

Market opportunities in environmental goods and services, renewable energy, carbon finance and CATs

Country report: USA

October 2008

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This report is one of seven on the opportunities for exports to, and direct investment and joint ventures in, the markets for environmental goods and services (EGS), carbon abatement technologies (CATs), renewable energy and carbon finance in selected countries (see Annex A for definitions of these sectors). It should be noted that the nuclear sector was excluded from the review. The other countries are Australia, Brazil, China, India, South Africa and Turkey – representing a mix of emerging/high growth and developed overseas markets in these sectors.

The findings from the reports have been fed into an overview report which:

- provides an assessment of the UK's competitive advantage in EGS, CATs, renewable energy and carbon finance,
- maps this onto the market opportunities as revealed from the case studies, and
- suggests the opportunities for UK exporters and direct investors by market and sector.

The report considers the general market opportunities presented in the selected countries. It is based on desk research that drew on the most readily available and accessible information sourced from within the country concerned and from international agencies.

It provides background designed to be helpful in focusing the more detailed investigations that will need to be carried out by anyone interested in selling to or investing in the relevant markets and countries.

The report does not assess specific opportunities for UK exporters and/or investors – or their appropriate route to market. However, it shows where there are significant market opportunities in environmental goods and services, renewable energy, carbon finance and CATs.

Summary of market opportunities in environmental goods and services, renewable energy, carbon finance and CATs

Opportunities

- 1 There are significant opportunities in the USA for exports and/or direct investment in hazardous waste management, solid waste management, water and wastewater treatment, as well as in advanced conventional energy generation and renewable energy. There are future opportunities in air pollution control, cleaner technologies, generation technologies and asset management. A map of current and future opportunities in the environmental and low carbon markets in the USA is set out below.

| Sector | Current opportunities* | Future opportunities | Policy framework (current) |
|--|------------------------|----------------------|----------------------------|
| Environmental Goods and Services | | | |
| Air pollution & control | 😊 | 😊 | Good |
| Cleaner technologies | 😊 | 😊 | Good |
| Energy management | | | |
| Environmental consultancy | 😐 | 😐 | |
| Environmental monitoring | 😐 | 😊 | Good |
| Marine pollution | | | |
| Noise & vibration | | | |
| Land remediation | 😐 | 😊 | Fair |
| Waste management | 😊 | 😊 | Good |
| Water supply | 😊 | 😊 | Good |
| EGS overall | 😊 | 😊 | Good |
| Carbon Abatement Technologies (CAT) | | | |
| CCS | 😐 | 😊 | Good |
| Generation technologies | 😐 | 😊 | Good |
| Low carbon transport fuels | 😊 | 😊 | Good |
| Asset management | 😐 | 😐 | |
| CAT overall | 😐 | 😊 | Fair |
| Other opportunities | | | |
| Renewable energy | 😊 | 😊 | Good |
| Carbon finance | 😐 | 😐 | Fair (by state) |

| Key | | |
|-----|---|--|
| | 😊 | Relatively large market size and activity, relatively demanding regulation, relatively high public expenditure in this sector and relatively liberal trade and investment regime |
| | 😐 | Mix of modest market size and activity, modestly demanding regulation, modest public expenditure and liberalising but still restrictive trade and investment |
| | 😞 | No or minimal market size and activity, no regulation, and restrictive trade and investment regime |
| | | No or inadequate information |

* The assessment of current opportunities is based on the most recent official data and information on market size and sector activity. In many cases this can refer to 2005 figures and as such certain conclusions in this report may not capture very recent developments in some sectors or announcements concerning the near future. A variety of sources, methods and time-frames was drawn on to assess future opportunities – covering the next five-ten years based on government policies and/or budget allocations and/or independent forecasts and projections.

Market entry options

- 2 The United States is a relatively open global economy and has a history of supporting liberalisation in overseas trade and investment. Apart from a few import quotas and strategic industry-ownership restrictions, British firms doing business in the USA face few barriers. It is the UK's largest single export market and the UK is the sixth biggest exporter to the US, after Canada, Mexico, China, Japan and Germany. The USA is also the leading overseas destination for British investment. The availability of possible market entry strategies is summarised below:

| Route to market | Availability | Comment |
|---------------------------------|--------------|---|
| Export | • | The US is the world's largest export market for EGS and CATs |
| Foreign direct investment (FDI) | • | The US economy is the world's largest recipient of FDI |
| Joint venture (JV) | • | The US encourages JV initiatives and there are particular incentives for JV with UK and other EU businesses |

Source: SQW Consulting

Gaps in the evidence base

- 3 A thorough trawl of readily available reports, studies and policy statements with regard to the markets under review and consultations with stakeholders found little evidence on the opportunities in the USA in the following markets:
- Energy management (EGS)
 - Marine pollution (EGS)
 - Noise and vibration (EGS)
- 4 This is not to say that this evidence is unavailable. More information could undoubtedly be found on specific market opportunities and constraints from specialised and technical policy statements/guidance, journals and trade press. However, it was beyond the terms of reference for this review to investigate the opportunities in this degree of detail.
- 5 The report should be read as an introduction to the most significant opportunities in the US markets. It has been designed to provide a focus for the more detailed investigations that will need to be carried out by anyone interested in selling to or investing in the markets. In particular, it will be necessary to understand and assess the circumstances in each of the States within the USA which can vary considerably (for example, in terms of regulations) but the details of which were beyond the scope of this review.

1: Introducing the USA market

This section provides background information on the USA economy and the drivers and international legal dispositions affecting the growth of the market for environmental goods and services, renewable energy, carbon finance and CATs.

Key facts

- 1.1 The United States is a long established global centre for international trade in goods and services. The combination of a historically-stable economy, largely liberal trading regime and sound monetary policy have played a large part in making the US the world's largest national importer and host for overseas investment. Since the economic downturn of 2001/02 inflows of foreign direct invest have steadily increased from US\$1.34 trillion in 2001 to US\$1.79 trillion in 2006.

USA – KEY FACTS (2001-2006)

| | 2001 | 2002 | 2003 | 2004 | 2005 | 2006 |
|---|------|------|------|------|------|------|
| GDP growth (annual % at chained US\$2,000) | 0.7 | 1.6 | 2.4 | 3.5 | 3.0 | 2.8 |
| Gross capital formation (% GDP, chained US\$2,000) | 19 | 18 | 19 | 19 | 20 | 20 |
| Energy consumption per US\$ of GDP (1000 Btu per chained US\$2,000) | 9.7 | 9.7 | 9.5 | 9.3 | 9.1 | 8.7 |
| Net energy imports (% energy consumption) | 27 | 26 | 28 | 29 | 30 | 30 |
| Carbon dioxide emissions per capita (metric tonnes) | 20.2 | 20.2 | 20.2 | 20.4 | 20.3 | — |
| Imports of goods/services (% GDP) | 14 | 14 | 5 | 17 | 18 | 19 |
| Foreign Direct Investment inflows (US\$ trillion) | 1.34 | 1.33 | 1.4 | 1.52 | 1.59 | 1.79 |

Source: US Bureau of Economic Analysis and US Department of Energy (2006) 'Annual Energy review 2006'

Drivers in environmental goods and services, renewable energy, carbon finance and CATs

- 1.2 The expansion of the United States' economy has coincided with increasing greenhouse gas (GHG) emissions. In 2001 GHG emissions stood at 6,865 MtCO₂e (million metric tonnes carbon dioxide equivalent). Latest preliminary data for 2006 suggest GHG emissions were around 7,075 MtCO₂e. A significant reason for the scale of GHG emissions stems from the US being the world's largest producer and consumer of energy. In 2006, 56 per cent of energy production was in the form of domestic fossil fuels, and a further 29 per cent was through imported petroleum. Renewable energy comprised just 7 per cent of total production. For greater detail of the energy flows in the United States refer to Figure B-1 in Annex B.
- 1.3 A major factor contributing to increased demand for environmental goods and services and carbon abatement technologies is the current high oil price. This has the significant effect of reducing the cost differential between fossil fuels and alternative energy sources. This is particularly important given the US's considerable reliance on private, petrol-driven, transportation.
- 1.4 Energy security is also a key concern for the US. The US economy is currently dependent on importing large amounts of petroleum, typically from 'unstable' regions, to keep up with domestic demand. The US hopes to decrease its reliance on foreign oil through the development of domestic renewable energy sources. A goal has been set to replace 75 per cent of Middle East imports by 2025 and in doing so US\$10 billion has been spent between 2001 and 2006 on developing cleaner, alternative energy sources.
- 1.5 In addition, there is now significant political and public consensus that the US must act to address the long-term challenge of sustainable development and global climate change. This is manifested in recent government initiatives aimed at developing renewable energy technologies, reducing the nation's GHG emissions intensity, and replacing the use of petrol with alternative biofuels.
- 1.6 Although the current financial crisis (the 'credit crunch' of 2007-2008, attributed to the US sub-prime mortgage market) is having an overall negative impact on investment and imports, there is some anecdotal evidence to suggest that segments such as clean technologies and renewable energy are maintaining impressive levels of financial investment compared to other industries in the USA.

International legal dispositions

- 1.7 The United States participates in numerous multilateral and bilateral international agreements. Multilaterally, the US is the largest funder of activities under the United Nations Framework Convention on Climate Change (UNFCCC) and the Intergovernmental Panel on Climate Change (IPCC). The status of the US against key international conventions is summarised below.

Table 1-1: Status of the USA against key international conventions relating to the environment

| International convention | USA's status |
|--|--------------|
| UN Framework Convention on Climate Change | Ratified |
| Kyoto Protocol | Not Ratified |
| Ramsar Convention | Ratified |
| Asia-Pacific Partnership for Clean Development and Climate | Ratified |
| Long-range Transboundary Air Pollution Convention | Ratified |
| Montreal Protocol | Ratified |

Source: SQW Consulting

2: The market for environmental goods and services in USA

This section describes the growth market for environmental goods and services (EGS) in the USA and outlines the drivers of this growth. It then provides more information on those segments presenting significant market opportunities.

Market growth and its drivers

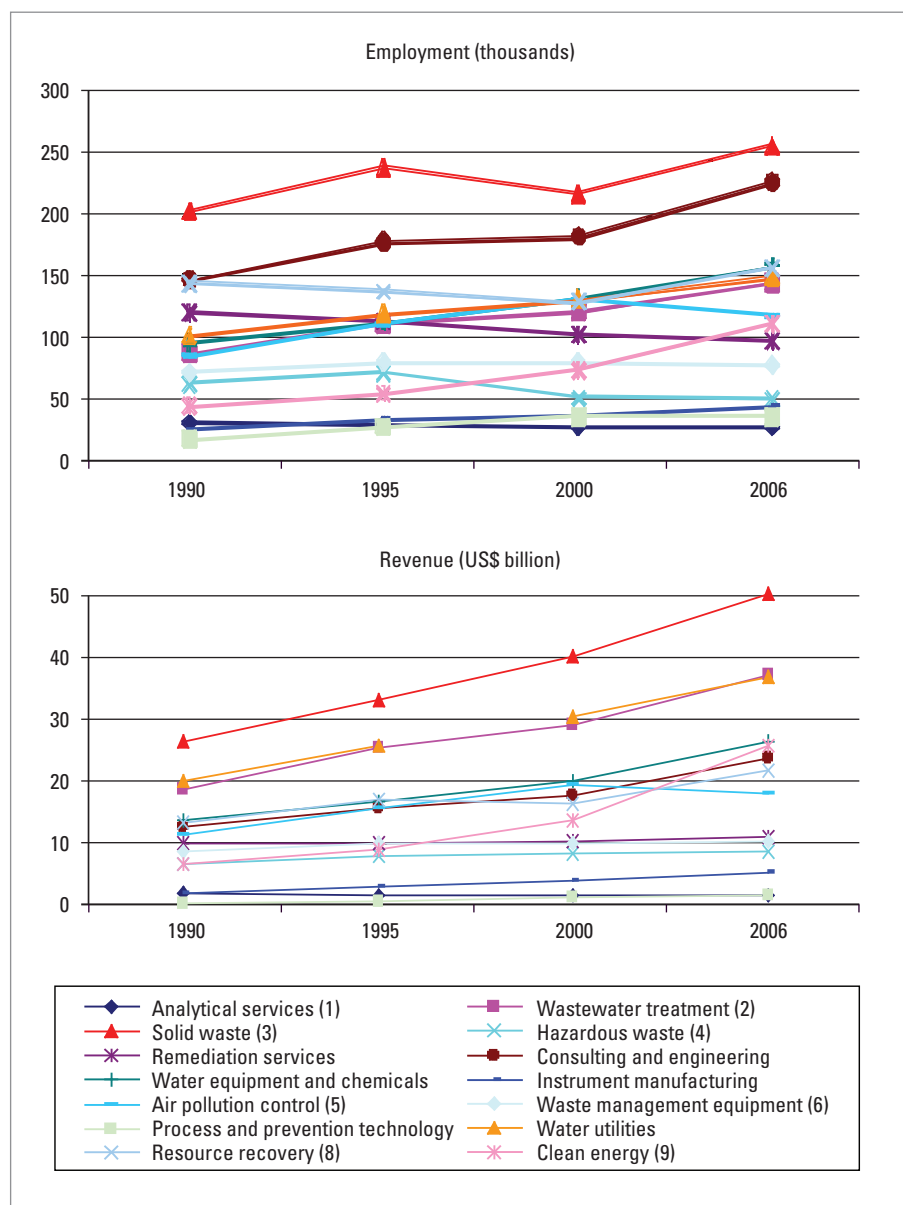
Growth

- 2.1 The US market for environmental goods and services (EGS) was estimated at US\$241 billion in 2004 (Environmental Business International, 2004). This represented a 5 per cent growth on the 2003 figure of US\$229 billion and comprised around 38 per cent of the 2004 global environmental market. The US had a positive trade balance of US\$2.9 billion in 2003 - US\$24.7 billion worth of exports being offset by US\$21.9 billion of imports.
- 2.2 As shown in Figure 2-1, revenue and employment in the environmental industry have seen steady growth – and fast growth in segments such as solid waste treatment. The largest segment in terms of both revenue and employment is solid waste management (US\$26 billion and 206,000 employees). Total industry revenue grew from US\$151 billion in 1990 to US\$274 billion in 2006. Employment also increased by 440,000 over the same period, from 1.1 million to 1.4 million.
- 2.3 In many segments of the United States' environmental industry domestic firms compete alongside foreign owned firms or affiliates. For example, major firms in the solid waste management market include Waste Management (US), Allied Waste (US), and Onyx (France). In the water utilities and wastewater treatment segment, firms include RWE (Germany), Veolia Environment (France) and Kelda Group (UK). The substantial level of US imports is likely to be the result of increased purchases from US-based affiliates of European and international firms.

Drivers

- 2.4 Continued economic growth and expansion in the US has driven demand for environmental goods and services, reinforced by regulation and stricter environmental standards. In some segments, for example air pollution abatement, the US has had demanding regulatory standards for many years. The United States Congress originally passed the Clean Air Act in 1963 to enforce clean air standards. The Act has seen numerous amendments since its inception to more resolutely enforce emissions standards.
- 2.5 Recently, the United Nations Framework Convention on Climate Change (UNFCCC) has driven the need for better air pollution monitoring systems as well as providing impetus to further reduce GHG emissions. In addition, many States are taking the initiative at the local and regional level to reduce air pollution. California has imposed strict air pollution rules forcing car manufacturers to build more environmentally friendly vehicles and ten north east and mid-Atlantic States have developed a Regional Greenhouse Gas Initiative to better co-ordinate emissions reductions through a regional strategy.

Figure 2-1: US Environment Industry – Revenues and Employment by Industry Segment: 1990 to 2006



Source: US Census Bureau (<http://www.census.gov/compendia/statab/tables/08s0372.pdf>).

- (1) Covers environmental laboratory testing and services.
- (2) Mostly revenues collected by municipal entities.
- (3) Covers such activities as collection, transportation, transfer stations, disposal, landfill ownership, and management for solid waste.
- (4) Transportation and disposal of hazardous, medical, and nuclear waste.
- (5) Includes stationary and mobile sources.
- (6) Includes vehicles, containers, liners, processing, and remediation equipment.
- (7) Revenues generated from the sale of water.
- (8) Revenues generated from the sale of recovered metals, paper, plastic, etc.
- (9) Revenues generated from the sale of equipment & systems and electricity.

- 2.6 The United States' growing population also adds pressure to maintain environmental protection and drives demand for environmental goods and services. Although the volume of municipal solid waste per capita has remained stable since 1990, the growing population means total waste has continued to increase. This has encouraged the development of recycling, waste-to-energy schemes, and demand for improved waste management systems.
- 2.7 Major investment in the water utilities and wastewater treatment infrastructure has been highlighted by the US Environmental Protection Agency (EPA). Between 2003 and 2023, an estimated US\$277 billion of spending is required to upgrade and maintain the nation's water systems. The US has a major trade deficit in the market (US\$5.3 billion in 2002) and it is expected that major European firms are likely to provide much of the expertise needed.
- 2.8 Consultations carried out for this review amongst UK Trade & Investment (UKTI) staff highlighted the growing demand from America's largest companies for EGS, particularly waste reduction. The examples of Wal-Mart and Dell demonstrates the increasing awareness that US 'big-business' can achieve efficiencies and cost reductions through applying EGS.

In October 2005, Wal-Mart announced it would implement several environmental measures to increase energy efficiency. The primary goals included spending US\$500 million a year to increase fuel efficiency in Wal-Mart's truck fleet by 25 per cent over three years and double it within ten, and cut solid waste from US stores by 25 per cent in three years. Through working with environmental consultants, Wal-Mart found that it could save US\$2.3 million a year on shipping costs through eliminating excess packaging on just one line of children's toys. (Gunther, CNN, 2006)

Similarly, US information technology manufacturer Dell has instigated a power management programme to increase resource efficiency. A 2007 pilot on more than 50,000 computers on the company's internal network resulted in savings of about 13 million kWh of electricity, equivalent to avoidance of 8,500 tCO₂ and savings of US\$1.8 million annually.

Market segments

- 2.9 The segments with significant current and prospective opportunities are water and wastewater treatment, solid waste management, and air pollution control. These and other opportunities are considered more fully below.

OPPORTUNITIES IN ENVIRONMENTAL GOODS AND SERVICES IN THE USA

Water and wastewater treatment

With total revenues of US\$61 billion in 2002 (EBI, 2002 cited in Baumert and Bloodgood, 2004), the United States accounts for the largest share of the global water utilities and wastewater treatment market. During the period 1994 to 2002, revenues earned by the US water utilities and wastewater treatment industry increased at an average annual rate of 3 per cent. In total the industry comprised 87,000 firms and 255,000 employees in 2002.

The US water industry was valued at nearly US\$114 billion in 2006, a 5.3 per cent increase over the US\$108 billion market in 2005. Market growth is forecast at 4- 5 per cent, according to the Environmental Business International (2004).

Trade data indicate that the US water utilities and wastewater treatment industry registered total exports of US\$240 million and imports of US\$5.5 billion in 2002. This equated to a substantial trade deficit of US\$5.26 billion. Although in recent years exports have remained relatively stable, imports increased at an average annual rate of 19 per cent between 1994 and 2002.

The US water/wastewater industry is expected to require significant spending on infrastructure in the coming years (<http://epa.gov/waterinfrastructure/infrastructuregap.html>). The most recent Environmental Protection Agency drinking water survey (2005) found that the country's 53,000 community water systems and 21,400 not-for-profit non-community water systems will need to invest an estimated US\$277 billion between 2003 and 2023. Water supply is a crisis issue in a number of West and South US cities. For example, the city of Atlanta, Georgia has less than a 90 days supply on hand. Drought in the western US, particularly California, has already placed increasing pressure on these States to seek solutions including conservation, demand management and technology alternatives.

European firms are already engaged in the sector and, as evidenced above, there are likely to be further significant opportunities for overseas firms through exports and direct investment.

Waste management

The United States generated 250 million metric tonnes of municipal solid waste in 2006, 82 million tonnes of which was recycled and virtually all of which was managed. The US market for solid waste management in 2002 was estimated by the US International Trade Commission to be US\$42.8 billion employing some 275,000 individuals, in approximately 11,200 firms (USITC, 2004).

In 2002, imports of solid waste management greatly exceeded exports. US imports totalled US\$1.3 billion whilst exports were just US\$503 million. During the period 1994-2002, US exports decreased at an average rate of 6 per cent; however imports increased year on year at an average rate of 16 per cent.

The solid waste management industry is concentrated. The three largest firms in 2001 accounted for almost 50 per cent of total revenues, with each firm's individual revenues exceeding US\$2 billion in 2002. In 2001 land-fill accounted for over 50 per cent of US solid waste management disposal. Recycling programmes recovered around 30 per cent, with the leading recycled materials by weight being paper/cardboard, garden trimmings, metal and glass. A further 15 per cent was disposed of through 97 Waste-to-energy (WTE) facilities, generating energy for around 2.5 million US homes.

The number of US landfill sites is continuing to decline whilst total waste is increasing. In around 20 States, landfill capacity is considered inadequate for the next ten years. This presents a number of opportunities. Remaining landfills are likely to prolong their life spans through the increased use of bioreactor processing technologies, which accelerate waste decomposition. In addition, most States will be likely to emphasise source reduction as the centrepiece of solid waste management plans. Such plans are likely to stimulate additional market opportunities for environmental engineers, consultants, technology companies, and large multidimensional waste management firms providing services related to source reduction. Moreover, additional outsourcing of waste management services is expected to continue, as part of an accelerating trend across industries to outsource many facets of administration, sales, and marketing expenses.

Air pollution control

In 2004, the USITC estimated the market for air pollution control goods and services to be US\$52 billion, which constitutes around 28 per cent of the global market. This breaks down into US\$2.4 billion of engineering, consulting and monitoring services in connection with air pollution abatement and US\$49.4 billion of air pollution abatement goods. In the period from 1994 to 2004 the market for such goods and services grew at an estimated average annual rate of 7 per cent.

Environmental Business International (EBI) (2004) estimated that US firms principally engaged in producing air pollution control equipment generated revenues totalling US\$19.1 billion in 2003 and firms mainly engaged in engineering and consulting services on air quality generated US\$1.2 billion. Revenues earned by US firms grew rapidly from the 1970s to the 1990s; however since 2000 growth has slowed significantly. Revenue growth largely coincides with the period in which the US was considered the world's most stringent regulator of air quality.

In 2004, US air pollution control goods and services exports were estimated at US\$4.6 billion and imports at US\$2.5 billion. As a result the US had a trade surplus of around US\$2.1 billion. Key air pollution control technologies and equipment utilised in the US market include: fabric filters (baghouses), electrostatic precipitators, scrubbers, selective catalytic reduction, electro-catalytic oxidation, sorbent injection, flue gas desulphurisation, catalytic converters and infra-red sensors.

The market outlook for air pollution control and abatement goods and services is particularly strong. Globally, the advancement of emissions trading schemes is likely to drive demand, and all signatories of the UNFCCC have agreed to monitor and reduce greenhouse gas emissions. The US Clean Air Act (and its subsequent amendments) has been a historical driver of US domestic demand. In particular the USA introduced a cap and trade system for regulating SO₂ emissions in 1990, which led to the development of a substantial market trading mechanism for pollutants. New initiatives, such as the Regional Greenhouse Gas Initiative (known as RGGI, or ReGGIe), and the fact that almost half of US electricity generation is obtained through coal-powered power plants, should further ensure a robust market in this area.

Cleaner technologies

Cleaner technology is not an industry in its own right but rather a component of spending in all industries (UKCEED, 2006). A relatively large and growing market that typically falls into the clean technology category is the green building industry. A recent Frost and Sullivan report (noted in Environmental Leader (2008)) estimated the US green building industry revenues of US\$12 billion in 2007, and this figure could rise to approximately US\$42 billion by 2015.

The report's forecasts considered potential government mandates and the recent advances made in green building products of all sorts. It concludes that the building industry's greening is now 'inevitable' — spurred by concerns about global warming and the rapidly gaining popularity of the Leadership in Energy and Environmental Design (LEED) certification programme, which is administered by the US Green Building Council.

Technologies leading the growth of green building include: structural insulated panels (a type of composite building material) for residential and commercial buildings, mineral cement-based interior finishing products that offer significant waste reduction and cost-effective benefits, eco-friendly drywall, and super-insulating windows.

Land remediation

USITC states that global revenues for remediation services have grown from US\$26 billion in 1996 to US\$30 billion in 2002 (USITC, 2004). According to EBI (2004), US remediation services firms generated revenues totalling US\$12 billion and employed 112,000 workers in 2002. Remediation exports totalled US\$460 million whilst imports reached US\$400 million (referenced in USITC, 2004).

EBI also reports that in 2001, just over 50 per cent of US demand for remediation services was served by 15 firms, each with US\$100 million or more in revenues. A further 26 per cent was met by 59 firms with between US\$20-100 million in remediation revenues and 21 per cent by nearly 600 smaller firms.

In the 1990s, the US Departments of Energy (DOE) and Defence (DOD) had been the two largest consumers of remediation services. By 2001 the US Department of Energy (DOE) accounted for 29 per cent of remediation spend, but privately initiated remediation surpassed DOD work. Between 1997 and 2001 remediation spend from private work grew at an average annual rate of 15 per cent and USITC estimated in 2004 that the demand from private projects and DOE work should be at about the same level by 2006.

Overseas firms do not have a strong presence in the US market, although some operate through affiliates. Future demand is likely to remain driven by a mixture of regulation and reaction to environmental emergencies. The evolution of federal and State regulation is expected to drive major environmental projects, in addition to satisfying private and public interests in the development of brownfield sites.

Source: SQW from various sources

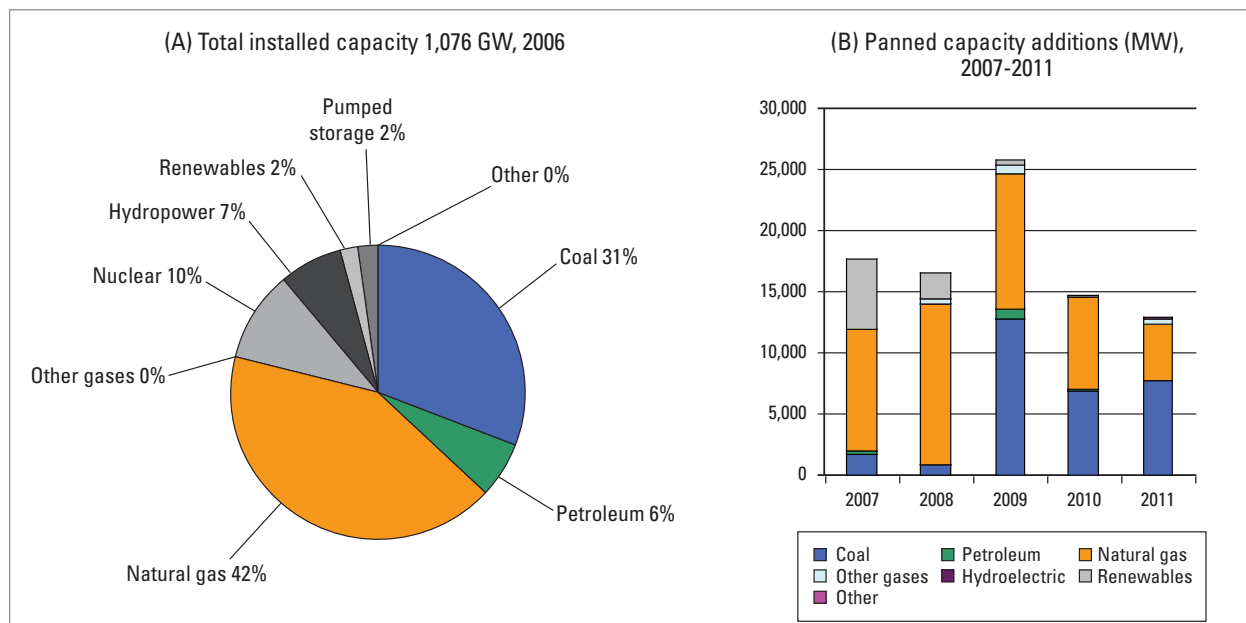
3: The market for carbon abatement technologies, renewable energy and carbon financing in the USA

This section summarises the readily available evidence on the market for carbon abatement technologies (CATs), renewable energy and carbon financing in the USA. It describes the general growth in the sectors and its drivers and presents information on those segments within the three sectors where there are significant opportunities.

Market growth and its drivers

- 3.1 The United States' energy demand was projected by the Department of Energy (2006) to increase by around 28-35 per cent between 2005 and 2030. This overall figure masks significant differences between specific sectors some of which were expected to experience substantial increases in future demand. The transportation sector, for example, was expected to need 43 per cent more energy in 2030, with annual crude oil consumption increasing from about 4.8 billion barrels in 2004 to about 6.8 billion barrels.
- 3.2 Similarly, the electricity sector was expected to grow by 50 per cent. Annual electricity consumption was forecast to increase from around 3,815 terawatt-hours (TWh) in 2004 to 5,300 TWh in 2030. In 2006, coal accounted for nearly half of all electricity generation followed by natural gas (20 per cent) and nuclear (19 per cent). Hydropower and renewables made up the remaining 12 per cent. This ratio is expected to remain largely the same in 2030, according to the US Energy Information Administration (EIA) (2008). The total installed generation capacity of the US was 1,076 GW (Figure 3-1 panel A) which in the short term to 2011 is planned to grow by another 87 GW of primarily coal and natural gas (Figure 3-1 panel B)

Figure 3-1: US electricity sector planned and installed capacity



Source: Energy Information Administration website, <http://www.eia.doe.gov/fuelelectric.html>

Market segments

- 3.3 The most active market segments currently and in the short to medium term are likely to be in low-carbon fuels and particularly wind and solar sources of renewable energy. Major investment has been made in furthering 'clean coal' technology and in the research and development of carbon sequestration. Bio-ethanol has considerable political support in light of the US's competitive advantage in corn production.

Carbon abatement technologies

OPPORTUNITIES IN CARBON ABATEMENT TECHNOLOGIES IN THE USA

Carbon Capture and Storage (CCS)

The National Energy Technology Laboratory (NETL) is owned and operated by the US Department of Energy. NETL's project portfolio includes research and development (R&D) activities conducted through partnerships, co-operative research and development agreements, financial

assistance, and contractual arrangements with universities and the private sector. NETL shapes, funds, and manages contracted research in the United States and more than forty foreign countries. Its research portfolio includes more than 1,800 projects, with a total award value of over US\$9 billion and private sector cost-sharing of over US\$5 billion.

NETL's Carbon Sequestration Programme involves two key elements for technology development: Core R&D, and Demonstration and Deployment. Core R&D integrates basic research and computational sciences to study advanced materials and energy systems. For example, NETL research and ongoing data collection on CO₂ storage has resulted in computer models that predict storage capacity and the permanence of CO₂ storage. Demonstration and Deployment speeds the development of new technologies through initiatives such as the Regional Carbon Sequestration Partnerships. Starting in 2008, these include large-volume sequestration tests to demonstrate the potential to store hundreds of years of CO₂ emissions. Technologies are being validated at test sites and ongoing data collection is confirming geologic and terrestrial sequestration capacity and effectiveness.

The Carbon Sequestration Programme's overall goal is to develop fossil fuel conversion systems that achieve 90 per cent CO₂ capture by 2012. The Department of Energy has so far awarded 4 regional partnerships with funding for large-scale sequestration projects. The most recent funding being US\$67 million to help demonstrate the permanent storage of 1 million tonnes of CO₂ in Illinois.

According to a 2005 DOE/NETL report, there is also State-led activity in the implementation of CCS technologies. Hawaii supports oceanic sequestration, Minnesota and Oregon seek to promote the health of their forests while sequestering carbon, and several Midwestern states (Nebraska, Wyoming, South Dakota, North Dakota, Oklahoma, Illinois, Oklahoma, and Idaho) have recognised the potential to capitalise on their farm and forest land to sequester carbon.

Combustion technology

Almost half of the electricity generated in the United States is from coal and US coal-fired plants have over 300 GW of capacity. According to the Pew Research Centre, of these, approximately one-third date from 1970 or earlier, and most of the rest from 1970-1989. Only 12 coal-fired plants have been built in the United States since 1990. At current consumption rates and with current technology and land-use restrictions, the US coal reserves have been estimated to last well over 250 years. Moreover, with improved technologies, estimated recoverable coal reserves at current consumption rates, are estimated to be sufficient for 500 years or longer.

Currently, the United States produces close to two billion tonnes of CO₂ per year from coal-burning power plants, as each 500-MW coal-fired power plant produces approximately three million tonnes per year of CO₂. The US Department of Energy's fossil fuel R&D programme seeks to drive all coal-fired power plant emissions to 'near-zero' levels by 2020. A further objective is to achieve up to 90 per cent of carbon capture and storage of remaining emissions by 2020. Work is also ongoing to improve the operational efficiency of coal-fired plants by up to 50 per cent by 2010 and 60 per cent by 2020.

The US recently proposed a US\$1 billion advanced 'clean coal' R&D project – FutureGen – with costs shared between the public sector (76 per cent) and industry (24 per cent). The aim for FutureGen was to demonstrate how Integrated Gasification Combined Cycle (IGCC) technology could improve generation efficiency and reduce emissions by integrating CCS capability. Although FutureGen was designed to be the first 'zero-emissions' coal-fired power plant the project has currently stalled due to issues regarding escalating costs and geographical location.

The development of energy-service companies (ESCOs) is providing opportunities for asset management in the CATs sectors. ESCOs are businesses that design and implement energy savings projects allowing building owners to upgrade their building assets. The ESCO performs an in-depth analysis of the property, designs an energy efficient solution, installs the required elements, and maintains the system to ensure energy savings during the payback period. The savings in energy costs are often used to pay back the capital investment of the project over a five to twenty-year period, or reinvested into the building to allow for capital upgrades that may otherwise be unfeasible.

The ESCO industry group in the USA was reported in 2008 to be growing at 22 per cent per year; up from 3 per cent per year five-eight years ago. The total revenues of 46 ESCOs surveyed by the group were approximately US\$3.6 billion in 2006 with around three-quarters coming from energy efficiency. Currently, around 80 per cent of ESCOs' customers in the USA are government departments and public institutions such as schools, hospitals and universities.

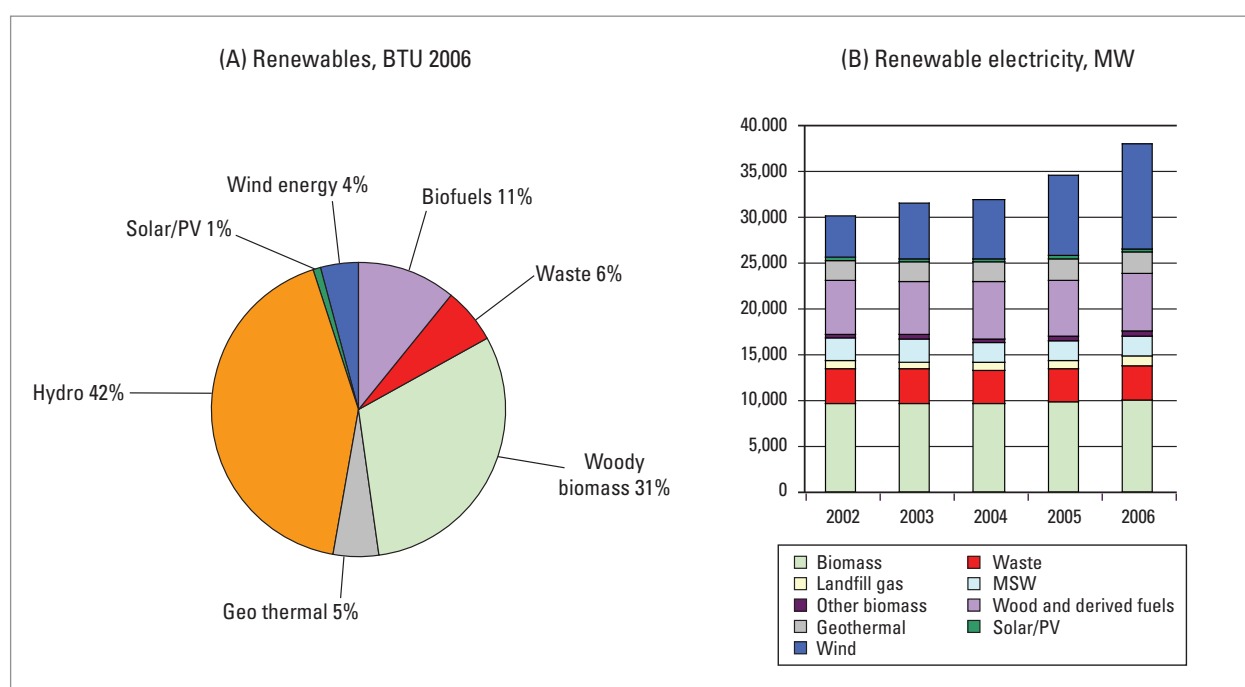
Source: SQW from various sources

Renewable energy

- 3.4 Initiatives aimed at stimulating the deployment of renewable energy technologies have numerous drivers in the US. Primarily there is the concern to meet the growing energy demand but other influences are at work such as reducing the adverse effects on the environment, encouraging the economic development of domestic industries, and providing reliable and diversified energy sources.
- 3.5 As panel (A) of Figure 3-2 shows, the largest renewable energy sources are hydroelectric (42 per cent), woody biomass (31 per cent) and biofuels (11 per cent). Renewable electricity capacity has grown over the last five years from around 96,000 MW in 2002 to 102,000 MW in 2006. Although conventional

hydroelectric accounts for almost three quarters of the total (excluded from panel (B) for illustrative purposes), there have been significant additions of wind capacity.

Figure 3-2: (A) US renewable energy consumption by source and (B) US renewable electricity capacity by source 2002-2006 (excluding conventional hydroelectric)



Source: Energy Information Administration <http://www.eia.doe.gov/>

- 3.6 Biofuels have been highlighted by the US government as a means to reduce reliance on foreign oil and to advance domestic interests. Around 18 per cent of land use in the US is arable land, giving considerable scope for biofuel crop production. US car manufacturer General Motors has already sold four million vehicles that use E85 biofuel (85 per cent ethanol - 15 per cent petrol) and by 2012 half of US production will run on E85 fuel.
- 3.7 The United States leads in venture capital investment, with over 60 per cent of the world's venture capital in clean energy during 2006, and a reported US\$800 million for biofuels alone. A 2008 report from the Renewable Energy Policy Network (REN21) suggested that a large majority of this has been directed towards developing and commercialising technologies for converting cellulose to ethanol.
- 3.8 Many States are taking a proactive approach to encouraging the development of renewable energy. As of 2006, 39 US States had established interconnection and net metering rules that require electric power companies to connect renewable energy sources to the transmission grid and to credit the monthly electricity bill of those residents with solar-electric systems when they generate more power than they use. Other specific examples include:
- New Mexico enacted a 30 per cent personal income tax credit (up to US\$9,000) for residents who purchase and install solar PV thermal systems
 - Minnesota mandated that all petrol sold in the state contain at least 10 per cent ethanol and as a result, a third of the US's E85 petrol stations are in this state.
 - Massachusetts has provided US\$2.5 million annually since 2002 in grants to consumers who install clean-energy technologies.

OPPORTUNITIES IN RENEWABLE TECHNOLOGIES IN THE UNITED STATES

Biofuels

In 2006, 106 biorefineries were operating throughout the United States to supply oil refineries and fuel suppliers. The long-term goal of the US Department of Energy's biomass R&D programme is to enable the US industry to produce biofuel equivalent to 30 per cent of current gasoline demand – about 60 billion gallons of biofuel per year by 2030.

In 2005, the United States overtook Brazil as the world's biggest biofuel producer; 95 ethanol refineries located in 19 States produced 3.9 billion gallons of ethanol - an increase of 17 per cent over 2004 and 126 per cent over 2001. In 2007 annual ethanol production soared by nearly two billion gallons to 7.8 billion gallons. The industry grew from 110 biorefineries operating in 19 States to 139 biorefineries in 21 States

In 2008, an estimated four billion gallons of ethanol production capacity will come online from 68 biorefineries under construction or expanding. Once all of the new construction currently underway is complete, the Renewable Fuels Association expects the US ethanol industry to supply more than 13 billion gallons of ethanol, representing nearly 10 per cent of the nation's gasoline demand.

US consumers have bought more than five million flexible fuel vehicles that can run on E85. However, without a ready supply of E85, many of these vehicles will continue to operate using traditional fossil fuel.

In December 2007, the expansion of the Renewable Fuels Standard (RFS) required the use of 36 billion gallons of renewable fuels annually by 2022. The original RFS called for 7.5 billion gallons of annual use by 2012. Significantly, the RFS requires that 21 billion gallons of the standard must come from advanced biofuels, including a requirement that 16 billion gallons come from cellulosic ethanol by 2022.

The recent pace of advancement in technology, policy, and investment suggests that the rapid growth of biofuel use could continue for decades and that these fuels have the potential to displace a significant share of the oil now consumed. A Worldwatch Institute study in 2006 found that advanced biofuel technologies could allow biofuels to substitute for 37 per cent of US petrol within the next 25 years, with the figure rising to 75 per cent if vehicle fuel efficiency were doubled during the same period.

Wind

The US is the world's third-largest wind power producer in terms of installed capacity. In 2004, wind power accounted for 19.6 TWh, or approximately 0.5 per cent, of total US electricity generation with 6,750 MW of installed capacity.

The US led the world in wind power installations in 2007. Global wind capacity increased by more than 20,000 MW, with just over one quarter of this installed in the US. The American Wind Energy Association estimated that new US wind projects installed in 2007 will generate about 16 billion kWh in 2008 – enough to power 1.5 million American households.

GE Wind (United States), Mitsubishi (Japan), and Vestas (Denmark), were the top three wind turbine manufacturers active in the US market during 2004. The US wind power industry broke all previous records in 2007, with 45 per cent growth and an additional 5,200 MW installed. Wind power is now one of the largest sources of new electricity generation of any kind. Wind projects accounted for about 30 per cent of all new power generating capacity added in the US in 2007.

Wind power development in Texas continues to outstrip the rest of the country, with 1,618 MW added in 2007, by far the most of any State. At least three gigawatt-size wind projects were proposed in the US as of early 2008, one in California and two in Texas. Wind industry manufacturing facilities surged from a very small base in the US in 2005 to over 100 in 2007 and many existing facilities are expanding. In 2007, new tower, blade, turbine and assembly plants opened in Illinois, Iowa, South Dakota, Texas, and Wisconsin. In the same year, seven other facilities were announced in Arkansas, Colorado, Iowa, North Carolina, New York and Oklahoma.

Industry estimates suggest that US imports of wind power services totalled US\$93 million in 2004, while US exports of such services totalled US\$110 million. There are several foreign firms that are active in the US wind power industry. For example, Japanese firm Eurus Energy has developed wind projects in California and Oregon and PPM Energy, which develops, maintains, and operates wind power facilities in the United States, is a subsidiary of UK-based Scottish Power.

Solar Photovoltaic (PV)

In 2005, the United States had an estimated 475 MW of installed solar photovoltaic (PV) capacity, enough to power about 240,000 homes. The US EIA data show that in 2005 domestic shipments of solar PV systems increased by 72 per cent from 2004.

The US was the third largest national market for installed solar PV capacity in 2003. The majority of new installations, about 35 MW per year, have been grid-connected, particularly in States that have instituted feed-in tariffs among other incentives beneficial to PV development. The Solar Energy Industries Association (SEIA) (2007) noted that current projections of US grid-tied photovoltaic installations grew by 45 per cent in 2007 to nearly 150 MW. The annual installed capacity has more than doubled since 2005. More than 12,700 sites connected photovoltaics to the grid in 2007.

California continues to dominate the US market with a 58 per cent domestic market share but annual installations grew an impressive 83 per cent outside California. Nevada, Colorado, Hawaii, Connecticut and Oregon doubled their annual installations compared with 2006. A total of 30 systems larger than 500 kW accounted for 30 per cent of the 2007 installed capacity. In the Mojave Desert in California, nine systems supply 354 MW at the world's only power plants generating electricity on a commercial basis from 'parabolic trough solar systems'.

In 2007, 'big-box' stores across the US installed and announced photovoltaic installations. Safeway, Whole Foods, Staples, Target, Home Depot, Macy's, and Costco, among others announced PV installations to help stabilise their electricity prices for future decades. Wal-Mart installed a 624 kW system on a store in Palm Desert, CA, and plans for installations at 22 more stores across California and Hawaii, totalling as much as 20 MW. Similarly, Best Buy has plans for PV installations on 35 stores in 2008 throughout the US. The big-box businesses helped to drive PV installation numbers in 2007.

A number of European firms, such as SolarWorld, BP Solar, Schott Solar, and Isofoton, have a strong presence in the US market according to the Solar Energy Industries Association (SEIA) (2007). Capital markets in 2007 helped finance many manufacturing expansions through public offerings and secondary equity offerings. Venture capital is flooding into clean technology and PV companies with promise of third-generation and nanotechnologies. Companies like Heliovolt and Miasole received significant VC and expansion capital for their growth in 2007. VC investment in solar was more than US\$1.05 billion in more than 70 financing rounds last year.

Source: SQW from various sources

Carbon finance

- 3.9 Carbon financing has been limited in the US. The national government's rejection of the Kyoto Protocol's principles has hindered carbon trading at a national level. Despite this, some carbon trading schemes are in existence at a local and State level. The largest among these is the Chicago Climate Exchange (CCX) where members have made voluntary, yet legally binding commitments to reduce GHGs. More than 350 members, ranging from large corporations such as Ford and Motorola, State municipalities such as Chicago and Oakland, and organisations such as the National Farmers Union have committed to reducing their aggregate emissions by 6 per cent by 2010. The World Bank reported in 2007 that CCX saw record-breaking transacted volumes of 10.3 MtCO₂ in 2006 (seven times higher than the previous year) at a value of US\$38.1 million.
- 3.10 Moreover, the CCX wants to expand its activity to other schemes and other regions. In mid-March, it announced the formation of the New York Climate Exchange (NYCX) and the Northeast Climate Exchange (NECX) to develop financial instruments relevant to the Regional Greenhouse Gas Initiative.

4: Policy and regulatory frameworks

This section describes the trade policy context, the extent to which environmental policies and regulation have become more demanding and the governance institutions responsible for trade, investment and environmental policy and regulation. A patchwork of environmental regulations and policies are in operation across the United States some of which are co-ordinated nationally whilst others have been set by individual states.

Trade context

- 4.1 The United States is an open global economy and has a history of supporting trade liberalisation. For example, it was instrumental in the creation of the General Agreement on Tariffs and Trade (GATT), an international code of tariff and trade rules. Although committed to multilateralism, the United States in recent years has also pursued regional and bilateral trade agreements.
- 4.2 The US is the UK's largest single export market and the UK is the sixth biggest exporter to the US, after Canada, Mexico, China, Japan and Germany. The US is also the leading overseas destination for British investment. The current trading strength of the UK pound compared to the US dollar makes the US an even more attractive investment opportunity. Consultations with UKTI overseas trade representatives suggested that UK plc is viewed as a 'green brand' by US businesses and held in high regard.

Environmental regulations

MAJOR FEDERAL ENVIRONMENTAL REGULATIONS

National goal to reduce GHG intensity

In 2002, the US Government set a national goal to reduce the GHG intensity of the economy by 18 per cent by 2012. It was hoped that meeting this commitment would save the release of 1,833 tCO₂e in to the atmosphere. To achieve this, the US created an inter-agency, cabinet-level committee to co-ordinate and prioritise federal research on global climate science and advanced energy technologies. The federal budget for climate change activities was increased and tax incentives were created to help spur GHG reductions by encouraging cleaner, renewable energy and more energy-efficient technologies.

Climate VISION

Climate VISION is a business roundtable initiative. It assists industry efforts to accelerate the transition of practices, improved processes, and energy technologies that are cost-effective, more efficient, and more capable of reducing, capturing, or sequestering GHGs. Many high polluting industries have become partners, including oil and gas production, transportation, and refining; electricity generation; coal and mineral production and mining; and manufacturing.

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EPAAct

EPAAct has a number of provisions designed to accelerate market penetration of advanced, clean-energy technologies. The provisions include tax breaks for production from advanced nuclear power; clean coal facilities; integrated gasification-combined cycle; energy-efficient commercial buildings, homes, and appliances (ie ENERGY STAR); residential energy-efficient property; business installation of fuel cells and stationary micro-turbine power plants; business solar investment tax credit; alternative motor vehicle credit; and nuclear power.

EPAAct authorises the Department Of Energy to enter into loan guarantees for a variety of early commercial projects that use advanced technologies that avoid, reduce, or sequester air pollutants or anthropogenic sources of GHGs. In addition, EPAAct mandates an increase in the renewable content of petrol from four billion gallons in 2006 to 7.5 billion gallons in 2012.

Clean Energy Initiative

Clean Energy Initiative consists of two partnership programmes that promote cost-effective technologies that offer improved efficiencies and lower emissions than traditional energy supply options.

The Green Power Partnership programme facilitates the purchase of environmentally friendly electricity from renewable energy sources by addressing the market barriers that stifle demand. Since its launch in 2001, the Green Power Partnership has grown to more than 600 partners who have committed to purchasing four billion kWh of green power.

The Combined Heat and Power (CHP) Partnership, also launched in 2001, provides technical assistance to organisations across multiple sectors that invested in CHP projects and assisted state governments in designing regulations that encourage investment in CHP. As a result, the programme now includes 170 partners who have installed 3,460 MW of operational CHP.

Source: SQW Consulting

- 4.3 Many State governments have given high priority to clean energy, energy efficiency, and climate change initiatives. Almost every State has enacted GHG emissions inventories and many have State-led clean energy programmes. Energy management/efficiency programmes designed to encourage a reduction in energy usage (through demand management, smart meters, flex-power programmes) are also increasingly common. California has the most stringent regulations, being the only state with a state-wide GHG emissions cap. Table 4-1 below shows some of the main types of actions and the number of States currently participating.

Table 4-1: Summary of State-led environmental policies and regulations

| Type of action | Number of States |
|---|------------------|
| GHG Emission Inventories | 42 |
| State Lead by Example Clean Energy Programmes | 35 |
| Climate Action Plans | 29 |
| Renewable Energy Portfolio Standards | 23 |
| Energy Efficiency Public Benefits Funds | 18 |
| Renewable Energy Public Benefits Funds | 15 |
| Climate Advisory Boards | 12 |
| GHG Emission Targets | 12 |
| Vehicle GHG Emission Standards | 11 |
| Energy Efficiency Portfolio Standards | 10 |

Source: Adapted from US Climate Change Action Report(2006), submission to UNFCCC.

- 4.4 Figure B-2 of Annex B provides a map illustrating the US States and the geographical spread of some of the key regulations.

Key institutions

KEY GOVERNMENT DEPARTMENTS AND AGENCIES INVOLVED IN ENVIRONMENT, TRADE AND INVESTMENT REGULATION

The **Environmental Protection Agency** (EPA) has the mission to protect human health and the environment. EPA has 17,000 highly qualified and technically trained employees; more than half are engineers, scientists, and policy analysts. The main roles of EPA are to develop and enforce regulations, offer financial assistance, perform environmental research, sponsor partnerships and programmes, and further educational efforts to develop an environmentally conscious and responsible public.

The **Department of Energy** (DOE) is principally a national security agency. Its overarching mission is to advance the national, economic, and energy security of the United States; to promote scientific and technological innovation in support of that mission; and to ensure the environmental clean up of the national nuclear weapons complex. The Department's strategic goals to achieve the mission are designed to deliver results along five strategic themes: Energy security, nuclear security, scientific discovery and innovation, environmental responsibility, and management excellence.

The **Energy Information Administration** (EIA) is a statistical agency of the US DOE. Its mission is to provide policy-neutral data, forecasts, and analyses to promote sound policy making, efficient markets, and public understanding regarding energy and its interaction with the economy and the environment.

Since 1935, the **Natural Resources Conservation Service** (NRCS) (originally called the Soil Conservation Service) has provided leadership in a partnership effort to help America's private land owners and managers conserve their soil, water, and other natural resources. NRCS employees provide technical and financial assistance based on sound science and suited to a customer's specific needs.

The **International Trade Administration** (ITA) of the Department of Commerce strengthens the competitiveness of US industry, promotes trade and investment, and ensures fair trade and compliance with trade laws and agreements.

The **International Trade Commission** (ITC) is an independent, quasi-judicial Federal agency with broad investigative responsibilities on matters of trade. The Commission also serves as a Federal resource where trade data and other trade policy-related information are gathered and analysed.

Source: SQW Consulting

Annex A: Definitions of environmental goods and services, renewable energy, carbon finance and CATs

A.1 The Defra/BERR Environmental Industries Unit has defined the individual EGS sectors as follows:

Table A-1: Constituent sub-sectors of the Environmental Goods and Services sector

| Sub-sector | Description | Examples of types of activity |
|--|---|--|
| Air Pollution Control | Defined as products, systems and services for the prevention, reduction and removal of gaseous and particulate pollutants from air | External and internal emissions and odour control, filters and catalytic converters |
| Cleaner Technologies and Processes | Defined as products, systems or services for cleaner more resource efficient technologies, processes or products which are not covered elsewhere | |
| Decommissioning/Decontamination of Nuclear sites | Defined as products, systems and services required for the decommissioning of existing nuclear liability sites and structures | Consultancy, decontamination, recycling and compaction technologies, waste collection and containment |
| Environmental Consultancy | Defined as services to provide assessment and advice relating to environmental issues | Environmental audits, environmental impact assessment, corporate environmental responsibility |
| Environmental Monitoring, Instrumentation and Analysis | Defined as products, systems and services for measuring and monitoring environmental parameters | Water, air and soil quality, meteorological conditions and flow rates |
| Energy Management/Efficiency | Defined as products, systems and services for energy management and energy efficiency | Energy consultancy/audits, building energy management systems, energy efficient products and efficiency advice |
| Marine Pollution Control | Defined as products, systems and services for controlling, clean up and minimising marine pollution | Products such as oil absorbents and booms and services such as marine pollution preventing techniques |
| Noise & Vibration Control | Defined as products, systems and services for monitoring and reducing noise and vibration | Noise meters, monitoring systems, acoustic buffers, enclosures and barriers and silencers |
| Recovery and Recycling | Defined as products, systems and services for waste segregation, recovery and recycling | Paper, organics, metals, plastics, glass, demolition and construction wastes, vehicles and white goods |
| Remediation and Reclamation of Land | Defined as products, systems and services for the identification, assessment and remediation/reclamation of land and buildings, including prevention of contaminant dispersal | Absorbents and injection equipment, monitoring systems and proprietary treatment processes and sampling/analysis and site investigation/engineering |
| Waste Management | Defined as products, systems and services for the minimisation, collection, treatment (not recycling) and disposal of waste | Advice on waste minimisation, landfill, mechanical and biological treatment, regulatory advice and technologies such as specialised containment, shredders, compactors and waste management vehicles |
| Water Supply and Wastewater Treatment | Defined as products, systems and services for the management of the fresh water environment, provision, treatment, distribution and storage of clean water and wastewater for industrial and domestic users | Resource development, demand management, manufacture of wastewater treatment equipment, design, construction, installation and operation of water and wastewater treatment facilities |

Source: DEFRA, *Sustainable Consumption and Production – Development of an Evidence Base: Annex 1, UK Government Definitions of the Environmental Goods and Services Sector (Draft Review September 2006)*

- A.2 For the purposes of the study, we have taken Renewable Energy and Carbon Finance out of the definition of EGS and CATs and treated them as separate sectors.
- A.3 Definitions for the individual CATs sectors are available from different sources including BERR's Strategy for CATs (2005), certain trade associations and prominent market leaders.

TABLE A-2: CONSTITUENT SUB-SECTORS OF THE CARBON ABATEMENT TECHNOLOGIES SECTOR

| Sub-sector | Description | Examples of types of activity |
|---|--|--|
| Carbon Capture & Storage (CCS) | Defined as a multi-stage process where carbon from power generation is captured either before or after combustion and transported to a long-term storage in geological formations. This approach can reduce emissions by up to 85 per cent depending on the type of non-capture plant displaced | The entire supply chain for CCS technologies from R&D to demonstration and deployment. This includes manufacturing, as well as engineering and financial/business consulting services across the three main stages: <ul style="list-style-type: none"> • Carbon capture at plant • Transportation to a storage • Storage in a geological formation |
| Generation technologies that provide higher conversion efficiency | Defined as higher efficiency conversion processes, where the amount of fuel consumed and the associated emission of CO ₂ are reduced and the conversion processes are made more efficient (eg emission reductions of 10-30 per cent are possible depending on the performance of the old and replacement plant. Even higher levels can be attained by adding co-firing with biomass (typically a 5-10 per cent mix) | The entire supply chain for renewable technologies from R&D to demonstration and deployment. This includes manufacturing, as well as engineering and financial/business consulting services. Main technologies are: <ul style="list-style-type: none"> • Supercritical boilers • Integrated Gasification Combined Cycle (coal) • Combined Cycle Gas Turbine (gas) |
| Substitution to low carbon transport fuels | Defined as fuels used for transport based on the fermentation and distillation of replenishable organic matter, such as agricultural crops (eg sugar cane or beet, rapeseed) or woody material. Commonly known as biofuels, the main commercial varieties are bioethanol and biodiesel, where the former can be used as the main fuel and the latter is typically mixed with standard diesel in different proportions. Currently, there are second and third generation biofuels | Production of crops and other organic matter to be converted into fuel. The design of technology and equipment for producing biofuels. The production of different types of low-carbon fuels including bioethanol and biodiesel |
| Asset Management | Defined as planning, procurement and maintenance of energy generation facilities | Business planning, condition assessment, data gathering, technical maintenance |

Source: BERR, British Biogen, Energy Asset Management plc

A.4 Renewable energy is defined broadly in all sources consulted and a generic definition is as follows:

TABLE A-3: RENEWABLE ENERGY

| Sub-sector | Description | Examples of types of activity |
|-------------------|--|---|
| Renewable energy | Defined as energy technologies that use natural resources such as sunlight, wind, flowing water, tides and waves, biomass and geothermal heat. The availability of these resources is either unaffected by energy capacity installed (eg solar and wind energy) or can be replenished in the short-term (eg hydro and biomass) | The entire supply chain for renewable technologies from R&D to demonstration and deployment. This includes manufacturing, as well as engineering and financial/business consulting services. Main technologies are: <ul style="list-style-type: none"> • Wind (onshore and offshore) • Solar (thermal and electric) • Hydro (smaller scale) • Biomass (heat and power) • Geothermal • Marine (wave and tidal) |

Source: various sources

A.5 Carbon Finance is also a term which is not standardised across the literature and a definition reflecting the content attributed to it by several sources is as follows.

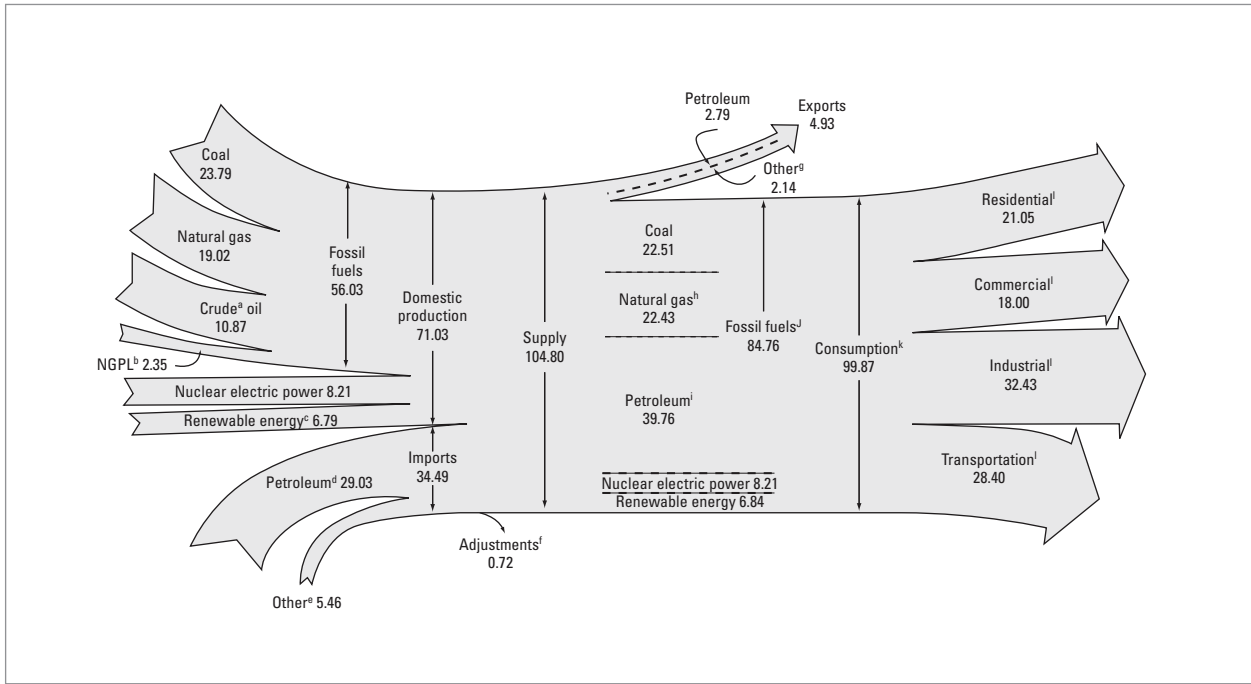
TABLE A-4: CARBON FINANCE

| Sub-sector | Description | Examples of types of activity |
|-------------------|--|--|
| Carbon finance | Defines as the investments in greenhouse gas emission reduction projects, the creation (origination) of tradable commodities on the 'carbon market', and the provision of financial and business services associated with all of the above | Trade in carbon commodities and derivatives on different markets and exchanges, such as CERs, EAU, VERs and others CDM and JI project assessment, registration, finance and development |

Source: various sources

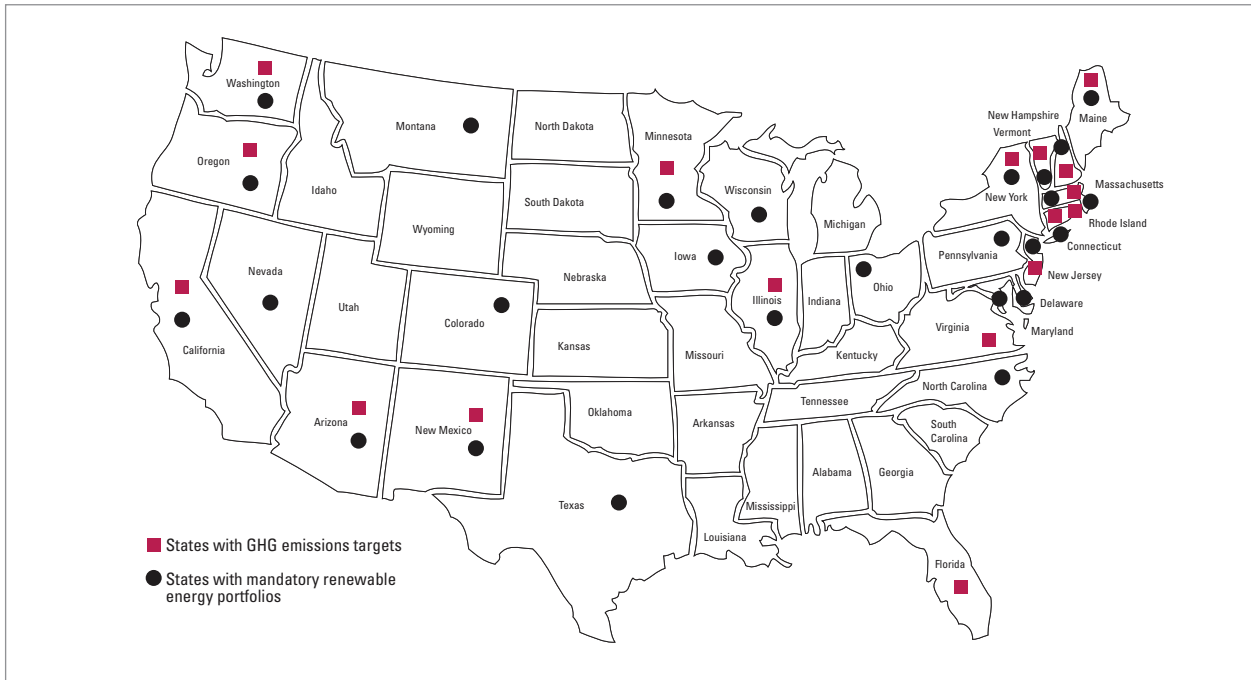
Annex B: Additional information

Figure B-1 : Energy flow through the US economy (2006)



Source: US Department of Energy, Annual Energy Review (2006)

Figure B-2 : Map of US state initiatives



Source: SQW and PEW Centre on Global Climate Change <http://www.pewclimate.org/>

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