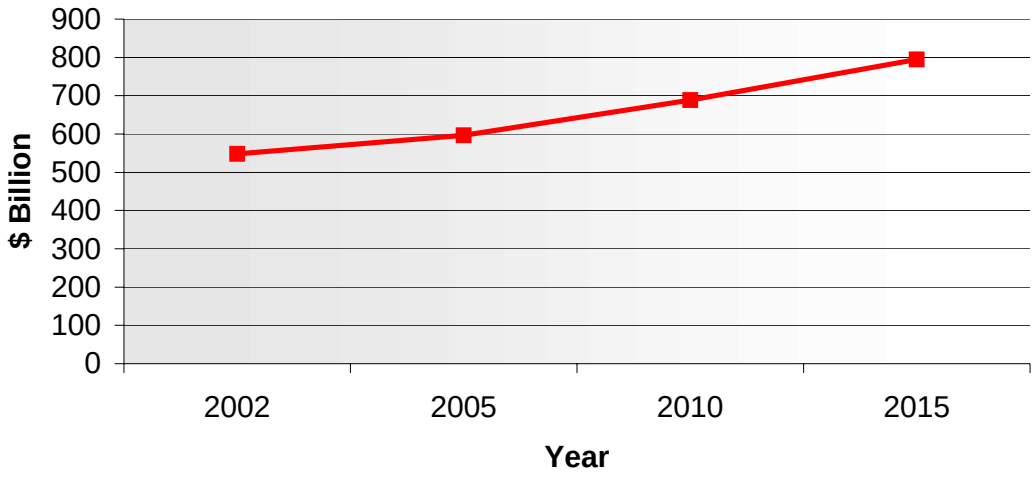
The global market for the EGS sector is still dominated by demand for waste management and water and wastewater treatment services. These sectors account for 72% of the global EGS market (EBI 2004).

The JEMU report contained forecasts for world EGS market growth to 2010. The authors of this report have been unable to identify more up to date, credible forecasts for world markets so have taken the world market size data as shown above and used the JEMU annual compound growth figures to forecast to 2015. This is likely to be an underestimate given that this report contains significantly larger estimates for market size in the UK and countries such as China than those used in the JEMU report. Nevertheless, using this methodology the forecasts show world markets growing to $688 billion by 2010 (matching the JEMU forecasts)

[10] Details of other individual EGS sector markets are can be found in the matrices in Annex 2. It should be noted that the data used in Annex 2 has been obtained from a wide range of sources and that it varies greatly in terms of its source, methodology and definitions. For these reasons, direct comparisons between countries and across markets is fraught with difficulty.

and just under $800 billion by 2015. The latter figure represents an overall growth in the world market of approximately 45% between 2002 and 2015.

Chart 2.2: World EGS Markets to 2015



Several attempts have been made to measure the size of the UK environmental goods and services (EGS) industry. These studies have used a variety of approaches and the results are summarised in the table below.

Table 2.1: Estimates of UK environmental industry size, £ millions

Subsector	1999 (ECOTEC, 2001)	2000 (ECOTEC, 2002)	2000 (JEMU, 2002)[(c)]	2005 (Forecast from JEMU 2002)	2004 (Defra, 2005)[11]	Aggregate from sub-sector analysis in this study
Air Pollution Control (APC)	1820	1000	907	1002		583[12]
Cleaner Technology and Processes (CTP)						177[13]
Contaminated Land Remediation (CLR)	244	400	638	814		494[14]
Energy Management (EM)						2,648[15]
Environmental Consulting Services (ECS)	594[(a)]	750	600	766		1,230[16]
Environmental Monitoring and Instrumentation (EMI)		800	100	116		189[17]
Marine Pollution Control (MPC)						22[18]
Noise and Vibration Control (NVC)	119	100	77	98		369[19]
Renewable Energy (RE)	527		200	402		290[20]
Waste Management (WM)	4537	2500	4600	6452		8100[21]
Water and Wastewater Treatment (WWT)	3766[(b)]	3000	7334	7334		9400[22]
Research and Development	40					
Other			410	523		523[23]
Total	11,647	8,550	14,866	17,506	25,000	24,025

(a): referred to as "environmental management"
(b): wastewater treatment only

11 This study did not break down turnover by subsector.
12 This figure is derived from Defra's expenditure survey covering the private and public sectors. It does not include the automotive sector or service industry use of APC equipment such as petrol stations, dry cleaners and cremation services.
13 Based on URS survey of sector (URS, 2005)
14 The figure is based on the figures in the MBD and Summersgill reports and excludes traditional dig and dump techniques which are usually included within waste management turnover figures.
15 Takes the UK market for thermal insulation as a proxy for sector turnover (UK has a small net surplus in exports of such materials) to which the turnover for insulation installation, energy services and micro-CHP are added.
16 The turnover figure from the ENDS Directory of Environmental Consultants minus £100m counted under noise and vibration services. This figure undoubtedly double counts some services also included within the turnover figures for the energy management and water and wastewater treatment sub-sectors.
17 Includes ambient air monitoring, the commercial market for environmental laboratory services, pesticide monitoring and provision of utility meters.
18 This is the Maritime and Coastguard Agency's total expenditure on pollution prevention and treatment added to the value of exports from the oil pollution control equipment industry
19 This is taken from Defra's annual survey of expenditure on noise and vibration control (not including construction or service industry expenditure) together with an estimate for the market for noise consultancy, exports of automotive noise control equipment and reduced noise road surfacing and other mitigation expenditure.
20 From DTI, 2004a
21 From ONS, 2005d
22 From ONS, 2005d
23 From JEMU 2002

Estimates for the size of markets range from a total of £8.6 billion to £14.9 billion for the year 2000. The wide range reflects inconsistencies in the estimation processes, such as which subsectors are included, and how they are measured, and limited data availability.

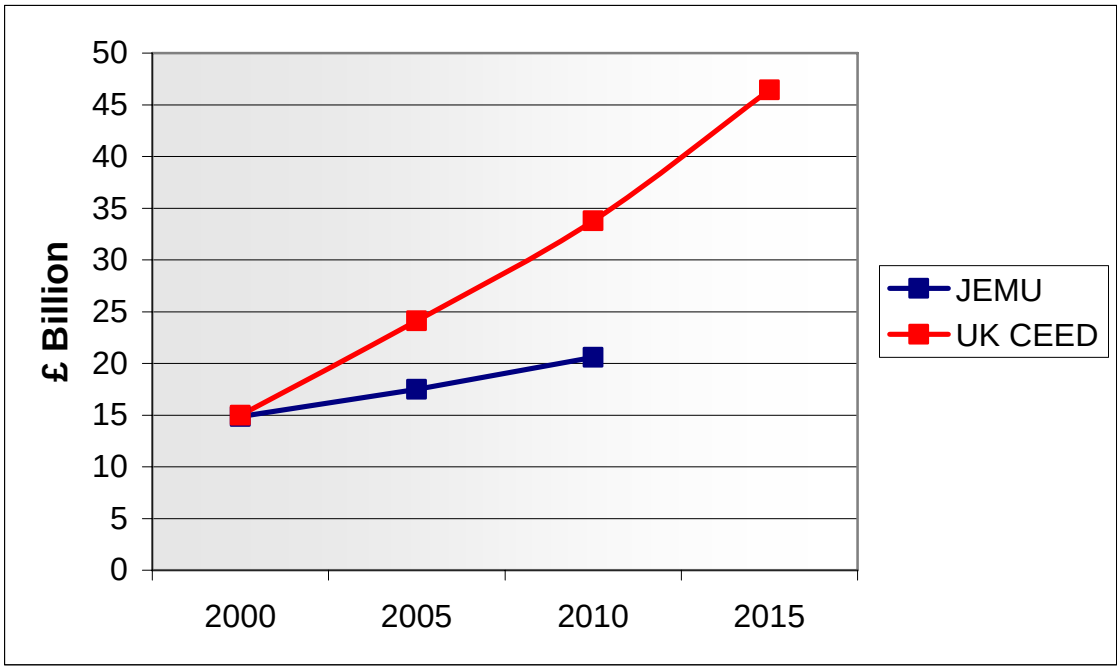
A more recent study (Mansfield and Thomas, 2005) arrived at a total of £25b for total industry turnover in 2004, with no subsector breakdown, by consolidating studies undertaken by Regional Development Agencies and devolved administrations.

The present study is, in part, an attempt to arrive at an estimation of the industry size, by subsectors, using as explicit a process as possible. Our results converge to those of the Defra study, albeit arrived at by a different route (subsector analysis rather than regional aggregation), and so provide a degree of corroboration. It should be noted, however, that methodological challenges remain as a result of the definitional issues outlined in the previous section and the lack of consistency in data collection and analysis.

As with world market forecasts, the authors of this report have been unable to find any research that provides a more authoritative and up to date analysis of the UK's EGS sector's growth potential as a whole than the JEMU report. However, more up to date figures are available for the UK market in 2005 and these show the market is larger than predicted by the JEMU report in 2005. These figures are used as a starting point to project forward to 2015 using the detailed growth forecasts contained within the JEMU report.

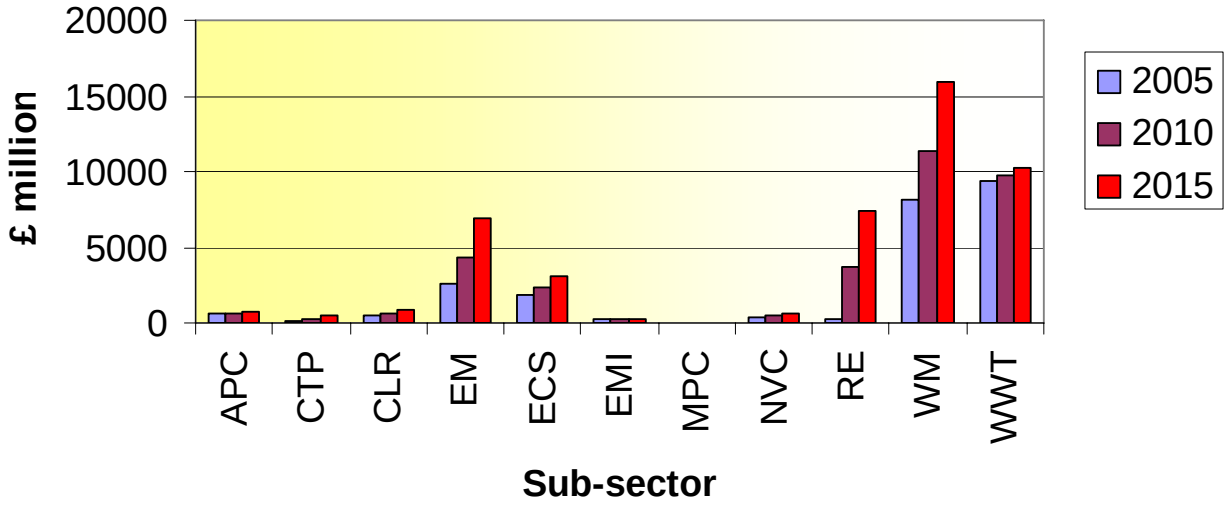
The projections suggest that the UK EGS market will grow from £24 billion in 2005 to £30 billion in 2010 and on to £39 billion by 2015. The 2010 projection is significantly higher than the JEMU forecast of £21 billion. It also represents a doubling of the market size between 2000 and 2010.

Chart 2.3 Projected Market Growth for UK EGS Sector



The graph below provides a breakdown of growth by sub-sector for the period 2005-2015. It shows that the waste management and water/wastewater treatment sector remain the largest but that energy management is a significant and fast growing sector together with environmental consulting services.

Chart 2.4: UK EGS Growth by Sub-sector 2005-2015



Key: *APC: air pollution control; CTP: cleaner technology and processes; CLR: contaminated land remediation; EM: energy management; ECS: environmental consulting services; EMI: environmental monitoring and instrumentation; MPC: marine pollution control; NVC: noise vibration control; RE: renewable energy; WM: waste management; WWT: water/wastewater treatment.*

2.1 Main Drivers of the EGS Sector

It is commonly assumed that the most important driver of growth in the EGS sector comes from legislation, whether at the international (e.g. Kyoto protocol, EU Directives) or national level. However, in recent years, high resource and commodity prices, as well as resource scarcity (e.g. clean water, energy) have increasingly driven market demand for alternative, 'cleaner' goods and services. These forces, together with changing patterns in the purchasing decisions of individuals and public and private sector organisations, are exerting a growing market pull that provide opportunities for the sector.

Other influences on the size of the EGS market vary from country to country, but may include: the relative stage of infrastructure and economic development; level of investment set aside by governments and companies for improving environmental performance; availability of finance for company growth and R&D; consumer awareness of, and attitude towards environmental issues; whether or not improving environmental performance is seen as a competitive advantage (e.g. supply-chain conformance to ISO 14001, corporate social responsibility action).

Some of the largest companies in the world (GE, BP) are refining their business models to exploit the increase in demand for green products and these companies have the scale to influence significantly such a transition both through their purchasing decisions and through those of their supply chain. At the same time, there is a growth in start up activity in the sector, which in turn is stimulated partly by increasing access to new venture funds focused on the sector.

As noted above, highly developed countries such as the US, Japan and Western Europe have large markets for environmental goods and services. However, because the basic infrastructure in these countries has been long established, there is relatively less opportunity

for significant growth in industries such as water treatment, waste management, and air pollution control. Of course there will always be a need to innovate on these fronts, especially as environmental legislation becomes more stringent and customer awareness increases, but these drivers for growth cannot be compared to the surge in demand for environmental goods and services that a rapidly developing country is likely to exhibit. Instead, it is anticipated that the key areas for growth in developed countries will be in fields such as renewable energy and cleaner technologies and processes, where a high level of research and development is currently being undertaken.

Conversely, the markets in developing countries, such as in China and Eastern Europe currently account for a low proportion of the global EGS market. However, high growth rates are expected in these countries, primarily for basic environmental infrastructure such as water and wastewater treatment, waste management and pollution control. In countries such as China, where economic development is taking place at unprecedented speed, market growth across the sector, including those subsectors which are usually associated with developed countries, are taking place more or less simultaneously.

Within the UK market, there are certain factors that are relevant to all or most of its subsectors, which are discussed below. Although not considered in detail below, the linked issues of resource scarcity and resource prices are likely to continue to be a major, if not *the* major factor, driving demand for the development of alternative technologies from the EGS sector.

Many of the drivers for this industry are the same as for mainstream industry. The air, noise and wastewater sectors are largely dependent on the manufacturing industry, the land remediation and energy management sectors depend on the construction market, etc. Likewise, the environmental industry consumes its share of products and services from mainstream industry. While the mainstream and environmental industries sometimes appear to be in two different camps, arguing for and against environmental regulation, they are fundamentally in the same business: improving our quality of life. Some sectors satisfy direct consumer demand; some satisfy the demands of society for a better environment made through the political process.

Central and local government can also help stimulate growth in the EGS sector through: timely transposition of EU Directives; leading by example in procurement; introducing supporting fiscal measures; and stimulating investment in R&D at national and regional level.

2.1.1 Transposition of EU Directives

The environmental industry in the UK has traditionally been driven largely by regulation, and the bulk of the UK's environmental regulations are transpositions of EU Directives. Timing of implementation may differ, as may definition of key terms, interpretation of ambiguities, and administrative procedures. In many cases, such as the Biofuels Directive, the directive only indicates a direction, and leaves targets and measures entirely up to the discretion of member states.

Good and timely implementation of the Directives can drive the industry's development and provide indigenous industry with a competitive advantage, as technology develops ahead of the rest of the market. For directives which create or significantly expand an EGS market, such as the Water Framework Directive, or the Waste Electrical and Electronic Equipment (WEEE) Directive, this is particularly important. However, at the same time, early implementation of Directives may be seen more generally within industry as impacting upon the competitiveness of UK Plc. Implementation of UK regulation which goes beyond the letter of a Directive, often termed 'gold plating' is similarly criticised.

Nevertheless, countries which transpose directives in a timely manner, interpret them in such a way as to maximise the size of the domestic market, and give industry clear and robust

indications of how and when it will be done, tend to put their domestic EGS industries in a good position to export to those countries which lag behind. An example of this is given in the Waste Management section, in which Austria set up an industry agreement for car takeback before the End of Life Vehicles (ELV) Directive was even proposed, and now Austrian companies have a sizeable portion of the UK vehicle 'depollution' equipment market.

The House of Commons Environmental Audit Committee acknowledges the contribution that proactive environmental regulations make to business competitiveness, and "that adopting more stringent domestic regulations, in particular aimed at cutting carbon emissions, could strengthen the long-term prospects of the UK economy by encouraging the development of new industries—industries which will be in ever-greater demand as oil prices rise and the world moves towards a low-carbon future (EAC, 2006b)."

The National Audit Office, in a study of Defra's record in transposing EU legislation, provides a number of recommendations for the timely and transparent transposition of EU legislation in consultation with industry (NAO, 2005).

Closely related to the timely transposition of EU legislation is the use of quality standards. These can be applied to products (such as energy efficiency standards for appliances, or ecolabels), people (such as training or proficiency requirements set by professional associations, or restrictions on who can undertake installations and repairs of equipment), or companies (licensing requirements for carrying on certain kinds of business). They can be statutory, voluntary, or built into procurement policies (see discussion below).

The higher the standards to which an industry operates, the more advanced its skill base will be. An industry working to very high standards in its domestic market can always compete in another market with lower standards, whereas competing in a foreign market with higher standards is more difficult. Countries which place high entry requirements on their domestic markets therefore give their domestic industries an advantage in both the domestic and export markets.

As an example, in the ongoing debate on transposition of the WEEE Directive, the UK IT recycling industry has requested that certification to ISO14001 or an equivalent environmental management system is a requirement for licensing WEEE recycling operators. Such a requirement, it is argued, would make the sector more transparent, thus discouraging bulk export of waste and stimulating innovation in the supply chain. It has not yet been made clear that this will happen.

WRAP recognises the importance to the recycling industry of quality standards for products, and has devoted considerable resources to their development in various waste streams. These standards help build confidence in both the industries that use the recyclate and the customers who buy the finished products, both of which in turn increase the market pull for recycled materials.

2.1.2 Public procurement policy

Central and local government and government agencies procure goods, services, works and utilities to a value of approximately £150bn per annum or 13% of GDP. This is almost ten times what UK companies spend on R&D. Spending of that magnitude directed towards environmentally better products and services would be a very powerful driver for EGS sector activity. In product categories where the cleaner alternative doesn't yet exist or is prohibitively expensive, it is unlikely that private enterprise will demand it, and equally unlikely that innovators will undertake the investment necessary to bring it to commercial production. In these cases, public procurement can supply the certainty of a large enough market.

The UK Government's 2005 Sustainable Development Strategy set out the ambitious goal to make the UK a leader in the EU in sustainable procurement by 2009. To lead this activity, the government appointed a Sustainable Procurement Task Force to develop a National Action Plan. The Action Plan makes clear that stimulating innovation in the UK's EGS sector is one of the primary benefits of taking such a lead (Defra, 2006). Associated activities such as the Forward Commitment Project and the Corporate Leaders Group on Climate Change are also addressing this area.

In a study for the European Commission (Bouwer, 2005), the UK was identified as one of seven countries (the "Green-7") that were noticeably ahead of the others in implementing green public procurement policies (the other Green-7 countries were Austria, Denmark, Finland, Germany, the Netherlands, and Sweden). The Green-7 all had national programmes with top-level political support, made use of national eco-label schemes, and had internet-accessible green procurement knowledge bases.

The study examined public tenders from 2004, and found that the UK ranked first in the percentage of "solid green" tenders (where green specifications are included for all or most possible aspects), and fourth if the "light green" tenders were included as well. However, the study only looked at open procedure tenders, and the UK has the lowest percentage of tenders issued in this way (23%, against an EU average of 72%) (Bouwer, 2005).

Conversely, the House of Commons Environmental Audit Committee found the UK's sustainable public procurement policy to be "far from satisfactory" (EAC, 2006a). It found that the Office of Government Commerce's targets and Public Service Agreements were focused primarily on costs and savings, there was confusion over which part of Government leads on sustainable procurement, and that there was not, in fact, a satisfactory web-based knowledge base (EAC, 2005b).

Public procurement of mainstream goods and services can have obvious impacts on the renewable energy and recycling sectors, as renewables and recycled materials can easily be written into specifications. According to latest reports, the UK Government as a whole has surpassed its (not very challenging) target of sourcing 10% of its energy from renewables, and most departments have met the target of 10% of their fleet being alternatively fuelled (SDC, 2005). 36% of paper was recycled in 2004 (EAC, 2005a).

It can also stimulate cleaner technology development by specifying energy, water, and material resource efficiency levels. In practice, three quarters of government departments have failed to assess water wastage in non-office properties, and 11 departments still haven't met 2004 water efficiency targets; less than half have increased building energy efficiency; only seven departments had adequate data on waste production and recovery (SDC, 2005). With over £26b of public building to be financed through PFI schemes over the next five years (HM Treasury, 2006), it is important that procurement policies carry over into this channel. In fact, however, industry has found that in the vast majority of PFI contracts, sustainability considerations, indeed any attempts at whole life costing, are put aside in favour of low capital costs (STC, 2005a).

2.1.3 Fiscal Measures

Environmental taxation, when used in a focused and transparent way tends to encourage investment in cleaner products and services by raising the price of environmentally undesirable outputs. The UK appears to be above the European average in using its tax regime to encourage uptake of cleaner technology (see table below)[24].

Table 2.2: Environmental tax revenues for UK, Germany, France and EU-25 as a percentage of total tax and social contributions in 2003

	Environmental tax revenues as % of total tax and social contributions, 2003	Environmental tax revenues as % of GDP, 2003
EU-25	6.58	2.7
UK	7.5	2.7
Germany	6.7	2.7
France	5.6	1.9

(Eurostat)

However, a report by the Institute of Fiscal Studies (2006) shows that environmental taxation as a proportion of total tax revenue peaked in 1999 at 9.8% and has since fallen back to 8.3% (2004 figures). Much of the decline can be attributed to the freeze in rises of fuel duty which is by far the largest component of environmental taxation (making up 90% of all environmental taxes). Indeed, there is some debate as to whether fuel duty can be considered an environmental tax as the duty was in existence long before an environmental justification was made for it. Other examples of current environmental taxes include the landfill tax and the aggregates and climate change levies.

The recent Stern Review on the Economics of Climate Change (2006) highlighted the importance of carbon trading in stimulating investment in cleaner, lower carbon technologies. The government has signalled that it will seek to strengthen and extend the carbon trading regime and also continue to assess the potential for the introduction of new environmental taxes. Such measures are likely to provide additional impetus for the EGS sector.

2.1.4 Research and Development

While cleaner technologies with environmental benefits can develop out of research in any industrial field, and that even technologies with applications in the environmental industry can grow out of research in seemingly unrelated disciplines, it is also worthwhile looking at R&D activities carried out by the environmental industry itself. HM Treasury estimates that the UK spends £800m p.a. on environmental research (Brown, 2006), which would include subjects outside the industry (e.g. flood defence, nature conservation), but exclude some areas within the industry (e.g. many of the technical areas contributing to energy management or instrumentation).

The environmental industry is relatively research intensive. A study carried out by Enviros (2003) found that 17% of companies spent over 20% of their turnover on R&D, and another 30% spent 5-20% on R&D. This study was biased towards research oriented companies, and included biotechnology in the environmental industry, but these numbers compare favourably with other industry sectors and suggest that the sector has a high skill base. By way of

[24] There are disagreements over what constitutes an environmental tax within the UK, however, so inter-country comparisons can be misleading. The House of Commons Environmental Audit Committee uses the Office of National Statistics' more inclusive definition of environmental taxes and concludes that the UK figures in the above table should be 8.6% and 3%. It also acknowledges the narrow definition used by HM Treasury, which would put the first UK figure at 0.4%. The Committee also points out that, using the ONS definition, the percentage of total taxes derived from environmental taxes has fallen steadily since 1999 (EAC, 2006b). This is exacerbated by the continuing deferral in inflation-only increases in the road fuel and rebated fuel duties, and the freeze in the aggregates levy, both announced in Budget 2006. The Environmental Audit Committee makes the point that with more awareness of the rationale behind environmental taxes, the public would be more accepting of them (EAC, 2006b)

comparison, the pharmaceuticals and aerospace sectors are considered the strongest UK sectors for R&D (DTI 2005e) and the corresponding figures in these sectors for 2003 were 32.5% and 14% respectively (DTI, 2005d). Meanwhile, whilst the automotive sector globally is considered R&D intensive, within the UK only 3.5% of its turnover was focused on such activities (DTI, 2005d).

The EGS sub-sectors considered most research intensive by the Enviros study were monitoring and instrumentation, renewable energy, and energy management, while waste, water and land remediation had low research intensities.

There is a rough correlation between sectors that spend high proportions of their turnover on R&D, and sectors that rely heavily on outside grants or contracts for R&D funding. Around a third of the companies sampled were aware of the various UK channels for R&D funding, and one in ten actually used them. Awareness and use levels for EU funding were about half of that for UK. The main barriers to further use of these programmes were related to information: there were too many programmes, it was difficult to access information about them, and the application and reporting procedures were bureaucratic and time-consuming (Enviros, 2003).

The study identified a need to focus more resources on the near-market and commercial demonstration stages of technology development; increased coordination between funding programmes, including interdisciplinary coordination; improving industry participation in agenda-setting; simplification of procedures and eligibility criteria; and a single web-based portal for information about all relevant funding sources.

Since this report was published, the government has been focusing increasing amounts of resources on R&D and commercialisation activities in the EGS sector. Between 2005 and 2008, DTI's Technology Programme will be investing £320 million to support companies by sharing some of the financial risk of their medium to long-term investments in technology. Many of the priority areas concern environmental technologies and year on year there are an increasing number of EGS sector companies applying to the programme.

2.1.5 Business Support

Defra's Business Resource Efficiency and Waste (BREW) programme is using £284 million of landfill tax funds to support research and implementation projects to help businesses reduce waste and increase resource efficiency.

Other bodies such as WRAP, the Market Transformation Programme, Carbon Trust, National Industrial Symbiosis Programme, Environment Agency and Regional Development Agencies are also delivering significant R&D and commercialisation programmes.

These programmes are likely to reverse the declining proportion of Government R&D funding devoted to environmental protection highlighted in a recent OST report (OST, 2005). The report also highlighted that UK R&D spending in this area in relation to GDP (2.3% in 1995-2001, 1.8% in 2004) is well below Germany (3.29%) and France (2.95%), but well above Japan (0.87%) and the US (0.48%).

2.1.6 Investor Activity

There is now an unprecedented amount of entrepreneurial activity in the EGS sector. The vibrancy of the sector is illustrated by UK CEED's Envirodaq index of UK-listed EGS sector companies. The index covers both established and newly listed companies, which derive at least 60% of their value from EGS activities. Between January and August 2006, the index grew from 42 companies to 76 as new companies listed and existing companies increased their exposure to the market. During the period June 2005 to end of May 2006, the index grew by 40% in value, compared to the FTSE 100's growth of 17 percentage points over the same period.

The London money markets have acted as a particular magnet for both investors and investees. The London Stock Exchange is rapidly emerging as the world's most popular exchange for the EGS sector with more than 50 companies listed on AIM alone with a value of over £7bn.

A growing number of private equity funds, such as the Low Carbon Accelerator fund, have been set up to invest in EGS sector companies, with renewable energy a key focus. There has also been growing activity in the carbon trading and related carbon offsetting markets. Investment banking group, Climate Change Capital (CCC) recently created the world's largest private sector carbon fund, raising US$830m in just three months. The fund will invest in low carbon technology in developing countries.

At the same time, there is significant M&A activity in the more established EGS subsectors such as waste management and water and wastewater treatment. Private equity funds, banks and multinational companies are increasingly attracted to the long term returns in these heavily regulated industries.

Chapter 3: UK EGS Industry by Sub-Sectors

This section is structured in the following way:

Each sub sector is defined and estimates of its size and potential growth over the next 10 years are provided. The estimates of size are derived from existing sources of data as referenced. The JEMU report is used as a starting point to estimate future growth in the sub-sectors as it is the view of this report's authors that it contained the only robust methodological approach for forecasting the overall performance of the sector. However, the figures from the JEMU report are compared to more up to date estimates of market size and growth forecasts in specific sub-sectors where available. Where the updated figures prove robust these are used for forward projections. As noted earlier, some of the growth forecasts in the JEMU report have proved underestimates but the remainder would appear to be realistic.

The estimates of sub-sector size are followed by an outline of market drivers and strengths and weaknesses.

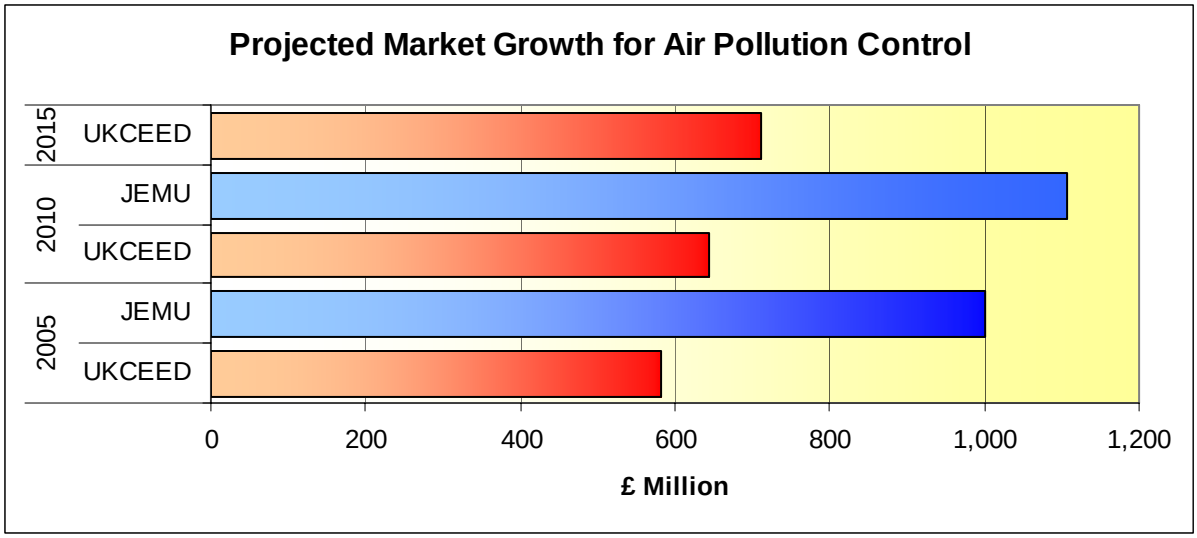
3.1 Air Pollution Control (APC)

The supply of air pollution technologies and services, such as gas scrubbers, dust collectors, thermal oxidisers and the installation/servicing of this equipment (JEMU, 2002).

3.1.1 APC Market Size

The market for APC is estimated at £583m for 2005, growing to £644m by 2010 and on to £711m by 2015. These figures are significantly below those appearing in the JEMU report as shown in the chart below. This is likely to be because of differences in definitions between the two reports and this report's exclusion of the market for vehicle pollution control. The latter is not included as there are few clear forecasts in this market and those that do exist vary by an order of magnitude. It is also the case that the market is already included within market assessments of the automotive sector.

APC is generally considered a relatively mature market and one which is likely to grow only slowly in the near term. Therefore the growth rate of 2% contained within the JEMU report is also used to forecast future growth in this report, although it should be noted this is slightly below long term growth trends in the economy as a whole and is therefore likely to be an underestimate.



Evidence

Defra's annual survey on industrial environmental protection expenditure found that £401m was spent on air pollution control in 2003 (41% capex), not including £49m capex on integrated processes (included in Cleaner Technology and Processes) (URS, 2005). Although the survey highlighted that capital spending on integrated pollution control measures has fallen in every year of the survey, more capital investment focuses on air quality than any other environment area.

These figures are for the extraction, manufacturing and energy and water supply industries only, i.e. they do not include construction or service industries. Some service industries are significant markets for air pollution technology, notably petrol stations, dry cleaners, and vehicle refinishers. For example, the cremation industry will be investing in equipment to reduce dioxins and heavy metals in the medium term[25].

In addition, public (i.e. government and local authority) expenditure on air and climate protection was £159m in 2003, rising to £182m in 2004 (ONS, 2005b).

The above figures would not include vehicular air pollution equipment expenditure, i.e. catalytic converters and particulate traps. This is a significant industry, but quantification of the UK's role in this part of the automotive supply chain is difficult. For example, annual compliance costs for the Euro V standard for cars, light duty vehicles and heavy duty vehicles in the UK (which would largely be the cost of emissions control technology) were estimated at between £307m and £666m by Defra, as part of the Air Quality Strategy Review (Defra, 2005a). The corresponding figures for the EU light diesel market are estimated at £860m-£5900m (particulate filters) and £650m-£7670m (deNOx) (Mansfield, 2006).

However, the benefits to UK industry have been estimated to be as low as £72.1 million (Searles, 2006). The difference can be attributed to the UK's low market share in the manufacture of the relevant components, and the fact that many subcomponents are imported (precious metals, honeycomb supports, particulate filters). The lower estimate also disregards incremental benefits to exhaust system assemblers, who come between the emissions control manufacturers and the car companies. The above figures refer to the incremental change in the industry brought about by one Directive, so the existing industry could be much larger.

[25] The costs were estimated to be £46m capital, and £7m p.a. recurrent, based on 90% reduction (Defra, 2002). Under current legislation, these costs will be lower (to achieve a 50% reduction) and must be implemented by 2012.

3.1.2 APC Market Drivers

APC is a mature market and there is evidence that as heavy industry relocates from the UK to lower cost regions so the market for APC equipment is likely to decline. Nevertheless, the major driver of the industrial air pollution control market is the implementation of the Integrated Pollution Prevention and Control (IPPC) Directive. The deadline for full compliance with the Directive is October 2007 and, by November 2005, the Environment Agency had issued over 1,200 permits for new and substantially changed sites. However, with 2,900 permits still outstanding it is expected that there will be some pick up in expenditure over the next 18 months as the remaining companies are brought within the scheme.

The local authority pollution prevention and control (PPC) regime is also an important player in this market with its coverage of 17,000 sites regulated under the local air pollution control (LAPC) and integrated pollution prevention and control (LA-IPPC) regimes processes (rising to 23,000 with the inclusion of dry cleaning).

Having finalised nearly all the first round of European reference documents on best available techniques (BAT) – the "BREFs" – the European Commission is embarking on a review of some of the earlier documents (details can be found at http://eippcb.jrc.es). This may provide an opportunity for companies with novel abatement techniques to gain official recognition for their products.

The market has been influenced by the introduction of lower emission materials in industrial processes. One example was the major shift in the 1990s to low-solvent/water-based coatings. In this area, UK legislation and guidance was ahead of much of Europe and subsequently informed the development of the EU Solvent Emissions Directive.

The Large Combustion Plants Directive (LCPD) (2001/80/EC) is another significant driver.[26] By the beginning of 2008, Member States have to comply with the revised LCPD either by ensuring that existing plants comply with the LCPD emission limit values (ELVs) or that existing plants are subject to a national emission reduction plan, except for existing plants that are exempt under the limited operating life derogation. This will tend to increase the demand for APC equipment, and in particular it will force seven major power plants to install flue gas desulphurization in the next two years (ENDS, 2006).

3.1.3 APC Strengths

The major companies active in the UK APC market are DCE Donaldson and AAF International, both US companies with manufacturing and research bases in the UK and other countries. Both offer a range of dust and fume filtration equipment for industrial processes. The remainder of the market is largely composed of many SMEs.

The UK has significant expertise and facilities for the development of retrofit emission reduction equipment for commercial vehicles, in companies such as Eminox, Engelhard, Lubrizol, Kleenair, and Johnson-Matthey. This was fostered in part by the Energy Saving Trust's TransportEnergy programme, which offered grants for purchases of emissions control equipment. This, in combination with tax breaks for cleaner vehicles, created a fertile environment for technical innovation. The programme has now been cancelled because of concerns over EU State Aid rules.

Substrates for catalytic converters and diesel particulate traps are an area of strength, with UK-based Dyson Group and Porvair manufacturing and exporting materials with both industrial and vehicular applications.

[26] The LCPD aims to reduce acidification, ground level ozone, and particles throughout Europe by controlling emissions of sulphur dioxide (SO2), nitrogen oxides (NOx), and dust (particulate matter (PM)) from large combustion plants (LCPs). These plants include power stations, petroleum refineries, steelworks, and other industrial processes running on solid, liquid, or gaseous fuel.

3.1.4 APC Weaknesses

Initially, slow permitting of industrial installations by the Environment Agency under the IPPC regime[27] may have caused some stagnation in the industrial air pollution control market in recent years. However, this problem is common to all EU member states. The pace within the UK has picked up over the last 18 months, and the UK is now described as "towards the front of the pack" in this regard[28] (ENDS, 2005a).

Germany has long had high standards in place for industrial air pollution control, and many of the 'BREF' notes, which provide guidance on implementation of IPPC throughout Europe, are heavily influenced by German technology. German companies also benefit from having a clear code (e.g. TaLuft) with precise and common standards applicable, whereas the UK "BAT" approach (now adopted in IPPCD) gives site-specific flexibility. This reduces the opportunity for common solutions to be supplied by APC companies. In the UK market many SMEs are being bought up by German companies and the technologies taken overseas (Cluett, 2006).

Defra is currently considering removing up to 4,000 processes from the Local Air Pollution Control regime, which covers approximately 10,000 industrial processes and 7,000 filling stations, on the grounds that their inclusion is not required by EU legislation. The Environmental Industries Commission has suggested that this may further weaken the domestic market (ENDS, 2006c). However, proponents of the proposals suggest that its aim is simply to improve the current system, and reduce the bureaucratic burden on businesses, rather than diminish its impact.

3.2 Cleaner Technologies and Processes (CTP)

The supply of equipment and expertise for cleaner, more resource efficient technologies, processes or products, which for example, decrease material inputs, reduce energy consumption, recover valuable by-products, reduce emissions or minimise waste disposal problems - usually involving minimising polluting emissions at source rather than adopting 'end-of-pipe' pollution control techniques (JEMU, 2002).

This is not an industry in itself, but a category of spending found within all industries. Moreover, the expenditures to be included change from year to year as 'cleaner' technologies become standard and are supplanted by even cleaner technologies. It is therefore extremely difficult to quantify and it is generally included within the other sub-sectors. The URS study below is the only one we are aware of in which an attempt is made to quantify UK expenditure on cleaner technology.

Part of the problem is defining what qualifies as a clean technology investment. According to ECOTEC, "Investments in cleaner production must be distinguished from investments in new processes where environmental considerations are not the prime motivation." (ECOTEC 2002).

Many cleaner technologies have a variety of benefits, some of which can be considered environmental, others not, and still others would depend on the definition of environmental. The decision to replace a toxic input with a non-toxic one, for instance, will result in less hazardous waste arisings (clearly an environmental benefit), but it may also reduce health and safety risks to employees. There may also be financial benefits from the reduced paperwork and training associated with hazardous material storage and handling. Technologies that reduce energy, water, and materials inputs will have obvious cost benefits, whereas

[27] Under the regime 6495 installations in the UK should be permitted by 30 October 2007 (ten Brink, 2003). However, of the 3700 permits now expected in England and Wales, only 1526 had been determined as of February 2006 (Environment Agency 2006a).

[28] Eight member states are the subject of infringement proceedings, (these include Germany and France, but not the UK) and Austria has been prosecuted for incomplete transposition (European Commission, 2005).

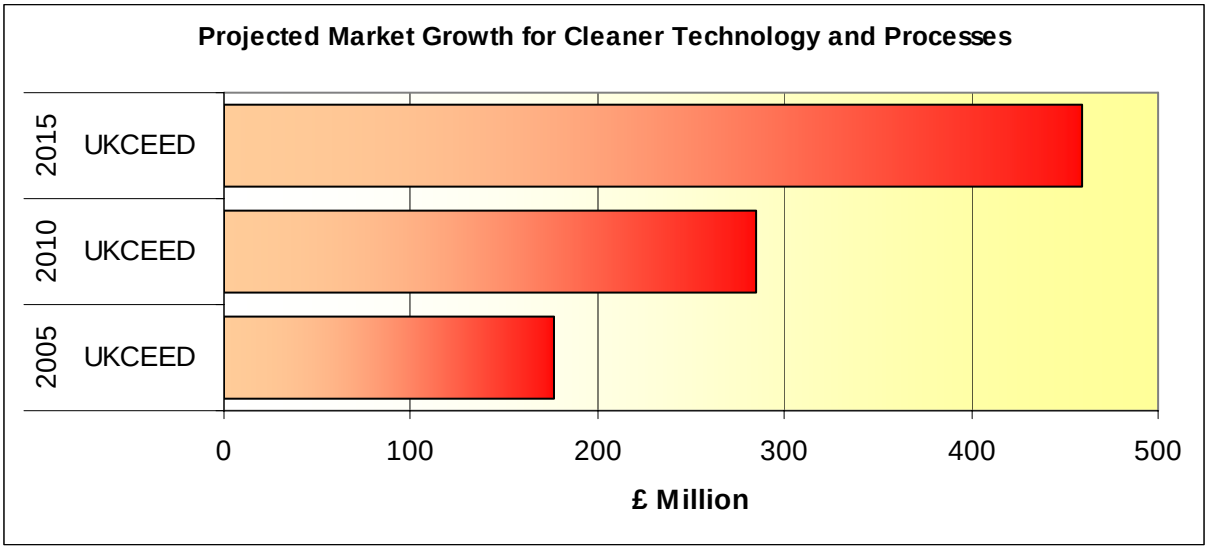
technologies that reduce emissions to the atmosphere or accidental contamination of the environment will generally be taken up for compliance reasons only. Therefore consideration of the prime motivation for investment would tend to favour the latter technologies. Yet all are legitimately considered cleaner technologies.

The issue is further clouded by the growing "bottom line" value of brands associated with strong Corporate Social Responsibility (CSR) values, and products that are marketed as cleaner, healthier, fairer, and less destructive. An environmental consideration could easily be a marketing consideration. This is particularly relevant in the UK, which has a strong base of environmentally aware consumers and workers. The importance of CSR in the UK market can be seen in the production of non-financial reports, discussed in the Environmental Consulting section.

Finally, technologies can be cleaner in some respects and dirtier (or more resource-intensive) in others. Technologies and processes that bring material efficiencies, for instance, could require more energy to use, or vice versa. Evaluation of overall impact would require life cycle analysis, which is not always possible at the level of entire technologies.

3.2.1 CTP Market Size

The market for CTP is estimated at £177m for 2005, growing to £285m by 2010 and on to £459m by 2015. The JEMU report did not provide a comparable forecast of UK market growth for the CTP. Most commentators predict double digit growth over the next 10 years as the economy grows generally and companies invest in integrated pollution control measures in response both to legislation and supply chain/consumer demand for cleaner products (see market drivers section below). The forecasts below use an annual growth rate of 10% for expenditure of this nature, although it should be borne in mind that, for the reasons outlined above, there can be wide variations in recording such expenditure year on year.



Evidence

Defra's annual survey of industrial expenditure on environmental protection found industry spending £177m on capital expenditure for integrated processes (as opposed to end of pipe solutions) in 2003 (URS, 2005). These figures are for the extraction, manufacturing and energy and water supply industries only, i.e. they do not include construction or service industries or the public sector. This market is defined as follows:

"Capital expenditure on integrated processes relates to new or modified production facilities designed to integrate environmental protection into the production process. This might include adaptation of an existing installation/process whereby the integrated expenditure is then the total purchase cost of the adaptation. It also includes installing a new process in which the design takes environmental protection into account and in this case the expenditure counted is only the extra cost compared with installing a 'dirtier' alternative." (URS, 2005)

There are many industries where technological advances are being made for a variety of reasons, including environmental benefits. An example would be powder metallurgy for production of small precision components. Environmental benefits such as reduced material and energy consumption in manufacturing, and lightweighting of components for further lifecycle energy savings, are just some of the drivers of this cleaner technology. At present, while there are UK manufacturing facilities using powder metallurgical technology, suppliers of the equipment and technology are predominantly German.

There are other technologies which are at earlier stages of development from nano-manipulation and self-assembly to bio and photo-based processes. These will provide major opportunities to reduce environmental impact and the cost of compliance with legislation. Examples of the type of technologies involved include:

- Development of micro turbines for pumping and energy capture using basic technologies such as piezo-electronics and phototonics
- Applications of carbohydrate-based processes for materials and energy production
- Powder metallurgy and net-shape casting
- Maintaining high quality of secondary materials for remanufacturing using microwaves
- Applications and formulations of biodegradable resins and polymers.
- Indicative, easily accessible lifecycle analysis of new and older technologies is an important example of a cross-cutting field requiring more work.

The ONS survey of VAT-registered enterprises found 2140 enterprises primarily engaged in "Research and experimental development on natural sciences and engineering" (ONS, 2005a). The gross expenditure on R&D across all industries was £21 billion in 2003 (OST, 2005), but it is impossible to say with assurance what portion of that figure can be ascribed to cleaner technology development.

3.2.2 CTP Market Drivers

The markets for cleaner technology are being driven by a combination of increasing supply chain customer demand, legislation and resource competition.

UK policy and legislation reflect the EU agenda, and includes incentives for more sustainable technologies such as: enhanced capital allowances, the landfill tax, the Waste Resources Action Programme, the Carbon Trust, the Low Carbon Building Programme, DTI's Technology Programme, the Framework for Sustainable Development on the Government Estate, catchment area planning, design standards such as BS8887, and duty differentials for alternative fuels.

There is also significant activity led by both government and the private sector in sustainable consumption and production, including producer responsibility and design for environment initiatives.

Anything that serves to raise the prices of energy, water, and waste removal tends to stimulate the development and take-up of cleaner technologies.

Until recently, the UK was within the bottom 8 of the EU-15 for domestic and industrial gas and electricity prices (DTI 2005a). However, a steeper than expected decline in North Sea gas supplies, coupled with soaring continental prices linked to oil, have pushed the wholesale gas price much higher and introduced extreme volatility since November 2005. As 40% of the UK's electricity is produced from gas, both are affected. Prices should remain high for several years as its takes time for new physical infrastructure to be put in place to diversify the supply. In addition, prices will be affected by a slow decline in nuclear generating capacity and by continuing uncertainties on investment flows into Clean Coal technology.

"Partial data from the International Energy Agency suggest that in 2005, average UK industrial electricity prices were above the EU/G7 median, while gas prices were below the EU/G7 median. Estimates suggest that in April 2006, industrial electricity prices in the UK including taxes were above the median for all consumers except the smallest, where they were around the median. Estimates suggest that in April 2006, industrial gas prices including taxes in the UK were below the EU15 median for small consumers, but above the EU15 median for medium and large consumers". (DTI, 2006a)

In contrast, water prices appear high in comparison to many EU countries. OFWAT estimate that water prices to business customers were the fourth highest in Europe in 2003, at 80p/m3, below Germany (127p), Denmark (124p), and the Netherlands (82p) (OFWAT, 2005b).

The landfill tax, currently at £21/tonne, is set to rise at £3/tonne/year, serving to increase the price of waste disposal and encourage material resource efficiency. The House of Commons Environment, Food and Rural Affairs Committee has echoed the many industry voices (Biffa and the Environmental Industries Commission have been strongly supportive, and even the CBI admits that it would spur innovation) that have urged the government to increase the escalator and reach the target of £35/tonne as soon as possible (EFRA, 2005).

The same industry voices have suggested that, over the next two years, investment will remain stagnant because landfill is still the cheapest and easiest option. Therefore Private Finance Initiative funding is the only significant incentive for investment in new technology and that mechanism is moving forward very slowly due to various delays and planning restrictions. As a result the positive cash flow in the sector is very high, which in turn is stimulating merger and acquisition activity and significant interest from VC funds.

3.2.3 CTP Strengths

The European Innovation Scoreboard ranks the UK at seventh (across all industrial sectors) out of the EU-25, with strong points being science and engineering education, lifelong learning, venture capital funding, ICT expenditure, high-tech service employment, and patent registrations (CORDIS, 2006).

The UK has at least 28 university centres devoted to cleaner technology development (UKCEED, 2002), and a host of companies that have spun off from the universities with commercialised technologies. For example, Oxonica, an Oxford nanotechnology spinoff, has a diesel fuel additive that increases fuel efficiency and decreases emissions. Intelligent Energy, a spinoff from Loughborough University, offers fuel cells and hydrogen generation and storage technologies, and will soon be commercialising a fuel cell motorbike.

The UK has a very high trade surplus of international technology and know-how payments, at £8 billion, second only to the US among the G7 (OST, 2005). This suggests that UK companies are successful at exploiting the IP of technologies and maximising the returns on the high value part of the innovations.

3.2.4 CTP Weaknesses

Although the UK is strong on innovation (as noted above) it scores less well on new-to-market product sales. Investment in integrated pollution control and cleaner processes has recently begun to grow but traditionally the emphasis had been on end of pipe solutions.

There are fears that the UK could become a "dumping ground for energy inefficient [household] goods" because of the lack of standards, or low standards, for household appliances (POST, 2005) although energy labelling has begun to exert a strong influence on the market. Nevertheless UK product energy efficiency standards "lag behind those in the Far East and North America" (STC, 2005a).

Gross expenditure on R&D in the UK has remained at a fairly constant 1.8-2.0% of GDP for the last decade, just below the EU-15 average. This is below Germany (2.6%, rising), France (2.2%, constant), Japan (3.2%, rising), and the US (2.6%, constant) (OST 2006).

3.3 Contaminated Land Remediation (CLR)

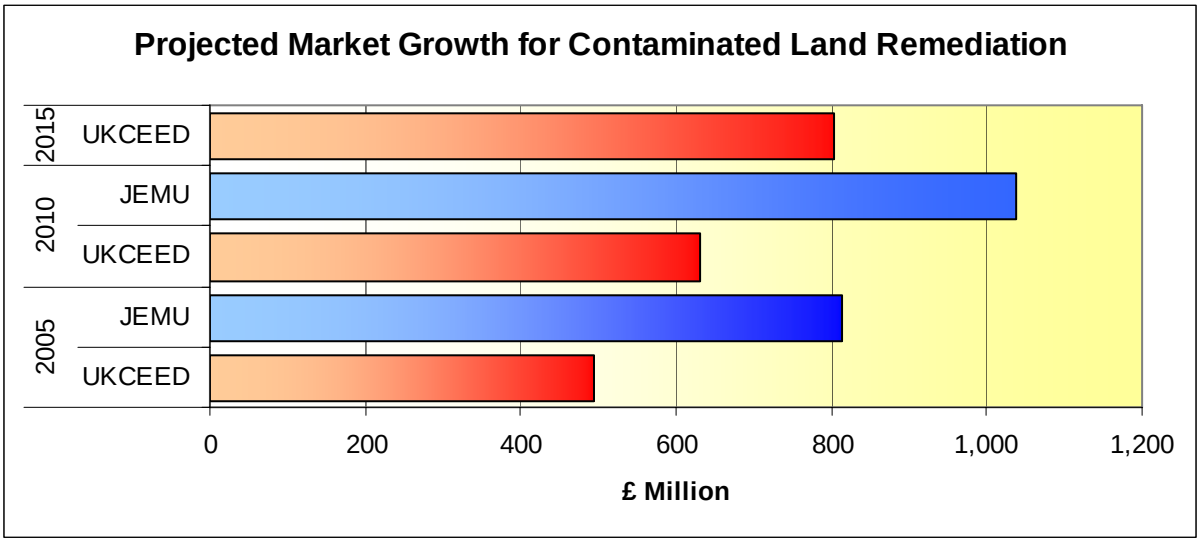
The supply of technologies and services for remediating contaminated land and ground water, and bringing contaminated land back into use (JEMU, 2002).

There are a number of ways in which contaminated land can be remediated including: physical removal and off site disposal ("dig and dump"); *in situ* and *ex situ* biological and chemical treatments, and containment techniques. Dig-and-dump, which forms almost half of the CLR market, may be more accurately put in the Waste Management subsector. While that activity is discussed below, it is not included in the industry size figure to avoid double counting.

This section is based both on a review of existing literature and data and the results of the scenario planning process on CLR which is detailed in chapter 4.

3.3.1 CLR Market Size

The market for CLR is estimated at £494m for 2005, growing to £630m by 2010 and on to £805m by 2015. These figures exclude 'dig and dump' activities which are included instead within the waste management subsector in this chapter. The exclusion of these activities is likely to be the main cause of the difference in market size estimates between this and the JEMU report as shown below. CLR growth rates of 5% per annum contained within the latter report are considered a reasonable estimate and are therefore also used in this report.



Evidence

The turnover of the UK remediation market was estimated at just over £1bn in 2005, a 7% increase from 2004 (MBD, 2005a). The 2004 total of £942m is broken down in table 3.4.

Table 3.1: Breakdown of 2004 contaminated land remediation turnover

	Turnover (£ million)	Percentage of total
Traditional dig-and-dump	448.4	47.6
Treatment and reuse of soils	**137.9**	14.6
Assessment and monitoring	356.1	37.8

(MBD, 2005a)

Of the assessment and monitoring portion, £90 million is laboratory testing of soils and groundwater, and the remainder includes sampling, monitoring and consultancy services. While the report from which these figures are drawn is regarded with scepticism in the industry (Grant, 2006), the figures for treatment and reuse of soils and assessment and monitoring are broadly in line with other estimates (Summersgill, 2006a). The UK treatment industry is composed of many small companies with a wide variety of technologies. While it is relatively small, it is growing quickly as the dig-and-dump market becomes more expensive.

3.3.2 CLR Market Drivers

The industry is currently expanding, driven primarily by brownfield redevelopment for housing. This in turn is driven by the government policy of ensuring 60% of new housing is built on brownfield land by 2008, and corresponding restrictions on development within greenbelts. As the percentage of new homes built on brownfield land has actually been closer to 70% (at least in England) for the last three years, the restrictions on greenbelt are the real driver. Many groups are calling for the target to be raised to provide additional stimulus. Undoubtedly rising land prices driven by the demand for commercial and housing developments increase the demand for clean up of contaminated brownfield land.

Implementation of the landfill directive (see Waste Management section) in 2004 drove up the gate price of hazardous waste (such as contaminated soil), and the effective price even further, because soils had to be transported further. This has consequently been a driver both for *in situ* treatment technologies and for sampling and testing, as increased sophistication of site investigation and risk assessment has meant that the volume of soil deemed to be hazardous can be reduced.

The large new housing, commercial and leisure developments in the South East, including Thames Gateway and the 2012 London Olympics will help keep the market strong. At the same time, increased pressure on hazardous waste landfills will raise the price of traditional dig-and-dump techniques and tend to favour *in situ* treatments.

Implementation of Part IIA of the Environmental Protection Act in 2000 has had the effect of encouraging land developers to carry out more thorough investigations on potential land purchases, thus stimulating the assessment and monitoring market. Pressure from banks and insurers to investigate potential liability arising from the Act has also led some landowners to voluntarily assess and remediate land.

3.3.3 CLR Strengths

There are a large number of companies involved in the CLR market (227 listed in CLAIRE/DTI 2006), around a third of whom are part of larger civil engineering, waste or consulting companies. There are also many subsidiaries of overseas companies, particularly of US companies. Equipment for remediation is largely generic and can be used in other civil engineering, mining and construction applications.

The UK historically has particular strengths in Assessment/Validation and less so in Remediation technologies. There is a minimal market for specialised remediation equipment, although the UK has some developers of such equipment, including Cornelson and Ground Remediation Systems. The UK does however have some strengths in the provision of non-standard or bespoke remediation plant (for dealing with mixed contaminants for example).

One particularly fast-growing treatment technology, bioremediation, is estimated to have reached £32 million in 2004, representing growth of 18% in the year (MBD, 2005a). UK-based Cleveland Biotech and Oil Cleaning Bio-Products Ltd are exporting biological solutions for land remediation around the world.

3.3.4 CLR Weaknesses

The UK's legacy of cheap landfills (see Waste Management section) has favoured dig-and-dump, at the expense of the development of treatment technologies. Also, the UK's use-based approach results in land frequently being remediated to a lower standard than in other EU countries where an absolute standard is applied regardless of use. This has hindered the development of some of the more sophisticated technologies as well as the assessment market (MBD, 2005a).

Suppliers of remediation plant components (such as pumps, piping and controllers) are not typically UK suppliers. The design and provision of standard remediation plant is also typically not from the UK, but from Germany and Italy as well as other European countries. UK remediation suppliers typically have a limited amount of small capacity remediation plant and a very limited amount of large capacity plant – this may limit their ability to compete with overseas suppliers for remediation contracts, once those overseas suppliers engage more actively in the UK market.

Historically, most of the new treatment technologies have come from the US (where Superfund money has paid for research) or the Netherlands and Belgium, where bans on landfilling treatable waste and a tendency to regard soil as a resource rather than as a waste have stimulated the treatment market (Summersgill, 2006b).

Local authorities in the UK have made slow progress in identifying potentially contaminated sites under Part IIA of the Environmental Protection Act (and getting them assessed and remediated if necessary).[29] At the same time, excessive regulatory burdens on the treatment industry in the UK have been an impediment to progress. These should be greatly reduced by the Mobile Treatment Licensing regime, which should be fully operational by April 2006. This reduces both the cost and the time involved in license applications for remediation plant.

Industry expansion means that there is a shortage of experienced personnel (ENDS, 2005a). It also means that few UK firms are exploring the export market (with the exception of Churngold, active in South Africa) (Churngold, 2004). This could weaken the UK's long term competitiveness.

[29] To date, just over 400 sites (in England) have been identified. In contrast, Germany had compiled a catalogue of 360,000 sites by 2000 (Dose, 2002), and France has largely completed a comprehensive list of 300,000 former industrial sites (http://basias.brgm.fr/).

3.4 Energy Management (EM)

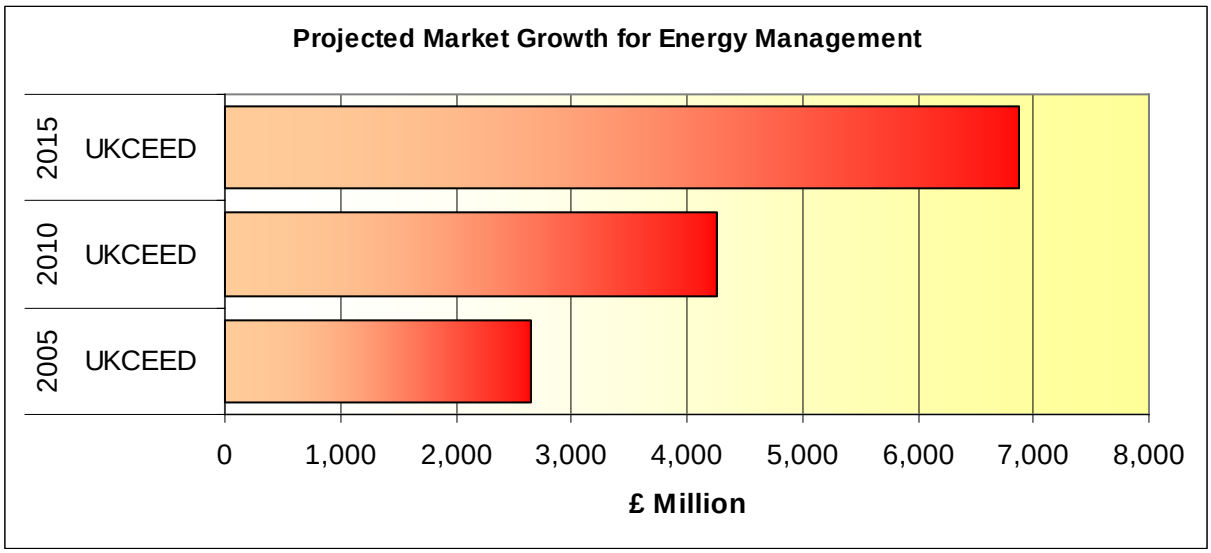
The supply of energy management and efficiency products and services such as energy audits, building energy management systems, energy efficient products, combined heat and power plants and efficiency advice (JEMU, 2002).

NB. It is important to distinguish between energy *efficiency* products, such as insulation, whose primary function is the enhancement of energy efficiency, and energy *efficient* products, such as particular models of washing machines, refrigerators, pumps or boilers, which can be found in every part of the economy. The latter are dealt with, insofar as is possible, in the Cleaner Technology section.

There is considerable scope for overlap between this sector and the Cleaner Technologies sector, and there may be some overlap with the Renewable Energy subsector, particularly in relation to on CHP plant running on biomass.

3.4.1 EM Market Size

The market for EM is estimated at £2.65bn for 2005, growing to £4.27bn in 2010 and on to £6.87bn by 2015. The JEMU report did not provide a forecast of UK market growth for the subsector but most commentators predict double digit growth over the next 10 years in response to regulation and market demand arising from mounting concern over climate change. The forecasts below therefore use an annual growth rate of 10% for the subsector.



Evidence

This industry has two very distinct parts:

- The domestic sector is dominated by cavity wall and loft insulation and draught proofing. Micro-CHP is also expected to become an increasing feature of the sector. Such applications can, in turn, be divided into the retrofit market, largely driven by incentive programmes, and the new build market, largely driven by the Building Regulations.

- The commercial and industrial sector is driven largely by energy prices, the Climate Change Levy and Climate Change Agreements, and the Emissions Trading Scheme. The distinction between retrofit and new build is not as important in this sector.

The 2005 market for thermal insulation was estimated at £1bn, of which 68.5% was for buildings and the remainder for industrial processes. As Table 2 in Annex 3 illustrates, the UK has a slight trade surplus in insulating materials, so the market size is a good proxy for the industry size.

The ONS survey of VAT-registered enterprises lists 990 enterprises primarily engaged in SIC code 4532, "insulation work activities", 96% of them with fewer than 50 employees. A conservative estimate of total turnover based on the distribution amongst turnover brackets[30] yields £858m (ONS, 2005a). This includes acoustic insulation and vibration damping.

The size of the energy services industry (serving the commercial and industrial market) in 2006 is estimated at £700-800m, of which £400-500m is contract energy management (Aldridge, 2006).

As of 2004, there were over 5.5 GWe of installed (good quality) CHP capacity, operating at around 60% of capacity (DTI, 2005a), including Europe's largest single CHP plant, operated by ConocoPhillips (CHPA, 2006a). There is very little growth in the sector, however: CHP has accounted for 7-8% of electricity generated for the last decade, well below the EU average (CHPA, 2006a).

The Regulatory Impact Assessment (RIA) for reduced VAT on micro-CHP estimates a cost to the exchequer of £5m p.a. for the second and third years, indicating anticipated annual sales of £40m (HM Revenue & Customs, 2005a).

3.4.2 EM Market Drivers

In the commercial sector, the Climate Change Levy, which effectively raises the price of industrial power, and the Climate Change Agreements "appear to have led to a different dynamic, changing how energy is perceived by the management team and particularly finance directors" according to the Carbon Trust (ENDS, 2005e).

In the domestic sector, successive changes in the Building Regulations have been the main legislative drivers. At the same time, various incentive programmes for domestic energy efficiency have stimulated the market including: The Energy Efficiency Commitment[31] (the level of commitment for 2005-08 is twice that in previous phase which is likely to be a key driver of more innovative approaches to energy management from the electricity suppliers); Warm Front[32]; and the Decent Homes Standard[33].

The Energy Performance in Buildings Directive is going to start having a major impact on initially the commercial sector (including public buildings) and over time the domestic sector.

More than anything, however, the price of energy is driving the energy efficiency market and making retrofit energy efficiency measures in existing buildings increasingly attractive and the application of advanced metering and monitoring technologies in new buildings increasingly viable.

The Cavity Insulation Guarantee Agency (CIGA) was seeing an increase in demand of 5% per month in 2005, and all four UK mineral wool manufacturers are expanding or planning to expand. Material prices were rising, and installers were facing manpower shortages (ESD,

[30] There are 30 companies in the >£5m bracket, which we assume to have turnovers of £6m.

[31] The Energy Efficiency Commitment (EEC) (Energy Efficiency Levy in NI) forces energy providers to finance efficiency measures in the domestic sector. In 2002-05, the EEC funded cavity wall insulation in 791,524 homes, loft insulation in 226,245 homes, loft top-ups in 528,496 homes, and 16 million square metres of DIY loft insulation (ESD, 2005).

[32] Warm Front provides funding for energy efficiency measures in low-income households in England, with similar programmes in the devolved regions. In 2001/02, Warm Front funded or partially funded cavity wall insulation in 99,350 homes, loft insulation in 94,500 homes, draught proofing in 143,740 homes, and 32,500 hot water jackets (NAO, 2003).

[33] The Decent Homes standard requires certain levels of insulation depending on heating fuel choice and house design.

2005). All three plasterboard manufacturers are increasing production, partly as a result of changes to building regulations coming into effect April 2006. (ENDS, 2005c)

3.4.3 EM Strengths

A review of the insulation supply chain for Defra found four main companies producing mineral wool (the primary choice for cavity wall insulation) in the UK (Knauf, Rockwool, Superglass, Isowool), with six plants between them. Knauf and Rockwool also design installation systems, as do many other companies. There are three plasterboard manufacturers in the UK: British Gypsum, Lafarge, and Knauf (ENDS, 2005c). The installation market is dominated by the Insta Network, Miller-Pattison, Millfold, and Mark Insulation (ESD 2005). New materials such as wool and recycled newsprint are also entering the insulation market although in very small quantities. This market is likely to grow in the future as the construction industry looks to source more sustainable material but it is still not commonly available.

The UK is strong in high-tech energy-saving technologies, such as low-energy LEDs, neural networks and fuzzy logic for building management systems, materials (including lightweighting and decarbonisation), glazing, and advanced design of heating equipment (HM Treasury, 2005). For instance, the UK exported £68m of LEDs (versus £59m in imports) (HM Revenue and Customs, 2006).

Researchers at the University of Southampton's School of Electronics and Computer Science have developed an "intelligent fuse box" to co-ordinate multiple energy sources and users within a household, with predicted savings of 20% (East, 2006a). A number of R&D projects are currently being carried out into the application of 'smart metering' technology for the home and in industrial applications (e.g. the Centre for Sustainable Engineering is leading a DTI funded Technology Programme in this area with EDF Energy and other commercial partners). Such technologies are also major enablers of increasing uptake of distributed renewable energy systems.

3.4.4 EM Weaknesses

The cost of energy is obviously an important driver for this sector, and as detailed in the Cleaner Technology and Processes section, until recently, even with the Climate Change Levy, the UK has enjoyed relatively inexpensive energy. There has been little demand for insulation of existing domestic buildings outside of EEC and social housing programmes (EST, 2005a). This places large parts of the industry at the mercy of government grant support programmes. It is too early to say whether recent energy price volatility will affect the market.

Most new-build homes either just comply or fail to comply with minimum energy efficiency requirements in the Building Regulations (EST, 2005a), which are not the highest in Europe (STC, 2005a).

The EU Emissions Trading Scheme should be a driver for industry to invest in energy management, but the UK's legal battle with the European Commission to increase the national allocation for Phase 1 has left little confidence in industry that Phase 2 will drive much investment.

Despite a raft of incentive programmes[34] for CHP there have been few new orders since 2000 (CHPA, 2005a).

"The UK is at the bottom of the EU table in terms of penetration of district heating in the national building stock, despite suitable urban environments with high levels of building density and mixture of uses attractive to the installation of district heating" (CHPA, 2006a).

[34] E.g. (1) Exemption from the CCL of fuel used in CHP and electricity generated from CHP; (2) Enhanced Capital Allowances (ECAs) for CHP plant and associated services; (3) Exemption from business rates for large-scale CHP on prescribed assessment properties; (4) VAT reduction for domestic CHP (5) Accounting for CHP potential in setting CCA targets; (6) Community Energy programme; (7) Bio-Energy Capital Grant Scheme; (8) EEC

District heating not only allows more efficient use of energy directly, but it also opens up possibilities for the use of large-scale CHP, biomass and energy-from-waste.

In addition, there are few micro-CHP devices in commercial production, and the latest market projection from the Society of British Gas Industries does not anticipate significant market activity until around 2008 (SBGI, 2006). WhisperGen, the only mass-produced unit available in the UK at present, is manufactured in New Zealand. Powergen, the UK distributor, ordered the first £3.5m of an eventual £105m order in October 2004 (Micropower Council, 2004). BG-owned MicroGen is developing a domestic CHP unit in the UK and UK-based Ceres Power has a fuel cell domestic CHP unit in development.

In the UK, responsibility for energy policy is divided between many departments: Defra, DTI, DCLG, and HM Treasury, all of which have other competing priorities (STC, 2005a). As a result, policy may not be as clear or effective as the sector would like. For example, DCLG's focus on developing housing growth areas in the south east may not fully encompass Defra's desire to push for higher standards of energy efficiency in new buildings. Similarly, the latter may not be high on the list of priorities for new fiscal incentives from the Treasury.

3.5 Environmental Consulting Services (ECS)

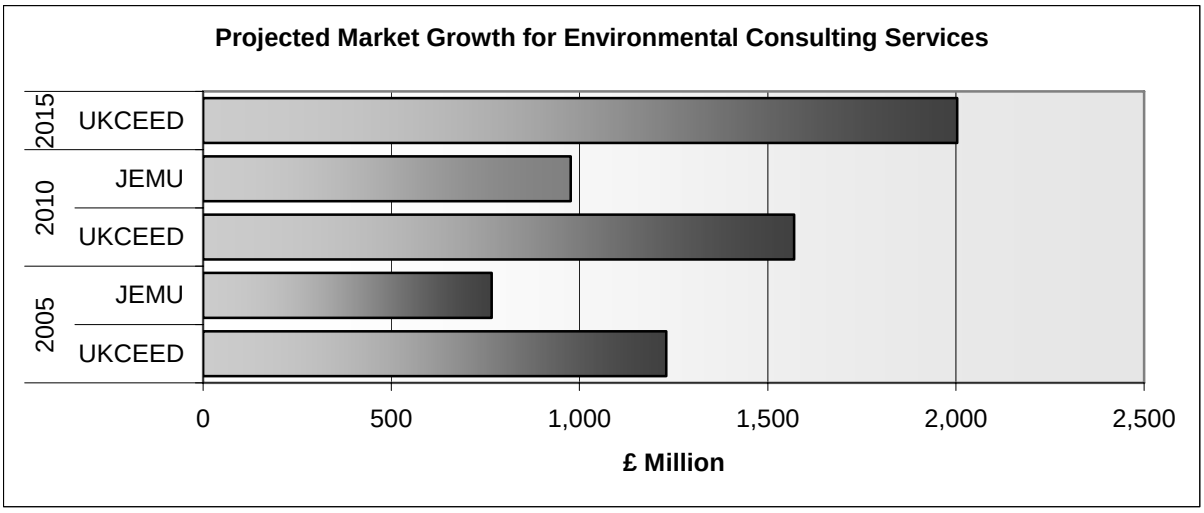
Services include environmental audits, assistance with environmental management systems and training, life cycle assessment, environmental impact assessment, advice on environmental regulations and environmental institution building (JEMU, 2002).

NB. Much of the environmental consulting industry overlaps with other sectors. Energy management services may be double counted, and it is often hard to disaggregate the consulting component of land remediation work. Environmental consulting is often seamlessly integrated into engineering contracts so that it cannot be viewed as a separate service.

3.5.1 ECS Market Size

The market for ECS is estimated at £1.23bn for 2005, growing to £1.57bn in 2010 and on to £2bn by 2015. These figures are significantly higher than those in the JEMU report as shown in the chart below. It is likely that this is because more accurate market analysis has since been undertaken and also because the sector has exhibited faster growth than forecast.

The JEMU report forecast the market for environmental consultancy would grow at 5% per annum between 2005 and 2010. Although the ENDS consultancy report (2006b) indicates that the market actually grew by 10% per annum during that period, UK CEED has used the lower 5% per annum as a conservative estimate of market growth.



Evidence

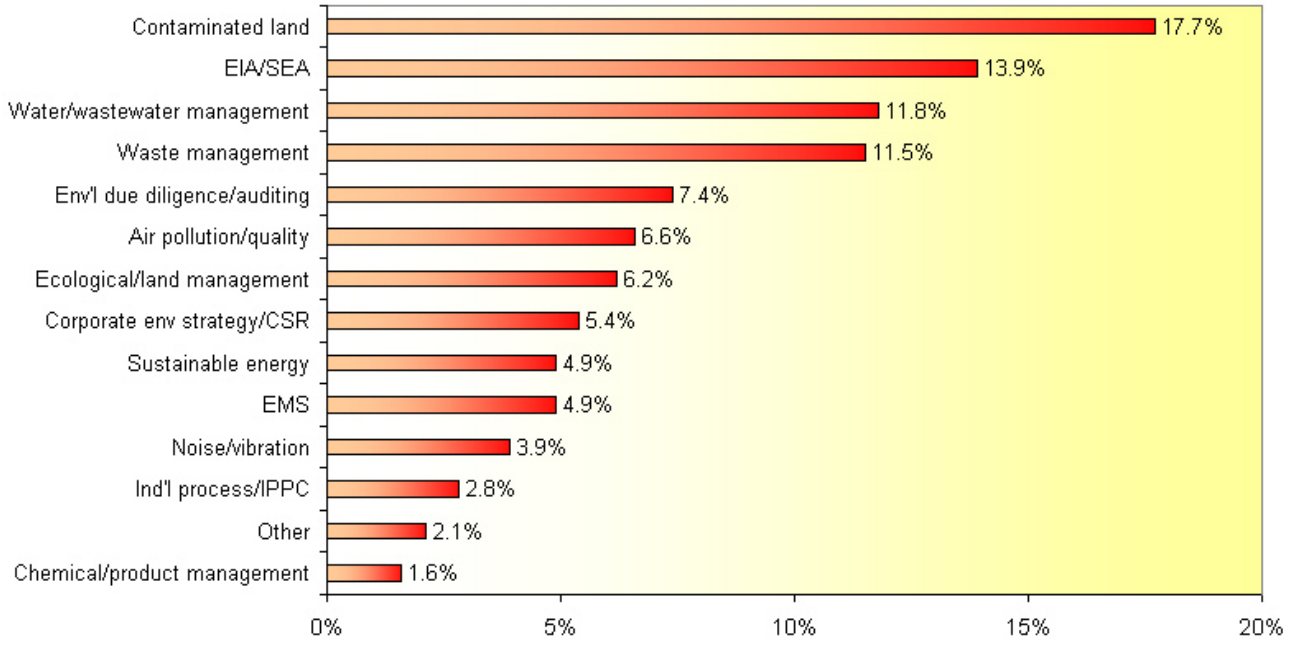
Using the total earnings of environmental consultants as a minimum figure for the turnover of the industry, in 2005 the total annual earnings of over 7000 environmental practitioners was estimated at £240m.[35] This is obviously a minimum figure. The size of the consultancy market in 2000 has been estimated at £600 million (JEMU, 2002) and £750 million (ECOTEC, 2001). A figure of £1,230m was estimated for the whole subsector by ENDS (2006b). The larger estimate would undoubtedly overlap extensively with most other subsectors, as well as areas outside of the EGS sector, such as flood defence, health and safety, and insurance. At the same time, many businesses that do not consider themselves to be environmental consultancies may contribute to EIAs or EMS work (Fuller, 2006).

Despite the high rate of growth for this subsector, the marketplace remains extremely fragmented with no single firm claiming more than a 5% market share

The chart below illustrates that the UK environmental consultancy market is dominated by contaminated land, environmental impact assessments/strategic environmental assessments, water/wastewater and waste management advice. Contaminated land is the largest earner for consultancies at £217m, followed by advice for Environmental Impact Assessment which netted £170m in revenues last year (ENDS, 2006).

[35] The 2005 IEMA survey of environmental practitioners surveyed 7119 practitioners, and had a response rate of 35.8% (IEMA, 2005). It is assumed that the average earnings of the respondents by membership category apply across the membership of IEMA.

Chart 3.1: Environmental Consultancy Broken Down by Activity



Adapted from ENDS 2006b

3.5.2 ECS Market Drivers

The environmental consultancy market is linked to, and dependent on activity in, all of the sub-sectors in the EGS sector. As the overall market expands, so do opportunities in consultancy, with particular growth in areas such as contaminated land, waste management, risk assessment and water resources. It is also closely allied to infrastructure engineering and the construction sector. Other areas experiencing a steady growth include the development of corporate responsibility programmes in business and associated environmental performance monitoring. There is also anecdotal evidence to suggest a steady increase in national, regional and local government procurement of environmental consultancy services for policy development activities. As a result of these market drivers, the annual growth in the UK for this subsector, has been averaging at approximately 10% year-on-year since 2000 (ENDS, 2006).

3.5.3 ECS Strengths

The UK consultancy industry is performing well overseas, with many of the top companies reporting significant overseas turnover, contracts, and staff in the ENDS Directory (ENDS, 2005d). There are growing opportunities for UK consultants willing to work overseas, particularly in central and Eastern Europe and the former Soviet republics (Trew, 2005). The UK industry is perceived as high value and high cost, and the overseas contracts are primarily in high value industries such as oil and gas, or on grant- and loan-funded projects (Fuller, 2006).

The UK leads in the EU in numbers of ISO 140001 accredited companies (see Table below). The EMAS standard, where Germany has a clear advantage, is less universally recognized and has less export potential outside Europe.

Table 3.2: Number of EMAS and ISO 140001 accredited companies in Europe, UK, Germany and France

	EMAS companies (2004m11)	ISO14001 companies (2004m10)
EU25	3061	31929
UK	66	5460
Germany	1677	4320
France	20	2344

(Eurostat, 2006)

CorporateRegister.com, a database of corporate non-financial reports, lists 277 reports filed by UK companies in 2005, ahead of Japan (221), the US (201), Germany (109) and France (72). In 2004, 14% of reports filed were from UK companies. Registration with the database is voluntary, however, and these figures could be influenced by differing degrees of awareness of the facility. However, as an indication of the importance of CSR reporting in the UK, every one of the FTSE100 companies publishes some sort of non-financial report, though 12 of these are short statements in the annual report or on the website (CorporateRegister.com, 2005).

3.5.4 ECS Weaknesses

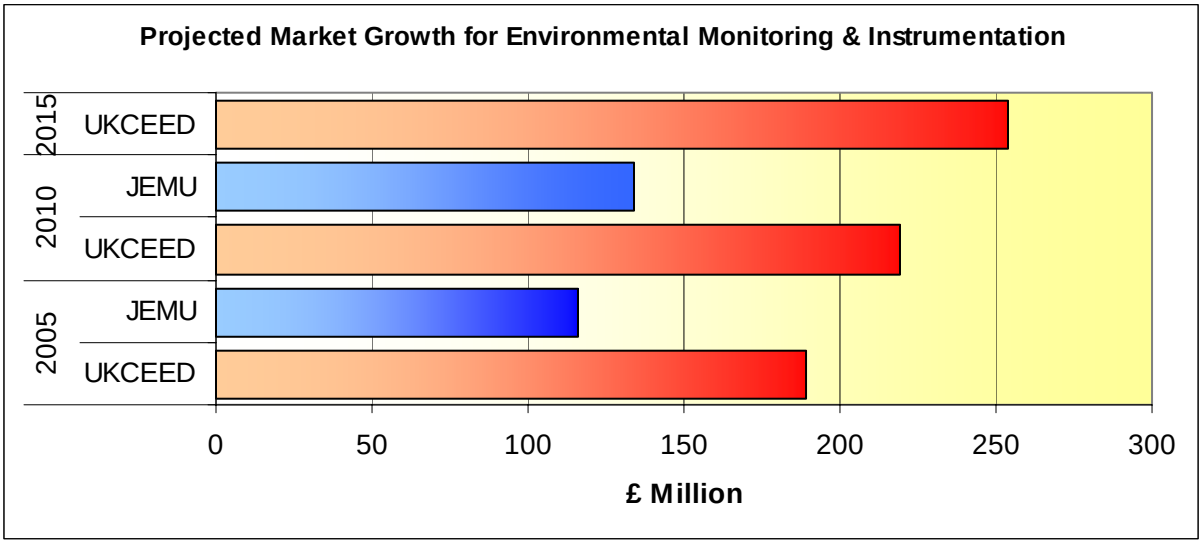
Skills shortages are reported throughout the industry, especially in environmental impact assessment and contaminated land remediation (Trew, 2005). Retaining highly skilled staff is often cited as a problem within this subsector; the average annual staff turnover for large consultancies is believed to be in excess of 20% (ENDS, 2006).

3.6 Environmental Monitoring and Instrumentation (EMI)

The supply of technologies and services for measuring environmental quality and monitoring pollution emissions, including laboratory analysis of environmental services (JEMU 2002).

3.6.1 EMI Market Size

The market for EMI is estimated at £189m for 2005, growing to £219m in 2010 and on to £254m by 2015. These figures are significantly above those in the JEMU report. This report, however, uses the same 3% annual growth forecasts for the sector.



Evidence

Industry environmental pollution expenditure figures given in other subsections (air, water, waste and noise) include monitoring. Air emission monitoring has been estimated at £30m (including equipment and installation/servicing, counted as part of the Air Pollution Control sector turnover), ambient air monitoring (replacement and enlargement of the local ambient air network) at £6-10m, and water effluent monitoring at £150-180m (counted in the Water and Wastewater Treatment sector turnover).

The total commercial market for environmental laboratory services has been estimated at £130m. This would include soil and groundwater testing (£90m), radiological testing, and marine spill testing (Davidson, 2006). Potable water testing and microbiological testing are counted under Water and Wastewater Treatment. Publicly owned labs such as NLS (turnover approximately £15m in 2004), CSL (was £40m in 2001/02), and CEFAS (£37m for 2004/05, though this includes some consulting and monitoring income) take a small part of the commercial market, and large government contracts. These would include potable water and microbiological testing.

Noise monitoring and instrumentation is included in the Noise and Vibration Control section.

It may be possible to identify other areas of the monitoring industry with quantifiable costs, i.e. the regulatory impact assessment of the Pesticides (Maximum Residue Levels in Crops, Food and Feeding Stuffs) (England and Wales) Regulations 2005 gives a recurring cost of pesticide residue monitoring of £7 million p.a. and one-off costs of £110 million (shared across the EU, and not all in monitoring) (at 2003/04 values).

Around 1.5 million electricity meters and 1 million gas meters are replaced in the domestic market every year (MTP, 2005), at a cost to consumers of £800m[36] (Ofgem, 2003), of which £39m is estimated to be the cost of the meters themselves (Energywatch, 2005). Only 34.8% of the public water supply is metered (in 2003), up from 27.7% in 1993 (Tambe, 2004). Around 200,000 new homes are built every year, requiring all three meters. Using average meter prices from above, electricity and gas meters for new builds would come to £3.1m p.a. The costs of new and replacement water meters is assumed to be included in the Water and Wastewater Treatment industry figures.

3.6.2 EMI Market Drivers

The market has been driven largely by legislation, in particular the Environmental Protection Act, IPPC and more recently the Water Framework Directive. Increasingly, the price of energy has been influencing demand in certain parts of the sector, particularly in connection with smart metering and building management systems. There is likely to be growing demand for water metering equipment in the short to medium term, as water shortages in the south and southeast lead to mandatory metering.

3.6.3 EMI Strengths

The environmental laboratory services industry is dominated by Severn Trent Labs (the largest environmental laboratory service provider in the world), Alcontrol, SAL, and TES Bretby.

Supply of laboratory instruments for environmental services is dominated by companies such as Agilent and Thermo Electron, both US companies, though Agilent has some UK-based research and manufacturing facilities. UK-based companies such as A-1 Envirosciences, offering a range of chemical analysis equipment, and Hach Lange, specialising in water analysis equipment, have an advantage because availability of support is critical to purchasing decisions (Davidson, 2006).

[36] This figure includes installation, servicing, and reading.

The Environment Agency has rolled out a series of quality certification protocols, known as MCERTS[37], to ensure monitoring and testing of environmental parameters are of a consistently high quality. These include equipment for emissions, ambient air, and effluent monitoring, and more recently, chemical testing of soils and direct toxicity assessment. Requirements for MCERTS accredited monitoring systems for PPC processes, coupled with the Large Combustion Plants Directive, have driven the market for industrial emissions testing, both manual and continuous, to full capacity (Curtis, 2006).

The MCERTS protocol for emissions testing equipment developed in parallel with the German TUV protocol. The EU is moving towards harmonising instrumentation standards, and these two protocols are likely to be the basis for a harmonised standard. This will be of great advantage to those companies with products already accredited. The MCERTS protocol for effluent monitoring is the first of its kind in the world.

There are a number of UK-based (or partially UK-based) companies producing MCERTS-accredited equipment for continuous emissions monitoring (including Signal, Codel, Land Instruments, PCME, Procal, Servomex), and continuous water monitoring (including Aquamatic). UK-based Enviro Technology Services produces ambient air systems and are a major exporter. It is estimated that 70-80% of the UK production of air monitoring equipment is exported.

Smart metering could be a major growth area in the future, driven by rising energy prices, Energy Efficiency Commitment money, the digitalisation of UK television services (which requires universal broadband access), and the demand for microgeneration.

While the UK is behind many other countries (including Sweden, France, the US, Italy, Australia, and New Zealand) in mandating the installation of smart meters, the UK has a strong skills base in microelectronics and wireless communication that could swiftly take advantage of a favourable domestic market (MTP, 2005). UK-based companies already providing technologies that could be applicable include Enercom, Wyless, Radio-Tech, Cambridge Consultants, Sinergy, Energy Metering Technology and Northern Design.

PRI has supplied over 175,000 domestic smart meters in Northern Ireland (Energywatch, 2005). Severn Trent Metering Services supply a smart multi-utility meter and have considerable export sales. The Elster Metering Group, now owned by British firm, CVC Capital Partners, has worldwide operations in electricity, water and energy metering and load control. They manufacture electricity meters in the UK for export to over 30 countries. As seen in Table 3 in Annex 3, counting parts, the UK had a trade surplus of around £67m on water, gas and electricity meters in 2005 (though some of these, such as those used on civil aircraft, would be for industrial processes outside the scope of this study).

The DTI has identified sensing and imaging equipment for environmental applications as one of its priority R&D strands in the Technology Programme.

3.6.4 EMI Weaknesses

The use of MCERTS protocols is not universal. While MCERTS for chemical testing of soils is required for data submitted to the Environment Agency, there are many remediation sites that never involve the Agency. While local authorities are encouraged to require data from MCERTS-accredited labs, many still do not. While MCERTS-accredited monitoring is required for Part A processes under IPPC, it is up to the discretion of local authorities to require it for Part B processes under LAPPC (see Air Pollution Control). The Source Testing Association reports that an increasing number of local authorities are requiring it (Curtis, 2006).

[37] For more information, see http://www.mcerts.net

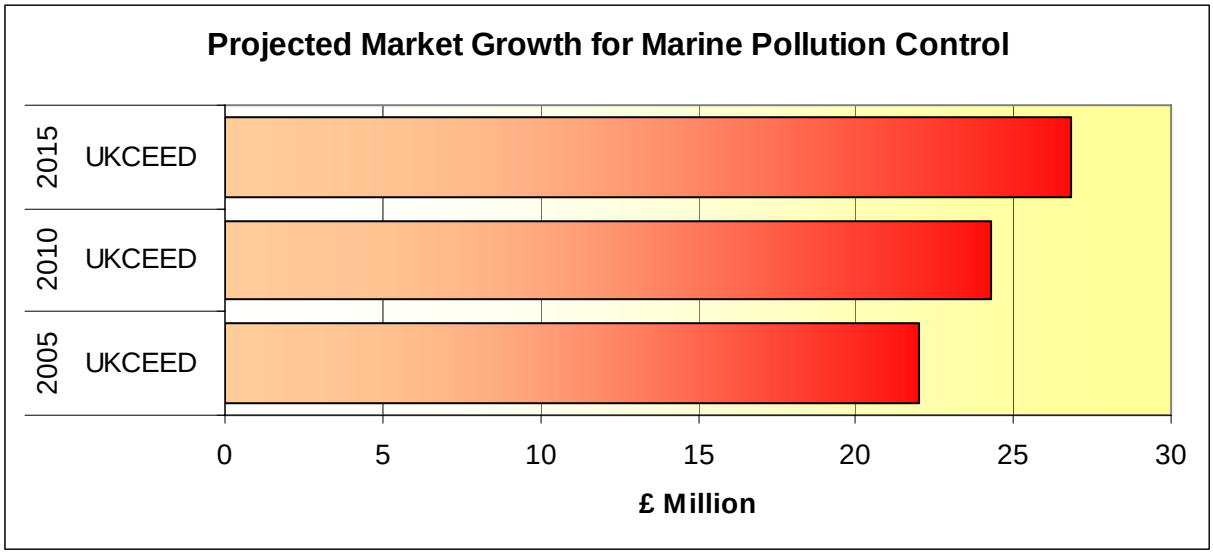
The MCERTS protocol for chemical testing of soils covers treatment of samples within laboratories, but the methodology for taking and storing soil samples prior to their delivery to a laboratory is at present a matter of contractual agreement only, with no third-party verification.

3.7 Marine Pollution Control (MPC)

The supply of technologies and services for controlling and minimising marine pollution – including products such as oil absorbents and booms; and services such as marine pollution prevention training, monitoring and clean up services (JEMU, 2002).

3.7.1 MPC Market Size

The market for MPC is estimated at £22m 2005, growing slowly to £24m in 2010 and on to £27m by 2015. The JEMU report did not contain any projections for this sector and following discussion with industry representatives the authors of this report have used a low growth rate of 2% per annum for the forward projections shown in the chart below. It should be noted, however, that this is slightly below long term growth trends in the economy as a whole and is therefore likely to be an underestimate.



Evidence

All UK ports, harbours and oil handling facilities are required to maintain spill response contingency plans, and most maritime local authorities maintain such plans as well. The oil response industry is typically retained by a facility or geographical area for rapid response availability. This will involve a retainer fee, with additional payments for services rendered and equipment used.

In addition, the Maritime and Coastguard Authority (MCA) spends £2.3m on aerial spraying and surveillance, and another £0.9m on pollution control. Overall, the MCA spends £14m p.a. on the Cleaner Seas business area, which includes the above costs, contributions to satellite surveillance of shipping and oil rigs in partnership with other North Sea maritime countries, and other pollution prevention activities (MCA, 2005).

In 2004, there were 664 incidents involving discharges of oil, chemicals and other substances within the UK Pollution Control Zone. Eighteen of these involved over 2 tonnes of oil, with a total of approximately 112 tonnes (ACOPS, 2004). The MCA, quoting ACOPS as a data source,

gives 633 incidents, 10 of them involving over 2 tonnes of oil, but gives a total of 3204 tonnes of oil at risk (60 tonnes lost) from the 11 incidents in which the MCA provided assistance (MCA, 2005). While the cost, if any, of cleaning up any given spill is dependent on many variables, a crude historical average for Europe is US$8595.52/tonne, at 1997 values (Etkin, D.S., 1999). This gives a minimum figure of £642,000 in 2004 values for cleanup of the larger spills that year.

This compares with the cleanup costs of two major incidents in the UK's past: the Braer, in 1993, cost $83 million, and the Sea Empress, in 1996, will probably cost $62 million when all the claims are settled.

Industry leaders estimate that the UK manufactures around £16m of oil pollution control equipment p.a., and consumes £5-8 m. Imports are around £3m, exports £11-14m. 30-50% of the market is absorbents, produced by some 20 companies, with 5-6 companies producing other equipment. There are approximately 100 companies employing between 1500 and 2000 people (R. Mabbott, personal communications).

3.7.2 MPC Market Drivers

Major pollution incidents drive activity in this market. Changes in national and international legislation have some impact but tend to be over the longer term. Response to marine pollution incidents is regulated by the National Contingency Plan for Marine Pollution from Shipping and Offshore Installations. This is in turn informed by the UK's obligations under various international treaties such as OSPAR, and EU measures (e.g. Bathing Water Directive).

The main export opportunities are in the established oil producing areas (e.g. Middle East) and emerging suppliers such as Russia.

3.7.3 MPC Strengths

Due to its offshore oil and gas industry, and its geographic position in the gateway to the North Sea, the UK has had a great deal of experience in marine pollution control. The UK is a world leader in the development and manufacture of pollution control equipment, and is well-respected as a supplier of services. OSRL, the world's largest global provider of oil spill services, and Vikoma Int'l, a leading supplier of equipment, are both based in Southampton.

As the nature of the global market changes, overseas markets are shifting their emphasis from response to preparedness and prevention. New entrants to international treaties and regimes are making up for the decline in spill numbers. It is estimated that UK companies have a 10-15% share of the world market (R. Mabbott, personal communications).

3.7.4 MPC Weaknesses

The world market for marine pollution control is declining, as shipping safety increases, partly as a result of the phasing out of single-hulled tankers. The decline in output from the North Sea will also contribute to the decline of the UK market. Therefore, little or no growth in the market is forecast in the short to medium term.

There is no statutory requirement for maritime local authorities to maintain contingency plans for marine spills, as it is for ports and harbours, and no dedicated funding for them to contract standby response services. However, the Civil Protection Act may generate more activity from Local Authorities. The change to the hazardous waste disposal regime, and in particular reduction in availability of landfill, is having a negative impact on the sector.

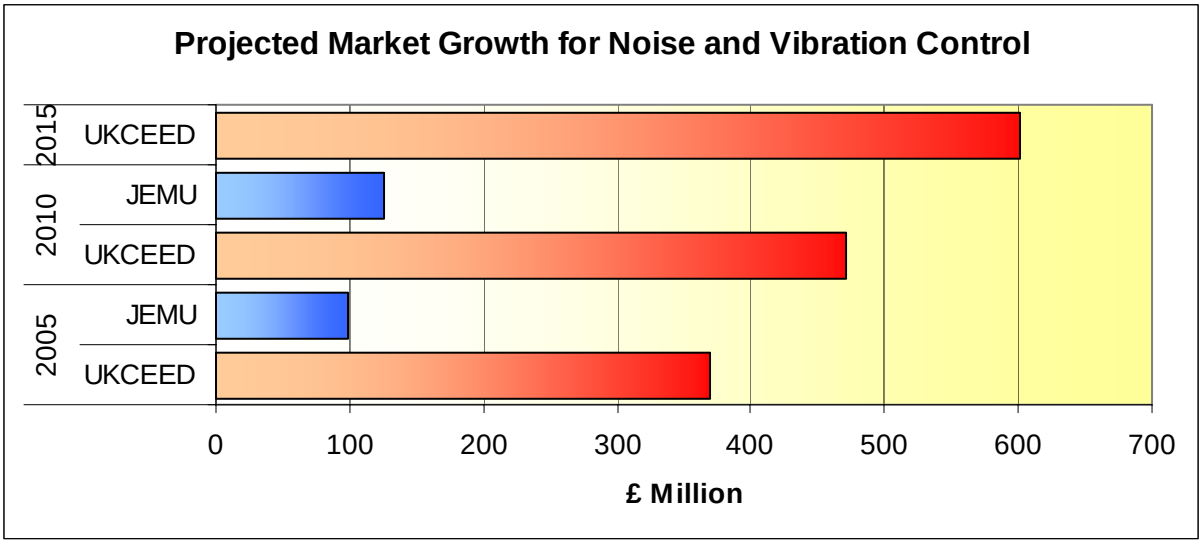
The UK Government preference for spraying offshore spills, rather than containing and absorbing them, limits development of more environmentally positive technologies. EU funding for research is relatively untapped in the UK.

3.8 Noise and Vibration Control (NVC)

The supply of technologies and services for monitoring and reducing noise and vibration. Technologies include noise meters, monitoring systems, acoustic buffers, enclosures and barriers and silencers; services include noise monitoring and control advice (JEMU 2002).

3.8.1 NVC Market Size

The market for NVC is estimated at £369m for 2005, growing to £471m in 2010 and on to £601m by 2015. These figures are significantly above those in the JEMU report possibly due to the availability of more detailed market analysis. The same annual growth figures of 5% per annum are used in both reports.



Evidence

Defra's annual survey on industrial environmental protection expenditure found that £30 million was spent on noise and vibration control in 2003 (10% capex), not including £7 million capex on integrated processes (included in Cleaner Technology and Processes) (URS, 2005). These figures are for the extraction, manufacturing and energy and water supply industries only, i.e. they do not include construction or service industries, both of which are significant users of noise and vibration control products and services. They also exclude workplace measures.

Workplace measures can be estimated from three recent regulatory impact assessments (RIAs). The RIA for the Control of Vibration at Work Regulations (2005) estimates total compliance costs (including assessment, education and prevention) of around £60 million p.a. Similarly, the RIA for the Physical Agents (Noise) Directive estimates compliance costs of around £60 million p.a. (at 2003 values). The Final Regulatory Impact Assessment of Draft Control of Noise at Work Regulations estimates compliance costs of £60 million p.a. These costs would be additional to any workplace measures already in place, and so should be taken as a minimum.

One industry leader has estimated the market for noise consultancy at £100 million (Tompsett, 2006). A great deal of this would be additional to the industrial expenditure figure above, as it would come from the construction industry, government (noise mapping projects), planning departments and local authorities. Local authorities in England and Wales, for instance, spent £44 million on noise control in 2002/03 (CIPFA, 2004a).

The Highways Agency is committed to specifying quiet road surfaces on all maintenance contracts, and considering acoustic fencing and earth mounds. In addition, it is committed to resurfacing 60% of the trunk road network, or 2500 km, regardless of maintenance need, by 2011. There is a £5m p.a. Noise Mitigation Programme for additional measures at specific hotspots (Highways Agency, 2006). The Agency has posted repaving targets on its website, including 200 km in 2005/06 and 160 km in 06/07 and 07/08. However, actual repaving in the three years from 2002 to 2005 has been only 484 km, at an average annual cost of £54m. Spending in 2005/06 was £29m as of February 2006, and it appears that no resurfacing ahead of maintenance needs will be funded until at least 2008 (UK Parliament, 2006; Pease, 2005).

Much noise and vibration control equipment is integrated into buildings (insulation, double glazing), landscapes (walls and fencing), or machinery (automotive silencers, heating, ventilation and air conditioning silencing), and so is not counted as a separate environmental expenditure. A figure for thermal insulation has been given in the Energy Management section, so will not be repeated here, though many thermal insulation products can fulfil noise reduction requirements as well.

The automobile silencer industry is difficult to measure, as automotive component manufacturers tend to be secretive about turnover and prices. HM Revenue and Customs (2006) estimates sector exports of £111m in 2005 (including exhaust pipes), whilst £102m of silencers are imported.

3.8.2 NVC Market Drivers

Traditionally the Health and Safety at Work Act has influenced demand in this sector. However, there are now many other legislative drivers in the sector including:

- The forthcoming Control of Noise at Work Regulations
- The transposition of the Control of Vibration at Work Regulations (2005)
- The Physical Agents (Noise) Directive
- The Environmental Noise Directive
- Changes to the Building Regulations (Document E)
- The Outdoor Machinery Directive
- Directives and international agreements on noise output from vehicles and aircraft
- Environmental Impact Assessments requiring noise and vibration assessments and subsequent mitigation measures
- Control of Noise from Construction sites (Control of Pollution Act 1974)
- PPG24 provides guidance on how noise should be taken into account in development control and often results in the inclusion of noise mitigation
- Legislation that controls the noise emitted from residences and recently extended to cover Licensed premises (the Noise Act 1996).

3.8.3 NVC Strengths

The UK's acoustic profession is strong and its professional institute is one of the largest of such bodies in Europe. The large number of legislative drivers outlined above has grown the market for UK companies operating in the sector, whilst the large commercial and residential building programmes under way in the South and as part of city regeneration elsewhere will also strengthen the demand for acoustic/thermal insulation, particular where building takes place to a higher density.

UK noise consultants are well regarded internationally, with the main competition coming from the US. Accession countries, the Middle East and Southern Europe provide the most attractive overseas markets for UK companies (Tompsett, 2006).

Despite the delay in transposing the Environmental Noise Directive, which requires member states to map sources of environmental noise and draw up action plans for dealing with them, the UK has already completed much of the mapping required.

IAC Group, the world's largest supplier of noise control equipment, is headquartered in the UK, though much of the manufacturing is done overseas. Industrial noise abatement technology is covered by UK companies such as Flo-Dyne, Kimpton, and Sound Dead Steel.

3.8.4 NVC Weaknesses

The profession has tended to be undervalued with fee rates for consultants low compared to those of other professions. The resulting low salary levels have made it more difficult to attract skilled personnel into the profession resulting in skills shortages.

Since privatisation of many formerly public research institutes, there is little centrally-funded research in this field. Perhaps as a result of this, there has been very little EU funding for demonstration projects for urban noise reduction projects in the UK.

3.9 Renewable Energy (RE)

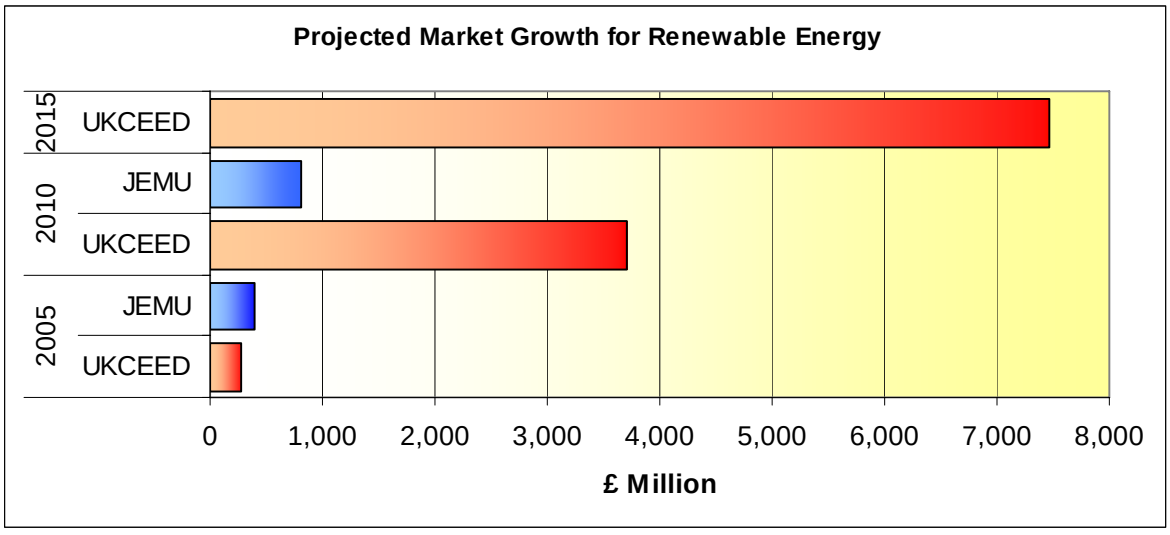
The supply of technologies and services for the generation, collection or transmission of energy from renewable sources such as biomass, solar, photovoltaic, wind, tidal and geothermal sources. Includes the manufacture of equipment, design, construction, installation, management and operation of RE facilities (JEMU 2002).

The above definition does not list hydro as an example of renewable energy, and many definitions include only small hydro (cut-off points vary). In the UK, hydro projects over 20MW are only eligible for Renewable Obligation Certificates if they are commissioned after 1 April 2002. Some older large-scale hydro plants have scaled back their capacity in order to qualify, resulting in a 2.5% loss of large scale hydro capacity from 2001 (RESTATS, 2006).

Combined heat and power is covered under the energy management section.

3.9.1 RE Market size

The market for RE is estimated at £290m for 2005, growing rapidly to £3.7bn in 2010 and on to £7.5bn by 2015. Whilst the 2005 figure is below that of the JEMU report, predicted growth significantly outstrips the JEMU forecasts. Most commentators predict at least double digit growth in the sector as the UK expands capacity to meet its targets for renewable energy generation. A relatively conservative growth figure of 15% per annum is used for forward forecasts.



Evidence

Renewable energy provided 4% of the UK's generating capacity in 2004, 3.58% of its electricity[38], and 1.7% of its primary energy requirement (not counting passive solar) (RESTATS, 2006).

A 2004 study for DTI measured the 2003 turnover of the industry (including the supply chain, excluding hydro over 20MW, and excluding energy sold) at £290m (DTI, 2004a). However, applying the capital costs per MW from the 2004 study with the increases in capacity for 2004 from the table below (excluding large hydro, sewage sludge digestion and cofiring, for which no cost/MW data were available) yields a minimum of £246m for 2004, just for capital expenditure, and just for electricity. Using an alternative set of capital costs (Oxera, 2005) pushes this figure up to £283m[39].

The DTI study (DTI 2004a) predicts this market will grow to between £15 billion and £19 billion by 2020.

Table 3.3: Installed and planned UK renewable electricity capacity

	2004 installed cap. (MWe)	Increase from 2003 (MWe)	2004 Generation (GWh)	Increase Jan-Nov 2005 (Mwe)	Awaiting or under construction, Nov 2005
Onshore wind	809.4	131	1736	230.8	1589.5
Offshore wind	123.8	60	199	90	853.4
Wave/tidal	0.5	0	<0.05		4.5
Solar PV	8.2	2.2	4		7.3
Small hydro	184	(18.9)	282	3.8	123.6
Large hydro	1406.3	12.3	4648		
Landfill gas	722.2	103.1	4004	29.6	133.2
Sewage sludge digestion	119	18.4	379		
Municipal solid waste combustion	307.4	8.6	971		104.2
Other biofuels	184.3	0.4	927		79
Co-firing with fossil fuels			1022		
Total	3865.1	317.1	14,172	354.2	2894.7

(RESTATS, 2005a; DTI, 2005b)

The income from electricity sold can be estimated at 3.58% of total electricity turnover, yielding £411m in 2004[40]. Alternatively, DG Energy and Transport figures give a 'spot price' of around 30 euros/MWh during 2004, and the IEA give a retail industry price of $78/MWh for the same year. Working from the total of 14,172 GWh generated from renewables, the DG Energy figure gives £289m, and the IEA figure £604m for renewable electricity turnover.

However, only 82% of renewable energy was sold as electricity in 2004. The value of the remaining 3111 Gwh equivalent would depend on what form it is used and how it is generated.

[38] 3.1% counting Renewable Obligation eligible sources, 4.4% using the Renewables Directive method (RESTATS, 2006)
[39] The Oxera study does not give a figure for solar PV, so the figure from the DTI study is used.
[40] Based on total turnover of electricity producing companies of £11,491m (ONS, 2005d)

The Oxera study estimates a subsidy of £1,161m p.a. to that portion of the renewables industry covered by the Renewables Obligation. This comes from sales of Renewables Obligation certificates (£864m), Levy Exemption Certificates subsidy (£168m), EU ETS benefit (£116m), and capital grants (£13m). Another £129m in subsidised improvements to the national grid to allow renewable contributions to supply cannot be considered income (Oxera, 2005).

The table below shows employment levels in the UK renewable energy sector.

Table 3.4: Estimated employment figures (including retail) for the UK renewable energy industry, 2003:

	Scotland	Rest of Uk
UK demand	1300	4200
Export	200	430
Emerging technologies	40	200
Total	1540	4830

(DTI, 2004a)

3.9.2 RE Market Drivers

In addition to the government's 20% renewables target for 2020, the most important driver for renewable energy in general is rising energy prices. For the utilities market, the Renewables Obligation, applying to the supply of electricity, is the primary policy driver within the UK. This will soon be joined by the Renewable Transport Fuels Obligation, affecting road fuel suppliers. The domestic microgeneration market is small (fewer than 100,000 existing installations) and largely driven by grant programmes (EST, 2005b).

Recent volatility in the wholesale energy market (see Cleaner Technology section) could improve the feasibility of certain borderline projects in the near term.

The carbon market created by the Kyoto Treaty and the EU Emissions Trading Scheme is providing some impetus to the development of renewable energy projects in developing countries, and India has recently become the fourth largest wind market in the world (Ernst & Young LLP, 2006). This could be a market for UK companies.

3.9.3 RE Strengths

The UK has a strong skills base for wind, wave and tidal power, due to the transferability of skills from the offshore oil and gas, shipbuilding, and aerospace industries (DTI, 2004a).

The UK has "world class expertise" in hydro (DTI, 2004a). Gilbert Gilkes & Gordon, for instance, founded in the Lake District in 1853, supplies hydro power technology around the world. The trade figures for small hydro equipment show a significant trade surplus for micro- and small hydro equipment (HM Customs and Excise, 2006).

The UK has good wind and wave natural resources. The UK is leading in research and development of wave and tidal energy generation (DTI, 2004a). Ocean Power Delivery, in particular, is manufacturing and exporting the Pelamis, an offshore wave energy converter. Wavegen, bought by Voith in 2005, offers land-installed marine power energy transformers (LIMPETs) and breakwater turbines. Marine Current Turbines hopes to have its SeaGen tidal turbine commercially available in 2007-08. The DTI is funding R&D activity in wave power through its Technology Programme.

The UK has experience in micro-wind turbine development and manufacture. Windsave, Renewable Devices, and XCO2 produce turbines small enough to use in urban and residential areas. All three are approaching commercial production stages; Windsave and Renewable Devices have signed supply deals with major energy utilities (Anon, 2006). Renewable Devices

sources all components from within the UK, Windsave sources most from within the UK (Mid Wales Energy Agency, 2005).

For larger turbines, while most equipment is imported (see Weaknesses), there are UK production facilities. Renewable Energy Systems has constructed 1100MW of turbines in the UK and overseas, and is currently involved in several offshore projects. Vestas, one of the world's largest manufacturers, has production facilities in England and Scotland and equipment is exported. Peter Brotherhood has a joint venture with RePower, which focuses mainly on project management and maintenance (although the company has also build a medium sized wind turbine on its assembly lines).

The UK has a good knowledge base in PV technology, and transferable skills from the semiconductor and electronics industries, but faces strong competition from Germany and Spain, as well as the US and Japan (DTI, 2004a). Sharp opened a PV module factory near Wrexham in 2004. The commodity code that includes photovoltaic cells (85414090, other photosensitive semiconductor devices), shows exports of £144m, versus imports of £119m, for 2005 (HM Revenue & Customs). UK-based Thermomax produces and exports solar thermal collectors.

The UK's heavy reliance on landfills has left a large resource for landfill gas utilisation. This appears to be nearing saturation (RESTATS, 2005b). As with other landfill technology (see Waste Management section), this could be an area for export growth.

The UK has experience in all parts of the biomass supply chain, from R&D through plant operation, particularly advanced conversion technology. Wellman Process Engineering, for example, is moving towards demonstration phase of a fast pyrolysis reactor that can turn 250 kg/h of wood into liquid fuel. Talbott's and Bronzeoak, both UK-based have produced small- and large-scale biomass and energy-from-waste plants in the UK and overseas. The government's Biomass Task Force make strong arguments for significant UK growth in the latter areas.

3.9.4 RE Weaknesses

Almost universal access to the national grid reduces the market for microgeneration in remote areas.

Large scale wind generation equipment is largely imported, especially from Germany and Denmark. The supply chain seems to be set, with high costs to new entrants and component-manufacturer relationships in place (DTI, 2004a).

The UK is fifth on Ernst & Young's Near-Term Wind Index, behind the US, Spain, Germany and India. "Grid capacity and planning remains a barrier to development in the near-term". The Index points out that a number of offshore wind projects have been delayed for commercial feasibility reasons (Ernst & Young LLP, 2006).

There is strong local opposition to onshore wind projects, energy from waste, and some biomass projects.

Manufacture of larger biomass plant equipment, as well as EFW and landfill gas equipment, is generally imported (DTI, 2004a).

Biofuel production has only recently come to the UK (with Argent in Motherwell producing up to 50 million litres p.a.), and the market is dominated by Brazilian bioethanol imports (HM Revenue & Customs, 2005b). While production capacity should be multiplying over the next few years (with Biodiesel Corporation's 284 million litre p.a. plant coming onstream in Teesside and several smaller bioethanol plants planned), there is industry concern that the buyout price

set in the Renewable Transport Fuels Obligation may not be sufficient to support UK investment (EIC, 2006).

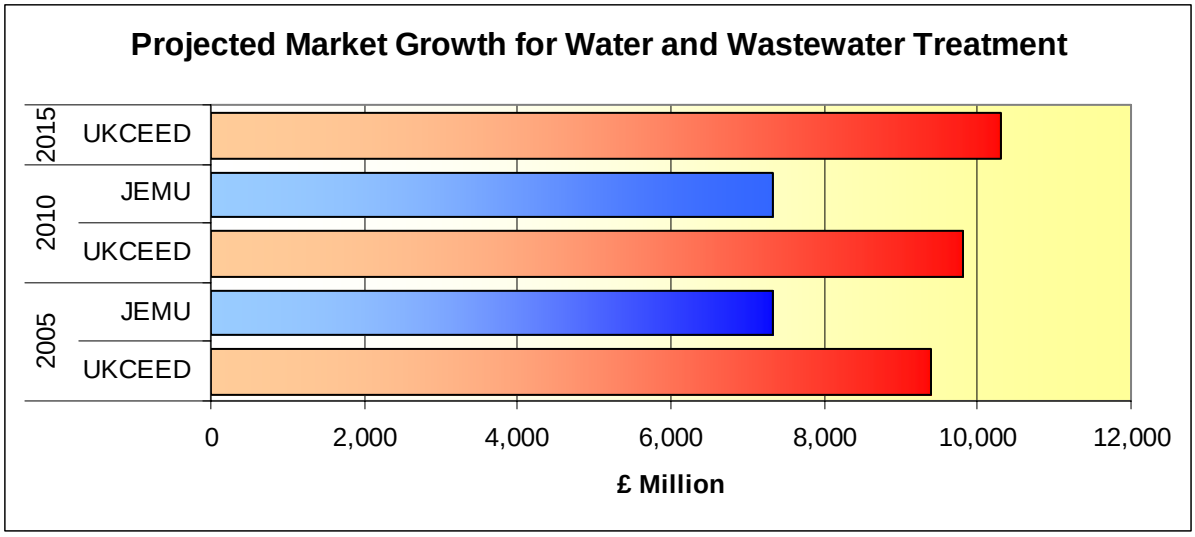
With the exception of biomass heating and ground source heat pumps, microgeneration technologies are too expensive at present to compete without grant or regulatory support (EST, 2005b).

3.10 Water and Wastewater Treatment (WWT)

The supply of technologies and services for the provision of drinking water and waste water treatment for industrial and domestic users. Includes manufacture of WWT equipment, design, construction, installation, management and operation of water and waste water treatment facilities (JEMU, 2002).

3.10.1 WWT Market Size

The market for WWT is estimated at £9.4bn for 2005, growing to £9.8bn by 2010 and on to £10.3bn by 2015. These figures are significantly above those in the JEMU report as shown in the chart below. The JEMU report also forecast a zero growth scenario for the sector, although taking into account inflation, this actually suggests a contraction. However, the most recent OECD forecasts for the sector in the UK (OECD 2005) suggest a modest growth (although remaining below growth in the economy) and UK CEED has used these figures to project sector growth.



Evidence

Regulated water companies in England and Wales collected £3.6bn in water charges and £3.7bn in sewage charges in 2004/05. Water companies in turn had operating expenses of £2.9bn, and capital investment of £1.6bn (water) and £2bn (sewage) (OFWAT, 2005a) (see table below).

Scottish Water's turnover for 2004/05 was £960.5m. Capital investment was £520m and core operating expenses were £270m (Scottish Water, 2005).

The Northern Ireland Water Service collected £345.6m in 2004/05, a combination of customer charges (£40.1m) and parliamentary subsidy (Department for Regional Development, 2005).

The total turnover for these companies in 2004/05 was £8.6bn.

Table 3.5: summary of regulated UK water companies income and expenditure, 2004/05 (£m)

	England and Wales	Scotland	NI
Water income	3593	960.5	345.6
Wastewater income	3736		
Operating expenses	2900	270	
Capital investment	3600	520	

(sources in text above)

Some water provision expenditure bypasses the regulated companies in England, Wales and Scotland and the NI Water Service, as a number of companies abstract their own water. In 1997/8, 57% of freshwater was abstracted directly by end users, the big sectors being electricity and gas production (33%) and fisheries (12%) (ONS 2005). In 2001, 72% of freshwater abstraction in England and Wales bypassed the regulated companies (Tambe, 2004), mainly in the form of cooling water for power plants. Likewise, a segment of industrial expenditure on wastewater treatment will be for onsite treatment and/or reuse, supplied by companies such as Black & Veatch, Copa, Environmental Treatment Systems and Pell Frischmann, and therefore will not register as income for the regulated companies. This could explain the discrepancy between the figures above and the two tables below, offering statistical information on a larger group of companies identifying themselves as in the water and wastewater sector.

Table 3.6: summary of Annual Business Inquiry Information on UK Water Industry, 2004

	Water provision	Sewage collection and treatment	Totals
Enterprises	107	1041	1148
Employment	28,000	22,000	50,000
Turnover	**£4.2b**	**£5.2b**	£9.4b
Purchases of goods, material and services	**£1.4b**	**£1.4b**	£2.8b

(ONS, 2005d)

Defra's annual survey of industrial expenditure on environmental protection found industry spending £883 million on wastewater treatment in 2003 (13% capex), not including £30 million capex on integrated solutions (included under Cleaner Technologies and Processes). These figures are for the extraction, manufacturing and energy and water supply industries only, i.e. they do not include construction or service industries (URS, 2005). Public expenditure on wastewater management (not including the Scottish Water or NI Water Service budgets) was £242 million in 2003, rising to £264 million in 2004 (ONS, 2005b).

Additional industries that could be included within this subsector include:

- Rainwater products (including piping and guttering): £224.4m in 2005 (MBD, 2005b)
- Rainwater harvesting systems (approximately 400 systems installed p.a.) (UKRHA, 2006)
- Home water softeners and purifiers: market size $143m in 2000 (Datamonitor, 2002)
- Manufacture, installation and maintenance of storm drainage recycling systems.

3.10.2 WWT Market Drivers

The bulk of the UK water industry is very closely regulated, and must meet set performance standards, within environmental constraints, at a certain price. This is determined every five years by the Periodic Review (except in Scotland where it takes place every four years). The environmental constraints are increasingly shaped by EU legislation such as the Water Framework Directive and the Bathing Water Directive. While it is a mature industry, with low

growth rates and relatively low investment in R&D, innovation is driven by increasing environmental constraints, increasing efficiency drives, and shortages of water. It is also attracting growing M&A activity as evidenced by the recent purchase of Thames Water by Macquarie, an Australian Bank and sales of other companies such as AWG and South East Water.

Capital investment of £18.9bn is forecast for England and Wales between 2005 and 2010 and a further £2.25bn for Scotland between 2006 and 2010. Up to date figure for N Ireland are not currently available. Water Framework Directive driven investment is still under discussion, but UKWIR estimates in 2003 put it at around £18bn in the UK.

Internationally, the sector is forecast to grow by 6% per annum to reach a world market of £35bn by 2009 (UK FEI 2006) and by around 33% by 2025 (OECD 2006).

3.10.3 WWT Strengths

The UK has historically enjoyed very high standards of penetration, dependability, efficiency, and environmental impact.

The structure of the water industry in England, Wales and to some extent Scotland, gives service providers a degree of flexibility to integrate with other industries (waste management, laboratory services) and to export services overseas.

Water industry investors rate the regulatory process as transparent and fair, and feel that water prices will be sufficient to pay for the necessary improvements (Whelan, 2005).

The UK is home to a number of large infrastructure engineering companies, such as AMEC, Balfour Beatty, Biwater, and Laing O'Rourke. These companies have built large parts of the existing UK water and wastewater infrastructure and now provide similar services around the world. Other companies have built similar international networks on more specialised services, such as Bodycote (testing of water and materials) Amtec (surveying and inspection) and Wolseley (supply of plumbing and drainage products). Similarly, services to the water industry are a large part of the portfolio of many of the UK's leading environmental consultancies.

There are a multitude of smaller companies providing anything from turnkey treatment works (Avent Engineering, Barhale), to local drain clearance. Pipe installation, repair, maintenance, and associated civil engineering are undertaken by both large (Clancy Docwra, Alfred McAlpine) and small firms. Some of these have significant export activity – Fusion Group sell plastic piping and associated technology to eastern Europe, and Perco develops and licenses trenchless (no dig) technologies and exports equipment around the world.

3.10.4 WWT Weaknesses

The Periodic Review process gives rise to a fluctuating cycle for companies specialising in capital construction for the water industry, with all companies receiving their lists of required improvements at the same time. Ofwat data shows the range of investment required to be between £1.2Bn and £1.7Bn.

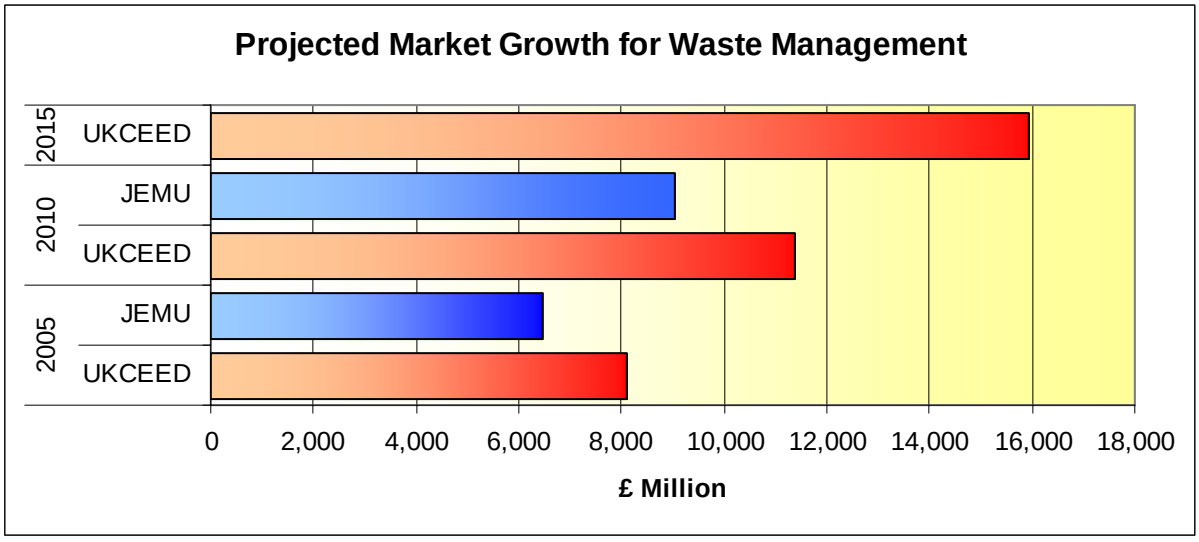
Despite the flexibility to integrate with other industries discussed above, the regulatory structure does impose some inflexibility. It has been suggested, for instance, that limitations on the use of regulated wastewater treatment facilities prevent the potentially advantageous use of excess anaerobic digestor capacity for biodegradable municipal waste.

3.11 Waste Management (WM)

The supply of services such as waste collection, treatment, disposal, waste minimisation and regulatory advice, recycling (metals, plastics, compostables, glass, demolition and construction wastes etc) and technologies such as bins, shredders, compactors and WM vehicles (JEMU, 2002).

3.11.1 WM Market Size

The market for WM is estimated at £8.1bn for 2005, growing to £11.4bn in 2010 and on to £15.9bn by 2015. This is significantly above the figures contained within the JEMU report as shown in the chart below. It is thought that this is because the large and growing market for recycling is now better understood and estimated. The JEMU report predicted annual growth for the subsector of 7% which this report also uses as a robust estimate of future growth.



Evidence

Defra's annual survey of industrial expenditure on environmental protection found industry spending £1.36bn on solid waste management in 2003. These figures are for the extraction, manufacturing and energy and water supply industries only, i.e. they do not include construction or service industries or the domestic sector, all of which are significant generators of waste (URS, 2005). Public expenditure on waste management was £3.3bn in 2003, rising to £3.5bn in 2004 (ONS, 2005b).

Table 3.11: Turnover and employment for the waste management industry in 2004

	Waste collection and treatment	Recycling	Totals
Enterprises	1354	1553	2907
Employment	52,000	17,000	69,000
Turnover	**£4.9bn**	**£3.2bn**	**£8.1bn**
Purchases of goods, material and services	**£2.4bn**	**£2.4bn**	**£4.8bn**

(ONS, 2005d)

The majority of companies in the sector are SMEs with 90% of companies having less than 50 employees (HSE 2004). However, in terms of size, the top eight waste management firms had a combined turnover of £2.9bn, out of a total turnover of £4.4bn (which would include much

more than waste collection and treatment). Estimates for the number of people employed in the sector range from 69,000 in the ONS study (2005d) to 160,000 in the HSE study (2004). The latter study covered the four SIC codes shown above but didn't include local authority staff employed in waste activities (a further 36,000).

Table 3.8: SIC codes used in the definition of the UK waste industry

SIC	Industry description
37.100	Re-cycling of metal waste and scrap
37.200	Recycle of non-metal waste and scrap
51.570	Wholesale of waste and scrap
90.002	Refuse disposal activities

HSE 2004

The larger companies in the waste industry are highly integrated, and many companies are engaged in all four SIC codes, plus several additional areas (see Strengths section). However, the majority of the SMEs are single products companies.

Onyx Group estimates the 2005 hazardous waste transport and disposal market (much of which would overlap with the industry expenditure figure above) to be £264m (excluding contaminated soil), broken down as follows:

- Oil/water: £122m
- Inorganic: £32m
- Solids (landfill): £17m
- Secondary liquid fuel: £60m
- High temperature incineration: £33m

(ENDS, 2005f)

There is evidence that suggests the industry is much larger. The British Metals Recycling Association claims that the metals recycling industry has a turnover of £3.5bn (Millington, 2006), greater than the ABI figures for the entire recycling industry. One reason for the discrepancy may be the use of SIC codes for recycling which only include those companies whose main activity is recycling (for example, it won't include the value of glass containers collected by local authorities and delivered directly to glass manufacturers for closed loop recycling) and therefore underestimate total activity. WRAP's estimate for the turnover of the specialist (non-metals) recycling and reprocessing sector is £1.2 billion.

WRAP's website states that sector turnover is predicted to expand rapidly from £11.8bn to between £20 and £30bn within 15 years[41]. Unfortunately, the report authors have been unable to find a reference to the source of this forecast.

3.11.2 WM Market Drivers

EU Directives on Landfill, Waste Electrical and Electronic Equipment (WEEE) and End of Life Vehicles (ELV) are the main drivers in the waste market across Europe. The Integrated Pollution Prevention and Control (IPPC) Directive also covers the largest waste management activities (including incineration, hazardous waste and landfill sites). At the UK level, landfill tax and domestic recycling targets have been the major factors influencing the market over the last 5 years.

Recent reform of the planning process, including the Planning and Compulsory Purchase Act (2004) and the publication of PPS10, is designed to force planning authorities to take into

[41] http://www.wrap.org.uk/businesses/investors/why_invest_in.html

account the need for waste management facilities at a regional level and find places to site them, but it is too early to see whether these measures are being properly implemented through the planning hierarchy.

The UK waste management market is experiencing significant investment in recycling collections and reprocessing facilities as it seeks to meet government targets and catch up with the standards reached in some other European countries. The increasingly stringent targets tend to favour the larger waste companies who are able to offer a wider range of 'one-stop' services. At the same time, there is less emphasis on innovation in the market as it is generally assumed that investment in existing technologies and processes (e.g. kerbside collection systems, civic amenity sites, transfer stations, materials recycling facilities) can enable targets to be met.

The significant opportunities in the UK waste market for higher value waste management and treatment technologies are illustrated by the increasing investment activity in the sector, whether in mergers and acquisitions (e.g. FCC purchase of WRG) or share floats (e.g. Biffa's demerger from Severn Trent). The UK's Institution of Civil Engineers (2004) estimate that from 2004 to 2020 the UK will need between 1500 and 2300 new facilities to recycle, reprocess, treat and dispose of its waste at a cost of between £10bn and £30bn to meet the EU Landfill Directive's requirements for diversion of biodegradable municipal waste from landfill.

A recent OFT report (2006) makes a number of recommendations about how the municipal waste market may be opened up to new entrants and the government has committed to implement many of the measures. It has also set up a new waste infrastructure development programme, along with changes and simplifications to arrangements for the award of waste sector PFI contracts. All of these measures could provide new opportunities in the waste management market.

The Government is also providing significant funding to help achieve the EU targets:

- An extra £355 million towards funding Private Finance Initiative (PFI) projects to support investment in waste disposal facilities and divert waste from landfill. An extra £255 million of PFI credits is being provided for 2006/07, and £280 million for 2007 /08. This support is available to local authorities for building infrastructure.

- The Business Resource Efficiency and Waste (BREW) programme seeks to incentivise businesses to reduce the amount of waste they send to landfill, and also assist them in developing ways to achieve this. The fund is initially to run for three years with £43 million allocated for 2005/6, £95 million for 2006/7 and £146 million for 2007/8.

- The Waste and Resources Action Programme (WRAP) aims to accelerate resource efficiency by creating efficient markets for recycled materials and products and removing barriers to waste minimisation, re-use and recycling. WRAP plans to spend £77.1 million in 2006/07 and, provisionally, £79.5 million in 2007/08.

- The Waste Infrastructure Development Programme is a new Waste Implementation Programme (WIP) initiative. It is producing a comprehensive strategy for the construction of the estimated £10 billion of infrastructure needed to meet the obligations of diverting biodegradable waste away from landfill. The related demonstrator programme was set up to provide £30 million of assistance to set up new waste treatment technology demonstration projects. The programme is intended to overcome the possible risks of introducing alternative technologies in England through the provision of accurate and impartial technical, environmental and economic information to key decision makers in local authorities and the waste industry in general.

Large new development areas (e.g. Thames Gateway, Growth Areas and the 2012 Olympics) provide other opportunities for market expansion.

3.11.3 WM Strengths

The waste industry is dominated by large integrated waste management firms. A number of these are owned by overseas companies: Onyx and Cleanaway (both owned by Veolia); Sita (owned by Suez); WRG (owned by FCC). Of the UK-owned companies, Biffa (recently demerged from Severn Trent), CSG, Grundon, Viridor and Shanks are the largest. Most of these companies offer a range of integrated services, from domestic and private collection, through treatment, recycling, composting, energy recovery, and landfill. Many also offer consulting and land remediation services.

The UK's experience with landfills puts it in a good position to benefit from rising standards in countries with inadequate infrastructure. For example, Brazil has some 100,000 tonnes of urban waste per day being inadequately disposed. Landfilling it properly would require an initial investment of $570 million, and annual costs of $420 million (USCS, 2005).

The UK also has a wide range of SMEs developing and applying alternative technologies, although few of these have yet been able to break through as major players in the sector. Examples include TEG Environmental and Civic Environmental, with in-vessel aerobic treatment; Greenfinch Biogas and Sustainable Waste Systems, with anaerobic digestion; Dundee Energy Recycling, with incineration; Compact Power and Graveson Energy Management, with pyrolysis technologies; Comex, Estech Europe, and Sterecycle with autoclave treatment; and Fairport and Orchid Environmental with thermo treatment.

The UK is leading EU policy development in certain areas. For example, PAS-100, a quality standard for composted organic waste, was developed in the UK.

The UK metals recycling industry is well-established, and considered a major player in the EU and global markets. UK-based EMR and SIMS (ultimately Australian, but largely UK-based) are among the top ten metal recyclers in Europe. While the UK manufacturing industry has declined, there are ample markets overseas for the recycled material.

3.11.4 WM Weaknesses

The UK has a legacy of cheap landfills, partly as a result of the void spaces left behind by the mining and quarrying industry, and partly because an abundance of coal and oil has made it less necessary to use solid waste as a source of energy (CIWM, 2005a). As a result, the UK still landfills almost half of its solid waste, sends the second highest percentage of municipal waste to landfill of the EU-15, and has one of the lowest recycling rates in Europe. The increases in Landfill Tax are changing the cost equation and hence increasing recycling rates (as is government targets on household recycling). Nevertheless, a fundamental shift is required in the industry, both in terms of structure and financial investment, to transform it from a landfill business to a process technology sector

Development of alternative treatment facilities has been held back by an adversarial planning process. Local opposition to facilities, particularly incineration, can be intense, adding costs, time, and uncertainty to investments in this sector. At the same time, the waste industry as a whole suffers from a skills shortage, particularly if and when technology becomes more sophisticated (Gower, 2005).

There is ample scope throughout the waste industry for illegal practices, i.e. unlicensed waste carriers, household collections taking commercial waste for cash payments, dilution of hazardous waste to non-hazardous concentrations, disposal to inappropriately licensed landfills, shipment of wastes overseas, and fly-tipping. The House of Commons Environment, Food and Rural Affairs Committee has called attention to the inadequacy of the Environment Agency's enforcement resources, and the seriousness of the fly-tipping problem, especially as

it becomes more expensive to dispose of waste legally (EFRA, 2005). This has a number of negative consequences for the industry.

As an example, it is estimated that five years ago, perhaps as many as a third of the UK's car dismantlers were unlicensed or inappropriately licensed (ERM, 2002a). The implementation of the ELV Directive is forcing many of these to shut down or lift their standards. A large percentage of dismantlers are joining CarTakeBack, which offers them training, insurance and other services to help them comply with the regulations. Part of this package is automotive depolluting equipment supplied by Seda, an Austrian company that has been producing such equipment for a decade. Not only did Austria implement the ELV Directive much earlier than the UK, but it had an industry agreement in place from 1996 on the takeback of ELVs (European Commission, 1997), creating an environment in which Seda could flourish.

Another negative consequence of illegal practices is that our picture of how much waste there is and what happens to it may be inaccurate, and there may be resistance from certain parts of the industry to attempts to get more accurate information. The EFRA Committee acknowledged widespread industry agreement that the available data is "abysmal". In the words of the Committee, "This kind of information is important, in order to allow for effective forward planning by local and national government, and to inform investment decisions by private companies which may be contemplating building waste treatment facilities" (EFRA, 2005). The OGS report (2006) also found that there is a general lack of market intelligence and that this was hindering the market's development.

Although there is increasing investor activity in the sector, as noted above, historically the sector has been under-capitalised. The scale of investment required to meet more stringent standards will require investor confidence, which in itself is largely a function of certainty in the scope and application of regulation. There is no precedent for the scale of funding required and therefore the ability to manage the financial risk inherent in the investment will be critical to achieving the necessary transformation in the sector. EU competitors and financial institutions have shown themselves more than willing to buy out UK operators and technology if UK companies and financial markets are unable to rise to the challenge.

A number of government reports point to a lack of competition in the municipal waste market with 8 or 9 large players responsible for over 70% of waste collection by weight (OGC 2006, OFT 2006). Most of these players tend to be strong in particular regions but not nationally with the result that competition in some regions is particularly weak. This is exacerbated by the strong presence of local authority direct service organisations (DSOs) in the market, which are likely to inhibit new private sector entrants, and insufficient skills in local authority procurement agencies for setting effective tender briefs.

Continuing consolidation in the market place will tend to further restrict competition although the consolidation itself is a direct response to the large investments needed to deliver more sustainable waste management practice.

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ANNEX 1. Defining the Environmental Goods and Services Sector

It is important that the definition used for the environmental goods and services sector, and the choice of quality to be measured, match the purpose for which the measurement is intended. It is important, therefore, that this purpose be clearly stated at the outset. If the purpose is to enhance UK competitiveness, this should be elaborated. Do we want to increase jobs in the UK, and if so, what kind of jobs? Do we want to increase domestic manufacturing capacity? Do we want to lead the world in development of cleaner technology? Do we want to maximise export revenue, or encourage high-tech export rather than low-tech?

If we take the Energy Management subsector as an example, policies to encourage thermal insulation in new buildings and policies to encourage retrofitting of existing stock would probably have similar effects on insulation manufacturers, but the former would raise the sustainability skills of the UK construction industry, whereas the latter would create a lot of relatively unskilled jobs. Policies to encourage new build thermal efficiency may be more encouraging of innovation, as there is more scope for new products, but a detailed understanding of both the technical issues and the industry structure would be necessary to predict the implications of any particular policy.

An example of the complex interactions between EGS subsectors can be seen in the plasterboard market. Plasterboard can be seen as a noise reduction product or as a thermal insulation (Energy Management) product. Roughly half of the UK output can also be seen as a recycled product (though as a finished product it would not be counted at market value), because it is made from a byproduct of the flue gas desulphurisation process (Air Pollution Control). The use of low sulphur fuels by the power industry (Cleaner Technology and Processes) reduces the amount of byproduct available, and this in turn is in competition with the recycling industry (Waste Management), which collects offcuts and demolition scrap.

It should also be realised that policies that benefit one sector of the industry may disbenefit others. Energy efficiency decreases consumption of energy, including renewable energy, and subsidies for renewables may decrease the overall cost of energy, discouraging efficiency. Pollution prevention decreases the market for remediation and treatment.

Many definitions have been used in the past. In fact, it is difficult to find two studies that have used the same definition, interpreted in the same way.

Environmental Business International (EBI) uses a definition comprising 14 subsectors grouped into three divisions: services, equipment, and resources. The OECD, with Eurostat, published a definition in 1999 that is very similar to the EBI definition, but includes construction/engineering costs of environmental plants, and adds several categories: sustainable agriculture, fisheries and forestry, natural risk management, and eco-tourism. It also makes research and development, cleaner technologies and cleaner products into separate categories.

The OECD/Eurostat definition is summarised as follows:

The environmental goods and services industry consists of activities which produce goods and services to measure, prevent, limit, minimise 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.

The definition itself, however, does not match the summary. It includes provision of drinking water and waste management, two essential infrastructure services, without making any distinction (as is done with energy and agriculture) between sustainable and unsustainable. Thus, abstracting from an aquifer at a rate greater than it is being replenished, or carting refuse away and burning it, are both considered environmental services.

At around the same time, APEC developed a list of environmental goods to satisfy the decision made in the Doha round of WTO negotiations to work towards eliminating tariffs on environmental goods and services. The OECD and APEC lists are often combined.

The JEMU list is a modified form of the OECD/Eurostat definition. It has been used by regional bodies to map the EGS sector, but has been subject to varied interpretation. The Mapping Group is in the process of rewriting the JEMU definition, specifying exactly what is to be included and how it is to be measured.

In the following list, we have expanded the JEMU subcategories into lists of sub-subcategories, the inclusion of which (and within which subcategory) the Mapping Group may wish to consider individually. In some cases, vagueness and overlap are unavoidable. For instance, a point will have to be defined for each material waste stream, at which the material ceases being waste and starts being a secondary resource. Collection, sorting, and smelting of waste aluminium is clearly Waste Management, but at what point does the handling of the recycled aluminium leave the Waste Management industry and enter the packaging, aerospace, or other industry? The answer in this case may be very different from that for composted organic wastes, or aggregates made from mining and demolition wastes. Double glazing can be installed for noise abatement, or thermal insulation, or both. The bulk of double glazing sold in the UK, however, is in the form of conservatories, which in practice often reduce the thermal efficiency of houses.

The Cleaner Technologies and Products category has been left unexpanded, because much of it can be covered by the other subcategories. Marine Pollution Control could probably be easily combined with Contaminated Land Remediation.

Air Pollution Control

Industrial emission control (scrubbers, electrostatic precipitators, etc)
Industrial ambient (workplace) air control
Indoor air quality (active – i.e. air conditioning, air purifiers)
Indoor air quality (passive – cleaner products, ventilation systems)
Indoor air super-purification (for semiconductor manufacture, etc)
Mobile source emission control – equip. manufacture, installation and repair
Mobile source emission control – fuels/additives manufacture
Industrial/mobile source emission control for greenhouse gases
Industrial/mobile source emission control for ozone depleting substances
Odour control (industrial)
Odour control (indoor)
Process engineering to reduce emissions
Research and development of new/improved air pollution technologies
Research and development of technologies with reduced emissions

Cleaner Technologies and Processes

Contaminated Land Remediation

Prevention of contamination (bunds, geotextiles, storage and containment precautionary measures, oil interceptors, sustainable urban drainage systems)
'Dig and dump' operations (essentially waste disposal)
Containment technologies
Soil cleaning technologies
Associated land forming and (re)vegetation
Groundwater remediation
Surface water remediation
Shoreline and shallow water remediation
Nuclear decommissioning
Environmental cleaning of industrial facilities
Supply of machinery and technology for above operations
Research and development of new/improved remediation technologies

Energy Management

Manufacture of energy efficient appliances/equipment
Manufacture of energy monitoring and control equipment
Manufacture of energy conservation material (insulation)
Manufacture of CHP equipment
Supply of energy from CHP equipment
Design of energy efficient new buildings
Modification of existing buildings to upgrade energy performance
Energy management advice, installation of systems
Process engineering to reduce industrial energy consumption
Research and development of new improved energy management technologies
Research and development of more energy efficient technologies/processes

Environmental Consulting Services

Environmental audits and reporting
Environmental Management Systems
Life cycle assessment
Environmental impact assessment
Regulatory/legal advice
Investment screening
Stakeholder engagement

Environmental Monitoring and Instrumentation

Manufacture of instrumentation and laboratory equipment (including software)
Laboratory testing of samples
In situ monitoring i.e. of emissions, nitrate levels, water quality
Metering of supply services (water, electricity, gas)
Enforcement monitoring (oil spill detection, waste tracking, vehicle testing, food testing)
Research and development of new monitoring and measurement technologies

Marine Pollution Control

Prevention of marine pollution (incl. double hulling)
Shoreline and shallow water remediation (see Contaminated Land Remediation)
Offshore oil/gas technologies (i.e. produced water containment/treatment)
Manufacture of equipment for above operations
Process engineering to reduce pollution from marine activities
Research and development of new/improved marine pollution control technology
Research and development of marine technologies with lower pollution risk

Noise and Vibration Control

Manufacture/installation/repair of transport noise control equipment
Manufacture/installation of industrial noise/vibration control equip.

Manufacture/installation of noise barriers/deflectors
Manufacture/installation of building noise insulation
Road surface modifications
Traffic control measures
Manufacture of noise testing/monitoring equip.
Noise testing/monitoring/mapping/consulting services
Process engineering to reduce noise and vibration
Research and development of new noise/vibration control technologies
Research and development of technologies with lower noise/vibrations

Renewable Energy

Manufacture/installation/repair of generation equipment
Supply of renewable energy
Modifications to grid for transmission of renewable energy
Supply of renewable fuels
Distribution/storage of renewable fuels
Supply of agricultural feedstocks for biomass/biofuels
Research and development of new/improved renewable energy technologies
Research and development of cleaner/more efficient non-renewable energy technologies
Process engineering to make non-renewable generation cleaner/more efficient

Water and Wastewater Treatment

Supply of potable tapwater
Supply of potable bottled water
Supply of water for industrial uses
Supply of ultrapure water/distilled water for industrial uses
Construction/maintenance of plant/infrastructure for treatment/distribution of water to buildings
Manufacture/installation for management of water/wastewater within buildings (e.g. plumbing)
Manufacture/installation of systems for treatment/reuse of industrial wastewater
Construction/maintenance of infrastructure for removal of wastewater from buildings
Construction of plant for treatment of wastewater (including septic tanks, natural systems)
Operation of wastewater treatment plant
Construction/maintenance of infrastructure for removal/treatment of surface runoff
Manufacture/installation of water-saving appliances/equipment
Manufacture/installation of greywater systems
Manufacture/installation of rainwater harvesting equipment
Treatment of sewage sludge (see Waste Management)
Process engineering to use less water/produce less wastewater
Research and development of new water management/treatment technologies
Research and development of technologies that use less water/produce less wastewater

Waste Management

Collection and transport of general solid wastes
Manufacture of equipment/vehicles for storage/collection/transport of solid waste
Collection and management of specialized wastes (ELVs, WEEE, decommissioned ships)
Demolition of buildings/structures
Construction of landfills/incinerators (without energy recovery)
Operation of landfills/incinerators
Treatment of waste prior to landfill/incineration
Construction of energy recovery facilities
Operation of energy recovery facilities
Sale of energy from energy recovery facilities
Construction of material recovery facilities/equipment
Operation of material recovery (including composting) facilities
Sale of sorted, untreated waste materials
Sale of discarded/donated items (clothing, books, toys)
Sale of treated recyclate (glass pellets, aluminium ingots)
Sale of finished products with high recycled content (paper, aluminum cans)

Product service systems (see source81)
Use of waste materials as fuel (i.e. in cement kilns, co-firing)
Use of industrial byproduct as industrial input
Management and treatment of low-level radioactive waste
Management and treatment of high-level radioactive waste
Management and treatment of medical waste
Management and disposal of human remains
Treatment of sewage sludge (see Water and Wastewater Treatment)
Process engineering to produce less waste
Research and development of new waste treatment technologies
Research and development of technologies that minimise waste production

Other

Climate change modeling
Climate change adaptation
Carbon capture and storage
Technologies to reduce the need for travel
Erosion control
Shoreline protection
Training in any of subsector-specific skills

Measurement Issues

Some sub-subcategories may be difficult to measure economically. The Waste Management industry, for instance, is paid at one end for disposing of waste, and paid at the other for supplying secondary materials (or recovered energy). These payments in some cases cancel each other out, however, so that a farmer taking organic waste, or a cement kiln taking combustible waste, is both receiving a good and performing a service, and little or no cash may change hands.

Annex 2: Case Studies

Introduction

The final part of this study focused on developing more detailed case studies of two specific subsectors to identify key drivers of future growth. The two areas selected, in conjunction with the DTI, were Contaminated Land Remediation and Environmentally Smart Buildings. They were chosen to provide contrasting examples with the former considered a more mature subsector and the latter covering a number of different subsectors and also platform technologies that are in themselves not unique to the EGS industry (e.g. the information and communications technologies required to enable the 'smart' applications in the home).

For each sector, the UK CEED team held scenario development workshops to define four scenarios, based on the combination of key drivers identified by an expert panel. The workshop then selected one scenario for further analysis, based on a combination of which scenario was considered most likely and also of most value for further review.

For each of the scenarios selected, a further workshop was held to review the value chain and UK capabilities in the sector and then to develop a strategic roadmap. The roadmap covered the development required in products, services, supporting technology platforms and underlying industry capabilities to achieve the scenario depicted for 2015 in that sector.

In addition, a vision for UK industry on how to seize the opportunities presented by the 2015 scenario was constructed, together with the challenges considered by the participants as being critical to address.

UKCEED used fast-track scenario development and fast-track strategic road-mapping approaches facilitated by Codexx, our consulting partner for this work. It is suggested that such an approach would prove valuable in mapping out opportunities in other EGS subsectors, particularly where there is limited empirical data.

Although this was designed as a stand alone process, some of the outcomes have been reflected in the main body of this report.

A2 Contaminated Land Remediation

A2.1 Key question for scenario development

"How attractive a market will the Contaminated Land Remediation sector across Europe be for UK industry in 2015?"

A2.1.2 Expert Participation

The following personnel participated in the scenario development workshop on 21st March 2006:

Jonathan Selwyn – Director, UKCEED
Stephen Mahon – Chief Executive, Centre for Sustainable Engineering
Phil Shepperd – Centre for Sustainable Engineering
Noah Myers – Consultant, URS (on secondment to DTI)
Bill Leverett – Environmental Consultant
Alastair Ross – Director, Codexx (workshop leader)

A2.1.3 Key drivers

The workshop identified the drivers that would impact the development of this sector up to 2015. Those drivers shown in bold were considered most significant by the review team:

POLITICAL

- **Degree of EU harmonization**
- **Germany drive for EU directive on contaminated land**
- **EU expansion**
- UK decision on expanding nuclear power generation
- War/terrorism
- Politicial priorities on environment v other issues
- WTO/EU services directive

ECONOMIC

- Developing countries environmental prioritisation
- **Public sector funding for remediation (e.g. tax incentives) particularly in accession states and Eastern Europe**
- EU economic growth over period
- **Land / property values**
- Availability of remediation 'cost cap' insurance
- Investment industry view of risk in land remediation
- Costs of travel
- **Growth in business off-shoring (particularly to E Europe)**

SOCIOLOGICAL

- **Public view on contamination 'scare factors'**
- Demographics and ethnic mix in EU
- Availability of environmental hazards information to public
- **Cultural view of environment across EU and accession states (e.g. public desire to protect 'green field')**
- Cultural view on best solutions for environmental challenges – 'East v West'

TECHNOLOGICAL

- **Operational cost of cleanup (e.g. ref land costs)**
- **Cost of new remediation technology v labour costs**
- Public sector funding for new environmental technologies (e.g. research grants, academic-industrial networks)
- Scalable technology to enable economic remediation across large and small applications
- Integrated remediation technology (utilising different technologies to create a single remediation solution)
- Recycling of remediated waste
- **Availability of new assessment and monitoring technology for remediation**
- Continuation of Intellectual Property framework
- Learning from UK government/military work on decontamination

ENVIRONMENTAL

- **New evidence of impact of chemicals on health**
- **Impact on water resources driven by a combination of climate change and increased house building**
- Climate change/Extreme weather – catastrophic impact

LEGISLATIVE

- **Proposed EU directives for Waste, Soil**
- **Implementation of EU Landfill directive (e.g. Landfill tax in the UK)**
- Implementation of EU Water framework directive
- EU REACH programme for chemical hazards definition
- Development of IPPC regime
- UK quota for new housing and commercial property on brown-field sites
- **Development and harmonization of land remediation standards across EU**

A2.1.4 Selection of Key drivers

Drivers were analyzed, grouped then ranked against Impact and Uncertainty. The workshop attendees then voted on those that they considered to be the key drivers for the future development of this sector up to 2015. The two drivers selected were **EU Regulation** and the **European Property Market**.

A2.1.5 Construction of Scenario Logic

Using these two drivers as the axes for the environment space, 4 key scenarios were defined:

Scenario space for **'Contaminated Land Remediation sector across Europe in 2015."**		**EU Regulation**	
		LO	HI
European Property Market Activity	HI	***'No place like home'***	***'Green and pleasant land'***
	LO	***'Little England, Little Value'***	***'Strangled by red tape'***

A2.1.6 Selection of scenario for further detailing

The meeting agreed that on current trends the positive scenario ***'A green and pleasant land'*** offered most value in further definition and later analysis for UK industry's ability to exploit.

A2.1.7 Scenarios

The four scenarios for the Contaminated Land Remediation Sector are detailed in the following pages.

“A Green and Pleasant Land” (Chosen scenario)

In response to the growing power of Asian and North American trading blocs, the EU has pulled out of its constitutional crisis and recognised that it has to put aside national differences in order to compete as a world power. At the same time, it has embraced public pressures for a cleaner environment from Western European countries. The European Commission gained new powers in areas traditionally reserved for national governments, and used them to bring in strong environmental protection legislation, such as the EU Framework Directives on Soil and Waste and harmonised environmental standards across all EU countries.

By 2015, Turkey, Croatia, Romania, Norway and Switzerland have joined the EU, and much of the Balkans, Iceland, and many former Soviet republics are working towards accession. The European economy is booming and companies are falling over each other in the rush to get into the world’s largest and richest single market. Europe’s cities are growing, and its citizens are relocating themselves as barriers to immigration and land ownership (apart from the price) drop. Six of the ten most expensive cities to live in are in Europe. There is thus pressure to clean up old industrial areas as land prices rise across Europe, and particularly so in the old Eastern bloc countries with their legacy of less regulated industries.

The mixture of traditions and cultures spurs mini-Renaissances in art and science, typified by the dazzling architecture of the 2012 Olympic facilities in London. The fact that the entire Olympic village was sited on previously contaminated land made the Games as much of a showcase for the UK remediation industry as for the athletes. Combining innovative technologies such as bio-remediation from Scandinavian and Dutch companies with UK expertise in assessment, testing and practical deployment of remediation systems has already won Anglo-Swedish and Anglo-Dutch companies solid reputations from Madrid to Istanbul. The land remediation business is in full swing as industries are either cleaning up or moving out of the EU, the high prices they get for their premises easily paying for the remediation of the polluted soil they leave behind.

All European landfills are closed to everything but the most intractable wastes, and there is talk of the next step: mining historic landfills for resources and remediating them. In this field, as with nuclear decommissioning, the UK has had considerable practice in its home market. All of this will stand it in good stead in bidding for the structural fund-driven contracts coming up in the pre-accession countries, such as the Chernobyl cleanup.

"No Place Like Home"

With the UK economy worth 22% more than it was in 2005, the market for commercial property has grown accordingly; new builds, starts and work contracted accounts for 20 million m^2, 10% of the 2005 area. Another 15 million m^2 have permission. In housing, the Sustainable Communities initiative begun by the previous government is nearing completion, having been responsible for 200,000 new homes in the south of England in the period. The next wave of house building is now beginning, in the Midlands, Yorkshire/Lancashire and south west areas, as higher speed train connections, better long term freight economics and lessening concerns about emissions with the rollout of hybrid, bio-fuelled and now fuel cell vehicles, bring those areas into the influence of London and the south east. Whilst the 2000s saw a focus on the conversion of brown-field land, this has pretty much been hollowed out, and the focus now is on clearance and rebuild. Whilst not of revolutionary proportions, a trend has grown in recent years to sweep away Victorian housing and industrial buildings as they get to be prohibitively expensive to refurbish, and go out of fashion.

The health of the UK property market has been reflected everywhere in Europe in the last decade, in line with the growth of the economy and the revival of agriculture. Now freed from the straitjacket of the CAP, and reaping the benefits of investment in energy and other non-food crops over the past 10 years, land prices are very strong, and this had a knock-on effect on urban prices.

This activity is good for the Contaminated Land Remediation (CLR) sector. Particularly in the monitoring and assessment of land, companies are finding it difficult to cope with the volume of demand and are investing in training and the application of more efficient assessment technologies. However, the resistance of individual EU Member States to harmonised standards in Waste legislation, since the German attempt in 2008 to introduce a Contaminated Land Directive, has thrown up obstacles to business beyond the UK. Northern European countries mostly agree on *what* should be controlled and removed from land and groundwater, but differ in the degree of cleanup, with Scandinavian countries and Germany requiring a higher percentage removal of most contaminants than the UK. The last few percent of cleanup requires proportionately more effort which UK firms are not always geared up to and which they cannot cite in tenders as having great experience in. Southern and Eastern Europe, on the other hand, generally prohibits fewer substances and has lower cleanup percentages. The issue is heavily influenced by climate change, because the increasing problems arising from extreme weather and periodic sea inundations is focusing the minds and cheque-books of policymakers on energy policy rather than cleaning up toxins.

The differences of view among the legislators have been reflected in the European Standards body, CEN, and other standards bodies. Discussions have stalled for the third time since 2006 on standards for different grades of land. The diversity of standards across countries limits the effective operation of the remediation market in the EU and with most standards in Northern Europe exceeding those in the UK, limits UK CLR industry's export potential.

“Little England, Little Value”

August 2015:

Another record dry hot summer has led to a spate of bush fires in Hampshire that has destroyed over 2000 homes in the last two months leaving almost 10,000 people homeless. The shortage of land for rebuild, following a decade of housebuilding from the Sustainable Communities Programme commenced by Lord Prescott, has driven urban prices beyond the reach of most consumers. This has resulted in the need for the clean-up of brownfield sites, but the additional cost does not make this economic for developers.

The UK domestic market will struggle to benefit from the experience of its European neighbours, who have shared a common Soil Remediation Protocol since 2009. Both Germany and Poland have experienced greater loss from fires in the last 5 years, believed to be due to the impact of climate change. But these countries’ domestic investment in home-grown technologies have enabled a rapid clean-up and rebuild. However, their techniques do not meet the UK’s more stringent remediation regulations, which is no comfort to the many thousands of former home-owners, who face a winter in expensive temporary accommodation

- Same lack of open market in Europe as Phil’s, but low property market means little drive for land remediation and therefore little opportunity for CLR companies. Construction industry in decline in the UK

“Strangled by red tape”

Driven by an increasingly powerful environmental axis of Germany, Denmark and the Scandinavian countries, the EU is now reaping the results of its ever-tightening environmental standards. The legislation implemented between 2006 and 2010, especially the contaminated land framework directive of 2009, imposed ever tighter regulations within the Union and whilst the countries with strong economies and high quality environments have managed the downturn better, the less developed economies of Southern and Eastern Europe have been hit particularly hard.

Land prices have been pushed downwards in the industrialised areas of these countries as it has become increasingly uneconomic to clean up land to the quality required by the legislation and the cost of compliance has increased industry’s move offshore. Whilst some EU money has been made available to assist countries in land remediation, disputes over which CLR companies should benefit from the contracts have slowed progress. More prosperous residents of the cities and towns affected have relocated to the booming cities of Western and Northern Europe, notably Munich, Copenhagen, Lyon and Birmingham. Such cities, which first embarked on major regeneration and cleanup in the 1990s, have become thriving cosmopolitan centres of commerce and culture.

However, even the booming cities of the West have more recently started to become victims of their own success with a perception of overcrowding resulting in some downward pressure on house prices. At the same time, advances in information and communications technologies, and a radical relaxation in greenfield development rules in the UK, have enabled many people to retreat to the rural idyll that was last popular in the 1980s.

The EU’s environmental legislation proved the final nail in the coffin of the pro-Western secular government in Turkey. The urban middle-classes rose up against the impending high entrance costs of joining the EU block and voted for an Islamic fundamentalist regime which is now making plans to join the increasingly powerful Middle Eastern Trading Confederation.

The other winners from the legislative drive have been the big contaminated land companies specializing in the increasingly efficient assessment and remediation technologies which have replaced less cost-effective manual methods such as ‘dig and dump’. The industry is dominated by consolidation of existing CLR companies and vertical integration of property development/construction companies into major remediation service companies such as Virgin Land, EON and Carillion exploiting new technologies such as bio-remediation .

A2.2 Contaminated Land Remediation: Analysis of UK capabilities and development to 2015

Introduction

In this section we assess the full extent of the opportunities for the UK supply base in Contaminated Land Remediation up to 2015, and analyse the ability of UK companies to meet the competitive challenges that are emerging in those areas.

To do this we involved experts in this sector and utilized Strategic Road-mapping to determine the potential development of the UK supply sector to meet the opportunity presented by our scenario for 2015 'A Green and Pleasant Land' where the combination of a high level of EU Environmental Regulation and a booming EU property market has led to major growth in the remediation of contaminated land and hence opportunities both in the UK and across Europe for companies in this sector.

A2.2.1 Expert Participation

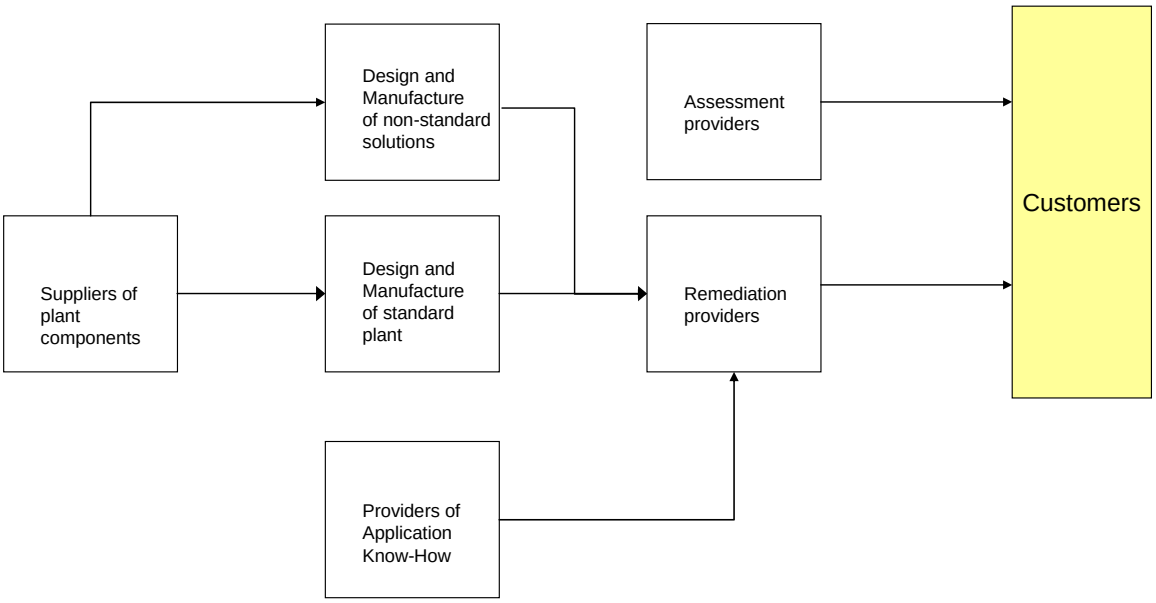
The following personnel participated in the scenario development workshop on 28th April 2006:

Jonathan Selwyn – Director, UKCEED
Bill Leverett – Environmental Consultant
Clive Boyle – Environmental Consultant, Vice-chair of EIC contaminated land group
Redding Thompson – Group Leader, Soil and Groundwater, URS
Alastair Ross – Director, Codexx (workshop leader)

A2.2.2 Overview of the Contaminated Land Remediation Sector in the UK

An overview of the remediation value chain is shown below:

Figure 1: Overview of Value chain for UK Contaminated Land Remediation Sector



Key points on the UK market and suppliers:

- The lifecycle for contaminated land remediation starts with an Assessment of the land. Often the cycle is halted here if the level and nature of contaminated found requires such a high level of remediation with associated risks that this is not cost effective within the overall development programme. If this is not the case, the land will then undergo Remediation and finally a final Assessment or Validation to confirm that the remediated land meets requirements.

- Considering the cost across the remediation cycle (or revenue obtainable by remediation suppliers) currently the split is estimated to be approximately 10% on initial assessment, 80% on remediation and 10% on validation. It was considered by the workshop attendees that by 2015, this would change to 20% for initial assessment, 60% for remediation and 20% for final validation, The anticipated changes in % makeup reflects both improved economies in remediation and the recognition that appropriate investment in assessment is required in order to optimise and achieve best cost effectiveness of remediation projects.

- The UK historically has particular strengths in Assessment/Validation and less so in Remediation technologies.

- Suppliers of remediation plant components (such as pumps, piping and controllers) are not typically UK suppliers. The design and provision of standard remediation plant is also typically not from the UK, but from Germany and Italy as well as other European countries. The UK does however have some strengths in the provision of non-standard or bespoke remediation plant (for dealing with mixed contaminants for example). The UK is also strong in providing specialist remediation solutions such as bio-remediation that do not use conventional remediation plant.

- The UK market for land remediation is now more attractive to UK and foreign suppliers due to the changes in landfill legislation which have severely limited the previous ‘dig and dump’ approach. However, UK remediation suppliers, lacking a market for their services for many years, are in catch-up with established competitors on the European mainland

- UK remediation suppliers typically have a limited amount of small capacity remediation plant and a very limited amount of large capacity plant – this may limit their ability to compete with overseas suppliers for remediation contracts, once those overseas suppliers engage more actively in the UK market.

- The UK remediation supply industry has a limited supply of experienced personnel (i.e. typically 10+ years of remediation experience).

- For major land development programmes, such as the Thames Gateway scheme, a cost-effective solution is based on a ‘Cluster’ solution where remediation plants would be installed at points within the area determined by logistics.

- One issue limiting market growth in the UK is the variable and, in places, poor application of the contaminated land legislation (Part IIA) together with the "uncertainty" over landfill disposal requirements and costs, with possibly a light touch regulation from Environment Agency as the new regime settles in.

A2.2.3 Vision for the UK Industry

The workshop developed a 2015 vision for the UK industry which was considered 'Ambitious but achievable', this comprised the following elements:

- The UK will focus on providing assessment services and bespoke (not standard) remediation solutions.
- There will be a healthy UK remediation industry in size, margins and image.
- There will be consolidation within the UK remediation sector to build large players with more capability for investment, offering development and export.
- There will be a continued growth in UK remediation assessment business across Europe.
- By 2015 there will be maximum recycling capabilities for soil which will be based on sustainable solutions.
- There will be a substantial soil recycling infrastructure established across UK regions.
- There will be an effective supply of UK remediation 'brokers' established, operating trading marketplaces (e.g. growth in exchanges such as the 'Waste Exchange' http://www.waste-exchange.org/).
- Remediation cluster solution will be established to support large regional development schemes such as the Thames Gateway and the London Olympics development, providing business and marketing opportunities for UK suppliers.
- The UK home demand for remediation will be met substantially by UK operators.
- There will be a growth in nuclear cleanup business for UK leaders in the UK and abroad.
- UK government funded technical development programmes for remediation assessment, technologies and application will continue – utilizing joint academic-industry programmes.

A2.2.4 Strategy to achieve vision

The workshop used strategic road-mapping to develop a potential strategy for the UK industry to achieve the proposed vision, with the objective of identifying the key activities required and highlight the potential barriers. Within the time constraints of this project, this roadmap is by intent at an overview level – further insight would be gained from additional review and analysis. We excluded Nuclear Remediation from the scope of the roadmap, due to its specialist nature.

The strategic roadmap aligns the required product/service offerings, over time, with the opportunities and threats posed by market and external events, It then identifies the required technologies to enable these new offerings and also enablers within the industry itself such as skills, investment etc.

The summary roadmap is shown below with a more detailed one in the Appendix.

	2006-08	2009-12	2013-15
Market + Externals	• Continuation and enhancement of UK remediation tax breaks, other incentives •Introduction of practical waste guidance from DEFRA •Improved clarity on risks for assessment from DEFRA, EA •Transposition of EU environmental liabilities directive •Major UK developments in Thames Gateway, Olympics •Increase in landfill tax escalator	•EU soil framework directive •80% brownfield quota for new housing in UK •Possible opening of Asian markets for remediation •2012 Olympics in London •Part IIA-driven remediation	•UK Olympic legacy •MOD execute its obligations on land cleanup •Potential legislation in UK to ban landfill of soils
Product and service offerings	• New assessment & remediation solutions for current sites	• New remediation solutions for complex sites	
Enabling technologies	•Improved application of current technologies, funded R&D for new technologies and improved brokering	▪ Electrochemical, advanced thermal and biochemical solutions	▪Breakthroughs in biokinetics and nanotechnology
Required UK industry enablers	•Improved training and accreditation •Improved remediation plant capacity •Ongoing DTI funding for near-market and long-term R&D •More realistic remediation contract liabilities and terms •Govt database on remediation technology approvals •Enforcement of Part IIA by Local Authorities	•DTI trade mission to E Europe for remediation •Consolidation & cooperation in UK suppliers •Availability of improved market knowledge	

Figure 2: Strategic roadmap for UK Contaminated Land Remediation Sector up to 2015

Commentary from the roadmap:

- The road-map shows how the UK supply industry (and other UK bodies) would best respond to the 2015 scenario. It identifies key external events – such as new EU regulation and the 2012 London Olympics (as a potential show-case for UK remediation skills). It identifies new product and service offerings and the supporting technology developments required. Finally it identifies the key actions required for the UK industry to be capable of developing the new product and service offerings and new technologies.

- The road-map identifies the actions required by both industry and government to improve the remediation market in the UK and also to better position UK suppliers to compete in it

- Key requirements on UK industry over the next 3-5 years are:
    - Improved training and accreditation
    - Growth in remediation plant capacity
    - Consolidation to develop major players who can compete across Europe

- Key requirements on UK government bodies over the next 3-5 years are:
    - Improved guidance on waste risk assessment and classification
    - Consistent enforcement on Part 2A regulations
    - Use of tax incentives to promote remediation
    - Ongoing DTI funding for new remediation technologies and application
    - Enabling major national developments like Olympics site to be a remediation showcase

A2.2.5 Barriers to realizing vision

The workshop participants identified the key barriers to achieving the proposed vision for the UK remediation supply sector:

1. Lack of clarity on waste standards (currently being defined by case law) – industry is looking to the UL government to define. This is inhibiting both UK developers and remediation suppliers from investment.

2. The perception of the remediation industry as a ‘waste’ industry, rather than an increasingly high tech and development focused industry.. This colours both the government’s view and potential employees when students and can only be improved through marketing.

3. The need for multiple government departments (e.g. DTI, DEFRA, Education) to work together to enable key requirements in the proposed strategy.

4. Current lack of experienced UK professionals in assessment and remediation.

5. Industry concern over possible changes in government policy and support for brown-field development.

6. Potential shortage of UK university science skills in areas key for this sector such as Hydrogeology.

7. The fragmented makeup of the UK remediation supply base with a long tail of SMEs and few large and medium-sized suppliers.

A2.3 Scenario Development: ICT-Enabled Environmentally Smart Buildings

A2.3.1 Key question for scenario development

"How attractive a market will the ICT-enabled environmentally smart buildings sector across Europe be by 2015? This sector is considered to cover the use of Information and Communications Technologies (ICT) to improve the environmental performance of residential and commercial buildings. This encompasses environmental and energy sensors and control systems located within buildings and linked via broadband-enabled networks to external monitoring and optimisation services. The opportunity for utilising these technologies to enable energy saving in homes is of interest due to the proportion of national energy consumption and CO2 emissions from homes ('Energy - gas and electricity - used in the home is responsible for 25% of the UK's carbon dioxide emissions.' *Source: DEFRA 2006)*

A2.3.2 Technologies in scope for this sector

The technologies that comprise this sector are:

- *Building Management Systems*
- *Metering technology*
- *Environmental sensors*
- *Lighting control systems*
- *Energy auditing/optimisation software and services*
- *Broadband / mobile network hardware, software and service providers*
- *Environmental sensor technologies*
- *Data loggers*
- *Building Optimisation software*

A2.3.3 Expert Participation

The following personnel participated in the scenario development workshop on 29th March 2006:

Jonathan Selwyn – Director, UKCEED
Stephen Mahon – Chief Executive, Centre for Sustainable Engineering
Bill Leverett – Environmental Consultant
Bruce Pittinghale – Head of Climate Change, Fenland District Council
Peter James – Visiting Professor of Environmental Management, University of Bradford
Alastair Ross – Director, Codexx (workshop leader)

A2.3.4 Key drivers

The workshop identified the drivers that would impact the development of this sector up to 2015. Those drivers shown in bold were considered most significant by the review team:

POLITICAL

- **Political stability of countries supplying energy**
- **Will of international governments to reach new international agreement on climate change (e.g. Kyoto 2)**
- Governments mandating the use of environmentally smart technologies in Public Buildings
- Government introduced league tables for 'greenness of buildings'
- Security concerns at use of building monitoring (terrorism and criminal)
- Consistency of views on environmental improvement by political parties
- The impact of the UK Government's Energy Strategy Review
- Eradication of fuel poverty

ECONOMIC

- Investment in energy supply infrastructure
- Liberalisation of energy market across the EU
- Increasing energy consumption due to economic growth in EU
- **Prices of commercial and residential property**
- Continual growth of China, India and other emerging economies drive up resource prices of technologies
- Price rises on electronics materials and components
- Growth of renewables as a share of total energy supply

SOCIOLOGICAL

- Perception of safety of in-building wireless metering/monitoring networks
- Perception of privacy and civil liberty issues from building monitoring
- **Growth of an IT/internet literate population comfortable with using new technologies in the home/office**

TECHNOLOGICAL

- Supply limitations on materials such as steel for micro-generation technologies
- Degree of investment in enabling networks (i.e. mobile 3G, internet) across Europe
- Availability of integrated 'sense and respond' technologies enabling building management systems to identify external and internal environmental conditions based on sensor and forecast data and optimize the environment accordingly x
- **Existence of technology standards for interoperability of key environment technologies**
- Availability of skills for the development and support of building environment monitoring and optimization technologies
- Pace of development for low power environment monitoring and optimization technologies
- Growth in micro power generation
- **Pace of development for environment monitoring and optimization technologies that are easy to install and support (e.g. based on digital TV, broadband, mobile and other technology platforms)**
- Impact of analogue TV 'switch off' in the UK in providing an enabling infrastructure in homes and apartments

ENVIRONMENTAL

- **Increased demand for cooling technologies and related support requirements**
- Climate change
- Catastrophic weather conditions
- The impact of Voluntary codes of practice (e.g. BREEAM)

LEGISLATIVE

- Harmonisation and simplification of UK national planning regulations for the use of microgeneration technologies in buildings
- **Updates following the EU EPBD directives**
- Usage of 2011 census for environmental data gathering
- **Changes in the Emissions Trading Scheme**
- Impact of WEEE/ROHS regulations
- New Health & Safety regulations
- EU directive for the opening up the energy services market

- UK Government mandate on energy regulators and the importance in the mandates of environmental issues

A2.3.5 Selection of Key drivers

Drivers were analysed, grouped then ranked against Impact and Uncertainty. The workshop attendees then voted on those that they considered to be the key drivers and further discussed them. The meeting selected 'International agreement on climate change' as one key driver, and then considered 'Energy prices' and 'Development of integrated environmental monitoring technologies' as well as 'Government mandate on energy regulators in support of improved environmental mandate' as the other driver. After consideration it was agreed that high energy prices would be an implicit assumption in all scenarios and the other scenario driver selected was. 'Cost of networked technologies for resource efficient buildings'.

A2.3.6 Construction of Scenario Logic

Using these two drivers as the axes for the environment space, 4 key scenarios were defined:

Scenario space for 'ICT-Enabled Environmentally Smart Buildings sector across Europe in 2015."		**Cost of networked technologies for resource efficient buildings'**	
		LO	HI
International agreement on climate control as implemented in UK	HI	***'Low carbon programme'***	***'Status Quo'***
	LO	***'Leadership at a cost'***	***'Lights Out'***

A2.3.7 Selection of scenario for further detailing

The meeting agreed that on current trends the scenario '***Leadership at a cost'*** which was based on the interaction of availability of low carbon building technologies and the lack of a strong international agreement on climate change offered most value in further definition and later analysis for UK industry's ability to exploit.

A2.3.8 Scenarios

The four scenarios for the Contaminated Land Remediation Sector are detailed in the following pages.

“Low carbon programme”

The British Government announced today that it has signed the Global Low Carbon Economy agreement that seeks to nullify the effects of global human carbon emissions without affecting the quality of life today or in the future.

The Environment Minister announced that the UK has entered a global Emission Trading Scheme that has been further developed at national level to allow everyone to enjoy the benefits of worldwide travel and warm homes. The widespread availability of low-cost integrated smart home management systems for effective operation of home heating, lighting and appliances has enabled the introduction of a ‘Personalised Carbon Credit’ for each adult. Surplus credits can be sold to other users utilizing the new carbon credit e-marketplace.

Deputy Prime Minister also announced changes in the Building Regulations to encourage super insulated buildings that use smart management systems that will keep the micro climate within the guidelines set down by those that use them. Since 2008 the analogue switch off has been implemented and this has accelerated the availability of smart home management technologies, leading to a high level of intelligent networks and grid management in both new and existing properties that will allow for the efficient use of energy across the country.

The Energy Minister of the Department for Trade and Industry weighed into the debate by providing a scheme for the integration of micro-generation, including individual wind turbines and micro-CHP, that will allow buildings to feed surplus electricity into the national grid, whilst providing cooling from the ground source heat pump. He also announced figures from the Smart Buildings Systems Trade Association that showed 15% growth in this sector’s exports in the last 12 months, building on the UK’s strong competencies in these technologies.

The Treasury announced that new community-led heating and cooling systems are to be provided across the cities of the United Kingdom, providing heat, light and electricity to city centres during the day and for the excess capacity to be provided into surrounding homes of the fuel poor, thereby eliminating fuel poverty by 2016.

This range of measures is supplemented by the Education Minister announcing a new set of curriculum activities that will put in place the skills and technology for implementation into the future.

“Status Quo”

A strong post-Kyoto treaty has been translated into a coherent UK energy efficiency strategy. Building regulations have been significantly tightened and the historically high energy prices have encouraged both domestic and commercial interest in renewable energy and upgrade of building stock to a more sustainable design.

Unfortunately one aspect of energy efficiency which has not moved forward in any tangible way is the smart management of energy use and space utilization in buildings. The government has shown no desire to lead in this area and the technology industry is still coming to terms with the collapse of the fourth dotcom bubble. A combination of terrorist attacks on the physical internet, Chinese censorship, a shortage of silicon and the spiralling costs of the WEEE and RoHS directives has broken any hope of cross platform integration of technologies. The analogue switch-off has been postponed indefinitely as the public has no confidence that the Government can deliver Coronation Street through the new set-top boxes.

Joanne Jones, the building manager of Grimsby Waterfront Apartments wakes up to find her telephone answering machine full. All the messages are about the same thing: it’s been a hot night, and people have been complaining about the radiators being on full blast. She looks outside, and notes the number of open windows. All that energy wasted. In light of the government’s hefty energy surcharge, and the development company’s corporate energy efficiency pledge, it’s been a bad night.

Joanne has talked to the Management Company about automatic integrated control systems, but they can’t get the numbers to make sense. And with three different platforms to choose from (Sony, Microsoft and Autonomy), only one of which will be around in five years, they’re not about to invest a lot of money in a system that might be obsolete and also provides barriers to easy interoperability with other systems.

The government has failed to provide any incentives for industry to develop integrated building management systems due to a lack of inter-departmental coordination and a failure to promote common standards.

“Leadership at a cost” (chosen scenario)

The government has been congratulated today after the completion of the 1 millionth new home built as part of its low carbon building programme. The election pledge made 8 years ago by Prime Minister Gordon Brown to deliver the world’s most energy efficient buildings in which to live and work has remained a central thrust of his last two terms of office. This has been supported by tax incentives for energy-efficient buildings.

The programme has fostered the UK’s latent excellence in electronic design, intelligent networks and grid management to ensure that all new buildings have the control infrastructure to deliver an environment that is comfortable, healthy and minimises the use of energy.

The launch of the programme, which also saw a broadening of Ofgem’s remit to guard both the environmental and cost concerns of consumers, was much criticised when the UK signed up to the Asia Pacific environmental technology development programme (AP6) with India, China and Australia rather than Kyoto 2.

The UK has faced escalating costs from having to fully fund the development of energy-efficient building technologies without benefiting from trading the new EU Carbon Efficiency credits. The credits are allocated nationally to building owners who demonstrate consistent carbon reductions as part of the contraction and convergence scheme in the EU. This has led many in UK industry and government to doubt the economic wisdom of going it alone.

However, although costly, the programme has led to a greatly reduced reliance on imported energy, through the implementation of micro-generation technologies (now accounting for 15% of all UK energy use) and energy savings which have reduced usage by 20% from the 2006 level. But the real win is the establishment of a lead position for the UK in the supply of equipment and services for networked monitoring and control systems in the built environment, which has resulted in a successful export industry.

“Lights Out”

Harvey Smith, Energy Manager at Wickstead Council, sighed. High energy prices mean that he still has a job but the results of the failure to ratify Kyoto 2 are really coming through and making it very unsatisfying employment. Only this morning the supplier of his Building Management System (BMS) had said that they weren’t supporting the product any more due to customers’ lack of willingness to pay for updates and enhancements. The supplier said they were concentrating on Scandinavia, and the few growth areas in the UK economy, such as high cost office buildings. There is also a growing lobby to roll back some of the recent changes in building regulations and other environmental legislation, such as the requirement to monitor building energy consumption. Not that this would make any difference, in Smith’s view, as few people seemed to take any notice of the information provided.

Smith reflected that there had been so many wasted opportunities for improving energy efficiency. For example in his mother’s sheltered home. The council had spent thousands of pounds across the region putting in new broadband links to meet the needs of new assistive technologies, and the need to distribute digital TV as a result of analogue switch off. He’d told them that there was a great opportunity to put in state-of-the-art metering and control systems cost-effectively on the back of it and hence improve energy efficiency in council properties, but no-one had listened. His colleagues in the private sector say that the same thing is happening there. None of the suppliers are really talking to each other, so there is still the need to use different systems for building management, energy analysis, lighting control and so on. And the potential to integrate these applications with, for example, space management and room booking systems, for overall building energy optimisation, isn’t being seized.

He’s also sad at what’s happened to his friends amongst the suppliers, a number of whom who have lost jobs due to the flat UK market. Because of the low demand in the UK, many of the products are being supplied from China and India where BMS applications are more sophisticated. Only the other day he heard that most users of his BMS in Asia are using version 7 of the BMS software while he’s still on version 3, all higher versions are not available in English.

Without any strong UK presence, the development of application and equipment which is occurring is really focusing on managing temperature extremes, such as they get in North America and China. He marvels at the way they link with real time weather data and adjust heating, cooling, solar shading and other features automatically.

A2.4 ICT-Enabled Environmentally Smart Buildings: Analysis of UK capabilities and development to 2015

Introduction

In this section we assess the full extent of the opportunities for the UK supply base in ICT-Environmentally Smart Buildings up to 2015, and analyse the ability of UK companies to meet the competitive challenges that are emerging in those areas.

To do this we involved experts in this sector and utilized Strategic Road-mapping to determine the potential development of the UK supply sector to meet the opportunity presented by our scenario for 2015 'Leadership at a cost' where the combination of decreasing cost for the enabling technologies and the lack of international agreement on climate change has encouraged the UK to seek to reduce energy consumption in homes through the use of environmentally smart homes..

A2.4.1 Expert Participation

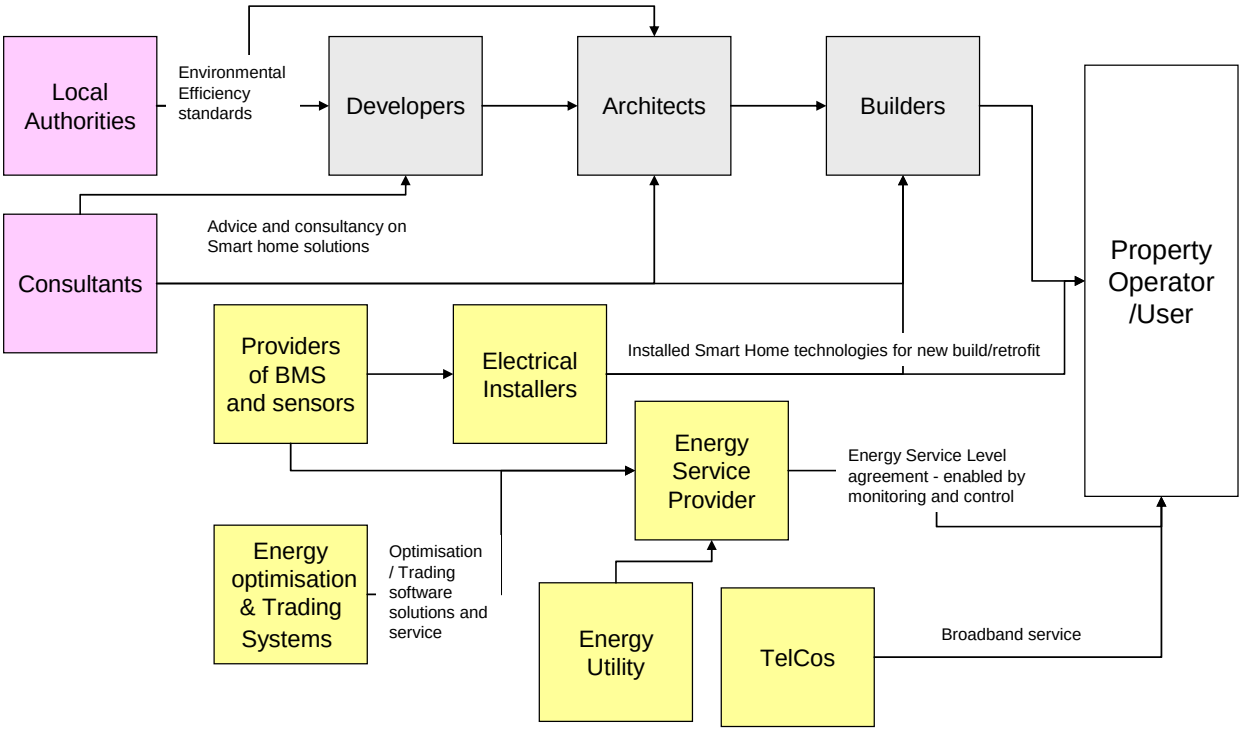
The following personnel participated in the strategic workshop on 8th May 2006:

Jonathan Selwyn – Director, UKCEED
Stephen Pattenden, TAHI Secretary ('The Application Home Initiative Ltd')
Stephen Mahon – Chief Executive, Centre for Sustainable Engineering
Bill Leverett – Environmental Consultant
Alastair Ross – Director, Codexx (workshop leader)

A2.4.2 Overview of the Environmentally Smart Buildings Sector in the UK

An overview of the environmentally smart buildings value chain is shown below:

Figure 1: Overview of Value chain for ICT-enabled Environmentally Smart Buildings Sector in the UK



Key points on the UK market and suppliers:

- The value chain as it stands in 2006 primarily serves large commercial buildings with solutions to manage their power and environmental performance in their buildings. The market for 'smart homes' and small buildings is immature.

- Currently a complete 'end-to-end' solution for environmental optimisation of operating buildings only exists for large commercial buildings. Companies such as Trend (now part of Honeywell) provide Building Management Systems (BMS) to monitor and control lighting and temperature and monitor and control other building services. The vision of the 'Smart Home' remains just that in 2006, with no large complete demonstrator of a cost-effective integrated solution for a large market yet shown*. "One of the major findings of the work that TAHI has carried out is that making everything work together in the home is very difficult. Multiple service providers delivering multiple services and applications utilising existing systems in the home need methods of linking everything together safely, reliably and predictably."* (Source: The Application Home Initiative Ltd, 2006).

- The market for these solutions for homes is not yet there either. Consumers, small businesses and landlords do not see the need for such a service; they do not have the knowledge to select and implement such as solution and no major service providers exist to implement and operate such solutions.

- The market for ICT services and technologies to enable environmentally smart homes will be triggered by a combination of rising energy prices and increased regulation on improved energy efficiency. Once conditions are right, then the opportunity will be there for providers to move into the market.

- As the market develops we believe that the major player in the market will be "Energy Service Providers". These may well be existing utilities, but could also be new entrants, such as major supermarkets, which have excellent links to the home consumer. The operating scenario envisaged here is for an Energy Service Provider (ESP) to agree a 'Service Level Agreement' with a consumer to operate their home to a specific temperature comfort level for an agreed cost (which may well be fixed over a period of time to attract the consumer). In return the ESP will have environmental control and monitoring systems installed in the home (comprising sensors, wirelessly linked to a controller) and linked via broadband to the ESP's automated monitoring operations. The ESP will utilise Energy Optimisation and Trading Software to run a large network of homes, optimise their use of energy and trade excess energy on the grid.

- The strengths of UK industry in this sector today is in Sensor and Control technologies, Telecommunication, Utilities (and potentially large supermarkets who decide to become an ESP) and in software development. There are certainly opportunities for UK companies in developing intelligent software for monitoring and optimisation massive and complex networks of homes (expertise akin to that provided by Autonomy Corporation PLC).

- Weaknesses of the UK industry are with installers who are limited in their expertise and architects, who have not had the degree of experience in implementing 'Smart Homes' that competitors in countries such as the Netherlands, Germany and Denmark have had.

- The DTI Technology Programme issued a call in April 2006 on 'Energy Efficiency' in the built environment which was looking at holistic optimum design of buildings, and buildings management systems. The call included four themes of relevance to this area: Holistic Optimum Design; Advanced Building Management Systems; Home Appliance Networking; Demand Controlled Ventilation.

A2.4.3 Vision for the UK Industry

The workshop developed a 2015 vision for the UK industry which was considered 'Ambitious but achievable', this comprised the following elements:

- An EU set of integrated standards for the 'Smart Home will be in place by 2015 to cover interoperability of technologies
- There will be low cost technologies available (e.g. sensors) together with suitable power management technologies for operation in homes
- Develop UK expertise in software for optimisation and control of networks of multiple buildings
- The availability of an energy service offering, enabled by integrated technology offering and changes in OFGEM regulations
- Building regulations improve to trigger the need for increased energy efficiency
- A strong UK body exists for 'Smart Buildings' which drives standards, provides an effective forum and competence centre for members and lobbies government departments
- Emergence of major Energy Service Providers in the UK
- Government investment in UK software sector for development of network monitoring and optimisation software

A2.4.4 Strategy to achieve vision

The workshop used strategic road-mapping to develop a potential strategy for the UK industry to achieve the proposed vision, with the objective of identifying the key activities required and highlight the potential barriers. Within the time constraints of this project, this roadmap is by intent at an overview level – further insight would be gained from additional review and analysis.

The strategic roadmap aligns the required product/service offerings, over time, with the opportunities and threats posed by market and external events, It then identifies the required technologies to enable these new offerings and also enablers within the industry itself such as skills, investment etc.

The summary roadmap is shown below with a more detailed one in the Appendix.

	2006-08	2009-12	2013-15
Market + Externals	•Energy performance in Buildings directive for homes •UK-wide mandatory water metering •10% of energy in new homes from renewables •All companies brought into carbon trading scheme	•New UK and EU standards for building energy efficiency drives use of ICT systems for building environmental efficiency •Introduction of standards to enable interoperability of smart home devices •UK introduces carbon trading scheme for individuals •Increased energy shortages occurring	•First new UK nuclear capacity comes on stream
Product and service offerings		•Availability of low cost building management devices and sensors •Availability of systems for remote control of energy usage in homes •Market entry of integrated energy services providers – utilities and new entrants	▪Carbon credit card
Enabling technologies	•New power and metering technologies •Integration of building systems with external networks for monitoring and optimisation	▪Systems management solutions for network management ▪Software solutions for optimisation of networks of home energy consumers	▪Hydrogen fuel storage and energy management
Required UK industry enablers	•Launch of an agency to promote 'Smart Homes' •UK government funded Smart building/home demonstrator programme	•Improved installer skills, through education and accreditation •EEC and ECA applied to smart meters and other Smart buildings •Government mandating of energy monitoring devices in white goods •Public procurement of buildings with smart building technologies in place •Industry standardisation for inter-operability	

Figure 2: Strategic roadmap for ICT-enabled environmentally smart buildings up to 2015

Commentary from the roadmap:

- The road-map shows that proven offerings that are cost-effective will not be suitable for homes or small commercial buildings until 2009 onwards. Current Building Management Systems are too expensive and complex for these smaller buildings. In addition, the interoperability between different in-building devices and the ability to link them to an internet-enabled network for remote monitoring and control requires the development of suitable technologies and perhaps standards. We see the need for government-sponsored support in bringing existing technology to market in the form of large scale demonstrators and in supporting R&D for new technologies.

- However, technology development is not the only issue that needs to be addressed. The market itself needs to be further developed by increased regulation to drive consumer desire for improved energy efficiency in their homes. It is very likely that this will be assisted with increasing energy prices over this period.

- To support the emergence of ESPs, changes in OFGEM regulation will be required.

- The value chain for this industry in the UK needs to be aggregated, and we see the need for a well-funded agency to promote 'Smart Homes' in the UK to assist in this

A2.4.5 Barriers to realizing vision

The workshop participants identified the key barriers to achieving the proposed vision for the ICT-enabled Smart Buildings sector:

1. Providing an holistic integrated solution that can be provided cost-effectively, installed and operated reliably for private homes.

2. Informing and encouraging private consumers to utilise a solution for smart homes – likely to be provided by an energy utility as part of an overall service offering.

3. Fragmented nature of current value chain for the required technologies and services.

4. No ‘one-stop’ solution exists for home energy optimisation solutions. No resulting major demonstrator in place to show the availability of this technology, the benefits and issues.

5. Regulatory barriers to establishing an ESCO (Energy Supply Company) as they would be well placed to drive the development of an overall solution and the uptake by consumers.

6. Lack of proven energy savings together with implementation and running costs to enable a business case to be developed for use.

7. Interoperability of the different devices needed for a home energy management solution.

8. Lack of a cohesive government strategy and programme to develop a ‘joined up’ solution to utilise smart-home technologies to reduce energy consumption in homes.

9. Lack of an integrating player – white goods company, Microsoft, Utilities company, Telco other?

10. The commercial market model is not yet clear.

11. Housing Associations have the goal to improve efficiency and reduce fuel poverty, but do not yet have an available solution that meets their needs.

12. Current issues in consumers selling excess power to the grid.

13. Limitations in remotely controlling white goods, boilers, lighting etc – existing products can’t do – legacy of old products in houses.

A2.5 Appendix

Strategic roadmap for UK contaminated land remediation sector - detail

	2006-08	2009-12	2013-15
Market + Externals	• Continuation and enhancement of UK remediation tax break and other fiscal incentives •Introduction of practical waste guidance from DEFRA etc with examples •Improved clarity on risks (SGVs etc) for risk assessment from DEFRA and Environment Agency •Transposition of EU environmental liabilities directive •Major UK developments in Thames Gateway and Olympics •Increased landfill tax escalator	•EU soil framework directive •80% brownfield quota in UK •Opening of Asian markets for remediation •2012 Olympics in London •Possible acceleration of renaissance of UK Northern cities •Part IIA remediation	•UK Olympic legacy •MOD execute its obligations on land cleanup •Potential legislation in UK to ban landfill of soils
Product and service offerings	• New field assessment techniques •Small site remediation solutions •Rapid remediation solutions •Gate treatment at landfill sites •Cluster remediation sites for development areas	• Soil treatment centres for single contaminants •Solutions for mixed contamination sites •Remediation solutions for hardcore sites (currently sitting in landbanks) •Treatment for high organic content soils	
Enabling technologies	•Improved application of geophysics – down-hole and ground penetrating radar – for assessments •Improved application of current technologies •New technologies and applications from funded collaborative R&D •Advanced oxidation processes •Brokering in Soils	▪ Electrochemical approaches ▪Advanced thermal techniques ▪Advanced biochemical solutions	▪Breakthrough in biokinetics enabkes fast and effective in-site treatment ▪Nanotechnology
Required UK industry enablers	•Improved remediation plant capacity •Training in core science at Universities (e.g. Hydrogeology) •Technical training for remediation systems •Application training in remediation •Improved skills accreditation of companies and people 'Remediation Industries Accreditation' •Launch of an 'Institute for Land Remediation' •Ongoing DTI funding for near-market R&D •Funding for long-term R&D in remediation •Launch of new Faraday for remediation technologies •Introduction of more realistic remediation contract liabilities and terms •Available government database on remediation technology approvals •Recognition of MCerts for chemical testing of soils at EU level •Enforcement of Part IIA by Local Authorities	•MCerts for soil sampling •Recognition of value of treatment based remediation (enabling a 'healthy market') – reasonable client expectations on time, cost and certainty •DTI-led trade mission to Eastern Europe for remediation •Balanced UK supplier base with some consolidation into bigger more mature players •Improved working between UK Assessors and Remediation companies to generate downstream UK remediation work •DTI provide good information (inc metrics) on remediation marketplace to help suppliers	

Strategic roadmap for ICT-enabled environmentally smart buildings sector - detail

	2006-08	2009-12	2013-15
Market + Externals	•Energy performance in Buildings directive applies to private housing from June 2007 •UK-wide mandatory water metering •10% of energy in new homes to come from renewables •All companies brought into carbon trading scheme	•Increased EU levels and approval of smart homes technology •UK government incentives to increase level of local energy generation •BREEAM excellence ratings for all new builds •All new buildings to have smart metering as part of Energy Performance in Buildings directive •UK introduces carbon trading scheme for individuals •EU standards in place for SMART building systems interoperability •Increased energy shortages occurring •New UK building regulations for insulation and enabling CHP	•First new UK nuclear capacity comes on stream
Product and service offerings		•Availability of low cost building management devices and sensors •Availability of systems for remote control of energy usage in homes •Market entry of integrated energy services providers •Utilities introduce service level offerings to homes for energy services •Supermarkets, Telcos and other providers compete with traditional utilities to provide housing warmth •Carbon obligations on energy suppliers passed on to consumers requiring in-home monitoring to meet	▪Carbon credit card
Enabling technologies	•Micro CHP, Cheap PV •Smart metering integrated with building renewables to enable remote monitoring and export of excess energy to the grid •BMS systems integrated with digital TV/media networks	▪Low power inverters (for control of local renewable energy systems (e.g. windpower) ▪Systems management solutions for network management ▪Software solutions for optimisation of networks of home energy consumers	▪Hydrogen fuel storage and energy management
Required UK industry enablers	•Launch of a well-funded agency to promote 'Smart Homes' •UK government funded Smart building/home demonstrator programme (possibly leveraging Thames Gateway/Olympics)	•Improved installer skills, through education and accreditation •EEC and ECA applied to smart meters and other Smart buildings e-enabled technologies •Government mandating of energy monitoring devices in white goods •Public procurement of buildings with smart building technologies in place •Introduction of Stamp Duty on housing purchase based on level of energy efficiency in the house •Industry standardisation for inter-operability	

ANNEX 3. Size of Global Environment Markets

The following summary of global market data is drawn from sources listed in the bibliography. Where a country doesn't appear and/or there is no data for a particular cell, this indicates that it has not proved possible to identify any data for that country.

Total	**World**	**France**	**Germany**	**US**	**Japan**
	2001: $548 billion (EBI 2004a) (uses EBI definition)	2002: $22.2 billion pollution control equipment (USCS 2004a)	2003: €1.58 billion industrial expenditure on environmental protection (excl. construction) (SBD 2006)	2001: $211.2 billion (EBI definition) (EBI 2004a); 2002: $220 billion, 1.6 million jobs, 60000 firms, 2003: exports $23.3 billion (doesn't include water supply, only some waste management) (ITA 2004); 2004: $78.5 billion (solid/haz waste management, wastewater treatment, pollution control services, analytical services) (Datamonitor 2005a)	2001: $93.3 billion (EBI def.) (EBI 2004a); 2002: $92.4 billion (ITA 2004)
	China	**India**	**South Africa**	**Brazil**	**Mexico**
	2000: $30bn output value of environmental products, $68bn resource comprehensive utilization, and $1.2 billion environmental services, total production value of environmental industry $13 billion (ITA 2005) 2003: $17.5 billion pollution control equipment (USCS 2004a)	2005: $13.5 billion environmental market (Singhal 2004); 2002: $4.17 billion pollution control equipment (USCS 2004a); 2004: $5.29 billion environmental management technologies/equipment and services (USCS 2004b)	2003/04: $10.7 million gov't. expenditure on pollution abatement (not including sewerage and sanitation) (SSA, 2006)	2004: $1.8 billion, total of air, water, waste (USCS, 2005d) 2003: $2.94 billion pollution control equipment (USCS 2004a); 2003: $2-3 billion (equipment, engineering and consulting services and instrumentation associated with pollution control and cleanup) (UKTI, 2003a); 2001: $3193 million (USCS 2002)	2003: $5.2 billion technologies and services market (ITC 2005a); 2001: $3.6 billion (EBI def.) (EBI 2004a); 2002: $2.9 (ITA 2004); 2002: $1.987 billion pollution control equipment (USCS 2004a)

APC	**World**	**France**	**Germany**	**US**
	2001: $34 billion (EBI 2004a)	2003: €1940 million (includes clean vehicles, sulphur-free fuel, biofuels) (IFEN 2005); 2002: €212 million (€79 million monitoring, €133 million industrial abatement) (UKTI, 2003b)	2002: €3.03 billion gov't and production industry expenditure on protection of ambient air (SBD 2006); 2003: €634 million industrial investment in air quality control (excl. construction) (SBD 2006)	2003: household filters and purifiers, $.6 billion (EBI 2004b); 2003: APC equip, vehicles and stat. sources, $18.53 billion (EBI 2004b); 2001: $18.2 billion (EBI 2004a)
	India	**Brazil**	**Mexico**	
	2004?: industrial $0.4 billion, vehicular $0.6 billion (USCS 2005a) 2004: $423 million (USCS 2004b)	2004: $70 million (including equipment, engineering, consulting services and instrumentation) (USCS, 2005d) 2001: $230 million (USCS 2002)	2003: $80-85 million auto emissions control and testing equipment (USCS, 2003a) 2001: $0.14 billion (EBI 2004a)	

CTP	**World**	**France**
	2001: $3 billion (EBI 2004a) (process and prevention technology equipment)	2003: €1627 million (R&D) (IFEN 2005)
	US	**Mexico**
	2003: hybrid cars, $1.62 billion, green buildings (value put in place) $11.85 billion (EBI 2004b); 2001: $1.4 billion process and prev. tech equip (EBI 2004a)	2001: $0.04 billion process and prev. tech. Equip. (EBI 2004a)

CLR	**World**	**France**	**US**
	2001: $29.4 billion (EBI 2004a) (may include MPC); 2004: $26.91 billion (Datamonitor 2005a) (includes industrial services)	2002: €1 billion (remediation, related equipment and services) (Wakai, 2002); 2002: €105 million (UKTI, 2003b)	2003: site remediation/ind. decontam & cleanup, $12.39 billion (EBI 2004b); 2001: $11.1 billion (EBI 2004a); 2004: $8.10 billion (Frost & Sullivan 2005b)
	Japan	**Brazil**	**Mexico**
	2003: $900 million (USCS 2004c)	2004: $60-80 million (USCS, 2005h)	2005: $1 billion (ITC 2005b);

	World	France	US
			2001: $0.3 billion (EBI 2004a)

	World	US
EM	See RE	2003: household compact fluorescents, $.58 billion, super-efficient appliances $2.4 billion (EBI 2004b); 2005: Energy Service Companies revenue $2.1 billion (Frost & Sullivan 2006)

	World	France	US
ECS	2001: £31.5 billion (EBI 2004a); 2004: $46.1 billion (Datamonitor 2005a) (consulting and engineering)	2002: €700 million (env. engineering) (UKTI, 2003b)	2003: env. Consulting and engineering, $19.08 billion (EBI 2004b); 2001: $16.6 billion (EBI 2004a)
	India	**Mexico**	
	2004: $159 million (USCS 2004b)	2001: $0.11 billion (EBI 2004a)	

	World	US
EMI	2001: $6.6 billion (instruments) + $3.8 billion (analytical services) (EBI 2004a); 2004: $4 billion (analytical services) (Datamonitor 2005a)	2003: env. Instruments and information systems, $3.97 billion, lab testing and vehicle smog tests $4.07 billion (EBI 2004b); 2001: instruments $2.4 billion, analytical services $1.3 billion (EBI 2004a)
	India	**Mexico**
	2004: $53 million (USCS 2004b)	2001: instruments $0.08 billion, analytical services $0.03 billion (EBI 2004a)

	France	Germany
NVC	2003: €1405 million (IFEN 2005); 2001: €613 million (building insultation €534 million, outdoor acoustic walls €79 billion) (UKTI, 2003b)	2002: €310 million gov't and production industry expenditure on noise abatement (Fed. Stat. Off. Germany 2006); 2003: €97 million industrial investment in noise abatement (excl. construction) (SBD 2006)

	World	EU 25	US	Japan
RE	2001: $23.9 billion (including energy efficiency, demand side management) (EBI 2004a): 2005: biofuels $15.7 billion, wind (capital costs) $11.8 billion, solar PV (including installation) $11.2 billion, fuel cells and distributed hydrogen $1.2 billion (Makower 2006) 2004/5: $42.2 billion investment in clean energy (Liebreich, 2005)	2005: $9 billion (Frost and Sullivan 2005d) (unclear what this includes)	2003: household solar energy systems, $.2 billion (EBI 2004b); 2003: clean energy systems and power sales, $12.73 billion (Solar, wind, biomass, landfill gas, fuel cells, geothermal, small scale hydro) (EBI 2004b); "US Renewables sector represents ~ US$13 billion annually" end 2004, 17,000 MW installed, annual increase 880MW in 2004 up to 4000 MW in 2013 (Rosenfeld 2005); 2001: $10.8 billion including energy efficiency and demand side management (EBI 2004a)	930 MW wind power end of 2004 (Takegoshi 2005)
	China	**India**	**Mexico**	
	end 2004, 1.32 GW (UKT&I 2006)	2004?: $500 million for RE equipment (USCS 2005b) 2004?: $2.5 billion including energy efficiency (USCS 2005a)	2001: $0.11 billion, including energy efficiency and demand side management (EBI 2004a)	

	World	EU 25	France	Germany
WWT	2001: water utilities $87 billion, water treatment works $78.6 billion, water equipment and chemicals $43 billion (EBI 2004a); 2003: $300 billion end price for water consumption and treatment (ABS Energy Research 2003); 2004: $604.8 billion water provision revenue (Datamonitor 2005b)	2004: $257.7 billion water provision revenues, includes Russia and probably other non-EU countries (Datamonitor 2005b); 2004: $620 million outsourcing of industrial water treatment (Frost & Sullivan 2005g); 2005: $57 million membrane bioreactor market (Frost & Sullivan 2005c); 2002: €7200 million wastewater treatment,	2003: wastewater €11155 million, supply of drinking water €7461 million (IFEN 2005); 2002: water supply industry turnover €10139.5 million, gross investment in tangible goods €368.5 million, 34701 employees (Eurostat 2006); 2004: water provision revenues $21.1 billion (Datamonitor 2005b) 2005: €11 billion WWT market; €1 billion repair and renovation of wastewater sewage lines (USCS, 2005e)	2002: €16.320 billion gov't, production industry and privatised public entity expenditure on water treatment (SBD 2006); 2003: €631 million industrial investment in water protection (excl. construction) (SBD 2006); 2002: €7.9 billion water supply industry turnover, €2.5 billion gross investment in tangible goods (Eurostat 2006); 2004: $36.4 billion water provision revenues (Datamonitor 2005b) 2005: $5 billion p.a. invested in wastewater treatment, expected to decline to 2008; $430 million on water treatment equipment (Dose, 2005)
	China	**Japan**	**India**	**US**
	2004: water provision revenues $34.4 billion (Datamonitor 2005b)	2004: water provision revenues $28.3 billion (Datamonitor 2005b) 2003: $12.4 billion investment in water supply facilities, $29.4 billion sewage systems, $3.6 billion wastewater treatment equipment (USCS, 2005f)	2004: water provision revenues $19.1 billion (Datamonitor 2005b); 2004?: water market $1 billion, one-third provisioning, one-third municipal treatment, one-third industrial treatment. Water treatment chemicals $150 million (USCS	2003: water treatment equipment and chemicals, $21.4 billion, wastewater treatment $30.42 billion, water utils $32.56 billion, home drinking water systems $1.36 billion (EBI 2004b); 2001: Water equip $17.1 billion, water treatment works $31.6 billion, water utils $33.7 billion (EBI 2004a); 2004: municipal water equipment (exc. pipes and fittings) $4.1 billion (40% of water usage in

	World	EU 25	France	Germany
		2003/04: $471 million water quality inspection and disinfection services (SBJ, 2006)	2005c); 2004?: $1.24 billion (USCS 2005a)	US) (Frost and Sullivan 2005a); 2004: microfiltration membranes (for ultrapure applications) $792 million (Frost & Sullivan 2005f); 2004: water provision revenues $115.8 billion (Datamonitor 2005b)

	South Africa	Brazil	Mexico
WWT (continued)	2004: water provision revenues $12.7 million (Datamonitor 2005b) 2003/04: $498 million gov't expenditure on water schemes and services; $1269 million gov't. expenditure on sewerate and sanitation (SSA, 2006)	2004: $1.1 billion (including equipment, engineering, consulting services and instrumentation) (USCS, 2005d) 2004: $1.1 billion investment in basic sanitation ($1.6 billion forecast by utilities for 2005) (USCS, 2005i) 2004: water provision revenues $9.2 billion (Datamonitor 2005b); 2001: $1.6 billion water and wastewater treatment (USCS 2002)	2001: water equp $0.4 billion, water treatment works $$0.65 billion, water utils $0.76 billion (EBI 2004a); 2004: water provision revenues $10.6 billion (Datamonitor 2005b) 2005: $369 million industrial wastewater equipment and services (Ceron, 2006) 2003: $2.6 billion equipment and services for whole market (including irrigation and desalinisation) (Ceron, 2004) 2004: $442 million equipment and services for potable water supply (Ceron, 2005b)

	World	France	Germany	US	Japan
WM	2001: equipment $32.6 billion, hazwaste $17.8 billion, resource recovery $35.7 billion, other WM $120.7 billion (EBI 2004a); 2004: $102.9 billion WM services, $18.7 billion hazwaste (Datamonitor 2005a)	2003: waste €10522 million, radwaste €594 million, streetcleaning €1106 million, recycling €4937 million (IFEN 2005) 2003: recycling industry turnover €5482.2 million, gross investment in tangible goods €335.1 million, 27780 employees (Eurostat 2006) 2002: €4869 million	2002: €14.31 billion gov't, production industry and privatised public entity expenditure on waste management (SBD 2006); 2003: €190 million industrial investment in waste management (excl. construction) (SBD 2006); 2003: €3.8 billion recycling industry turnover, €163.8 million gross investment in tangible goods (Eurostat 2006)	2003: WM and recycling equip, $9.8 billion, solid waste management and recycling $43.17 billion, hazwaste including nuclear $4.54 billion, recovered material sales $16.7 billion, consumer goods made from recyc. Mat. $3.23 billion (EBI 2004b); 2001: WM equip $9.5 billion, WM $41.9 billion, HazWM $5 billion, resource recovery $10.5 billion (EBI 2004a)	2003/04: $10 billion domestic waste disposal and sewage; $12.2 billion industrial waste; $126 million other waste (including nuclear) (SBJ, 2006)
	China	**India**	**Brazil**	**Mexico**	
	2004-06: 15 billion RMB planned for medical, hazardous, radioactive waste treatment and disposal facilities, actual investment much slower (USCS 2005g)	2004?: $2 billion (USCS 2005a)	2004: $630 million (including equipment, engineering, consulting services and instrumentation) (USCS, 2005d) 2001: $1.2 billion solid waste treatment (USCS 2002)	2005: $800 million hazwaste (ITC 2005b); 2001: WM equip $0.23 billion, WM $0.46 billion, HazWM $0.08 billion, Resource recovery $0.22 billion (EBI 2004a) $558 million hazwaste equipment and sales (including land remediation) (Ceron, 2005a)	

	France	
Other	2003: general administration €2087 million, improvement of quality of life €2971 million (IFEN 2005)	