

ACCESSING INTERNATIONAL MARKETS

# WASTE TO ENERGY: AN INNOVATIVE UK INDUSTRY

*Hit the world running* UK

# INTRODUCTION

This brochure highlights the UK's strengths and experience in the waste to energy industry, part of the country's transition to a low carbon economy.

Other brochures are available that provide an overview of the UK's environment and water sector:

- Waste management and recycling
- Contaminated land and remediation
- Air pollution control
- Environmental instrumentation, monitoring and analysis
- Water and wastewater.



Above: The award winning Lakeside Energy from Waste facility, near Heathrow, has the capacity to recover energy from up to 410,000 tonnes a year of residual waste, producing 37MW of electrical power, enough to meet the needs of 50,000 households.

# LEADING THE UK'S LOW CARBON TRANSITION

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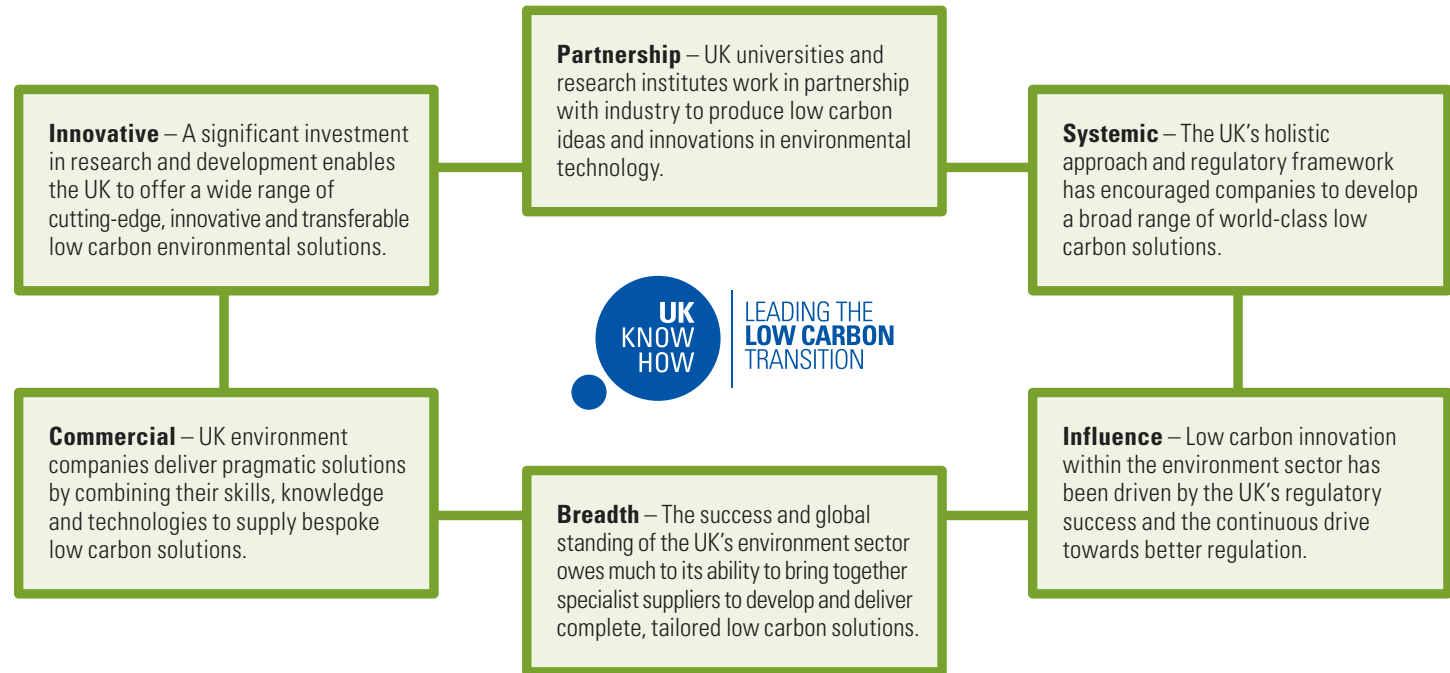
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The UK is rapidly becoming a global hub for world-class low carbon solutions. Within the environment and water sector, the UK offers knowledge, technology and experience to bring about incremental and sizeable reductions in carbon emissions – a low carbon consultancy on a big scale. With a progressive business

and policy environment that fosters carbon reduction, the UK is designing and developing the solutions that will increasingly prove valuable to international partners looking to reduce and manage their own emissions.



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Waste to energy is an increasingly recognised approach to resolving two issues in one – waste management and the recovery of renewable energy in the form of electricity and/or heat from residual waste. The creation of renewable energy from biomass decreases reliance on fossil fuels and limits the creation of greenhouse gases and the release of particulate matter into the air.

The UK is home to a successful and growing waste to energy industry. The country has made a commitment to provide 15 per cent of all energy requirements from renewable sources by 2020, including waste to energy. In 2009, a total of 477 waste to energy projects provided 58 per cent of the UK's renewable energy provision.

The UK excels in both the extraction and production processes necessary to turn waste into energy. Its extraction capability is borne out of a long history of underground mining and a waste management history steeped in landfill disposal.

Production is carried out via two methods, biological and thermal.

The UK offers expertise in both these areas, which currently divert some five million tonnes of waste from landfill in the country each year.

It is forecast that UK waste to energy projects will generate almost £2 billion in annual revenues and £20 billion in infrastructure construction by 2020.

This is on top of the some £10 billion required for the construction of Municipal Solid Waste infrastructure to collect, recycle, re-use and produce the high calorific value biological material that creates the Refuse Derived Fuel (RDF) used in waste to energy facilities.

## INDUSTRY DRIVERS

The main drivers for the continued development and implementation of waste to energy technologies, both in the UK and internationally, include:

- The need to reduce reliance on natural resources
- The need to reduce and recycle waste to landfill
- The need for security of energy supply during a time of ever-increasing global energy demand

- The emergence of Combined Heat and Power solutions for urban and district heating systems
- Global environmental concerns raised by climate-change issues
- International agreement on low carbon emissions.

## KEY UK FACTS

- 14 per cent of renewable sources in the UK are used to generate heat
- Of this, 93 per cent is direct combustion of biomass (biomass being derived from solid waste, landfill gas, animal and sewage sludge)
- In 2009, there was 1,932MW of installed capacity by all such forms of biomass in the UK
- In 2009, the biomass produced in the UK for bio diesel and bio ethanol came to one thousand tonnes of oil equivalent.

Source: Energy Trends, Department of Energy and Climate Change, June 2010

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As a result of significant investment both by the private and public sector in R&D, the UK is providing a global lead on low carbon solutions and the development of innovative emission-reduction technologies.

It has taken the opportunity to become an international player in the waste to energy market by introducing new Advanced Thermal Treatment technologies, developing its world-leading expertise in methane gas conversion and targeting niche areas for Anaerobic Digestion development.

With this advancement, the UK hopes to lead the way in developing projects which achieve saleable certified emissions reduction (CER) units, thereby meeting compliance obligations under the European Emissions Trading Scheme. Converting this opportunity into a reality has been driven by the skills of internationally orientated UK companies and individuals.

## UK STRENGTHS

The UK's significant expertise in waste to energy stems from:

- Its global leadership on climate change and the carbon markets
- Its long history of waste management expertise
- Its concentration on the development of low carbon high-efficiency green technologies
- Its complete understanding of the waste hierarchy and range of waste to energy technologies to ensure appropriate selection
- The status of London as a global financial centre, with a high concentration of Clean Technology Funds to promote technology development
- Its status as the number-one recipient of foreign direct investment in Europe, second globally to the US

- Its world-leading universities, offering internationally renowned R&D facilities
- Its development of niche solutions to fill the waste to energy technology gap
- Its leading legal framework, with experience of delivering often complex combined waste collection and energy-recovery projects.



Above: Advanced Plasma Power Gas plasma scale version of 11MWe net output power island.

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## EXTRACTION

The UK has an international reputation for the extraction of waste for conversion into heat and electricity – expertise that it is exporting across the globe.

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### Landfill gas

The UK is seen as a world leader in landfill science, technology and management, with globally renowned expertise in extracting landfill gas (or biogas) and turning it into an energy source. After extraction from the landfill in question – a process which helps it to reduce its carbon footprint – the biogas, a combination of mainly methane and carbon dioxide, can be used in an engine or turbine for power generation, or to provide heat for industrial processes near the landfill, such as brickworks.

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### Coal Mine Methane (CMM) and Abandoned Mine Methane (AMM) gas

The UK has long-established expertise in removing coal-mine gases such as methane to achieve a safe working environment. For many years, it has also utilised these waste gases for the creation of energy, achieving high standards of health and safety along the way. Coal-mining companies employing this technology are able to achieve significant greenhouse-gas reductions against their carbon-intensive operations.

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### Sewage sludge

The UK has expertise in turning sewage sludge into energy. The sludge is firstly anaerobically digested by fermentation, with the resulting biogas being compressed and purified before being transformed into mechanical and thermal energy. This is then turned into electricity.



Above: Coal Mine Methane is extracted for health and safety reasons and then harnessed for energy creation.

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### PRODUCTION

The UK offers world-class capability in the two methods used to produce energy from waste: biological and thermal.

Biological treatment for energy recovery essentially involves the Anaerobic Digestion (AD) process, a technique that accelerates the degradation processes that produce methane.

The thermal process involves two commercial areas – mass burn incineration and Advanced Thermal Treatments (ATT) such as pyrolysis, gasification and gas plasma technologies, as well as advancements in autoclaving, a Mechanical Heat Treatment.

The UK is home to numerous ATT providers, offering niche solutions that are highly efficient in the conversion of waste to energy and have significantly reduced greenhouse gas and particulate matter emissions, compared to mass burn incineration. They are also less visually intrusive than mass burn

incineration, are modular in design so can be scaled to suit, and are more appropriate for locations close to developments, thus cutting down transport costs and related pollution.

The UK has identified the potential capacity in the next 10 years for the construction of facilities and associated infrastructure for as many as 1,000 commercial scale AD plants and a mix of some 180 biological and non-biological thermal treatment plants, with annual waste input capacities of between 30,000-800,000 tonnes. There is also capacity to build a large number of mechanical biological treatment plants.

### THE WASTE INDUSTRY PROVIDES A THIRD OF THE UK'S RENEWABLE ELECTRICITY

### CONSULTANCY

The UK has a highly active sector of waste to energy consultants, encompassing both large global enterprises as well as a wide range of niche specialist providers. Their in-depth knowledge is in high demand overseas, with many of them taking on advisory roles for national governments and regional and local authorities.

UK expertise can analyse particular country requirements and suggest bespoke integrated waste management solutions in accordance with local legislation and fiscal drivers.

The UK is particularly well placed to offer advice and guidance on Waste Life Cycle Risk Modelling, especially important for the funding of new waste to energy schemes with an anticipated life span of 25 years or more where waste stream inputs will invariably change.

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## ENVIRONMENTAL TRANSFORMATION FUND

The Environmental Transformation Fund (ETF) is part of the UK Government's financial commitment to tackling climate change within the UK and developing countries. There are two parts to the fund, managed separately, to reflect the different challenges of its international and national elements.

The ETF has four main aims:

- To reduce carbon emissions, or have the potential to reduce carbon emissions in the longer term, through the use of technology
- To accelerate the development and deployment of low carbon energy and energy-efficiency technologies
- To contribute to the building of UK skills and capacity in the demonstration and deployment of low carbon technologies
- To ensure the coherent delivery of Government funding.



Above: New 2MWe rice husk combustion plant in Cambodia. (Courtesy of Torftech Ltd.)

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Delivering client solutions in the waste to energy industry requires the coming together of many different areas of expertise, including financial and legal.

### FINANCE

The majority of waste to energy projects require significant capital investment. The UK is a global financial hub with proven experience in the financing of such projects through the banking and equity markets.

The UK has pioneered the use of project finance and public private partnerships (PPP's) to deliver public infrastructure, including waste management and waste to energy facilities. Experience gained in the UK places companies in a strong position when entering new markets planning to use similar funding mechanisms.

In recent years, the UK has seen the prolific expansion of Clean Technology Private Equity Funds, which focus solely on the low carbon renewable technology sector to help enable R&D and, ultimately, commercialisation.

### LEGAL

Waste to energy projects are often highly complex in legal terms, with legal advice required in areas such as planning, the environment, finance and surety of supply. UK legal services are used by clients around the globe to ensure that such projects can be delivered within a legal framework suitable for all parties.

### SOLVING GLOBAL PROBLEMS ON A LOCAL SCALE

Commercially driven and entrepreneurially minded, the UK waste to energy industry is ready to respond quickly to business opportunities overseas. Offering cutting-edge products and technology, as well as world-leading consultancy, its adaptable and innovative solutions can help to address any waste to energy challenge, wherever it may be in the world.



Above: A 9940kW of state of the art installed capacity, generating electricity from sewage gas from a population of one million in England's second largest city, Birmingham. (Courtesy of Monsal Ltd.)

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### KEY ORGANISATIONS

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#### Anaerobic Digestion and Biogas Association

Represents all companies involved in the anaerobic digestion and biogas industries, to help remove the barriers they face and to support them in growing their business.

[www.adbiogas.co.uk](http://www.adbiogas.co.uk)

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#### Combined Heat and Power Association

Works to promote the wider use of Combined Heat and Power solutions and community heating.

[www.chpa.co.uk](http://www.chpa.co.uk)

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#### Technology Strategy Board – Environmental Sustainability Knowledge Transfer Network

Brings together people from business, academia, research, finance and technology to stimulate innovation in a specific environmental field through knowledge transfer.

[www.innovateuk.org/sustainabilityktn](http://www.innovateuk.org/sustainabilityktn)

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#### Renewable Energy Association (REA)

Represents renewable energy producers and promotes the use of all forms of renewable energy in the UK.

[www.r-e-a.net](http://www.r-e-a.net)

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#### Renewable Energy Foundation

Encourages the development of renewable energy and energy conservation whilst emphasising that such development must be governed by the fundamental principles of sustainability.

[www.renewable-energy-foundation.org.uk](http://www.renewable-energy-foundation.org.uk)

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Though driven heavily by international issues such as energy security and climate change, renewable energy policy in the UK is largely defined at the national and regional level. The EU also plays a role, passing the **Renewables Directive** in 2001 and making the commitment, in 2007, to achieve 20 per cent of its total energy from renewables by 2020.

The UK has implemented a number of policies and strategies which can be used to assist international customers in developing their own set of regulations. They include:

- **The National Waste Strategies:** provide the policy framework within which energy from waste operates and reflect the coming together of energy and waste policies.
- **The Waste Strategy for England 2007** and the **Energy White Paper (May 2007):** set out the UK Government's policy on energy and waste, placing strong emphasis on

links with overall energy policy and the need to consider greenhouse gas emissions. The key objectives are less waste, more re-use and recycling, recovering more energy from waste, and less landfill.

- **The Renewables Obligation:** places an obligation on UK suppliers of electricity to source an increasing proportion of their electricity from renewable sources. In 2006-7 the obligation was set at 6.7 per cent (2.6 per cent in Northern Ireland), rising to 15 per cent by 2015. A new banding scheme provides more targeted levels of support to different technologies, including eligible energy-from-waste schemes.
- **The UK Biomass Strategy:** brings together current UK Government policies on biomass for energy, transport and industry and acknowledges the importance of fuels sourced from biomass in tackling climate change.

- **Planning for a Sustainable Future White Paper:** proposes reforms to how the UK takes decisions on nationally significant infrastructure projects – including energy, waste, wastewater and transport – responding to the challenges of economic globalisation and climate change.
- **The Waste Incineration (England and Wales) Regulations 2000 (EU Waste Incineration Directive 2000):** introduced stringent operational conditions, technical requirements and strict emissions limits for plants incinerating and co-incinerating waste.
- **The Landfill Directive (Directive 1999/31/EC):** aims to divert biodegradable municipal waste away from landfill and encourages local authorities to consider the role that energy from waste could play in achieving this objective.

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■ **The Landfill Allowance Trading Scheme:**

intended to provide a cost-effective way of enabling England to meet its share of UK targets under the Landfill Directive.

■ **The Renewable Transport Fuels Obligation:**

requires suppliers of fossil fuels to ensure that a specified percentage of the road fuels they supply in the UK is made up of renewable fuels.

■ **Renewable Electricity Tariffs:**

introduced in 2010, these are tariffs payable to energy users generating their own renewable electricity. Renewable Heat Tariffs are set to be introduced in Summer 2011.



Above: Lakeside Control Room.

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  - TURNING SEWAGE INTO ELECTRICITY
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UK sustainable power group ENER-G Natural Power Ltd creates energy in a unique way. It converts methane and other greenhouse gases from landfill waste sites, mines and anaerobic digestion into green energy.

Using this process at a single landfill site can typically provide power for 2,000 homes, while preventing highly damaging methane gas from escaping into the atmosphere.

Managing Director Hugh Richmond states: "We offer our clients a complete 'one-stop-shop' and carry out the design, installation, maintenance and financing of long-term contracts. The projects we are involved in are making a big difference to the communities we serve, both in the environmental and economic benefits they bring and the skilled jobs they create."

ENER-G's clients in the UK include large waste management companies such as SITA, WRG, Biffa and Viridor, as well as a number of local authorities.

On the global front, the company exports its expertise to numerous countries, including Hungary, Lithuania, Mexico, Poland, South Africa and Spain. It recently won a major contract to generate green electricity for the City Council of Johannesburg, where the methane captured from seven local landfills will be converted into electricity for 25,000 homes.

[www.energ.co.uk](http://www.energ.co.uk)



Above: Ener-G Landfill gas extraction plant at landfill site in Hungary.

# IDENTIFYING THE OPTIMUM TECHNOLOGY

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SHREWS Ltd is a Scottish company involved in the development of renewable energy projects, particularly waste to energy and biomass-related developments.

The company, which has worked closely with UK Trade & Investment, has progressed numerous international projects through the conceptual design, planning and approval stage and project funding.

Examples include a project in Latvia to convert around 40,000 tonnes of mixed and hazardous waste into low-cost heating for the town of Malpils. To process the waste, SHREWS will be using a pyrolysis/gasification technology which can accept a wide variety of carbonaceous waste material, is efficient and meets international environmental standards, as well as those of the local community.

Company Director John Birchmore says: "Projects only happen if they are acceptable to the local people. This is achieved by selecting a good technology, which offers efficiency and low emissions."

[www.shrews.co.uk](http://www.shrews.co.uk)

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UK engineering firm Torftech Group has been providing solutions to gas/solid processes worldwide for nearly 30 years.

Its TORBED® Energy Technologies are novel but well-proven generic techniques used for transferring heat to solids and generating energy from solids. They provide precise, rapid, smaller-scale and lower-cost solutions to the drying, torrefaction, pyrolysis, gasification and combustion of a wide range of renewable fuels.

TORBED® units handle almost any shape of feed solids, including micron-sized powders, sludges and slurries. The low-pressure drop across these units facilitates process gas recirculation, allowing easy flue gas or process gas stream recirculation to be maintained at high temperatures.

First introduced in 1986, TORBED® units are now in commercial use throughout the world. Hundreds of them have been designed, built and installed across Europe, North America, South Africa, New Zealand, Australia, China, India and Japan for applications such as the torrefaction of biomass, the pyrolysis of coal wastes, the gasification of agricultural residues and the combustion of paper sludge.

[www.torftech.com](http://www.torftech.com)



Above: 3.5MWth Waste Wood Gasifier.



Above: 12MWth 6.0 tph Paper Sludge Combuster, Canada.

# TURNING SEWAGE INTO ELECTRICITY

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Thames Water, the UK's biggest water and sewerage company, saved £15 million in electricity bills in 2008/09 by generating its own renewable power from sewage sludge.

The company generated a staggering 14 per cent of its power needs from either burning sewage sludge or the methane derived from it, using thermal destruction and anaerobic digestion/CHP methods.

After generating the electricity, Thames Water sent none of the sewage sludge to landfill, offering it instead to farmers to use as fertiliser or to developers as landscaping material or soil improver.

[www.thameswater.co.uk](http://www.thameswater.co.uk)



Above: A 9,700tds/annum advanced sludge digestion plant with fully integrated CHP, improving the quality of sludge and maximising biogas for energy generation. (Courtesy of Monsal Ltd.)

# HOW WE CAN HELP

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UK Trade & Investment (UKTI) is the government department that helps UK-based companies succeed in the global economy. We also help overseas companies bring their high-quality investment to the UK's dynamic economy – acknowledged as Europe's best place from which to succeed in global business.

UKTI offers expertise and contacts through its extensive network of specialists in the UK, and in British embassies and other diplomatic offices around the world. We provide companies with the tools they require to be competitive on the world stage.

UKTI is committed to helping companies across the globe enhance their awareness and understanding of the many products and services offered by UK suppliers.

For further information, please contact:

Ricky Belgrave  
Environment & Water Team  
UK Trade & Investment  
1 Victoria Street  
London SW1H 0ET  
UK

T: +44 (0)20 7215 8000

E: [ricky.belgrave@ukti.gsi.gov.uk](mailto:ricky.belgrave@ukti.gsi.gov.uk)

[www.ukti.gov.uk](http://www.ukti.gov.uk)

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Any enquiries regarding this publication should be sent to our Enquiry Service by email: [enquiries@ukti.gsi.gov.uk](mailto:enquiries@ukti.gsi.gov.uk) or telephone: +44 (0)20 7215 8000 (Monday – Friday 09.00-17.00).

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