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UK Low Carbon Capabilities

*China-UK Low Carbon and Energy Efficiency
Business Conference*





The Carbon Trust has written this paper on behalf of the UK Foreign and Commonwealth Office. The Carbon Trust's mission is to accelerate the move to a sustainable low carbon economy. It is a world leading expert on carbon reduction and clean technology, advising governments and leading companies around the world.



英国外交及联邦事务部

The UK and China have developed an increasingly strong low carbon partnership as both countries seek to accelerate the transition to a low carbon future. We believe that business has a huge role to play in this transition. UKTI and the Climate Change and Energy Network in China are working together to match UK low carbon capability to the needs of Chinese companies. We want to increase awareness of technologies that are available and through the roadshow, demonstrate how they can positively impact on business in China.



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UK low carbon capabilities

The UK has developed low carbon capabilities in a multitude of sectors. This report describes the low carbon capabilities of UK industry in selected sectors that have been identified as particularly relevant to China. Based on an assessment of China's national policies and priorities as well as those specifically relevant to the provinces of Chongqing, Guangdong and Hubei, the report provides examples of technologies and services for which the UK has leading expertise in five sectors:

- Green Buildings
- Transport
- Clean Energy
- Waste Management
- Energy and Low Carbon Services

If you are interested in obtaining further information on UK capabilities or wish to discuss specific commercial opportunities, UK Trade & Investment (UKTI) can provide you with contacts for relevant companies and organisations.

1. Overview of low carbon sector and capabilities in the UK

The UK has developed a vibrant low carbon sector with world-class capabilities. This includes large multinational firms as well as small and medium-sized technology companies with capabilities ranging from urban design and high-end engineering to specialised components, software and services.

The development of a market for low carbon technology and services has been supported by UK government policies and targets incentivising companies to increase energy efficiency and reduce carbon emissions. Examples of key policies, regulations, and initiatives that have driven demand for low carbon solutions in the UK are:

- The **Renewables Obligation (2002)** legislation mandating a share of electricity that suppliers have to provide from specific renewable energy technologies
- The **Climate Change Act (2008)** introducing a legally binding carbon reduction target for the UK as well as five-year national carbon budgets to achieve this
- **National Renewable Energy Action Plan (2010)** setting out the trajectory and measures to supply 15% of the UK's energy consumption from renewable energy sources by 2020.
- The **Carbon Reduction Commitment Energy Efficiency Scheme (2010)** requiring large polluters not covered by the EU ETS to purchase an allowance for each tonne of carbon emitted.
- **Feed-In Tariffs (2010)** for small-scale low carbon electricity generation
- The **Green Investment Bank** was launched in 2012 to finance low carbon investments
- A programme for **nationwide roll-out of smart-meters to all UK homes** between 2014 and 2019.

Furthermore, the low carbon sector has benefited from the UK's strong 'innovation ecosystem' that includes academic and technological centres of excellence, sources of finance and support for start-ups, and a strong system of intellectual property.

Table 1 below summarises key areas of low carbon expertise the UK could provide that match needs identified in China. These are described in more detail within the following sections.

Table 1 Summary of UK low carbon capabilities

| Sector | Area of Expertise | Example Capabilities |
|------------------|-----------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Green Buildings | Lighting Solutions | <ul style="list-style-type: none"> • Organic LEDs • LED luminaires • Lighting design |
| | Building Fabric | <ul style="list-style-type: none"> • Building material from renewable/recycled raw materials |
| | Energy Management | <ul style="list-style-type: none"> • Energy Management Systems • Smart metering solutions and technology |
| | Low Carbon Design/ Architecture | <ul style="list-style-type: none"> • Low carbon architecture/design firms • Low carbon building standards |
| | HVAC | <ul style="list-style-type: none"> • Insulation material • Retrofitting solutions |
| Transport | Low Carbon Transport Technologies | <ul style="list-style-type: none"> • Drive trains, • Energy storage solutions • Hybrid and full electric vehicle systems • Low carbon commercial vehicles and buses |
| | Transport System Management | <ul style="list-style-type: none"> • Transport system planning consultancy |
| Clean Energy | Wind | <ul style="list-style-type: none"> • Construction and deployment • Connection to grid • Wind and meteorological assessments • Offshore drive-trains, power systems, composites, sub-sea cables, anchoring platforms, vibration and stress analysis |
| | Solar | <ul style="list-style-type: none"> • Innovative financing mechanism • Grid integration |
| | Biomass and -fuels | <ul style="list-style-type: none"> • Biomass in coal co-firing/conversions • Production of high blend biofuels • Lignocellulosic conversion to bioethanol • Second generation sustainable bacterial biofuels • Biobutanol |
| | Grid Solutions | <ul style="list-style-type: none"> • Smart meters • Design of smart grids • Advanced transmission monitoring control • Advanced distribution network components • Distribution automation • Cyber security |
| Waste Management | Solid Waste Management | <ul style="list-style-type: none"> • Anaerobic digestion technologies, • Pyrolysis • Mechanical sorting of waste • Waste incineration systems • Waste management consultancy |

| | | |
|--------------------------------|-------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| | Waste Water Management | <ul style="list-style-type: none"> • Monitoring and measurement • Innovative filter techniques • Network planning • Engineering design • Equipment provision • Anaerobic digestion technology |
| Energy and Low Carbon Services | Energy Management and Accounting Services | <ul style="list-style-type: none"> • Energy site surveys and audits • Advice on implementation of energy efficient technologies and optimisation of manufacturing processes • Solutions for managing energy and carbon data • Carbon accounting/footprinting • Certification and labelling |
| | Sustainability Consulting | <ul style="list-style-type: none"> • Strategic consultancy services |
| | Innovative Financing Solutions | <ul style="list-style-type: none"> • Energy performance contracts (EPC) • Financing solutions for distributed energy |

2. Green Buildings and Construction

The UK green building and construction sector has benefited from a number of policies aimed at increasing energy efficiency in buildings. For example, building regulations and minimum performance standards for the design and construction of homes have been introduced, aiming to make every new home zero carbon from 2016. “Pay-as-you-save” financing schemes have also been established to encourage investment in building energy efficiency.



In response to growing demand, the UK has developed a number of capabilities within the green building sector that are relevant to China.

Lighting solutions

The UK has built on a long history of innovation in lighting technologies, with a large number of companies offering low carbon solutions. Areas in which the UK has particular strengths are: lighting sources such as those provided by **Thorn Lighting**; lighting design (e.g. by **Cundall**, **Holophane Europe**, **LAPD Consultants** and **PLM Illumination**); and products where novel light sources are integrated with power conditioning and control technology (e.g. from **Brandon Medical**, **Dialight** or **Enfis**).

Building Fabric

A number of UK companies have developed innovative environmentally-friendly building materials that use renewable resources or recycled materials. Products include

- Eco-minerals produced from fly ash from coal fired power plants by **RockTron**

- Insulation products made from renewable raw materials such as **Limetechnology** or **Hempcrete**, who developed a mix of hemp hurds and lime
- Various recycled plastic polymer raw materials by companies such as **Axion Polymers**
- Window films for retrofitting e.g. by **SolaVeil**.

Energy Management Systems and Smart Metering

The UK is home to several companies with competitive Energy Management System (EMS) technologies or sustainability management software products, such as **eSight Energy** and **Credit 360**. Furthermore the UK has built significant capabilities in smart-metering over the past years, ranging from providers of turnkey solution, e.g. **AstralWeb**, to world-leading smart meter technology providers such as **Sentec** (see box below).



Sentec is the world leading supplier of smart grid and metering and smart home technology. Sentec has been involved in smart meter design for gas, water, and electricity for over a decade and helped its partners to sell over 12 million smart grid products in markets across the world. They are now leading the development of technologies for Smart Grid applications in the distribution network and for consumers in Smart Home and Energy Management.

Sentec has recently launched MicroMonitor, a new technology platform that provides low-cost energy sensing at the point of use, a crucial component in the smart home of the future. The ultra small sensing technology can be incorporated into a variety of products such as a wall outlet, a plug, or built directly into an appliance. The device wirelessly senses and transmits the consumption of individual appliances in real-time. With a low cost and no batteries to replace, it enables consumers to easily monitor the consumption of any appliance in their home.

Sentec is offering the MicroMonitor technology for license to manufacturers of in home displays, appliances, home automation systems and building management systems for integration into their platform or device.

For more information contact:

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Low Carbon Building Design and Architecture

The UK is home to some of the world's leading engineering and architectural firms, e.g. **Foster + Partners** or **Arup**, which have been involved in many of the world's highest profile low carbon

projects such as Masdar City. Furthermore the UK's **BREEAM standard** is the world's leading design and assessment method for sustainable buildings (see Box below).

BREEAM®

BREEAM is a voluntary measurement rating for green buildings developed by the **British Building Research Establishment (BRE)**. Since its launch in 1990 it has become the world's foremost environmental assessment method and rating system for buildings, with 200,000 buildings with certified BREEAM assessment ratings.

BREEAM assessments are carried out by certified assessors and follow a simple scoring system rating each building against 8 weighted categories: Management; Health and Wellbeing; Energy; Transport; Water; Materials; Land Use; and Pollution.

Heating Ventilation and Air Conditioning (HVAC)

The UK has developed expertise in energy auditing and technology solutions to retrofit existing buildings for **heat retention** and **passive cooling**.

3. Transportation

The UK has extensive capabilities in the low carbon transport sector, which is driven by the need to reduce transport emissions through uptake in electric vehicles; lower carbon intensity of conventional vehicles; increased uptake of biofuels; electrification of rail transport; and increased efficiencies of freight operations. These objectives are supported by government programmes such as grants for the purchase of low-carbon vehicles, R&D funding, higher fuel emission standards, regulatory support for the uptake of biofuels, and funding for low-carbon public transport.

Transport system planning/management

The UK is home to some of the world's leading transport consultancies, including **Arup**, **Atkins** and **Ricardo-AEA**, making it a global leader in the field of transport system planning and management.



Low Carbon Transport Technologies

The UK has strong capabilities in low carbon vehicles, including design capabilities such as **Computer Automated Design (CAD) software**, virtual testing of components and systems, and technical monitoring skills. Furthermore, there are several component manufacturers in the UK offering innovative **drive trains** and **energy storage technologies** (such as flywheels, and hybrid and full electric vehicle power systems). The UK also has strong capabilities in **low carbon commercial vehicles and buses**.

4. Clean Energy

The UK has ambitious renewable energy targets set out within its Renewable Energy Action Plan (15% of the energy consumption and 30% of its electricity consumption to be supplied from renewable sources by 2020). The UK has therefore been developing strong capabilities in a number of renewable energy technologies that are relevant to China.

Wind

The UK is one of the leading countries in the world developing off-shore wind, utilising decades of experience with oil production in the North Sea. It currently has 17 offshore wind farms with capacity of over 2.2 GW and plans, with plans to have 65 GW installed by 2020. UK capabilities along the entire off shore wind value chain include: drive-trains, power systems, composites, subsea cables, anchoring platforms, vibration and stress analysis, and environmental impact assessments.

Offshore Wind in the UK



Building on decades of experience producing oil in the North Sea, the UK has developed a strong offshore wind industry. Along the supply chain, areas of particular strength for UK companies are those related to service and infrastructure. For example:

- **Gravity Base Foundations, OWEC Tower** and **Gravitas Offshore** offer **innovative foundation solutions for offshore wind turbines**.
- **Prysmian, BPP Cables** and **JDR Cable** supply **advanced cables** for offshore applications.
- **South Boats** and **Alicat** design and manufacture **service vessels** for offshore wind farms.
- **BiFab** produces **jacket sub-structures** for offshore wind farms.
- **Otso** and **OSBIT Power** developed advanced **personnel access and transfer systems** for the offshore industry
- **Cosalt Wind Energy** provides **operations and maintenance services** to the UK offshore industry.
- **Harland and Wolff**, and **OGN Group** provide a broad range of **engineering, logistic, installation and maintenance services** to the offshore wind industry.
- The consultancy **Natural Renewables** provides **full-cycle wind project development**.

Furthermore, the UK has built commercial on-shore wind farms for over 20 years and, driven by government incentives, has developed a large and mature wind energy sector. The UK therefore has substantial expertise relating to construction and deployment, connection to grid, environmental impact assessments, and wind assessments.

Solar

The introduction of feed-in-tariffs in 2010 has led to the rapid deployment of small scale solar PV in the UK, with over 300,000 installations providing a total installed capacity of more than 1.2 GW. While PV installations are typically imported, the UK has developed innovative downstream expertise in financing and deployment of distributed solar PV energy. **Financing solutions** include “rent-my-roof” contracts where solar developers lease rooftop space for installing PV and share energy benefits with building owners. The largest provider of these schemes in the UK is **Solar Century**. The UK also has expertise in **managing grid integration** issues resulting from a large number of distributed energy sources.

Biomass and Biofuels

The UK has particular expertise in using biomass for coal co-firing/conversions e.g. the recent conversion of the Tilbury B coal-fired power plant into the **biggest biomass power generating site in the world at 750 MW**. With regards to transport fuels, the UK has capabilities and know-how in the production, transfer, and use high blend biofuels (e.g. B30, B50, and E85). Furthermore, the UK also has capabilities in emerging areas such as **lignocellulosic conversion to bioethanol**; **second generation bacterial biofuels**; and **biobutanol development**. A leading example of biobutanol technology is **Green Biologics** (see Box below) which has developed technologies in production across a number of sites globally.



Grid Solutions

The UK leads Europe in smart grid applications, with companies like **Smarter Grid Solutions** having strong capabilities in **smart grid design and delivery**. The UK also has strengths in **smart meters**, **advanced transmission monitoring control**, **communication infrastructure**, **advanced distribution network components**, **distribution automation**, and **cyber security**.



Green biologics (GBL) is a global industrial biotechnology company based in England with operations in Brazil, China, the U.S. and India. GBL's patents and know-how enable the production of low-cost biobutanol and carboxylic acids from a variety of renewable biomass sources. GBL's products are direct substitutes for fossil-fuel derived chemicals, with performance characteristics that mirror their petrochemical alternatives and are cost-competitive with existing petrochemical-based processes. GBL focuses on lignocellulosic biomass, such as woody residues, sugar cane bagasse, corn residues and prairie grasses. GBL can also convert sugar crops such as sugar cane and molasses, sweet sorghum, sugar beets and cereal grains, and starch crops such as corn and cassava into biobutanol.

Biobutanol has many advantages both as a direct biofuel and as a biofuel blend to existing fuels:

1. Has an energy value similar to gasoline and much higher than ethanol; can be upgraded to aviation jet biofuel
2. Is non-corrosive and can be shipped via pipeline rather than in rail tanks and tank trucks.
3. Can be blended up to 40% with diesel fuel, be used in existing automotive engines with little modification
4. Emission reductions: hydrocarbon emissions by 95%; carbon monoxide to .01%; and oxides of nitrogen by 37%.
5. Can be made from a wide variety of non-food feedstocks such as wood and forest residues, temperate prairie grasses, corn stover, bagasse, and green bio-waste as well as low cost sugar crops such as sweet sorghum or sugar beets.

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5. Waste Management

The UK recycles over 40% of its household waste and about 52% of its commercial and industrial waste, with both figures having increased significantly over the past decade. The UK also treats about 66% of its sewage sludge through anaerobic digestion (AD), producing about 1 TWh of 'bio-gas' energy annually.



Solid Waste Management

The UK has particular strengths in **waste-to-energy** applications, with key capabilities in **anaerobic digestion technologies, mechanical sorting of waste, and waste incineration systems**. **Agrivert** is a market leader in anaerobic digestion applications. Furthermore, the UK has a broad range of companies offering consultancy services for waste management, such as **SLR Consulting, Arup** or **Peter Brett Associates** which have international experience in the implementation of complex waste collection and management systems.



SLR Consulting is an international environmental consultancy providing multi-disciplinary advice on sustainability issues for the energy, industry, waste management, planning & development, mining & minerals, and infrastructure sectors.

SLR has developed a particular area of expertise in developing landfill gas projects with financing from Clean Development Mechanism (CDM). For example, a landfill project it has conducted in South Africa has been assessed as one of the best waste disposal sites in Africa. SLR has also been engaged to manage the UNFCCC registration of landfill gas and waste water treatment works (WWTW)/organics CDM projects in other cities.

For more information visit www.slrconsulting.com

Waste Water Management

UK companies have expertise that spans different segments of the water value chain, including **turnkey solutions for water purification and waste water treatment plants**, as well as more specific elements of the value chain. Areas of particular strength for UK companies are **monitoring and measuring solutions** as well as **innovative filter techniques**. Companies such as **Bluewater** offer turnkey solutions including study scoping and network planning, engineering design, equipment provision and on-going operational support. The UK is also home to a number of consultancies providing advice on a broad range of issues around water and wastewater management globally, such as **Biwater** and **MWH Consulting**.



6. Energy and low-carbon services

Building on its capabilities as a global leader in financial and professional services, and driven by a policy environment that has incentivised companies to reduce their energy use and environmental impact, the UK has developed a growing and highly competitive energy and low carbon services sector.

Energy Management and Accounting Services

The UK has developed strong capabilities in analytical solutions such as **energy site surveys and audits**, advice on implementation of **energy efficient technologies and the optimisation of manufacturing processes**, and solutions for the **management of energy and carbon data**. The UK is also a world leader in the **measurement and accounting of carbon emissions**, pioneering the first product carbon footprinting standard, **PAS 2050**, as well as establishing the **Carbon Trust Standard**, which certifies organisations for carbon reductions, and the **Carbon Reduction Label** for certifying the carbon footprint of products.

Sustainability Consulting

The **professional services** industry in the UK has extended its expertise to cover the area of sustainability and low-carbon. UK consultancies are enabling business to address low carbon and sustainability issues in a way that has clear business benefits: reducing costs; managing risks; and unlocking new sources of revenue. Examples of specific areas of advice provided by UK consultancies are described in the Box below.

UK Sustainability Consulting

The UK sustainability consultancy market is made up of global professional service providers as well as smaller, specialised companies with world class expertise.

PwC – Value Chain Assessment

PwC carried out a risk and opportunity assessment for the value chain of a global packaged goods company's two key brands. The assessment included quantification of life-cycle environmental impacts such as carbon and water across the value chain. Value chain risks included the impact of climate change, water scarcity and population growth on their raw material supply chain. The findings were discussed during a workshop with the client's global procurement team to include long term sustainability trends into their organisation's long term strategic sourcing priorities.

Carbon Trust - Sustainability Strategy

The Carbon Trust advised a major UK hotel and food company in promoting sustainability across its hotels, restaurants and coffee shops. The Carbon Trust developed a long-term carbon management plan and identified sustainable opportunities and practical measures that would save costs by investing in technology and changing staff behaviour. Carbon Trust also helped the company develop a low carbon business vision and set long-term carbon reduction targets.

Innovative Financing Solutions

The availability of capital is often a major barrier to the implementation of energy efficiency measures. To help overcoming this barrier, several innovative financing solutions have emerged in the UK to help increase the market penetration of low carbon technologies. **Energy performance contracts (EPC)** are agreed between a property owner and an energy service company (ESCO), where the ESCO will provide the capital investment in energy efficiency for a particular property and be paid back in relation to the energy costs saved. Some of the UK's largest providers of EPCs are **MITIE** and **Envido**.



Appendix: List of UK companies and expertise

The matrix below summarises the list of UK companies and their respective areas of expertise covered within this report.

| | Lighting Solutions | Building Fabric | Energy Management | Low Carbon Design/Architecture | HVAC | Low Carbon Transport Technologies | Transport System Planning/Mgmt | Wind | Solar | Biomass and -fuels | Grid Solution | Solid Waste Management | Waste Water Management | Energy Management and Accounting Services | Sustainability Consulting | Innovative Financing Solutions |
|--------------------|--------------------|-----------------|-------------------|--------------------------------|------|-----------------------------------|--------------------------------|------|-------|--------------------|---------------|------------------------|------------------------|-------------------------------------------|---------------------------|--------------------------------|
| Agrivert | | | | | | | | | | | | ● | | | | |
| Alicat | | | | | | | | ● | | | | | | | | |
| Arup | | | | ● | | | ● | | | | | ● | | | | |
| AstralWeb | | | | | | | | | | | ● | | | | | |
| Atkins | | | | ● | | | ● | | | | | ● | ● | | | |
| Axion Polymers | | ● | | | | | | | | | | | | | | |
| Best Foot Forward | | | | | | | | | | | | | | ● | ● | |
| BiFab | | | | | | | | ● | | | | | | | | |
| Biwater | | | | | | | | | | | | | ● | | | |
| Bluewater | | | | | | | | | | | | | ● | | | |
| BPP Cables | | | | | | | | ● | | | | | | | | |
| Brandon Medical | ● | | | | | | | | | | | | | | | |
| Carbon Trust | | | | | | | | | | | | | | ● | ● | |
| Cosalt Wind Energy | | | | | | | | ● | | | | | | | | |
| Credit 360 | | | | | | | | | | | | | | ● | | |
| Cundall | ● | | | | | | | | | | | | | | | |
| Dialight | ● | | | | | | | | | | | | | | | |
| eight19 | | | | | | | | | ● | | | | | | | |
| Enfis | ● | | | | | | | | | | | | | | | |
| Envido | | | | | | | | | | | | | | | | ● |
| eSight Energy | | | ● | | | | | | | | | | | | | |
| Express Energy | | | | | | | | | | ● | | | | | | |

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|----------------------------|---|--|--|---|--|--|--|--|---|--|--|--|---|--|--|--|--|---|---|
| Foster + Partners | | | | ● | | | | | | | | | | | | | | | |
| Gravitas Offshore | | | | | | | | | ● | | | | | | | | | | |
| Gravity Base Foundations | | | | | | | | | ● | | | | | | | | | | |
| Green Biologics | | | | | | | | | | | | | ● | | | | | | |
| Harland and Wolff | | | | | | | | | ● | | | | | | | | | | |
| Holophane Europe | ● | | | | | | | | | | | | | | | | | | |
| JDR Cable | | | | | | | | | ● | | | | | | | | | | |
| LAPD Consulting | ● | | | | | | | | | | | | | | | | | | |
| Mainstream Renewable Power | | | | | | | | | ● | | | | | | | | | | |
| MITIE | | | | | | | | | | | | | | | | | | | ● |
| MWH Consulting | | | | | | | | | | | | | | | | | | ● | |
| Natural Power | | | | | | | | | ● | | | | | | | | | | |
| OGN Group | | | | | | | | | ● | | | | | | | | | | |
| OSBIT Power | | | | | | | | | ● | | | | | | | | | | |
| Otso | | | | | | | | | ● | | | | | | | | | | |
| OWEC Tower | | | | | | | | | ● | | | | | | | | | | |
| Peter Brett Associates | | | | | | | | | | | | | | | | | | ● | |
| PLM Illumination | ● | | | | | | | | | | | | | | | | | | |
| Prysmian | | | | | | | | | ● | | | | | | | | | | |
| PwC | | | | | | | | | | | | | | | | | | ● | ● |
| Ricardo-AEA | | | | | | | | | ● | | | | | | | | | | |
| RockTron | | | | | | | | | | | | | | | | | | ● | |
| Sentec | | | | | | | | | | | | | | | | | | ● | |
| SLR Consulting | | | | | | | | | | | | | | | | | | ● | |
| Solar Century | | | | | | | | | | | | | | | | | | | ● |
| Smarter Grid Solutions | | | | | | | | | | | | | | | | | | ● | |
| SolaVeil | | | | | | | | | | | | | | | | | | ● | |
| South Boats | | | | | | | | | | | | | | | | | | ● | |
| SPR | | | | | | | | | | | | | | | | | | ● | |
| SSE | | | | | | | | | | | | | | | | | | ● | |
| TMO Renewables | | | | | | | | | | | | | | | | | | ● | |
| Zytek Automotive | | | | | | | | | | | | | | | | | | ● | |