UK Renewable Energy Industry

Introduction and overview – the future is green!

Tidal turbine, Strangford Lough, Northern Ireland, generating electricity from tidal streams was plugged into UK's national grid in July, 2009

The UK is committed to *reduce CO2 emissions by 50% by 2020.* One of the key drivers towards reaching this ambitious target is the Government's obligation under the EU Renewable Energy Directive *to generate 15% of energy from renewable energy resources by 2020* – this is equivalent to a 7 fold increase in UK renewable energy consumption from 2008 levels.

In order to meet the 15% target, the aim is to produce:

- 30% of the UK's electricity from renewables, up from around 5.5% today
- 12% of heat from renewable sources – mainly from biomass, biogas and solar
- 10% of transport power from renewables, up from the current 2.6% – achieved mainly by the electrification of the rail network

Renewables describe energy sources that do not deplete the earth's natural resources and do not create added waste products. They are therefore sustainable in that they can be used indefinitely without degrading the environment. The impetus for renewable energy has grown much stronger in recent years due to two related concerns: *energy security* (i.e. unreliable and increasingly costly energy supply) and *climate change* (i.e. the need to reduce carbon emissions to counter rising global temperatures).

An executive recruitment firm, GRS Group, says *salaries in the energy market as a whole have risen 12% in the past year.* In order to compete with similar markets like oil and gas, companies are increasingly offering competitive salaries. London–based Ruston Wheb recruit for the environmental and clean technology market and Ian Jenkins, Senior Director, emphasises that *"There is a big recruitment gap in the renewables sector. Within the wind sector there's been a sevenfold growth in headcount in that sector in the last 3 – 4 years, and because this is still quite an early stage market there isn't a renewables talent pool you can tap into."*

Elemental renewables

The main climatic or environmental renewable energy resources are:

- **Solar** radiation – Both light and heat from the sun can be harnessed for their energy, and several different conversion techniques have been developed, including photovoltaic (PV) cells. Solar energy can be collected directly as heat or converted to electrical power.
- **Water or Hydro** power was the first source of large scale electricity generation. It exploits the energy of flowing water from a reservoir to drive a turbine and generator. There is a fairly secure continual supply of water, and hydroelectric power accounts for 2 – 3% of the UK's generating capacity
- **Wind** too has been used for centuries as a source of energy both for motive power (such as windmills and wind pumps) and more recently power generation. The surrounding air can also be used as a thermal source for heat pumps.
- **Wave** and **tidal** energy are more recently exploited sources, using tides and marine currents to drive water turbines connected to generators to produce electricity.
- **Geotherma**l heat can also be harnessed and used directly for heat production or through a steam turbine for electricity. Ground source heat pumps also use the constant temperature of the earth's sub–soil as a source of heat.

Biological renewables

Biomass is biological material derived from living or recently living organisms, which absorb carbon dioxide from the atmosphere while growing. After being converted to energy, the carbon dioxide released back into the atmosphere matches that originally absorbed, so the whole cycle is carbon neutral. The following are examples of biomass accepted as renewable fuels:

- **Energy crops** – agricultural and forestry products grown specifically to be used for energy production, such as short rotation coppice.
- **Standard crops** and their by–products. Many crops can be used for food or fuel, such as corn, oilseed rape, wheat and many others.
- **Forestry** and forestry by–products. Again timber can be used for fuel, but more commonly the non–commercial by–products, such as sawdust, small wood cuttings etc. can be diverted to renewable energy production.
- **Waste management** – in landfill sites waste from bio–degradable material rots and releases methane gas, which can be treated to produce biogas which in turn is used in producing electrical power.
- Certain **animal by–products** from the food chain can be used for renewable fuel production.

These sources all provide fuels, or products that can be converted to fuels, of many different types: liquids, gases, pellets, chips and other solid fuels. In this form they can be used for any form of energy production: heat, electricity generation, combined heat and power or transport fuels.

Local authorities will be under increasing pressure to recycle or compost waste and reduce the amount going into landfill sites as well as capturing landfill emissions. *A huge growth in the industry is expected* with the development of anaerobic digestion (a technology for turning waste into renewable energy) which will *require chemists, engineers and technologists specialising in waste management.*

Example Renewable Industries:

1.Wind Energy Industry – exciting growth

Royal Seaforth Docks, Liverpool – one of 6 turbines from Peel Energy's wind farm providing sustainable energy to the local electricity grid ((c)Wind Prospect)

Introduction

The UK is the windiest country in Europe, so much so that we could power our country several times over using this free fuel. A modern 2.5MW (megawatts) turbine at a reasonable site will generate 6.5 million units of electricity each year, *enough to meet the annual needs of over 1,400 households, make 230 million cups of tea or run a computer for 2,250 years!*

Every unit of electricity from a wind turbine displaces one from conventional power stations: in January 2009, wind turbines in the UK had the capacity to prevent the emission of 3,682,563 tonnes of carbon dioxide per annum.

Since the first wind farm in the UK was built at Delabole, Cornwall in 1991, on–shore wind energy has established itself as a mature, clean energy generating technology. In 2007 wind energy overtook hydropower to become the largest renewable generation source, contributing 2.2% of the UK's electricity supply, with on–shore wind comprising the bulk of this. The future for the UK off–shore industry is promising – *late 2008 saw the UK overtake Denmark to become the World's leading country in terms of installed off–shore generation capacity.* Numerous projects are in the pipeline of planning and construction and the ambition is to hold on to this title. *Wind has been the world's fastest growing renewable energy source for the last seven years,* and this trend is expected to continue with falling costs of wind energy, energy security threats and the urgent international need to tackle CO2 emissions to prevent climate change.

Industry Growth

The growth in wind energy is reflected in Table 1 which illustrates the operational, under construction, consented (not built) and in planning status of both on–shore and off–shore development. However, constraints including slow planning consent, grid capacity and skills shortages need to be addressed if the industry is to deploy renewable energy generation to its full potential.

Table 1 UK Wind Energy Status, June 2009, BWEA (British Wind Energy Association) Statistics

On–shore Status	Schemes	Off–shore Status	Schemes
Operational	207	Operational	9
Under construction	37	Under construction	10
Consented, not built	125	Consented, not built	8
Projects in planning	272	Projects in planning	3

The off–shore wind industry started coming on–line later than the on–shore sector; it began with the installation of two turbines off the coast of Blyth, Northumberland in 2000. Although the number of off–shore schemes is lower, the capacity of each one is greater than on–shore schemes.

Whilst a variety of low carbon technologies have their role in achieving the ambitious renewable energy targets, at present, wind energy is the only clean domestic energy source capable of delivering on the scale and in the time–frame needed. Over the next decade and a half the proportion of the UK's electricity generated by wind and marine energy is likely to increase to well over 30% of supply.

Employment opportunities and future prospects

The range of employment opportunities within the wind energy industry is extremely diverse, and the scale of demand for talent is vast. Current installed capacity stands at 3.3GW (gigawatts); with projects already in the pipeline set to deliver 8.8GW; and the Government is committed to delivering at least 28GW of capacity from wind energy alone by 2020. To feed this colossal leap forward the *sector will draw in tens of thousands of new entrants.* At present around 5,000 people are employed directly in the UK's large scale on–shore and off–shore wind industries. The British Wind Energy Association (BWEA) anticipates that overall *the wind energy industry will need between 17,000 – 52,000 new recruits over the next 11 years.*

A single project provides a myriad of different jobs with graduates of different backgrounds in demand in consultation, planning and development, construction, operation and maintenance, technical, financial, legal and retail services. There is also plenty of scope for research and design work for those who aim to drive technological innovation forward for the future.

The importance of STEM subjects to entering this industry

Given the diversity of jobs in the wind industry there is no set pathway to entry. As this is a relatively young industry, most roles are not limited by specific disciplines so long as applicants have the key transferable skills employers seek. Regardless of what career options are being considered, a good grounding in STEM subjects is a worthwhile investment. This is seen as very valuable to employers and a key consideration for who they take on.

To provide some more specific guidance, below is a list of different recruitment areas in the wind industry accompanied by a description of the most desirable qualifications and skills sets sought for in candidates:

Planning – GCSE/AS/A level: Maths, English, Physical Sciences, often a pre-requisite. Degree level qualifications in Geography, Environmental Science related subjects and/or further specialist planning qualifications – i.e. 'BSc/MPlan Town and Country Planning' – are required to enter this end of the industry

Development – Attracts people from a variety of disciplines, though qualifications to Undergraduate Degree level or higher are the norm. Business acumen and management skills are essential.

Construction and installation – On the ground people involved in construction are often working for a construction company with a remit beyond renewable energy. Physical fitness and ability to cope with working in adverse weather conditions required. As for installation – GCSE: good grades in STEM subjects are desirable. Further education technician engineering courses (level 3 vocational qualifications) are a possible formal route of entry. At the management level – chartered engineering status/degree level qualifications are usually required.

Operation and maintenance – GCSE: good grades in STEM subjects are desirable. Further education technician engineering courses (level 3 vocational qualifications) are a possible formal route of entry into O&M. Entrants often re-train from other mechanical engineering/electro-technical backgrounds on the job. For a detailed background see www.windskill.eu/ Physical fitness and ability to cope with working at heights, and in adverse weather conditions is required (especially off-shore). O&M management roles – chartered engineering status/degree level qualifications desirable.

R&D and technology design – GCSE/AS/A level: STEM subjects a pre-requisite. Engineering, Physics, Mathematics subjects preferred at Undergraduate and Postgraduate level. PhD level training is often the norm.

Consultancy roles – There are a variety of specialist roles related directly to the industry. Consultants will often hold qualifications at the Postgraduate level.

Case study

Desk research and analysis, combined with on–site assessments, makes for a varied and rewarding career

Gemma Ebsworth

Energy Analyst,
Garrad Hassan Group

Describe what your work involves

I work in the Energy and Development Services group at Garrad Hassan, Bristol. My main role, as an Energy Analyst, is to make an assessment of the wind climate at a proposed wind farm and produce a reliable and independent prediction of the expected energy production. Each assessment often involves a site visit, lots of wind data analysis, wind flow modelling, report writing and liaising with clients. My work also incorporates several other aspects of wind farm development, including feasibility studies, mast inspections, and assessments of the predicted extreme meteorological conditions for turbine manufacturers.

Why did you choose this type of work?

My background in meteorology inspired me to get into the wind energy industry. Throughout my degree I studied several aspects of climate change, from the underlying science, to methods of adaptation and mitigation. I chose to work in wind energy as it enables me to use my technical and scientific skills, whilst also working in a fast–growing, prosperous and globally important industry.

How did you get started?

After graduating, I completed an 8 month period of work experience with an on–shore wind farm developer. My role was to assist with the developmental stages of on–shore wind farms, from site searching and feasibility studies, to environmental statements and planning procedures. This gave me a great insight into the wind energy industry as a whole, and geared me towards the more scientific and technical roles available within the industry. Following this period of work experience, I joined Garrad Hassan.

What is the importance of maths or science in your work?

Much of my work as a wind energy analyst involves using statistical techniques and models to analyse and interpret wind data. Many of our methods are based on both empirical and theoretical models of wind flows and the atmosphere, and as a result science and mathematics have a huge role in my work. Many aspects of my meteorology degree have also proved to be important, including a grasp of basic fluid dynamics and boundary layer processes.

Which A levels and degree subjects have you taken?

A levels – Mathematics, Physics, Geography and Environmental Science Degree – BSc Meteorology with a year in Oklahoma

What excites you most about your work?

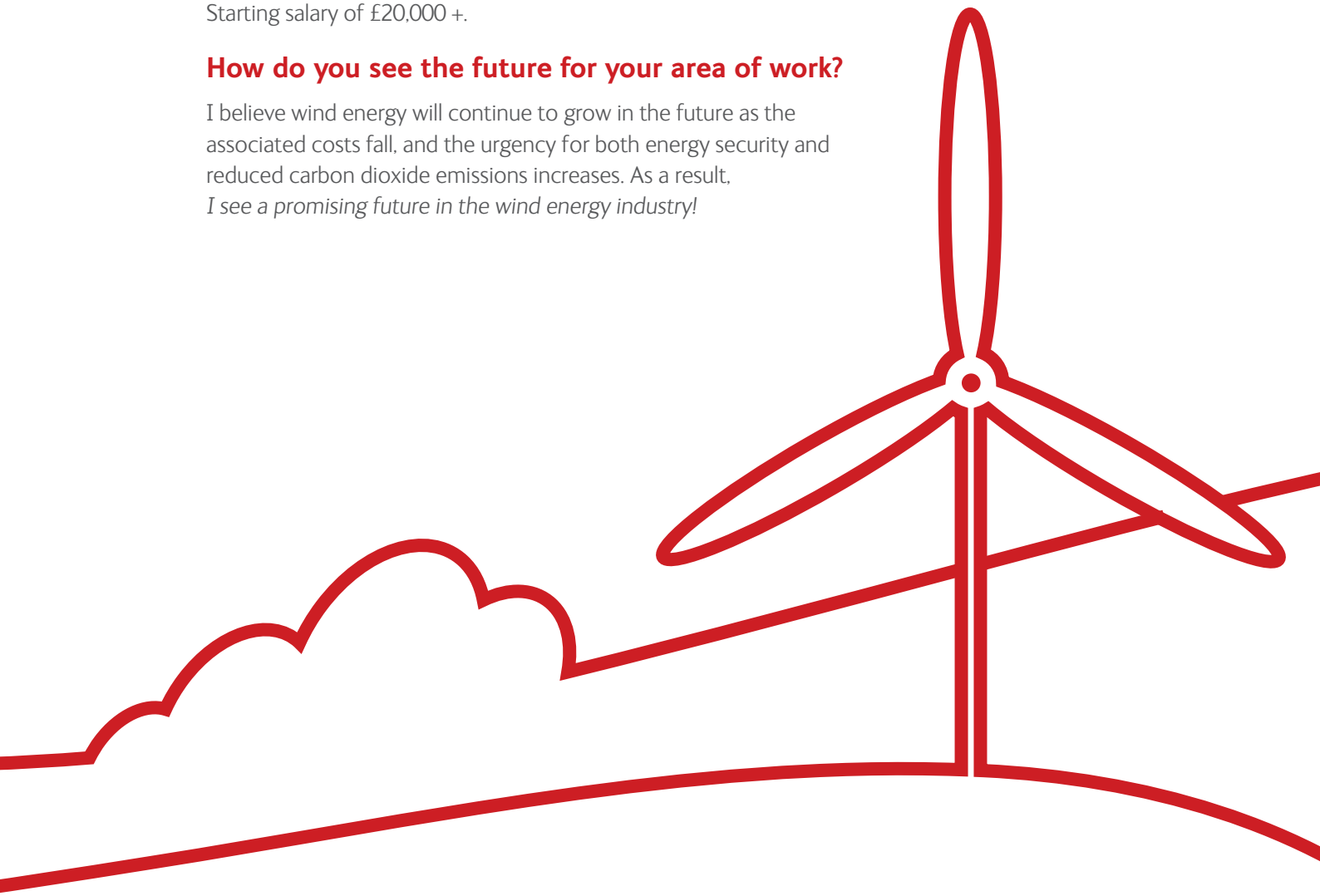
What excites me most about my work is the fact that it is so relevant in today's society, and as such, is constantly changing. New technologies and markets are steadily emerging, and there is so much scope for research and development to refine and improve our methodologies. No two energy assessments are the same, and we are often presented with new challenges requiring new ideas and understanding. *Every day is different!*

What could you earn?

Starting salary of £20,000 +.

How do you see the future for your area of work?

I believe wind energy will continue to grow in the future as the associated costs fall, and the urgency for both energy security and reduced carbon dioxide emissions increases. As a result, *I see a promising future in the wind energy industry!*



2.Wave and Tidal Energy – pioneering the future!

The PowerBuoy wave energy converter is to be used as part of the Wave Hub project

Wave and tidal power is at an innovation stage and some exciting progress has been made by pioneering UK companies. The world's first commercial wave power generator is on Islay, in the Western Isles of Scotland. A new tidal stream generator – an underwater turbine powered by the streams of tidal current – is being developed in the Bristol Channel off the north Devon coast.

Plans are nearing completion for what will become *the world's largest wave farm project*, the Wave Hub, to be sited off the coast at St. Ives, Cornwall. Wave Hub will be used to test up to 40 prototype wave energy machines to see how much power they can generate and how well they work and cope operating out at sea. The hub will be connected by undersea cable to a new electricity substation connected to the National Grid. A contract for the installation of electrical equipment to link the Wave Hub with the National Grid has been placed with Powermann Ltd., Poole. Nigel Ritchie–Lilley, Engineering Manager for Powermann said: *"Over the past 12 months we've seen a significant growth in our work within the renewable energy sector and we are very excited about our first wave energy project...we're pleased to be playing a role in such a ground breaking project that will put the region on the world stage for the development of wave energy devices."*

Wave energy – The energy contained in ocean waves is a huge potential source of renewable energy, and the UK has wave power levels that are among the highest in the world. Ocean waves travel great distances without significant losses and so act as an efficient energy transport mechanism. The energy can be captured by various devices, which produce enough movement either of air or water to drive generators that converts the energy into electricity.

Tidal energy – Electricity generation from tidal stream has the big advantage that the output can be reliably predicted even though the strength of the tidal stream varies throughout the day. Various designs are being developed including propeller blades driving a generator (an underwater wind turbine), aerilon shaped wings that move up and down, and sets of sails turning on a conveyor.

Case study

Working in the renewables industry provides the opportunity of being at the forefront of developing clean energy solutions

Rebecca Sykes

Wave Energy Consultant,
Garrad Hassan Group

Describe what your work involves

The majority of my work is based in the area of wave energy, extracting useable power from the ocean surface waves. At Garrad Hassan we provide consultancy services to the marine energy industry which includes advising companies who are developing their own devices, investors assessing the viability of devices for potential investment, and the assessment of suitable locations for device deployment. The main body of my work involves developing and implementing software to be used in the performance assessment of wave energy devices. This involves working with pre–existing software and coding in–house software which we use to generate the results which are compiled into reports for our clients. We also support experimental model testing in wave tanks to validate the software.

Why did you choose this type of work?

This work involves the direct application of the skills and knowledge I developed during my PhD research, which is satisfying as you can see the benefits of your time spent studying.

How did you get started?

When I was near to completing a BEng course in Aeronautical Engineering I felt that I would find it *more rewarding to join an industry which I feel will be more beneficial to the evolving needs of society.* I chose a course on renewable energy at Loughborough University which covered the main renewable technologies which I found to be a great grounding in this field. This provided a stepping stone to my PhD research on wave energy.

What is the importance of maths or science in your work?

Maths is especially important in the work I do. I am interpreting mathematical formulae from books and academic papers into computer code and so the understanding of the implications of what is being expressed mathematically must be understood before it can be applied.

Which A levels and degree subjects have you taken?

I chose Maths, Physics and Chemistry at A level, then a BEng in Aeronautical Engineering and an MSc in Renewable Energy Systems Technology. I am currently finalising a PhD related to the hydrodynamics of a type of wave energy converter called an Oscillating Water Column.

What excites you most about your work?

Being a consultant means you need to consider the needs of the client primarily and so it is satisfying to be able to meet their needs. However, I am interested in the advancement of the industry in contributing to power generation using renewable energy, so I do get excited when a particularly well performing device is modelled.

What could you earn?

Starting salaries at about £25K are in line with most engineering professions, and the progression depends on the level of management and responsibility that you accept. *Being a new industry there is a lot of potential to develop your career.*

How do you see the future for your area of work?

There is a general increase in the amount of interest in wave energy as people come to realise that the combined pressures of increasing CO2 levels, decreasing domestic fossil fuel supply and volatile non–domestic fossil fuel supply mean that alternative sources of energy are required. *Renewables are going to play a significant part in our futures* and the UK is one of a number of countries who are geographically well placed to greatly benefit from wave energy. This is still an emerging industry and larger power generators are just starting to become active, it does though require Government incentives to encourage investment and so can be dependent on the fickle nature of politics.

Degree Level Entry

As the importance of renewable energy has increased over recent years, more renewable energy degree courses have been added by UK university physics, engineering and other departments. Renewable Energy degrees include IT, electronics, mathematics, engineering, geology, and other natural and physical sciences. With practical project work including wind, solar, geothermal, wave, tidal and hydro power, these courses provide a good understanding of the renewable energy industry.

The following are degree courses in Renewable Energy:–

University of Exeter – BSc Renewable Energy

University of Dundee – BSc Renewable Energy

University of Nottingham – MSc Electrical Technology for Sustainable & Renewable Energy Systems

Cranfield University – MSc Offshore Renewable Energy

De Montford University – BSc Green Energy Technology

University of Glamorgan – MSc Renewable Energy & Resource Management

Heriot- Watt University – MSc in Renewable Energy Development

University of Reading – MSC in Renewable Energy: Technology & Sustainability

Durham University – MSc New & Renewable Energy

University of Leeds - MSc Electrical Engineering & Renewable Energy Systems

Universtiy of Edinburgh – MEng Mechanical Engineering with Renewable Energy

North East Wales Institute of Higher Education – BEng Renewable Energy & Sustainable Technologies

University of East London – MSc Renewable Energy & the Built Environment

Newcastle University – MSc Renewable Energy

Loughborough University – MSc Renewable Energy Systems – course via distance learning

Websites and links to Classroom Resources

'BWEA School Children's Pack on Wind Energy' – www.bwea.com/edu/schools.html – This children's pack has been produced to provide children aged 7 – 11 with information on wind and wind energy. Its purpose is to be fun and educational, encouraging children to think about wind as an energy resource – it provides helpful ideas for parents and teachers to inspire children.

'BWEA Education Pages' – www.bwea.com/edu/schools.html – These pages provide a useful introduction to how wind energy works alongside facts, figures and teaching materials for primary and secondary school teachers and students (ages 12 +).

'Wind with Miller' – www.windpower.org/en/kids/index.htm – "Wind with Miller" was developed for students aged 12 – 14 years and above as the main target group. The site contains useful guidance for teachers too, and provides an accessible introduction to wind power.

'The KidWind Project' – www.kidwind.org/lessons/ – This project consists of a team of teachers, engineers and scientists committed to innovative energy education. Their goal is to promote the elegance of wind power through affordable tools and training programmes that challenge, engage and inspire students of all ages. The site provides learning materials and free lesson plans for teachers.

'Wind Energy – The Facts' – www.wind-energy-the-facts.org/ – This publication is widely considered to be the most important wind energy reference in the world. It presents a detailed overview of the sector, with the most up-to-date and in-depth information on the essential issues concerning wind power today.

'BWEA Course Listings' – www.bwea.com/pdf/careers/WWT%20Courses.pdf – Visit this site for a full listing of courses relating to wind, wave and tidal energy. The courses are grouped according to the level of education, and include Short Courses, Further Education, Undergraduate and Postgraduate.

TES Connect' – www.tes.co.uk/searchResults.aspx?area=resources&keywords=Renewable%20energy – Comprehensive set of resources to introduce renewable energy activities in the classroom.

'EcoStyle (endorsed by The National Energy Foundation' – www.ecostyle.co.uk/products.htm – Interactive renewable energy kits for use in the classroom, including wind turbine kit, solar water heater kit, and photovoltaic kit.

'Green Energy' – www.greenenergyjobs.com/career-guide/ – This provides an overview of the career opportunities within the renewable energy industries.

'Energy & Utility Skills (Sector Skills Council)' – www.euskills.co.uk/careers – Includes careers sections on waste management, water, and power.

'Energy Zone (provided by The Energy Institute)' – http://energyzone.net/aboutenergy/res-teacher-teaching.asp – companies and environmental charities who have programmes and resources to support the teaching and learning of energy.

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