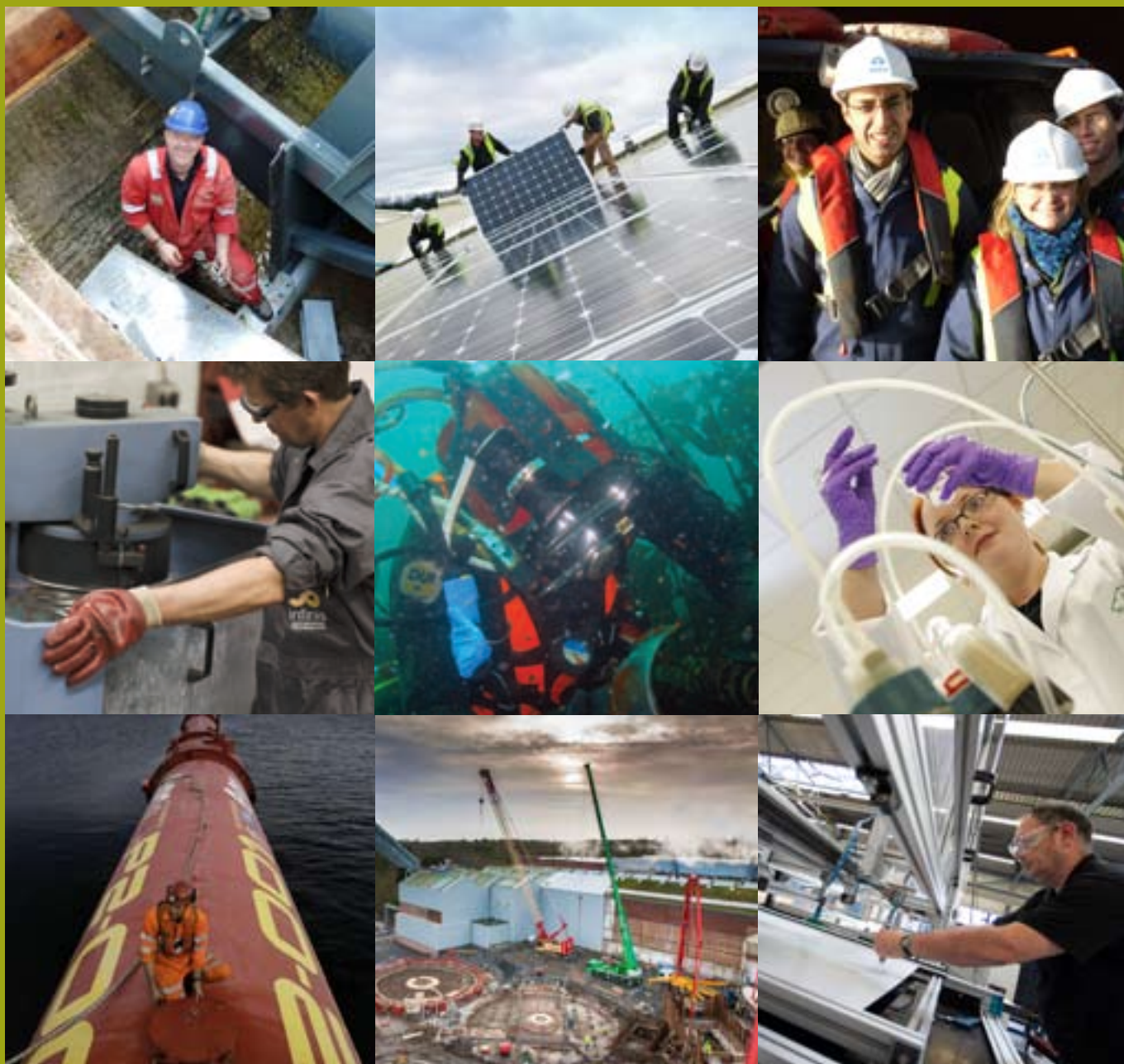


Renewable energy: **MADE IN BRITAIN**

Jobs, turnover and policy framework by technology (2012 assessment)



"Around the world, from China to Germany, our competitors are waging a historic effort to lead in developing new energy technologies... Nobody is playing for second place. These countries recognise that the nation that leads the clean energy economy is likely to lead the global economy."

Barack Obama

Gaynor Hartnell Foreword

Chief Executive of the Renewable Energy Association (REA)

The Locomotive Act of 1865 restricted steam engine vehicles to 2–4mph and obliged a man waving a red flag to walk 60 paces ahead. British engineers had patented combustion engine and electric motor vehicles by 1882 but they were not developed thanks to the powerful railway and carriage industries' success at winning and maintaining such highly restrictive legislation. Karl Benz, meanwhile, started selling his motor vehicles in Germany in 1888. It wasn't until 1896 that the UK speed limit was raised to a breakneck 14mph¹, enabling the beginnings of a domestic market. The rest, as they say, is history.



Renewable energy promises a technological transformation no less radical today, and the above anecdote serves as a warning; established interests can be strong enough to stymie progress; politicians can tend to favour protecting existing, rather than promised, industries and employees. But it also shows us that technological advance is ultimately irresistible and highly profitable for those brave enough to take the leap.

Germany is renowned for its quality car-making, yet in its government's own words its renewables industry is now 'on the verge of challenging the German

automotive industry's status as the flagship of German manufacturing'². We draw huge inspiration from Germany, not because it is one of the top performers on renewables in Europe – it isn't by a long way – but because it sets out a path the UK could follow. Like the UK, Germany started from a low base – just 3% renewables as a share of total energy 12 years ago. Like the UK, Germany is a major economy with a large population. In just over a decade it has increased its production of renewable energy nearly four fold. Joining-up energy, economic and industrial policy is key to its success. Their renewables sector today employs over 370,000 people and invests around €30 billion per annum – money that circulates in the German economy. It can be done.

Indeed it *must* be done. The OECD estimates that without new policies the world faces a 50% increase in greenhouse gas emissions. The International Energy Agency warns the window of opportunity to steer away from the brink is closing. These warnings come thick and fast and from the mainstream. Yet despite the critical role of renewable energy in our future prosperity, this vital sector remains marginalised in the broader UK policy framework. In emerging industrial policy, the high-tech agenda, skills and 'The Plan for Growth' renewables receive precious little attention and the sector is

poorly articulated in Westminster – that is no longer the case in Scotland. Not before time, we hope this report will put the spotlight firmly on renewable energy technologies in their own right. We're fiercely proud of our work at the REA because we know our members are mobilising the most important technologies in the world.

We're delighted to have worked with Innovas and our Sector Groups to finally put a figure of over 100,000 on the number of people employed across the whole UK renewables industry and its supply chains today. We want to triple that figure in the next decade. Energy made in Britain means diverse jobs, rural and urban. It means safe and secure energy, a rebalancing of our economy, new manufacturing and export opportunities and a better balance of trade. We want to work with the Coalition Government to put renewable energy right at the heart of its growth, skills and employment agendas. Together we can make the leap. A renewable energy revolution means we can be confident that 100 years from now there will not just be a proud history to be told, but a hopeful future.

¹ www.direct.gov.uk/prod_consum_dg/groups/dg_digitalassets/@dg/@en/@motor/documents/digitalasset/dg_180212.pdf.

² Renewable Energy: Perspectives for a Sustainable Energy Future, German Environment Ministry, 2011.

John Sharp

Managing Director of Innovas Solutions

The UK and devolved governments are tasked with many responsibilities on behalf of their citizens. The top responsibility these days is surely sustainable economic growth, supported by strong exports, a secure energy system, a more balanced economy and employment of UK nationals across all skill levels.



This is challenging enough when times are good, but especially so when navigating protracted stagnation following the economic eruptions

which began in summer 2008. On the positive side it has focussed attention on the fault-lines in our economy and the UK has been searching for new sectors to support which will bring both short and long term economic benefits. But there have also been worrying signals from part of Government that the green agenda cannot be afforded. Innovas's work on the booming low carbon sector suggests the opposite is true.

In the last few years the renewable energy sector has seen considerable growth over and above that seen in the UK as a whole. This report shows in 2010–11 it was a sector worth £12.5

billion. The UK renewable energy market is growing at a slower rate than most of the developed and major developing nations, where Innovas estimates global growth across the sector and its supply chains is forecast to increase market value from £360 billion in 2010–11 to £770 billion by 2020. The increase in global market value of £410 billion in that period (which is a conservative growth estimate) provides the UK with additional opportunities to export its not inconsiderable expertise and manufacturing capability.

(continued overleaf)

If the UK were to take a rather modest share of 3% of the increase in the global market value this would provide an additional £12 billion in international trade revenues and potentially a further 90,000 jobs in higher value manufacturing and service jobs. The UK could do even better.

Other areas of the world are taking the lead in areas where the UK has the capability to develop its own world leading companies. Whether or not they are interested in climate change abatement, what drives these countries is the compelling economic benefits, including jobs. There is no doubt that the majority of renewable energy technologies provide long term jobs across all skill levels at a regional and

local level. This is in sharp contrast to other energy generation technologies i.e. gas, nuclear, where much of the economic benefit will be seen overseas rather than in the UK.

When the UK gets it right, such as in offshore wind, long term support and planning is known and highly visible. Investment is then forthcoming and companies work together to develop the area. However when strategy and support is volatile (as with solar PV Feed-in-Tariffs), or technologies are hampered by lack of understanding or neglect, this creates uncertainty and leads to investors moving to other areas where the value of their investment is more certain. It also makes the development of

specific skills training for UK staff very difficult, as there is little long term visibility for training organisations to plan against.

It has to be said that the devolved governments, in many ways, are more advanced in their thinking and have seen the opportunities provided by renewable energies in economic and environmental terms more clearly than UK national government, especially in terms of jobs at a local level for people across all skill levels. Yet central government is key to providing the enabling framework. This report hopes to enrich understanding, technology by technology, of the renewable energy sector as a major engine of growth and employment.

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Will Hutton Introduction

This report could hardly be more timely. The government which aspired only two years ago to be the “greenest ever” is wobbling badly. In fairness it remains committed to ambitious targets to lower carbon dioxide emissions. But it balks at willing the means. While energy intensive industries complain at expensive tariffs, parts of the media – purporting to speak in the names of ordinary householders – drum up scare stories about sensible energy policies, from renewables to the Green Deal (or ‘conservatory tax’). On both the Government risks running up the white flag.

Yet a number of inviolable truths remain. The age of cheap fossil fuels is over, and peak oil production has either arrived or is close to arriving. The combination of a rising world population and rising living standards can only mean that we are collectively on a path to burning unsustainable amounts of fossil fuels – unless energy sources are changed and the intensity of energy use reduced.

Declining fossil fuel reserves are not the only problem. Exponential growth of carbon in the atmosphere will trigger a rise both in global temperatures and in the volatility of our weather. The victims will all too often be the weakest in our society and the weakest countries internationally. The quest is on to produce power from other sources – and that must include renewables, the subject of this impressive report.

This is too often presented as the preoccupation of a fringe who ignore the interests of the mainstream, but the logic of economics is relentless. Supply is called forth by demand, and demand for renewables exists at such growing levels not because of political correctness, but because business needs diverse sources of energy supply at predictable and stable prices. One of the drivers of the Industrial Revolution was the certainty that come what may people wanted to get from A to B faster and more reliably with cheaper clothes on their back – hence the case for the railway and the cotton mill. There is another revolution in the making: come what may business and society need diverse and resilient sources of energy that are independent from the



political and geological vagaries of fossil fuels.

Renewables are part of that mix. The report shows their variety and the strength of their growth. This is an important industry in its own right that deserves to be taken seriously – and for its obstacles to be recognised and as far as possible addressed quickly and effectively. It is one of the hotspots for industrial and business innovation; Britain must be part of it.

In part this requires leadership and conviction from Government, along with a readiness to stand up to cynical vested interests that find an all too ready ear from a media that likes to create narratives – whether true or false. There is even an extreme narrative on climate change that states it is a dishonest ruse got up by leftists and planners across the globe using dodgy science against the interests of ordinary people.

One of the strengths of this report is the matter of fact way it dismisses such narratives and shows effectively that renewables are about diversity, innovation and growth – a response to a market need. It would be perverse if many of the climate change sceptics who profess love of markets and competition successfully use state power to suppress the growth of such demand. That is the prospect – and to counter it we need stronger voices from the mass of people and from business arguing for common sense. This report will contribute to helping that voice better express itself – and I very much welcome it.

Executive summary

The renewable energy sector and its supply chains employ at least 110,000 people in the UK today

Innovas data shows renewable energy employed just over 99,000 people in the 2010/2011 financial year. This number will have increased to over 110,000 today, not least given the global and national boom in solar power last year. The total UK turnover for all renewables and their supply chains in 2010/11 was around £12.5 billion. Publicly funded incentives for renewables deployment have therefore been highly effective at leveraging private investment. The weighted average market value increase from 2009/10 to 2010/11 was 11%. This is far greater than national economic growth rates of 1.4% over the same period. The total export value for all renewable technologies was just under £1.6 billion in 2010/11.

Projections are notoriously difficult, but based on Innovas' conservative assumptions and historical performance, the sector's turnover is estimated to reach over £24 billion by 2020. If a direct proportional relationship between generation and employment is assumed, REA estimates over 400,000 jobs are needed to deliver the legally binding EU target of 15% of UK energy from renewable sources in 2020. The turnover associated with this rate of growth would be nearer £50 billion.

Offshore/onshore wind power and its supply chain account for most employment, at 31,400. Wind had the greatest turnover, at just over £4 billion in 2010/11 and the highest value of exports at nearly £500 million. In terms of sector turnover, solar power had by far the largest growth rate from 2009–2010 at 56%, which was dwarfed by growth from 2010–2011 estimated by REA at 280%. Towards the latter half of 2011, solar power is estimated to have employed around 25,000 people. Taken together, all bio-energy technologies employ nearly as many as wind at 31,200, with a combined 2010/11 turnover of £4 billion and exports of £430 million. Mixed waste-to-energy technologies and hydro saw the lowest 2009–2010 market growth at 2.6% and 2.8% respectively. Solar thermal had

the highest ratio of exports as a share of UK sector turnover, at nearly 26% for 2010/11. On average, exports represent approximately 13% by value of the UK renewable energy sector's turnover.

Jobs in renewable energy are nationwide and incredibly diverse – from highly skilled to manual

Innovas' regional analysis shows a good distribution of employment opportunities throughout the country. Regional initiatives can help to boost growth. From organic waste collectors to electrical engineers; geologists to biochemists; pipefitters to crane operators; welders to helicopter pilots; salespeople to factory workers. The sector's need for diverse skills can satisfy ambitious graduates and create new opportunities for the unemployed or those trapped in low-paid jobs.

International evidence shows current employment could boom by 2020

Germany, a similar sized economy to the UK, employed over 370,000 people in its renewable energy sector and delivered 11% of its total energy consumption from renewables in 2010. Renewable energy is the fastest growing energy sector in the world attracting over \$250 billion of technology investment in 2011. Around 1.5 million people are employed in renewable energy across Europe.

The decentralised nature of much of the renewable energy sector means increasingly close linkages with traditional sectors of our economy, including farming, waste management, forestry, energy management and construction. As an example, almost a third of Building Service Engineering companies are now involved in installing renewable energy technologies. SummitSkills estimates over 800,000 training opportunities are required this decade in the Building Services Engineering sector alone to ensure the UK has a workforce able to meet the demands of a low-carbon built environment.

However, the UK risks failing to fulfil its potential

Renewable energy accounts for over 12% of energy across Europe, and over 16% of global energy supply. Yet it accounts for just 3% of our energy supply here in the UK. Most EU countries intend to exceed their 2020 renewable energy targets. The Prime Minister's assertions that 'we are falling behind our competitors' in delivering 21st century infrastructure and that we need a 'horizon shift' is certainly the case for renewable energy. It should not be like this given we benefit from both world-class renewable energy resources and have a world-class engineering tradition on which to build.

Some technologies require urgent policy attention. Only offshore wind and marine technologies are categorised in this report as 'green' (meaning broadly positive) in terms of satisfaction with the policy framework. Of particular concern are policy failures, or lack of political support for: biomass CHP, onshore wind, solar thermal, liquid biofuels, on-farm anaerobic digestion and deep geothermal. Likewise some important mid-sized investors, including the commercial and public sectors, risk falling through the emerging policy framework which is polarised towards targeting either big utility or micro domestic investors.

There are many examples of the UK failing to build on early leads on renewable technologies and these failures cannot be afforded today. However, even where a lead has been lost, as the case studies in this report prove, there are exciting opportunities for innovation and new manufacturing.

The benefits of renewable energy must be understood and championed

Renewable energy technologies and their broad benefits for the economy are still relatively poorly articulated in Westminster and Whitehall and this needs to be addressed urgently. This report has been produced to improve understanding of the breadth of renewable heat, power, gas and transport technologies and their

employment and broader economic benefits.

Major economic benefits are not being routinely quantified. For example, the UK is increasingly dependent on imports of fossil fuels. Meeting the renewable energy targets will therefore deliver a balance of trade benefit estimated at £60 billion cumulative by 2020. This is money that, instead of being spent overseas importing oil and gas, could be more wisely invested here, delivering domestic jobs in renewable energy generation as well as improving our energy security. Such pronounced economic benefits need to be routinely understood and communicated alongside costs.

Parts of the media, and some politicians, persist in equating renewable energy solely with climbing household energy bills. Both nationally and globally, renewable energy receives far less subsidy than fossil fuels receive in subsidies and tax breaks. Renewables draw relatively modestly on household energy bills compared to fossil fuel driven price inflation. Credible analyses, including DECC's own 2050 Pathways Calculator, show that a renewable energy pathway is not more expensive than one which follows business-as-usual. From a macro perspective, the benefits already outweigh the costs.

The threat of acute skills shortages needs to be transformed into a national opportunity

Skills shortages are a major challenge for the sector. BIS could transform this threat into a vast national employment opportunity. Given market failures, the current approach to the skills challenge is inadequate and risks failing to optimise employment benefits for UK citizens at a time of worrying outlook for unemployment. At the high-skills end of the renewable energy sector we face a demographic time bomb. More care is needed to provide clear career entry paths into renewable energy for young people, unemployed people and those transferring from the traditional energy industries. As with many engineering and infrastructure sectors, renewable

energy falls short with respect to recruiting women and ethnic minorities.

There is a far more inspiring story to tell a supportive public – so tell it!

Public support for renewable energy remains high despite distortions in the media and political discourse fostered by well-resourced vested interests and anti-renewables groups. The renewable energy targets, ageing infrastructure, diminishing energy security, poor economic growth and high unemployment are a circle crying out to be squared. The Government's 'balanced energy mix' narrative doesn't do justice to the power of the renewable energy agenda for economic and social transformation. The renewable energy industry wants to work closely with the Coalition Government to develop a stronger

and broader national investment case that better articulates to the public the myriad of benefits of renewable energy, made in Britain.

Perceptions of renewable energy can lag behind reality. This is the fastest growing and most innovative energy sector in the world. REA and its 950 members are keen to help improve understanding of the renewable energy sector and the many benefits and opportunities it offers UK citizens. We hope this report helps. If you need more information get in touch. We are particularly keen to hear from decision-makers and from educational establishments including schools, colleges, universities and training centres. Contact: madeinbritain@r-e-a.net



Nine recommendations for Government

1

Go (much) bolder and broader

Government provides good leadership on offshore wind, where there is a level of join-up with industrial policy. Leadership works; major investors, including manufacturers, are being attracted to the UK. This approach now needs to expand right across the renewable energy sector, under a framework for integrating renewable energy, industrial, skills and economic policy like the one set out below.

2

Government must expedite stability and confidence for the industry

The UK has one of the most challenging renewable energy targets in Europe yet the industry is still waiting for key parts of the policy framework to come into focus. DECC's policy proposals are worryingly complex. Government also needs to pull in one direction to secure investor confidence.

3

BIS needs a Minister with a renewable energy remit

A Minister with responsibility for renewable energy is needed at BIS, along with dedicated civil servants, to put renewable energy at the heart of the growth strategy.

4

Monitor renewable energy employment

If you don't measure it, you can't manage it; employment in renewable energy should be monitored by the Office of National Statistics (ONS) to inform Government policy and communications.

5

Publish a national strategy for renewable energy skills

BIS should publish a skills strategy within the year. As with Green Deal, the Sector Skills Councils need to form a specific alliance on renewable energy. Clear training pathways will help unemployed and low-paid people and people transferring from the traditional energy sectors. The very low representation of women and ethnic minorities in the sector requires action, including by the industry.

6

No.10 should ensure cross-departmental join-up

Relaunch the Office of Renewable Energy Deployment (ORED) as a cross-departmental office chaired by the PM and DPM. It should work hand in glove with the Devolved Administrations and ensure renewable energy receives specific and joined-up policy attention from DECC, BIS, Defra, DCLG, HMT and DfT. The Office of Low Emission Vehicles provides a template.

7

Treasury should audit and report on benefits

HMT should audit and report on the benefits, not just the costs, of renewable energy policies. This should include employment, tax revenues, balance of trade benefits, industrial and export opportunities, market diversity and competitiveness, and energy security. Failure to quantify benefits results in misconceptions, weak advocacy and detachment from important broader national objectives.

8

ORED should enforce the long view

As the Business Secretary concedes, the short-term political cycle can work against sectors requiring a longer-term strategic focus. The public interest is not served when short-term political pressure on costs combine with poor understanding of benefits to suppress investment offering better medium or long-term value and security. ORED should enforce a long-term perspective on infrastructure investment and report annually to the PM. ORED should be supported in this by a cross-party consensus.

9

Empower people, communities and organisations to act

The Government, while retaining sensible controls on expenditure and public value, should remove the illogical and inflexible spending cap on the small scale Feed-in Tariffs (FITs), which drives complex and risky policy-making. Phase 2 of the Renewable Heat Incentive (RHI) should be expedited. Companies and organisations whose mainstream activities lie outside the energy industry play a major role as investors in renewable energy overseas. Here in the UK, the complexity of many policies (FITs, the Renewables Obligation, the Electricity Market Reform proposals and the Carbon Reduction Commitment) can serve to alienate these important investors.

The UK renewable energy imperative

Delivering jobs and growth

The major driver for UK renewable energy policy is the European Union's 2009 Renewable Energy Directive, which set a target for the EU to achieve 20% of its energy consumption from renewables sources by 2020. Because it started from a very low base the UK target is 15%. DECC's Renewable Energy Roadmap, published in July 2011, sets out how this target will be met, with contributions from electricity, heat and transport. The most recent UK data from 2010 showed that renewables contributed 54.3TWh, or 3.3%, of gross final energy consumption. To achieve the 2020 target, renewables consumption would need to increase by 16% every year over this decade – an ambitious challenge, but one that is achievable if Government puts the right framework in place. The industry has consistently shown that, given the right support, it can gear up rapidly and rise to the challenge.

The REA has long recognised the need for a comprehensive analysis setting out the economic opportunity presented by the industry, and, crucially, the current and potential employment across the whole UK renewable energy sector. The REA, working with Innovas, provides here the most up to date information on the renewable energy sector in the UK. The report presents the current employment, number of

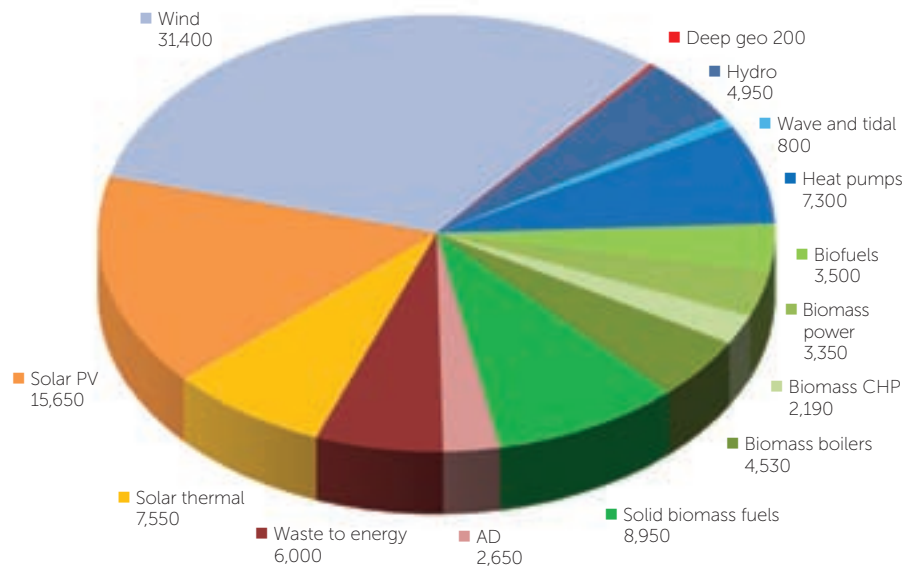
companies, sector turnover, global market turnover, and export value for each technology. The current UK policy framework for each technology is assessed and awarded a red, amber or green status. A regional breakdown is included to allow stakeholders to see the jobs and opportunities in their area.

Employment in the renewable energy industry is not currently defined in ONS statistics (see recommendation 4 opposite). Innovas datasets are based on data for the financial year 2010/11¹. The datasets are built from the bottom-up, from individual company data. They capture employment not only in firms exclusively involved in renewable energy, but employment in firms either

partly involved or for which servicing the renewables supply chain forms over 20% of their business. Where there is a large cross-over with other business activities – for example in the Building Services Engineering sector – care has been taken to best estimate Full-Time Equivalent employment in renewable energy.

This means that our figures, for example, for wind energy are larger than recent estimates because the data catches a wide range of companies involved in not just turbine manufacturing, but in enclosures, cabling, gear box and drive chain manufacture, grid entry switching systems, lubricating oils, towers and gantries etc.

Renewable Energy Employment (2010/11)



Tech-nology	Hydro	Wave & tidal	Heat pumps	Biofuels	Biomass power	Stoves & boilers	Solar Thermal	Solar power	Wind	AD	Mixed waste	Solid biomass fuels
Growth from 09–10	2.8%	5.5%	5.2%	3.9%	4.6%	5.0%	6.2%	56%	7.1%	3.0%	2.6%	5.4%

As the datasets are commercially focused they do not include R&D in academia or EU-funded employment. This means that associated research in R&D, which is significant in many areas, is not included in these figures. For wave and tidal, where R&D forms the cornerstone of the industry, we have included these figures, based on a recent analysis. There was no dataset for deep geothermal so these figures have been provided by the REA’s Deep Geothermal Sector Group, whose members account for most of the UK industry. See the methodology chapter for further information and where we invite input to continually improve understanding of the sector.

Overall employment across renewable energy and its supply chains stood at just over 99,000 people in the UK in 2010/11. This number has increased to at least 110,000 today given sector growth over the past year, including the national boom in solar power which saw the number of solar firms registered with Renewable Energy Assurance Limited (REAL)

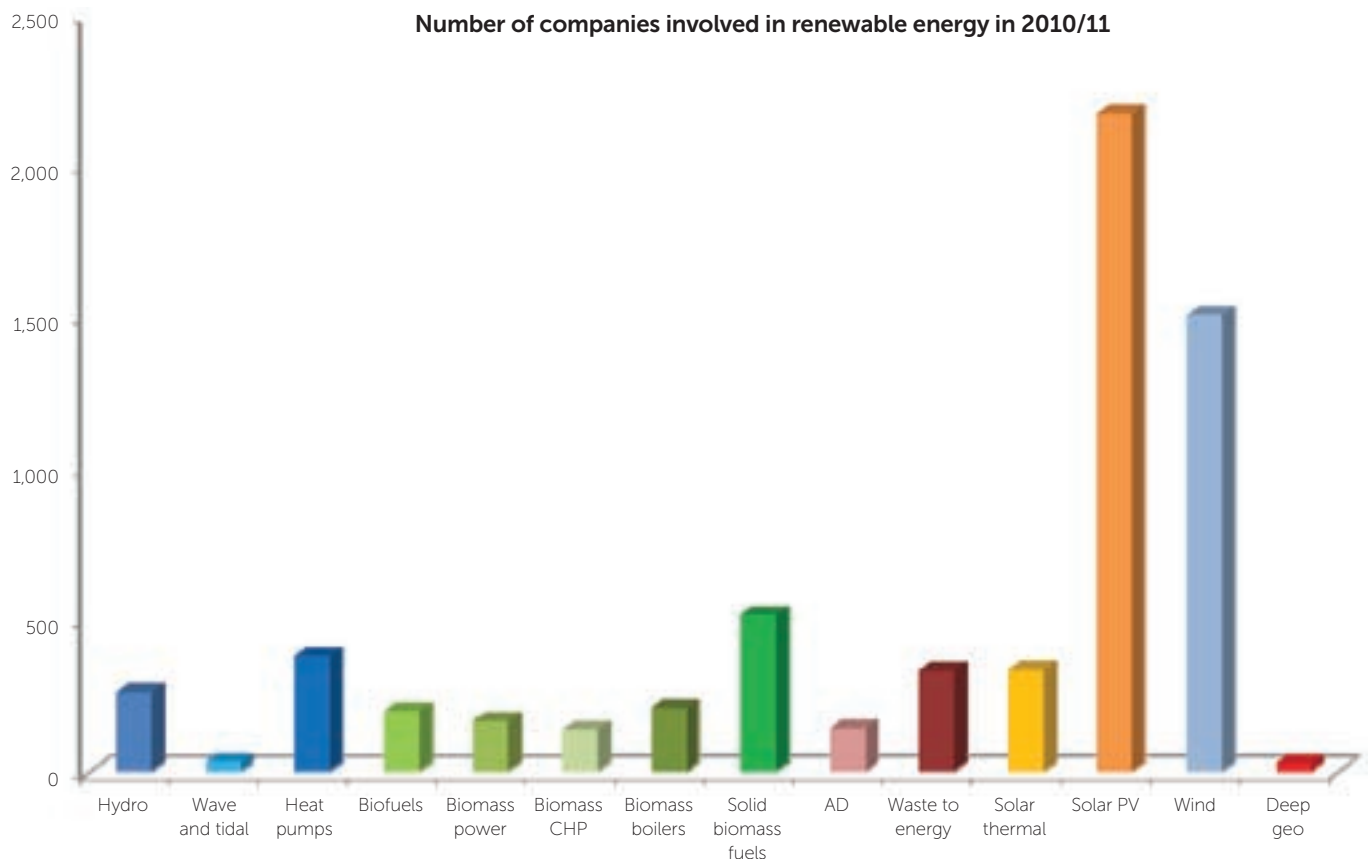
increase from 2,000 to 4,000. Overall there were a total of around 6,500 companies working in renewable energy and its supply chains across the UK in 2010/11.

All sectors exceeded the UK national growth rate over the same period (April 2009–April 2010) of 1.4% (and 0.5% the year after). The weighted average growth across the sector during this period is 11%. This was before the introduction of FITs and the RHI. With economic growth projected at just 0.8% this year, the renewable sector is growing at an average rate at least 10 times faster than national growth rates. There is the potential to perform much better. For example, REA estimates in 2011/12 sector turnover in the UK solar power industry increased 280% compared to 2010/11. Alongside dramatic developments in the international market for solar modules, this growth helped to drive down costs to the point where utility-scale solar is developing under the same subsidy as offshore wind, biomass CHP and AD.

The total UK turnover for all renewables and their supply chains in 2010/2011 was just over £12.5 billion. The total export value for all renewable technologies was just under £1.6 billion in 2010/11. Projections are notoriously difficult but based on conservative assumptions² Innovas estimates sector turnover in 2020/21 at over £24 billion. Innovas projections include historical growth rates, which are clearly insufficient to meet the 2020 renewable energy targets. If a direct proportional relationship between generation and employment is assumed, and if growth continues post 2020, REA estimates over 400,000 jobs are needed to deliver 15% of UK energy from renewable sources in 2020 (see conclusions).

The job types across the industry are tremendously diverse. The supply chain and employment types are set out for each technology.

¹ April 2010 to April 2011.
² Multiple sources, cross-referenced with historical trends and likely market responses to cost reductions.



The UK policy framework

“Business is telling me that the UK is missing big opportunities in the global market place because we have swung too far away from industrial policy.”

**Dr Vince Cable,
BIS Secretary of State**

Policy stability is essential for any new technology to establish itself. Risk, or perceptions of risk, adds to costs of finance. Two years into the new Government, when it has been vital to sustain momentum, we are still waiting for key parts of the policy framework to come into focus.

The Government has set out how it intends to reform the electricity market from 2013. The Electricity Market Reform (EMR) proposals involve replacing the Renewables Obligation (RO) as the key financial incentive for the deployment of larger scale renewable electricity generation. A four fold expansion of renewable electricity generating capacity is needed over the next eight years, and the curtailing of the RO and lack of clarity on what will replace it is profoundly disturbing for the sector.

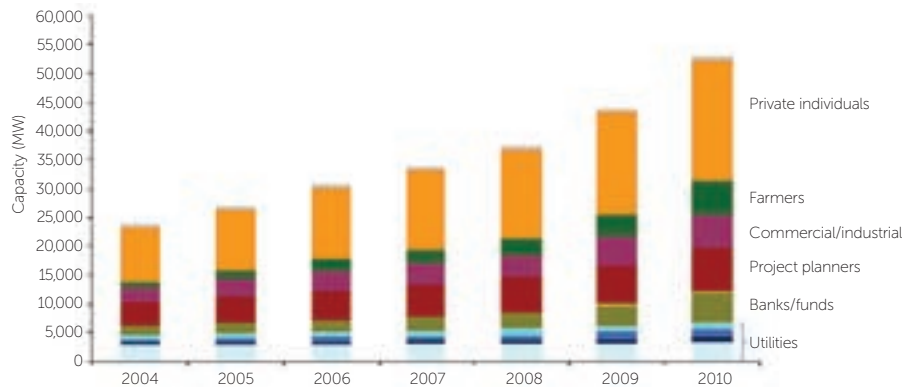
Investment has stalled in biofuel manufacture because of lack of forward clarity over targets. Renewables must account for 10% of our transport energy consumption by 2020, yet we have no trajectory set out for achieving this target. Government has refrained from setting out the targets because of concerns over sustainability, yet the UK industry has been exceptionally environmentally responsible and innovative in biofuel production.

The widely-reported difficulties with solar under the Feed-in Tariffs (FITs) have not helped confidence across the renewable energy sector. However, Governments around the world faced immense challenges dealing with the unprecedented price reductions in solar power. Going forwards, it is essential that investor confidence is rebuilt.

The Government’s reticence to recognise solar PV as a major contributor in the 2020 energy mix, despite exceptional cost reductions, illustrates its resistance to transformative new technologies. Renewables can transform ownership. The graph below shows the breakdown of investors in Germany under its FIT scheme. Investment is dominated almost entirely

by individuals, farmers, municipal governments and private project developers. REA is concerned that many of these important new investors are being squeezed out of a UK policy framework which is polarising between an old-fashioned utility model and domestic investors.

The Renewable Heat Incentive (RHI) is essential if our mandatory



Graph showing highly diverse ownership of German renewable electricity generation. **€25 billion was invested in renewable power in Germany by these diverse investors in 2011.** (Alexa Capital)



renewables target is to be met, and covers some of the cheapest forms of renewable energy available. It is a novel mechanism, and the UK has been rightly proud to hold it up as an example policy for others to follow. It must be allowed to flourish, and not be impeded by misplaced concern that the budget will be rapidly overspent as was the case with the FITs.

The UK industry needs not only greater stability in DECC's policy framework, but far greater cross-departmental collaboration. In Germany, industrial, energy and economic policy are considered in the round. In the UK, energy policy is considered solely through the lens of competition and carbon emissions reduction, although there is welcome appreciation of the industrial potential of marine renewables and offshore wind. Too often efforts to engage BIS and Treasury are frustrated while mainstream energy sectors (i.e. oil and gas) are courted.

11GW of coal and oil plants will close by 2015 and 7GW of nuclear capacity will reach the end of its operating life by 2018¹. 6.7GW of new gas CCGT plants were given planning approval in 2011². At this rate gas clearly risks crowding

out renewable power and locking the UK into fossil fuel infrastructure against the advice of the International Energy Agency and others. The UK increasingly looks like it is clinging to the technologies of the past. And doing so without having taken sufficient care to understand the technologies of the future.

The fastest-growing energy sector in the world

The European Union now employs around 1.5 million³ people in renewable energy with an estimated €130 billion of sales⁴ in 2010. According to the latest studies renewables could employ nearly three million people by 2020. The UK has a lower renewable energy target than most of its European neighbours. Most EU countries not only have higher targets but their National Renewable Energy Action Plans detail how these targets will be exceeded. Renewables now supply 12% of energy supply across Europe, 47% of energy in Sweden, over 30% in Austria and over 11% in Germany⁵.

An estimated £211 billion was invested in renewable energy globally in 2010 – an increase of 32% on 2009⁶. \$250–\$260 billion⁷ of investment in

renewable technologies took place in 2011. The 2011 global solar market is estimated at \$92 billion. Illustrating the dramatic price falls in crystalline solar, total installations rose 69% while revenue rose 29%. Wind attracted the second largest share of global investment at \$72 billion, with China accounting for 40% of the market, followed by the EU.

The Intergovernmental Panel on Climate Change (IPCC) estimates that solar, biomass, geothermal, hydro, wind and marine can meet 80% of world energy supply by 2050. The International Energy Agency will publish its first market report on renewable energy in July. With over 16% of global energy supplied by renewable energy, the UK (on just 3%), should realise that the renewable energy age has arrived. Renewable energy has entered the mainstream.

¹ Strategy for National Infrastructure, HMT & Infrastructure UK, March 2010.

² Infrastructure Delivery Update, HMT Budget 2012.

³ EmployRES, Final Report, European Commission, 2009.

⁴ The State of Renewable Energies in Europe, 11th EurObvER Report, 2011.

⁵ EUROSTAT and EurObvER.

⁶ Global Trends in Renewable Energy Investment, UNEP & Bloomberg Finance, 2011.

⁷ CleanEdge 2012 & Bloomberg New Energy Finance 2012.



Costs: fact over fiction

“What’s particularly baffling is that while government support given to environmentally beneficial renewable power sources is subject to seemingly endless media and political scrutiny, the 500% larger subsidies given to oil, gas and (to a much lesser extent) coal rarely get much attention.”

Fatih Birol,
Chief Economist,
International Energy
Agency

Fossil fuels benefit from six times the global subsidy of renewable energy. The International Energy Agency (IEA) estimates that global subsidies have risen to over \$400 billion in 2010 and will rise to £660 billion by 2020 – 0.7% of global GDP¹. The UK fossil fuel subsidy is estimated at £3.63 billion in 2010², mostly in the form of VAT breaks. This is considerably more than the £1.4 billion subsidy for renewable energy in the same year³. A further £3 billion in tax breaks for the oil and gas sectors was announced in this year’s budget.

Nuclear decommissioning and waste management cost taxpayers £7 billion in 2010. A recent special report by *The Economist* entitled ‘the Dream that Failed’⁴ stated the obvious: ‘nuclear has been getting more expensive whereas renewables are getting cheaper.’

Renewable energy added £20 to household energy bills in 2011⁵. During 2011 average energy bills rose £161⁶. Analysis by Ofgem⁷ and the Committee on Climate Change shows these bill increases were overwhelmingly due to fossil fuel price rises – not least the 40% rise in gas prices last winter. CCC

analysis shows that between 2004 and 2010, low-carbon energy policies were responsible for an increase of just 6.5% in energy bills⁸.

The IEA estimates that for every \$1 of investment not made in the power sector before 2020, \$4.3 needs to be spent post-2020 to compensate for increased emissions⁹.

The German Government puts Reserves-to-Production Ratios (RPR) for conventional oil at 42 years. When non-conventional oil is included, this is increased to 58 years. Natural gas has an RPR of 63 years and uranium, without reprocessing spent fuel, just 30 years¹⁰. The German Government accepts that peak oil will occur within five to 20 years for conventional oil and it anticipates ‘considerable’ price rises¹¹. Using public money to temporarily extend the era of fossil fuels through expensive investment in Carbon Capture and Storage, tar sands and shale gas is sub-optimal investment at best and environmental and economic folly at worst.

The need for urgent action is stark. Even under the IEA’s ‘New Policies Scenario’ the world is on a trajectory to temperature rises above 3.5°C. Global energy demand grows a third by 2035. Passenger car numbers double to 1.7 billion. Coal use increases 25% on 2009 figures. A new ‘golden age’ for gas is

insufficient to limit temperature rises to 2°C.

The success of vested interests (often anonymous) at running highly negative campaigns against renewables in parts of the media often says more about politics and resources than sensible argument. As the Prime Minister said recently¹²: “in any political argument about the allocation of resources, the voice of the present can be a lot louder than the voice of the future.” The US fossil fuel industry spends over 20 times more on lobbying than the renewables industry does¹³.

What are the benefits and costs of meeting our 2020 targets?

Countless credible reports show that renewable energy is no more expensive than business as usual. These include the McKinsey study for the EU 2050 Roadmap¹⁴, the European Commission’s own recent roadmap to 2050, Ofgem’s Project Discovery and Professor David MacKay’s ‘2050 Pathways Calculator’ modelling for DECC.

The higher upfront capital costs of renewable energy are offset by the fact that many renewable technologies have no fuel costs because they use free and readily available ambient energy. The

The British public wants more renewable energy

Despite the difficult economic situation and negative media campaigns, opinion polls consistently show public support for renewable energy is as strong as ever. A YouGov/*Sunday Times* poll in November 2011 revealed overwhelming public support for renewables. 76% of respondents believe the Government should be ‘looking to use more’ solar power, and 56% felt the same way for wind – while 60% believe Government is right to subsidise wind, compared to 26% against. A survey by *The Guardian* in January 2012 shows 60% of the public would actively support the development of wind energy in their locality, while only 27% would actively oppose. A

YouGov survey for Friends of the Earth and Compass in February 2012 shows 70% of the public would support new legislation on energy companies to reduce dependence on imported gas and coal and increase energy from domestic renewable sources, even when told ‘opponents say this would require too much public investment and there are more important things to spend money on at the moment’. Research by Cardiff University and Ipsos MORI in 2011 shows climate change is ‘an underlying and long-term concern for the public’. While 7 out of 10 people are concerned about climate change, 8 out of 10 are concerned the UK is growing too dependent on imported energy.

The public backs ambitious investment in renewable energy. The question is – do Westminster politicians?

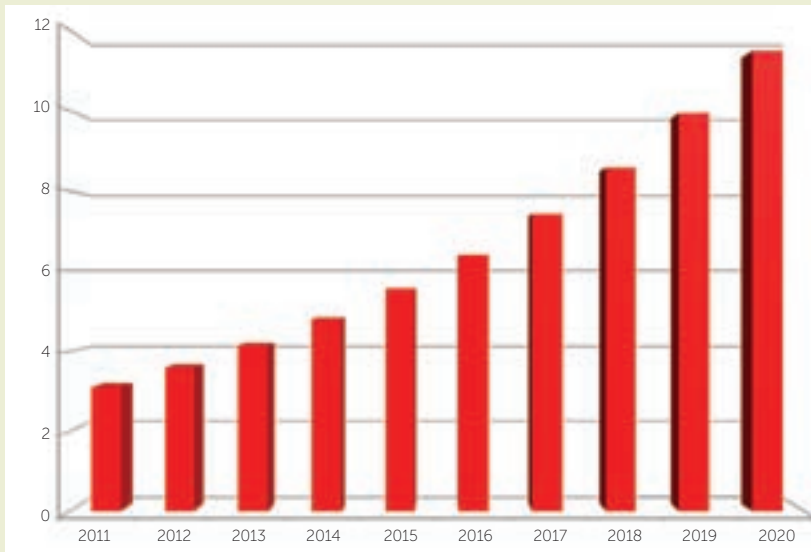
Don't ignore big benefits: the UK balance of trade

REA has calculated the balance of trade benefits to the UK as a result of meeting the renewable energy target. This calculation builds on research previously carried out for the REA by Delta¹⁷.

We estimate, based on DECC's current 'high' fossil fuel scenario that meeting the UK renewable energy

target will result in avoided exports of £11 billion in 2020 and £60 billion cumulative to 2020. The UK can either choose to spend these vast sums of money on increasingly unpredictable overseas imports, or it can create domestic added value by investing in UK skills and enterprise. Renewable energy made in Britain promises to greatly improve our balance of trade deficit, while boosting local employment, economic growth and energy security.

£60 billion
Cumulative spend on fossil fuel imports to 2020



transition is from a fuel-based to a more infrastructure-based energy system. The UK must take great care to embrace this characteristic of renewable energy, or it risks clinging to the past and failing to comprehend the future.

When the UK's Renewable Energy Strategy was published in 2009, the Government estimated that meeting our 2020 targets would cost, to 2030, a cumulative £60 billion more than the cost of conventional energy. This estimate was based on DECC's "Central scenario" fossil fuel price projections for 2020¹⁵. Given the dramatic rises in conventional energy prices in the last two years, these 2020 estimates now seem obsolete.

It appears that we are heading for DECC's 'High' fossil prices scenario in 2020 and, by DECC's own calculations¹⁶, this reduces the additional cost of renewables by a factor of four from £60 billion to £16 billion, i.e. around £12 per person per year. If fossil prices continue to rise as they have



done in recent years we will soon get to a position where renewables represent an economic saving compared with fossil fuels.

REA would welcome clearer assessment of renewable energy costs from Government – these can be hard to decipher from complex Impact Assessments, which often overlay new policies over existing policies making it hard to determine overall cost

projections. However, REA is keen to see the Coalition Government routinely assess *benefits*, not just costs.

One important example is balance of trade benefits. See box.

The German Government routinely assesses both the benefits and the costs of its renewable energy policies. From a macro perspective it asserts that 'the benefits of renewable energies are already greater than their costs today'. Money previously spent overseas on imports now stays in the region. An estimated additional €9 billion accrued to local authorities in Germany in 2010 as a result of employment, profits, taxes and rental revenues generated by renewable energy.

The further benefits of renewable energy investment are too wide to do justice to in this report. These include; tax and export revenues; energy security and geo-political relationships (including defence spending); a lower inflation economy¹⁸; increased market competitiveness and innovation; potential network savings from a greater balance of distributed power; increased consumer choice and empowerment, as well as climate change mitigation benefits. The UK Government has barely begun to understand, yet alone quantify, many of these benefits. That needs to change.

¹ World Energy Outlook 2011, IEA 2012.

² *The Guardian*, using OECD data, www.guardian.co.uk/environment/2012/feb/27/wind-power-subsidy-fossil-fuels.

³ *Guardian* figure checked by REA. PQ by David Mowat 19/01/12 to Gregory Barker DECC shows RO £1.3 billion subsidy 2010/11 and FIT £14.4 million subsidy. RTFO subsidy £421 million supplied to REA by DfT, and with only 22% supporting UK biofuels in 2010/11 the figure is accurate.

⁴ *The Economist*, March 10th edition, 2012.

⁵ Ofgem data supplied to REA.

⁶ Calculated from Rising Energy Bills Briefing, Save the Children, December 2011.

⁷ www.ofgem.gov.uk/Media/FactSheets/Documents/1/Why%20are%20energy%20prices%20rising_factsheet_108.pdf.

⁸ Household Energy Bills, The Committee on Climate Change, 2011.

⁹ World Energy Outlook 2011, IEA 2012.

¹⁰ Renewable Energy: Perspectives for a Sustainable Energy Future, German Environment Ministry, 2011.

¹¹ Renewable Energy: Perspectives for a Sustainable Energy Future, German Environment Ministry, 2011.

¹² Speech to Institution of Civil Engineers, 19th March, 2012.

¹³ No similar analysis is available for the UK that we are aware of. www.energyboom.com/policy/clean-energy-lobby-dwarfed-billion-dollar-fossil-fuel-expenditures-washington.

¹⁴ www.roadmap2050.eu.

¹⁵ Of \$80/bbl for Brent crude oil, 67p/therm for natural gas and \$80/t for coal 2020 estimates are in 2008 prices.

¹⁶ See Table 4, page 19 of the Impact Assessment of UK Renewable Energy Strategy (URN 09D/683).

¹⁷ This calculation is available on request from REA.

¹⁸ Energy prices are one of the biggest drivers of inflation – many renewable sources of energy are inflation-free.

The skills time bomb

“Many of the new (low carbon) industries are complementary to Britain’s industrial heritage, and they therefore offer those who have lost out through deindustrialisation the chance to return to high quality highly paid jobs.”

Low Carbon Cluster Sector Skills Assessment Report



There has been no dedicated assessment of employment and skill needs across the whole UK renewable energy industry to date. However, relevant reports leave no doubt that, without determined intervention, skills shortages will be acute. Analysis suggests over two million new engineers are needed across the economy in the next five to 10 years, for example¹. Shortages are already felt in some areas of renewable energy generation. This major challenge to the delivery of the renewable energy agenda also presents huge new employment opportunities. From organic waste collection to biogas vehicle design, from assembling solar panels in a factory production line to pioneering laboratory research applying biotechnology or nanotechnology – the jobs on offer are exceptionally diverse. The challenge for Government is to offer leadership and to work with industry and relevant agencies to ensure this tremendous potential is realised.

The UK Commission for Employment and Skills (UKCES) carried out the first national strategic skills audit in 2010². The audit identified the ‘low carbon’ agenda as a key driver of change but one that stands to be

seriously affected by skills shortages in the energy sectors and in engineering more broadly. The audit categorises the shortfall in professional technical roles in the gas, electricity and process manufacturing sectors as highest priority, requiring urgent action. These are some of the most relevant categories for renewables. So too are skilled trades in the built environment sectors, which are also categorised as top priority. Science and engineering professionals with specific expertise in low carbon energy generation are categorised as high priority where it is important to tackle skills shortages. The gas and electricity sectors are also identified as sectors with not only the greatest skills deficiencies, but the greatest significance for the vitality of the wider economy.

Looking forwards the renewable energy sector faces considerable challenges recruiting these urgently needed skills, and on a number of fronts as outlined below. (Note that the Qualification and Curriculum Framework categorise skills from Levels 1–8, where e.g. 1 and 2 are basic apprenticeships/ NVQs, Level 3 is A-Levels, an Undergraduate Degree is Level 6: a Postgraduate Degree is Level 7, etc.)

1. There is increasing competition for Science Technology Engineering and Maths (STEM) skills with other technology sectors. Equivalent STEM skills at Levels 4 and 5 are needed across a wide range of engineering disciplines. Technicians at Levels 2–4 are required across the energy generation sector. The lack of STEM qualified individuals is identified as both a critical short and long-term issue by the Low Carbon Cluster study³.

2. Large numbers of highly skilled people are retiring at a time when significant capital investment plans are being implemented – this presents a ‘double whammy’ of high replacement demand at the same time as substantial expansion demand.

3. Restrictions on immigration may impact on parts of the renewables sector. Flexibility is needed to help address these skill shortages, which are often needed at short notice. Restrictions on immigration makes it more difficult for employers to cope with peaks and troughs in domestic skill availability.

4. To further add to recruitment pressures, the number of 16–21 year



olds entering the labour market is forecast to decrease through to 2020, according to ONS population statistics.

5. Progress in improving home-grown talent is patchy. While the number of students taking science GCSEs has tripled over the past decade, there has been a recent drop in relevant apprenticeships. Vocational skills qualifications are dominated by lower level qualifications. The number of engineering degree graduates has increased over the past eight years, however the number of graduates with electrical engineering degrees is on a slightly downward trajectory⁴. Nearly a third of graduates are overseas students. There has been an impressive increase in the number of relevant post-graduate degrees taken, however the proportion of UK graduates is falling.

BIS's new Skills for Sustainable Growth Strategy prioritises a 'bottom up' approach to addressing the skills challenge in which 'employers must take greater responsibility for ensuring skills needs are met'. The strategy has apprenticeships at its heart and it commits funding for the training of young people and those who are unemployed. Beyond this the Government is looking to partner with clusters of businesses to co-fund training as part of an employer-led approach.

As BIS's own Skills for a Green Economy report makes clear, there is a serious risk of market failure in this sector. Stronger and broader Government intervention is needed to ensure skills are in place when they are needed. The continued emphasis on apprenticeships (Levels 2 and 3) and graduates (Level 6) means that there is a gap in the progression pathway. The renewable energy industry has a huge need for skilled technicians at Levels 4 and 5. The Technical Council's 18 month review has recently reported that 450,000 skilled technicians are needed across the economy by 2020. Its recommendations must be heeded.

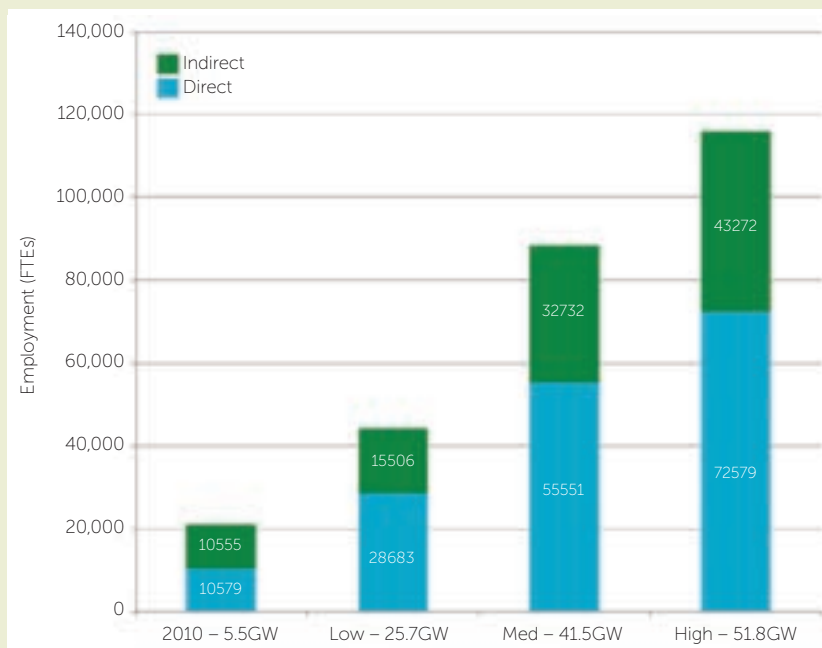
The Government's approach presents specific difficulties for the renewable energy sector. The sector is thinly stretched and scarce resources are being consumed by a highly complex and uncertain policy framework. Before we can engage with future skills needs, REA has prioritised

Spotlight on skills for wind and marine renewables

Research conducted by Energy & Utility Skills and RenewableUK⁵ suggests direct employment could reach as much as 72,000 by 2021 in a high-growth scenario (based on 51.8 GW of generating capacity) with an additional 42,000 indirect jobs created. The largest growth areas being operations and maintenance of onshore wind capacity and the design and manufacture of offshore capacity (jobs growth in the operation and maintenance of offshore capacity also increases rapidly from around 2016).

The skills required by the sector over the coming decade are already proving difficult to recruit from within the UK labour market. EU Skills produced evidence to the Migration Advisory Committee on engineering-related skills shortages in the wider UK power sector. The National Employers Skill Survey reports that skills shortage vacancies are most commonly found in associate professional and skilled trades occupations – precisely those most in demand in wind and marine energy. Therefore, the development and promotion of appropriate entry routes and progression pathways at Levels 3 and above are crucial to the current and future development of this sub-sector of renewables.

Summary of Wind and Marine Energy Employment Projections across three Scenarios for 2021, contrasted against 2010 Baseline.



the production of this report to improve basic understanding of existing employment across the industry. Many of our members are likewise coping with a policy framework in which determination to minimise subsidy, with potentially self-defeating haste, appears to be the only certainty. This leaves no 'fat' to invest in skills.

Out in the real world our SME members are more likely to be dealing with pressing problems, such as access

to finance, than engaging strategically with employer groups on future skills needs. For small and innovative companies staff turnover can be high and there can be a reluctance to invest scarce resources in personnel that may be poached by competitors. Where growth is strong, and it needs to be in renewable energy, staff are needed urgently – companies cannot afford for new recruits to undertake months of training.

¹ The UK engineering sector is vast, generating a quarter of all business turnover in 2010 and employing 5.6 million people. The Skills Councils estimate that over 2 million new engineers are required over the next 5–10 years to meet demand, not least as large numbers are retiring. *Engineering UK 2012: The State of Engineering*, Engineering UK, 2012.

² *Skills for Jobs: Today and Tomorrow: The National Strategic Skills Audit for England 2010*, UK Commission for Employment and Skills, 2010.

³ *Low Carbon Cluster*, Sector Skills Assessment Report, 2009.

⁴ Pers. Comm. EU Skills, 26/03/12.

⁵ *Working for a Green Britain: volume 2, Energy & Utility Skills and RenewableUK*, 2011. *Please note this uses a different methodology for assessing employment across the supply chain to Innovas.*

Made in Wales: a brilliant career



Sara Morgan BSc (Hons) MRes AIEMA, Development Manager at Tidal Energy Limited

Whilst studying for my bachelor's degree in Geography at the University of Wales I became increasingly interested in the interactions of society with the environment. Growing up in Swansea, I was in close proximity to the South Wales Valleys where coal mining and the energy intensive metal industries are etched into its history. The emerging renewables sector, with its potential to meet society's demands whilst using clean resources, captured my interest.

After graduating I worked as a research technician at the University of Wales, Swansea, and I was seconded to a tidal stream developer, before joining Cardiff-based Tidal Energy Limited (TEL) as Development Executive in 2008. I was promoted to Development Manager and played a key role managing the environmental and planning consents elements of TEL's Delta Stream project in Ramsey Sound, which has received funding from the European Regional Development Fund through the Welsh Government. I am currently identifying and developing sites for the next phase of TEL's development; a pre-commercial array project up to 10MW, which the company plans to install by 2017.

Since I joined, TEL and its parent company Eco2, have more than doubled staff numbers to keep up with their growing renewable energy development portfolios. There are several female managers at Eco2 and TEL, with degrees ranging from Mechanical Engineering to Environmental Sciences. The diversity of talent adds to our effectiveness. The expansion of the renewables industry has the potential to generate long-term, skilled employment for the UK and it's fantastic to be part of a company that is at the forefront of renewables innovation in Wales.



Crisis or opportunity? (we decide)

“Our competitors around the world have already recognised the value of technical skills and are taking action to get at the forefront of technology and innovation.”

Steve Holliday,
CEO, National Grid

Higher prioritisation is needed in skills for the renewable energy sector, and more resources are needed to ensure the UK does indeed maximise opportunities for its own citizens – an objective of the Skills for Growth strategy. The Green Deal Skills Alliance provides a model that needs urgently to be replicated for renewable energy. Renewable energy cuts across

the footprint of many Sector Skills Councils. BIS needs to bring them together specifically to address this sector’s needs.

Is it surprising that traditional energy-related courses across Europe have had difficulty attracting potential students⁶? Young people are concerned about climate change. Women account for only 8.7% of professional engineers in the UK – the lowest proportion in Europe – yet little is being done to attract them. The Low Carbon Cluster Skills Assessment identified under-representation of women and black and ethnic minorities as an important part of the recruitment problem. That is a situation the UK and the renewable energy industry cannot afford to tolerate. We might speculate on the reasons, but BIS needs to research why this situation exists and take steps with the industry to address it.

Vision and leadership is key. In the REA’s view the absence of a sufficiently well-articulated Government narrative on renewable energy is creating inter-related problems. Better communication of a compelling national vision for the renewable energy sector, and the very diverse employment opportunities it presents, is likely to inspire and inform new generations of young people.

Championing is also needed of less obviously attractive sectors such as waste-to-energy or biomass. As a recent study shows², a traditionally poor image of the waste industry has hampered recruitment, yet the sector is increasingly high value.

While Government initiatives such as the Low Carbon Roadmap seek to inspire, the Government is guilty of sending mixed messages and sometimes encouraging a negative perception of renewable energy. Recent examples include the 100 MPs publicly damning wind power and the Chancellor’s identification of gas as ‘cheap’ in the 2012 Budget while renewables were (incorrectly) equated with threatening increases to household energy bills. This leads to confusion, rather than confidence, about the Government’s commitment. It undermines any sense of ‘great purpose’.

Policy stability and confidence remains the bottom line. It is no accident that the areas where the skills agenda is best articulated – offshore wind and marine – are the areas where Government is providing strong leadership and adequate financial support.

Creativity is needed to harness the renewable energy opportunity to answer broader political concerns.

The Institute of Public Policy Research (IPPR) has identified the opportunity to help low-skilled workers trapped in low-paid jobs. Given one million young people are now unemployed, they too should be prioritised. With over 70% of the 2020 workforce having already completed tertiary education, the re-skilling of workers from the traditional energy sector should also be a priority. There is a need for clear pathways for retraining here, not least to help overcome resistance to change from the incumbent industries³.

Given the renewable energy targets, ageing infrastructure, pressing energy security concerns, the need to rebalance the UK economy and high levels of unemployment, it is surprising that this glaringly obvious circle is not being vigorously squared. That is certainly happening overseas. The UK Commission for Employment and Skills (UKCES) has been given an enhanced remit for 'inspirational leadership' but there is now no Government Minister with a 'Green Skills' remit and precious few BIS officials, we understand, with

a specific remit in renewable energy. If the UK is to transform these profound challenges into a national opportunity this needs to be addressed. The alternative is surely crisis on several fronts. REA looks forward to working with the Government to set out a much more positive and compelling vision.

¹ *Trends and Drivers for Change in the European Energy Sector*, European Monitoring Centre for Change, 2008.

² *The UK Waste Management and Recycling Industry, 2010 Labour Market Investigation*, Energy & Utility Skills, 2011.

³ *The Future's Green: Job's the UK's Low Carbon Transition*, Lawton K & Bird J, IPPR, 2009.

Tackling unemployment and training nearly 2,000 people per annum in green energy

Case study: British Gas

In May 2011, the British Gas Green Skills Training Centre in Tredgar, South Wales, was officially opened by Carwyn Jones AM, First Minister of the Welsh Government. The centre is a first for the UK and

aims to train people, including local long-term unemployed people, to give them the skills required for a career in green energy. The Heads of the Valleys, where the centre is located, has the lowest employment rate in Wales; 64% compared with 71% nationally.

Developed in partnership with the Welsh Government, JobMatch, Jobcentre Plus, SummitSkills and Blaenau Gwent County Borough Council, the state-of-the-art centre employs 38 people and offers training and qualifications for installers of new green technologies, as well as up-skilling opportunities for British Gas engineers.

The Centre features fully-functioning heating installations and energy efficient and microgeneration technologies to provide the best possible hands-on practice. Among the rapidly growing green technologies on show at the Centre are smart gas and electricity meters, solar thermal panels, solar photovoltaic panels and ground-source heat pumps. In 2011 nearly 2,000 people were trained at the centre. This included 963 British Gas staff and 143 unemployed people. 433 school children also visited throughout the year to learn about careers in green skills.



Growing integration with existing economic sectors

Renewable energy builds on a proud engineering base in the UK so it offers to engage with traditional engineering and manufacturing heartlands. It also reaches across a wide range of well-established sectors in our economy including farming, forestry, waste management, construction and energy management. It is beyond the scope of this report to set out the skills needs for each of these sectors but below the growing skills demands placed on the Building Service Engineering sector is presented in detail.

Skill needs in the Building Service Engineering sector

Since 2006, SummitSkills has been collecting data on companies in the Building Service Engineering (BSE) sector that are involved in installing renewable energy technologies. Figure 1 shows the percentage of BSE companies installing specific environmental technologies from 2008-2011¹. (Data for anaerobic digestion and mechanical heat recovery is only available for 2010/11.²)

SummitSkills' analysis shows a general increase with almost a third of the BSE industry now getting to grips with renewable energy technologies. This is an extremely promising start for the construction sector and its

role in the decarbonisation of the built environment. If the huge potential for onsite carbon emissions reduction is to be realised, including through Part L of the Buildings Regulations, the Green Deal, Feed-in Tariffs and Renewable Heat Incentive, significant numbers of new and existing employees need to be trained in the installation and operation of these technologies.

SummitSkills' Indicative Training Needs Analysis Report (Stage 2)³ covers training requirements over this decade. Table 1 shows the potential training needs for the sector for the UK.

SummitSkills therefore anticipates that by 2020, over 800,000 'learning opportunities' will be needed to meet projected demand for these technologies. This does not mean that 813,514 individual people will be trained because many companies intend to specialise in three or four technologies – meaning that the same individual may therefore benefit from three or four learning opportunities. SummitSkills therefore takes care to differentiate between 'learning opportunities' and individual learners.

To support the delivery of training needs, SummitSkills in association with the Skills Funding Agency and employers in the BSE sector, created the National Skills Academy for Environmental Technologies (NSAET). SummitSkills has identified a serious gap between potential demand for these skills and their likely availability, given the current training curriculum. Table 2 shows the potential gap in the English regions and devolved nations between 2010 and 2020.

Table 1: Predicted training requirements by technology 2010–2020

Technology	Total number of learning opportunities required
Solar water (SW)	74,013
Photovoltaic (PV)	97,154
Anaerobic digestion	41,602
GSHP	87,764
ASHP	87,764
CHP	75,104
Bio-fuel (BF)	49,189
Biomass (BM)	49,189
Micro-hydro	41,600
Micro wind	41,600
Rainwater harvesting	74,407
Fuel cell	20,115
Mechanical heat recovery	74,013 ⁴
Total	813,514

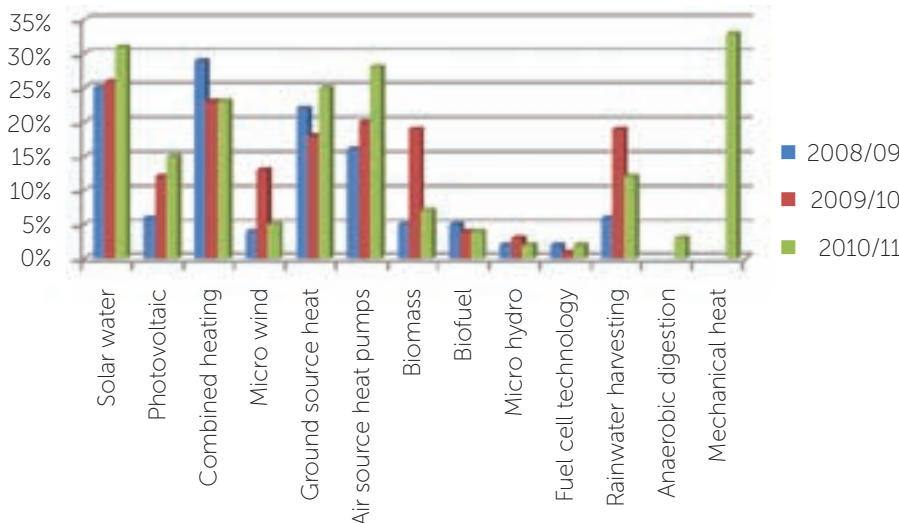


Figure 1: Percentage of BSE companies involved in the installation of environmental technologies between 2008 and 2011. Base = 6,700.



Table 2: Gap analyses between potential demand and current supply of environmental technology qualifications for the BSE sector by English regions. Figures in red show where there is a shortfall between the number of current learning opportunities and potential demand.

	East Midlands	East of England	London	North East	North West	South East	South West	West Midlands	Yorks and Humber	Northern Ireland	Wales	Scotland
2010	2,700	777	1,856	5,935	318	3,504	4,183	588	3,277	356	284	4,683
2011	3,620	8,634	7,520	1,664	9,121	8,224	3,078	8,818	5,250	3,064	3,497	4,438
2012	9,757	17,913	16,076	2,397	18,180	19,510	9,833	16,831	13,292	5,711	7,264	13,283
2013	9,887	18,287	15,676	2,390	18,284	19,673	9,710	17,037	13,239	5,784	7,461	13,468
2014	7,211	14,336	11,370	792	14,273	13,188	6,298	13,567	9,653	4,633	5,899	9,604
2015	3,987	9,395	7,010	1,439	9,430	7,627	2,802	9,217	5,416	3,232	3,874	4,882
2016	1,574	5,607	3,578	3,067	5,889	3,504	254	6,029	2,230	2,165	2,344	1,386
2017	989	4,709	2,793	3,478	4,992	2,476	400	5,238	1,435	1,906	1,973	510
2018	565	4,134	2,326	3,780	4,344	1,765	870	4,695	881	1,714	1,731	99
2019	481	3,968	2,153	3,832	4,231	1,618	945	4,576	772	1,713	1,665	220
2020	310	3,698	1,938	3,975	3,920	1,278	1,175	4,315	505	1,635	1,550	513
Total	35,681	89,904	68,584	25,591	92,346	75,359	24,402	90,911	49,396	31,913	36,974	42,056

If SummitSkill's demand projections are correct then demand for skills will quickly outstrip supply. This could lead to serious consumer issues with inappropriately or insufficiently qualified tradesmen or 'rogue traders' seeking to 'cash in' on potentially lucrative business opportunities. The NSAET is responding to this challenge by building a network of approved providers across England, to seek to meet this demand.

Before the development of the NSAET, the total gap between existing provision and potential need for learning opportunities stood at over half a million. Around 56,000 courses are therefore needed by 2020 given a staff to student ratio of 1:10.

¹ This data is derived from telephone interviews with over 6,000 BSE companies of every size, from micro businesses to large contractors with over 250 employees. The companies were statistically cut by

all the English regions and the devolved nations. The data is also cut by the four main industries associated with the BSE sector, namely plumbing, electrotechnical (electricians), air conditioning and refrigeration engineers, and heating and ventilation engineers, although in figure 1 all this data is combined.

² A full copy of this report will be available to purchase through the National Skills Academy for Environmental Technologies in the near future.

³ This report is available free to download at www.summitskills.org.uk within the research section.

⁴ Mechanical Heat Recovery has been added to data collection later, and is assumed to require a similar engagement to that of SW so identical data has been added here for completeness.

Jobs across the renewable energy industry

The renewable energy sector needs to expand rapidly. There are many skills that are specific to the renewables sector and require specialist training, some of which are detailed in the following technology sections.

However, for most technologies there are many common roles across the supply-chain, both in the installation or construction of the technology, as well as in ongoing support functions. These jobs can be general in nature and either do not need up-skilling or

they can be filled through on-the-job training. Examples include Demolition expert; Civil works personnel; Foreman; Surveyor; Structural engineer; Civil engineer; Quantity surveyor; Labourer; Electrician; Plumber; Brick layer; Roofer; Carpenter; Heavy equipment operator; Sheet metalworker; Security. The general management and administration necessary for the ongoing running of the businesses can be added to this. The types of jobs to be found here include Plant and Operations Manager; Office administrator; Health and safety manager; Environment officer; Shift manager; General labourer; Supervisor; Accountant; Purchaser; Customer care; Communications; Sales; Marketing and Logistics personnel.

Architect, Architectural technician and Planner are common professional

roles where more dedicated up-skilling is required. This is also the case for many Building Service Engineering roles. Roles dealing specifically with renewables in the financial and insurance industries are also emerging along with strategic positions in the public and private sectors. There is also significant ongoing research and development (R&D) activity being undertaken, not only within the supply chain, but also in academic institutions throughout the country.

The creation of these support jobs should be viewed as of equal importance to the more specialist roles as they are essential in ensuring the continued growth of the sector.

Onshore wind (power)

Background, current status and outlook

For centuries windmills harnessed the UK's abundant wind resource for irrigation, pumping and grain milling. Using wind power to generate electricity was first patented in 1891 by Scottish Professor James Blythe. Exactly 100 years later, in 1991, the first modern onshore wind farm in the UK was developed by pioneering farmer Peter Edwards of Deli Farm in Cornwall.

The UK was active in supporting R&D in wind energy in the 1980s but the late introduction of a policy to encourage its deployment resulted in the UK losing the opportunity to lead on the manufacture of wind turbines to Germany, Denmark and Spain. However, the wind industry has recently seen improved prospects for domestic turbine manufacturing, driven by strong political commitment to offshore wind. Siemens, GE, Vestas and Gamesa have been attracted to the UK, largely because of the huge ambition under the Round Three offshore licences. Mabey Bridge, an established specialist supplier of modular steel bridging and heavy plated steelwork, based in Wales, has diversified into the construction of wind turbine towers.

Onshore wind is one of the cheapest low carbon energy technologies. Secure, proven and quick-to-build, it is essential in meeting our renewable energy targets and carbon reduction objectives cost-effectively. Onshore wind now contributes over 27%¹ of renewable power generation. After



“Whatever the anti-wind brigade may say, public support for onshore wind remains consistently high.”
Jonathon Porritt

bioenergy it is the second largest contributor to UK renewable electricity supply. Each year onshore wind generates power equivalent to the needs of over two and a half million homes.

With around eight thousand components in a wind turbine, our analysis shows the wind industry is supporting a wider range of UK employment across the supply chain than is generally appreciated, from the manufacture of lubricating oils to gearboxes and cabling. Operations and maintenance are becoming increasingly important in employment as wind capacity expands.

Smaller turbines and turbine clusters up to 5MW in size have been significantly boosted by the Feed-In Tariff. The UK excels in the manufacture of small wind turbines so this offers significant opportunities in certain markets, such as for rural communities, businesses and schools. Smaller turbines are more likely to get planning

permission but they do not offer the same efficiency.

Internationally the cost of wind energy has fallen, however planning barriers in the UK have increased both the time and cost of development and discouraged the use of larger turbines, which are common across Europe, and which would bring the costs of generation down even further.

The maturity of this established sector means there is less potential for job growth compared to offshore wind and wave and tidal energy. However onshore wind forms an important base from which these newer sectors can be developed, and therefore it is essential that investor confidence in onshore wind is maintained. This requires local support, grid availability and much more consistently positive advocacy by Government.

¹ DUKES 2011, onshore wind generated 7,137GWh in 2010.

Current UK policy framework

Onshore wind has fared well under the Renewables Obligation (RO) although there has been a slow-down in planning approval rates, with just 26% of proposed capacity approved in England in 2010/11². Investor confidence is wavering in the midst of policy uncertainty. Public opinion polls consistently show strong public support for wind power, but

organised anti-wind campaigners and mixed messages from UK politicians risk this affordable technology failing to reach its potential. The situation is better for schemes over 50MW which are decided upon by Ministers rather than local authorities. All four qualifying schemes were approved in 2011. Approval rates are also more favourable in Scotland and Wales, although there are difficulties with the Welsh Government's position on upgrading the grid infrastructure.

Government proposes to reduce support for onshore wind under the RO

by 10% from April 2013³. A reduction of 40% in support is proposed for the smallest wind turbines under the Feed-In Tariff. In the current climate, these proposals, combined with complex and uncertain reforms to both the planning system and the electricity market, are cause for concern.

² State of the Industry Report, RenewableUK, October 2011.

³ DECC, October 2011, Consultation on proposals for the levels of banded support under the Renewables Obligation for the period 2013–2017 and the Renewables Obligation Order 2012.

British firm is one of the world's leading independent developers

Case study: Renewable Energy Systems

RES, a British family-owned firm, is one of the world's leading independent renewable energy developers with operations around the globe. From the Group's HQ in Hertfordshire, RES has been at the forefront of wind energy for three decades, building its first wind farm in Cornwall in 1992. Since then, RES has constructed more than 100 projects around the world.

The RES Group, which is active in a variety of renewable energy technologies, employs 468 people in the UK, 315 of whom work wholly, or in part, on onshore wind. They have developed 32 wind farms across the UK, providing around 10% of the country's installed wind capacity, with a further 680MW under construction or consented. RES is



committed to ensuring its wind farms deliver tangible benefits to the British economy. For example, two thirds of civil engineering work in the past two years was contracted locally or regionally.

Despite the recent challenging economic climate, RES has grown significantly. Employee numbers have more than trebled in the UK since 2007 and they will continue to rise as the company goes from strength to strength. The total turnover for 2011 for RES onshore wind activities was £177 million and this is expected to more than double by 2020.

Jobs in onshore wind

Design and development: Design engineer; Lawyer; Project manager; Financial planner; Economists; Electrical systems designer; Physics engineer; Environmental engineer; Environmental consultant; Meteorologist; Programmers and modellers; Aeronautical engineer; Communications expert.

Manufacture: Electrical engineer; Welder; Metal worker; Machinist; Skilled assembler; Test technician; Quality controller; Chemical engineer; Materials engineer; Mechanical engineer; Semi and non skilled workers.

Construction and Installation: Planning and environmental consultants; Project management and construction workers; Electrical engineer; Power generation engineer; Project manager; Turbine specialist engineer; Tower erector - crane operator; Health and safety manager.

Operations and maintenance: Electrical engineer; Power generation engineer; Energy traders.

Wind turbine towers manufactured in Wales

Case study: Mabey Bridge

Based in Chepstow, South Wales, Mabey Bridge can be traced back to the construction of Brunel's Wye railway bridge in 1849. Since then it has become a world-renowned specialist supplier of modular steel bridging, highway bridges, railway bridges and other heavy plated steelwork.

It recently moved into the renewable energy market where many of the machines and skills required to build turbine towers have parallels with bridge construction techniques.

By adapting to new market opportunities and transferring its construction expertise to the green energy sector, it has given UK energy companies the chance to buy British

instead of being required to import wind turbine towers from other countries.

In May 2011 Charles Hendry MP, the Minister for Energy and Climate Change, officially opened Mabey Bridge's £38 million state-of-the-art wind turbine tower manufacturing facility in Chepstow. The company funded the investment in full and has created 197 skilled jobs in the

South Wales region to date.

Since signing a preferred supplier agreement with REpower, one of the UK's biggest suppliers of wind energy, it has entered into a number of further supply agreements with other major wind turbine manufacturers and Mabey's towers have now been delivered and installed at a number of wind farm sites across the UK.



Key facts (2010/11)

Onshore wind employment across supply chain:	15,200
Number of onshore wind UK companies across supply chain:	730
Onshore wind sector turnover:	£2 billion
Total value global market offshore and onshore wind:	£130 billion
Export value offshore and onshore wind:	£500 million

Offshore wind (power)

Background, current status and outlook

The first commercial-scale offshore wind farm was commissioned in 2003. The sector has since developed rapidly, with the UK surpassing Denmark to become the largest generator of offshore wind power in the world. The UK has relatively shallow waters and truly exceptional wind resources. This, along with strong government support, has provided ideal conditions for the development of this technology.

In February 2012, the largest offshore wind farm in the world at 370MW was built by Dong Energy off the coast of Cumbria. This will be dwarfed by the 1GW London Array, developed by a consortium of Dong Energy, E.ON and Masdar. The first phase of construction should be complete by the end of this year. Currently, the installed capacity for offshore wind is 1.7GW, with around 7.4GW under construction and in planning under Rounds 1 and 2. Combined, this will be sufficient to meet the power needs of all the homes in Scotland and Greater London.

Up to 25GW of capacity is anticipated under Round 3 when the technology will move into deeper waters which are more challenging and expensive to develop. Government has established an Offshore Wind Cost Reduction Taskforce which aims to reduce costs to £100/MWh by 2020 and which is due to report this spring. Industry is working with government on this objective, but successful cost reduction requires a substantial market to secure sufficient learning, investment and innovation. Government's low offshore wind scenario which



“Offshore wind alone could support 50,000 direct and indirect jobs in Scotland by 2020.”

**Minister Fergus Ewing,
Scottish Government**

anticipates only 14GW installed by 2020 is insufficient. Industry wants to see an annual installation rate of 3 to 4GW each year by 2016/2017, along with ambitious targets through to 2030. This will secure cost reductions, a mature supply chain (including UK turbine manufacturing), servicing vessels, grid infrastructure and an improved skills base.

It is vital that momentum is maintained, and the volume of projects coming through the pipeline increases. There was disappointment when Ministers failed to approve an onshore substation in Little Dunham, essential for connecting over 500MW of offshore

capacity. The uncertainty introduced by the Electricity Market Reform proposals also needs to be resolved as quickly as possible.

Offshore wind presents a significant opportunity for skilled job growth, if the UK can rise to the skills challenge. Major manufacturers including Siemens and Gamesa have recently been attracted to the UK and are developing new types of turbine here. Four new testing and demonstration sites were announced by the Crown Estate last year, adding to the existing testing capabilities of the National Renewable Energy Centre and Vestas's new R&D facility on the Isle of Wight.

Current UK policy framework

Government increased support for offshore wind following an emergency review of the RO in 2010 due to significant increases in costs caused by the supply chain and market factors. Government

proposes reducing the subsidy by 5% per annum from 2015. Whether these cost reductions can be achieved depends partly on ambitious commitment to strong industry growth.

Offshore wind farms have a very long lead time, and therefore it is essential that developers understand and are comfortable with the Electricity Market Reform proposals. Much detail

is still lacking. Without long-term investor confidence, manufacturers will go to countries with attractive and well-defined support schemes.

A confident, clear and well-resourced consenting process is also essential. Industry wants more co-ordination in the process of connecting offshore windfarms, as this will reduce costs.

Offshore wind creating demand for subsea trenching

Case study: SMD

SMD, based in Tyne and Wear, is the world's leading supplier of subsea trenching systems. SMD supply all the major offshore installation contractors, as well as companies focussed on entirely on the offshore wind market such as MPI and General Cable.

The growth in demand for the next generation of SMD trenching vehicles is fuelled in part by the huge growth in the offshore wind market. Each offshore wind turbine needs to be connected by cable to export the electricity and this cable needs to be protected in some way, very often by burial with trenching machines.

When looking at the total predicted installed capacity in the UK alone, demand for SMD's specialist and proven subsea trenching technology is likely to grow and that is before the global

market is considered. SMD has already built extra production facilities to help cope with the predicted demand.

SMD is also using its subsea knowledge and manufacturing know-how to help build marine energy converter prototypes (such as the 1MW Atlantis Turbine) and associated technologies such as connector and cable management systems (essentially underwater plugs). It is also developing new technologies such as subsea drilling rigs to help install the technology.



Jobs in offshore wind

Design and development:

Planner; Lawyer; Financial planner; Economist; Electrical systems designer; Physical engineer; Project manager; Environmental engineer; Meteorologist; Programmer and modeller; Aeronautical engineer; Communications expert.

Manufacture:

Design engineer; Electrical engineer; Welder; Metal worker; Machinist; Skilled assembler; Semi and non skilled worker; Test technician; Chemical engineer; Materials engineer; Mechanical engineer; Quality assurance.

Construction and installation:

Planning and environmental consultant; Underwater diver; Project management and construction worker; Marine Engineer; Electrical engineer; Power generation engineer; Turbine specialist engineer; Tower erector; Crane operator; Health and safety manager; Specialist shipping and port personnel.

Operations and maintenance:

Electrical engineer; Sea and air transport personnel; Power generation engineer; Energy trader.



Joint venture partnerships on offshore wind could power millions of homes

Case study: Centrica Energy

Centrica Energy is responsible for securing gas and electricity supplies for millions of British Gas consumers across Britain. To enable this, Centrica Energy is involved in gas exploration and production, power generation and energy trading. Over the last few years Centrica has become a leading player in offshore wind development, with interests in three operational wind farms which together produce enough electricity to power around 220,000 homes.

Centrica Energy is in partnership with DONG Energy and Siemens Project

Ventures on the 270MW Lincs wind farm, shown here, which is currently under construction off the East coast of England. When completed Lincs will meet the electricity demand of around 200,000 homes.

Centrica Energy also has a strong development pipeline; it is currently awaiting consent decisions on two projects; Race Bank and Docking Shoal, off the Lincolnshire and Norfolk coasts. Centrica Energy's development opportunities also include the Round 3 Irish Sea Zone which has a potential capacity of 4.2GW. In March 2012, Centrica Energy and DONG Energy announced the creation of a joint venture partnership named Celtic Array Limited. Celtic Array will work to develop, construct and operate wind farms within the zone, which has the potential to generate clean, secure electricity for around three million homes.

Key facts (2010/11)

Current employment across offshore wind supply chain:	16,200
Number of UK companies across offshore wind supply chain:	790
Current sector turnover:	£2.1 billion
Total value global market offshore and onshore wind:	£130 billion
UK export market value offshore and onshore wind:	£500 million

Solar photovoltaics (power)

Background, current status and outlook

The UK enjoyed an early lead on photovoltaic (PV) technology in the 1970s but most UK R&D was abandoned after the oil shocks abated. Even so, in the late 80s the UK was the lead on commercialising solar technology internationally. BP Solar had its headquarters in the UK and Newcastle University was recognised as the leading global research centre. In the 1990s the world's first building-integrated solar façade was built in the UK, and we boasted the largest commercial building array in the world at Ford Bridgend.

The technology was developed for use in space by NASA and in remote off-grid applications in the 70s and 80s. In the 90s it was driven by major public support programmes, first in Japan and then later in Germany. When Germany launched its 1000 solar roof project in the mid 1990s the UK was left behind. Germany's successful Feed-In Tariff model has now been emulated by over 50 countries around the world putting PV on a trajectory to reach 'grid parity'. PV has delivered a consistent 20%+ price reduction with every doubling of capacity. Mainstream analysts¹ expect PV to deliver cheaper power than retail prices for grid electricity before 2020, in nearly all applications.

More PV capacity was installed than any other renewable across Europe last year and the UK has the fifth largest potential solar power market in the EU. The International Energy Agency has more than doubled its forecasts, predicting PV could become the major electricity generating technology in

"The largest technical potential of all energy sources."

Intergovernmental Panel on Climate Change



the world in 50 years' time. Research by the Intergovernmental Panel on Climate Change also spotlights solar as the biggest potential contributor for tackling climate change. Wind power is complemented by the annual generation profile of PV, so they are increasingly pursued in tandem in countries like Germany and Japan.

Installation accounts for around 80% of employment in the sector. The panels themselves account for around 40% of the total costs of a domestic system. Asia is taking an increasing share of the global manufacturing market, although modules can be assembled in the UK, or cells can be remanufactured into innovative building integrated products suitable for domestic and EU markets. The UK currently has around 4000 companies involved in the supply and

installation of solar PV, with around 60 further companies involved across the manufacturing supply chain, from mounting system manufacture to solar-powered transport research.

The domestic PV industry had a volatile start as the UK Government, along with many others, struggled to respond effectively to dramatic cost reductions. At the utility scale, the cost of solar power has fallen to that of offshore wind and anaerobic digestion, and the price continues to fall. Despite proving itself, the outlook for domestic solar power remains worrying this year, largely because of its continued constraint under a Treasury-imposed spending cap.

¹ Ernst and Young, IEA and the German Government, for example.

Current UK policy framework

From a modest 30MW of installed capacity prior to 2010, solar power boomed with the introduction of the Feed-In Tariff scheme (FITs) introduced after a successful campaign by REA and Friends of the Earth. Over 1GW of solar power

was installed in 2011/2012 making the UK market the sixth largest in the world. DECC now recognises PV as a technology which will make a significant contribution and plans to update its Renewables Roadmap later in the year to reflect this.

Concerns about current policy proposals for FITs persist, due to Government imposing a rigid spending cap on the policy. This year's projected

expenditure² could well be insufficient to safeguard a market of sufficient size to stabilise the industry. Solar now faces particularly poor treatment under writing-down allowances³.

² Impact Assessment – Comprehensive Review Phase 2a.

³ From April 2012 Solar PV receives the special rate of 8% writing down allowance rather than the main rate of 18%.

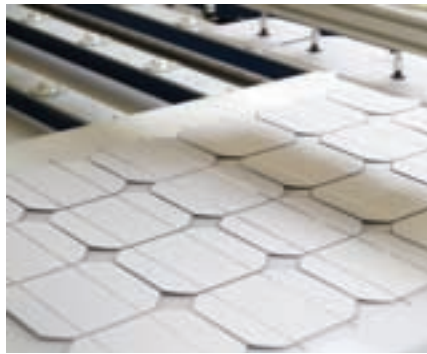
Visionaries in glass partner with Chinese manufacturer

Case study: Romag

Romag is a leading glass processor based in County Durham in the North East of England. The company has specialised in architectural, security and transport glass since 1943 and it is now a subsidiary of Gentoo Group.

Romag anticipated future opportunities and developed a successful range of top quality solar products in mono and polycrystalline cells. Its product range includes building-integrated solar tiles and its new stunning 'glass-glass' which embeds solar cells in a glass that can also reduce solar heat gain and control light transmission and shading.

Around 180 highly skilled staff are currently employed in manufacturing its product range and many more are



supported throughout the supply chain. Over the past year Romag invested around £1.5 million in a completely new state-of-the-art PV production line, trebling its production capacity. 20 new staff members have been employed and Romag is moving towards 24-hour operations to meet customer demand.

In an industry first, Romag recently signed a partnership agreement with Chinese solar giant LDK to supply, research, develop and design photovoltaic products and raw materials. The deal was witnessed

Jobs in solar power

Manufacturing and design:

Design engineer; Systems engineer; Production manager; Production supervisor; Electrical engineer; Laboratory technician; Quality assurance; Assembler line personnel; Chemist; Surveyor; Materials scientist; Warehousing/logistics personnel.

Installation and maintenance:

Planning and environmental consultant (ground mounted schemes); Roofer; Electrician; Instrumentation engineer, Controls and electrical systems technician; Installation engineers; Installation supervisor; Scaffolder; Service engineers; Panel cleaners; Security.

and welcomed by Energy Minister Greg Barker. This illustrates the huge potential for commercial partnerships whereby Chinese solar cells can be re-manufactured in the UK into innovative and aesthetic products for the growing domestic market, and for export abroad.

Passion, ambition and professionalism

Case study: EvoEnergy

In just five years EvoEnergy expanded from a one-man start-up to a company employing more than 200 staff and a turnover of £25.5 million per annum. Young entrepreneur Dr Kevin Hard started the business by investing £30,000 from the sale of his own house. EvoEnergy now has offices in Nottingham, London, Bristol, Halifax and Cornwall. It has installed solar systems on homes from the Orkney Islands to Penzance and carried out some of the country's largest commercial installations.

The workforce is young, enthusiastic and well-qualified. The average age is 32 and more than 60% of staff are graduates. EvoEnergy has invested in its own training academy, developing a career path

within the industry from scratch. All new employees undergo induction training and there are in-house courses. There is an ongoing, internal management training scheme and more than 40 staff are currently on this programme.

Quality training has helped the company to build a reputation

for technical excellence and professionalism. EvoEnergy is looking to develop its business for the long term. It is diversifying to offer solar thermal systems and it plans to become a Green Deal provider. Turnover next year is expected to reach £46 million, and £100 million per year within three years.



Key facts (2010/11)

Employment across supply chain:	15,650 (25,000 estimated by end 2011 ⁴)
Number of UK companies across supply chain:	2,200 (4000 installers registered with REAL by end 2011 ⁵)
UK sector turnover:	£1.8 billion (£5.4 billion REA estimate 2011/12)
Global market value:	£28 billion
UK exports value:	£315 million

⁴ REA analysis based on REAL data.

⁵ REA analysis based on DECC forecast deployment set out in Comprehensive Review Phase 2a and REA/Innovas research.

Hydro (power)

Background, current status and outlook

This mature technology was developed over 150 years ago. It is the world's largest source of renewable power, generating around 20% of global electricity and employing 2.7 million people¹. Modern hydro schemes are over 90% efficient with a very long life time. It is estimated that less than a third of the world's potential capacity has been developed², yet there is little potential for expansion of large scale in the UK, where it currently provides 1.3%³ of our electricity demand. New schemes are being developed across Europe, however, and existing schemes are being upgraded.

The UK has further development potential in modern run-of river hydro, including new high-head sites. Watermills were a common feature of the Medieval British countryside with 5,624 recorded in England in the Domesday Book. They helped to power the industrial revolution, particularly in its early stages, alongside coal. It is estimated that potentially 1000 traditional mill sites could be brought back into use. The Environment Agency has identified over 25,000 existing structures in rivers, such as weirs and locks, which provide further hydro power potential; the combined capacity of these sites would be over 1GW. The Agency recommends the development of half this potential in 5,000 sites, where a scheme could also help improve ecological conditions for fish. There have been similar studies in Scotland identifying further considerable potential for small to medium scale schemes.

There is also a largely untapped potential for hundreds of very small



"Our rivers and streams are a great untapped source of power."

**Energy Minister
Greg Barker,
DECC**

scale 'micro-hydro' or 'pico-hydro' schemes under 100kW capacity (mostly in the 10–15kW range) which can be implemented without the risk of significant environmental effects on small high-head watercourses. These can bring benefits to rural landowners and communities.

A wide range of turbines are manufactured in the UK. Manufacturers include Gilkes & Gordon which designs and supplies larger turbines; Ecowave in Somerset which makes 'crossflow' turbines for low to medium head schemes; Hydrover Turbines which makes 'turgo' turbines for medium to high-head schemes; Evans Engineering and Power Company which makes 'pelton' turbines, and NHT engineering. As well as providing a boost for manufacturing, the FITs have enabled significant growth in installation companies.

Each project is unique and hydro therefore does not benefit from economies of scale. Hundreds of former mill sites could be brought back into use; however, the eligibility criteria for refurbished schemes are excessive – for example, requiring the replacement

of runners, despite the fact they can last a hundred years. Hydro can often be in a location with sparse grid networks, adding to connection costs.

But it is the restrictive environmental licensing conditions, often requiring extensive civil works, that present the greatest barrier to the expansion of river-hydro. The EU Water Framework Directive has been interpreted by UK environmental agencies as requiring adaptations or constraints on the level of abstraction that, in some instances, reduce efficiency and greatly add to costs. The outlook for the sector is 'up in the air'⁴ and in some conflict with the anticipated 16GW of new small hydro anticipated across Europe by 2020. Planning permission is contingent on securing a licence which in turn can take over a year to negotiate and involve expensive environmental monitoring and extremely expensive engineered solutions, including fish passes.

¹ *Advancing Sustainable Hydropower*, International Hydropower Association, 2011 Activity Report.

² According to the British Hydropower Association.

³ DUKES 2011.

⁴ The State of Renewable Energies in Europe, 11th EurObserv'ER Report.

Current UK policy framework

Large-scale hydro is largely exploited and little further development is anticipated. River-hydro is supported under the Feed-in Tariff and the Renewables Obligation (RO), although the support for schemes above 2MW is too low to stimulate

deployment. Government proposes to cut support under the RO in half. The FIT currently encourages hydro schemes to downsize to 100kW schemes and under to maximise revenue, which is a perverse incentive.

REA would like to see a presumption in favour of consent for small and micro river hydro schemes, with interventions taken if there is

evidence that aquatic life is likely to be harmed. Permitted development rights for planning purposes for hydro are under consideration and this is welcome. There are some anomalies in business rating for hydro, which should be addressed. A fairer and more enabling framework is needed if the UK is to fulfil its river hydro potential.

Hydro and software innovators set for expansion

Case study: Ecowave

Ecowave started designing and manufacturing micro-hydro equipment in 2009 from its workshop in Clapton Mill, Somerset. Ecovave's small team completes much of the work in house, although they do sub-contract locally, and source materials locally whenever possible. This regular stream of work is greatly appreciated by local companies.

In 2010 Ecovave formed a partnership with UK-based control system engineers CIS and developed its own, and the UK's first, industrial standard micro-hydro control system, using cutting-edge software. Ecovave has already exported turbines to Ireland and anticipates great further opportunities in the export market.

Ecovave has seen substantial growth in the number of installers starting in this area. However, the



company perceives a nationwide shortage of installers and, more importantly, training courses to develop the multi-disciplined skill set a hydro installer needs.

In 2012 Ecovave is investing significantly in new production facilities, which will enable it to take on more staff and bigger contracts.

Ecovave sees considerable scope for expansion in the industry and is investing in its manufacturing capacity in readiness. Ultimately, for this innovative start-up, it will be factors outside its control which will govern the speed of expansion. Addressing the many barriers to hydro will allow this young company to thrive.

Reducing barriers to hydro with the Archimedes screw

Case study: Mann Power Consulting Ltd (photo left)

MPCL introduced the Archimedean screw as a hydro generator to the UK in 2004 and quickly became the leading specialists in the sector. Given the low-head nature of many British rivers, and a history of fish-protection issues preventing micro-hydro developments, the technology's potential was immediately obvious.

MPCL's extensive (and expensive!) environmental impact monitoring and fish-passage studies convinced the Environment Agency to allow Archimedean screw systems to run with minimal screening, significantly reducing capital costs. Consequently, literally hundreds of previously written-

off sites are now being revisited for development.

MPCL employs seven staff, plus agents in Scotland, Ireland and southern England. Due to increasing demand, another local firm, TWS Fabrication Ltd, has rapidly developed expertise in fabricating and installing the sluice gates and walkways for Archimedean screw systems.

As these installations spread, so too does the web of subcontractors involved in each design, from marine biologists to steel fabricators. MPCL provides support throughout the project cycle, from feasibility study, design, and project planning, to construction, installation and commissioning.

In the last financial year, MPCL paid over £90,000 in salaries and over £250,000 to subcontractors nationwide. Quite a step up from one man knocking on doors offering to do feasibility studies for free.

Jobs in hydro

Manufacture and design: Design engineer; Hydrogeologist; Marine biologist; Electrical engineer; Machinist; Welder; Metal worker; Structural engineer; Marine engineer; Reservoir engineer; Resource manager.

Installation and maintenance: Planning and environmental consultant; Project management; Construction worker; Project Manager; Electrical engineer; Power generation engineer; Maintenance engineer; Installation technician; Supervisor; Environmental and planning consultant; Environmental scientist; Ecologist; Service engineer.



Key facts (2010/11)

Employment across supply chain:	4,970
Number of UK companies across supply chain:	260
UK sector turnover:	£544 million
Global market value:	£13.7 billion
UK export value:	£57 million

Wave and tidal (power)

Background, current status and outlook

Seagen, built by Marine Current Turbines, is the world's first accredited tidal stream power station. Pelamis exported the world's first array of wave energy generators to Portugal. The UK industry has fought hard to retain its global lead in this nascent technology. Its resolve has been rewarded by increasingly strong and well-informed political backing.

The UK boasts a third of Europe's wave resource and half of Europe's tidal resource and the country punches above its weight when it comes to innovation in wave and tidal devices. We also have existing strengths along the supply chain, including a creative engineering base, and established expertise in marine foundations and moorings. The European Marine Energy Centre, based in the Orkneys, and Wavehub in Cornwall, have enabled the proving of commercial-scale prototypes in the field. Major international engineering companies are now investing in the UK sector including Siemens, Rolls-Royce and ABB.

6MW of wave and tidal capacity is installed in the UK, with the great majority in Scotland. The Scottish Government has been particularly proactive in encouraging the sector. The Carbon Trust estimates that if the UK industry can successfully build on its existing lead and achieve strong cost reductions, it could seize almost a quarter of the world's potential market¹. This would be worth an estimated £29 billion per annum to the UK economy in 2050, and it would support 68,000 jobs.



"Britannia really could rule the waves when it comes to marine renewable energy."

**Tim Yeo MP,
Chair, DECC Select
Committee and
President of REA**

11 leases were awarded by the Crown Estate in the first round of licensing in Orkney and the Pentland Firth, with a total potential capacity of 1.6GW. Companies are conducting site assessments and baseline environmental surveys in preparation for first deployments. The Crown Estate has committed £5.7 million in 'enabling actions' to accelerate and de-risk project development. The Scottish Marine Roadmap anticipates 1–2GW of wave and tidal power by 2020. Deployment is expected to accelerate in the next decade with The Carbon Trust forecasting an optimum potential for around 27GW of wave and tidal power by 2050.

Relative to its electrical output the sector has high levels of employment,

reflecting the work-intensive nature of R&D and testing for emergent technologies. Most devices operating in the UK were manufactured in the UK and RenewableUK estimates half of EU marine energy projects have been designed and manufactured here^{2,3}. Excluding controversial large tidal barrage schemes, seven out of the world's eight commercial wave and tidal devices are installed in the UK⁴.

¹ Marine Renewables Green Growth Paper, Carbon Trust, 2011.

² RenewablesUK Membership Consultation 1/3/2011.

³ Because the Innovas datasets exclude academic and EU-funded employment and include large controversial tidal barrage schemes e.g. the Sihwa lake tidal power plant in Korea, we defer to analysis by Cambridge Econometrics et al for RenewableUK and E&U Skills in the employment figures.

⁴ *The Future of Marine Renewables in the UK*, DECC Select Committee, 2012.

Current UK policy framework

The Government established a Marine Energy Programme Board last year to ensure policy coherence for the sector so that device prototypes can move as smoothly as possible to commercialisation. This will address areas where the Government can

provide support to the industry, such as public financing, grid connections, planning and consents. The Strategic Environmental Assessment for England and Wales has been completed and indicates no major issues. A Marine Energy Array Demonstrator fund of £20 million has recently been launched to enable tests on the performance and interactions of an array of several devices.

The Government proposes to increase financial support under the RO, from 2 to 5ROCs/MWh for wave and tidal from April 2013, for projects up to a maximum capacity of 30MW. There is some concern that the Green Investment Bank will not be investing in more high-risk innovative projects over this Parliament, as it was hoped it could assist the wave and tidal industry.

Award winner for wave energy innovation – and for best employer

Case study: Aquamarine Power

With its HQ in Edinburgh, Aquamarine Power employs over 60 people and it is one of the world's leading wave energy companies. Its innovative Oyster wave power technology has put wave energy on the map. Aquamarine Power has successfully raised over £70 million towards the commercialisation of its Oyster technology, through major multinational backing.

Not only has the company won numerous awards for technological innovation and leadership but Aquamarine Power was named as one of the best small companies to work for in the UK in the *Sunday Times* Best Companies list of 2012.

The first full-scale 315kW Oyster was officially launched at the European Marine Energy Centre in Orkney in November 2009. The device has withstood two winters in the harsh Atlantic waters and delivered over 6000 hours of offshore operation.

The next-generation Oyster 800 builds on this with improved power generation, reduced cost of power production, a simplified marine installation process and easier routine maintenance. Aquamarine Power has secured seabed leases totalling 240MW off the coast of Scotland as well as major financing towards the further development of the device. This includes a pioneering loan from Barclays Corporate to be repaid through Oyster 800 revenues. These milestones represent significant steps towards the commercialisation of innovative wave energy technology.



Jobs in wave & tidal

Planning and development:

Environmental and planning consultant; Marine biologist; Marine surveyor; Subsea engineer.

Design and manufacture (including Technology R&D):

Design engineer; Electrical systems designer; Project manager; Environmental project engineer; Environmental consultant; Oceanographer; Programmer and modeler; Fluid dynamics specialist; Communications and control engineer; Electrical engineer; Power generation engineer; Marine engineer; Electrical engineer; Welder; Metal worker; Machinist; Skilled assembler; Test technician; Materials engineer; Mechanical engineer.

Construction and installation:

Planning and environmental consultants; Project management and construction workers; Marine Engineer; Electrical engineer; Power generation engineer; Quantity surveyor; Turbine specialist engineer; Health and safety manager; Specialist shipping and port personnel; Divers; Controls engineer; Project manager; Marine installation crew; Health and safety manager.

Support services and other:

Device maintenance crew; Electrical engineer; Marine engineer; Power generation engineer; Energy sales people; Divers.

World-first innovators acquired by Siemens

Case study: MCT

Marine Current Turbines Ltd (MCT) is the world's leading tidal energy device developer. Its SeaGen project in Strangford Lough was the world's first commercial tidal flow turbine and it is now used as the industry benchmark world wide. The SeaGen is a 1.2MW tidal turbine. It was installed in April 2008 and the device regularly generates 20MWhs of electricity per day.

Siemens fully acquired MCT in February 2012 after a comprehensive assessment of all competitive tidal technologies. Siemens is one of the world's largest suppliers of eco-friendly technologies. The MCT acquisition is therefore a powerful endorsement of the commercial potential of cutting-edge UK innovation.

With headquarters in Bristol, MCT currently employs 30 people and it will be expanding to circa 50 people later this year. As part of MCT's expansion, a test facility and other technical facilities will be constructed in 2012. MCT's current business plans are to install an 8MW tidal array in Kyle Rhea Scotland, and a 10MW tidal array at the Skerries, Anglesey. Both are scheduled to be operational by 2015. The company is also currently working with other project developers in the UK, North America and Asia.



Key facts (2010/11)

Employment across supply chain ⁵ :	>800
Number of UK companies across supply chain:	33
UK sector turnover:	£86 million
Global market value ⁶ :	(£2.1 billion)
UK export value:	£8 million

⁵ Innovas 2010/2011 figure is 570, however this does not include academic or EU funded R&D which is an important component of this sector. We have therefore deferred to *Working for a Green Britain: Employment and Skills in the UK Wind and Marine Industries*, RenewableUK and Energy and Utility Skills, 2011.

⁶ As above, Innovas datasets include global tidal barrage schemes that the UK industry would not recognise as part of the global wave and tidal industry.

Anaerobic digestion – biogas

(power, renewable fuel for transport, green gas (biomethane) injection, combined heat and power)

Background, current status and outlook

The UK produces over 100 million tonnes of food waste and animal slurry each year. Food waste and livestock production each account for 3% of UK greenhouse gas (GHG) emissions¹. By capturing the biogas potential of organic wastes through bacterial fermentation in closed vessels, anaerobic digestion (AD) can reduce the escape of damaging methane emissions into the atmosphere. In addition, AD produces a by-product, called 'digestate', which is a natural fertiliser, creating an alternative market to fossil fuel fertilisers which are estimated to contribute nearly 5% to UK GHG emissions². On a unit of energy basis, AD can therefore dwarf the emissions reduction potential of all other energy generation technologies³.

AD is not a new technology – it can be low-tech, as used by 20 million Chinese households to produce gas for cooking. However, producing biogas at scale requires professional management. Biogas has many applications which are increasingly high-tech, for example it can be purified and injected into the existing natural gas grid. National Grid has estimated that biomethane produced from AD plants could provide around a quarter of the UK's domestic customer heating requirements⁴.

Compared to other major EU economies the UK currently lags in

"Biogas has benefits on so many fronts."

Janine Freeman,
National Grid

both the deployment of AD and in the development of enhanced applications. Of around 70 commercial AD plants currently operating in the UK, there are only two biomethane-to-grid plants and almost no examples of AD generated biomethane in use as a vehicle fuel. This compares with nearly 6,000 AD plants in Germany, which account for over 2% of total electricity supply, and an estimated 40 biomethane-to-grid projects being built in 2012. German AD plants are soon to be incentivised by a new 'flexibility premium' to generate power on demand to aid grid balancing.

Around 20 UK companies currently design and build AD plant, with around 80% of components sourced from the UK. Home-grown UK companies such as Biogen Greenfinch and Monsal have also developed AD for 100% food waste – an area where the UK is leading in technology development. Cost reduction is also underway in small-scale AD applications. The UK sector may be small but it is vibrant and ambitious; a further 78 AD waste plants

and 27 on-farm plant have planning consent and another 80 are in the planning system.

AD provides a very broad range of employment opportunities, from manual work collecting waste, to highly specialised engineering in its many applications including the use of compressed biomethane in dual fuel (gas and diesel) trucks. UK engineering has perfected advanced dual fuel engines which are being used by two major truck manufacturers (Volvo and Mercedes Benz). The huge potential is recognised by the Department for Transport in a new Technology Strategy Board competition to develop the infrastructure for dual-fuel trucks.

¹ The CCC estimate agriculture is responsible for around 9% of total UK CO₂e emissions with 36% of these emissions from animal manure and digestive processes www.theccc.org.uk/sectors/non-co2-gases/agriculture.

² CCC data, 55% of agricultural emissions are estimated to come from fertiliser use.

³ Renewable Energies: Perspectives for a Sustainable Energy Future, German Ministry for Environment, Nature Conservation and Nuclear Safety, 2011.

⁴ The Potential for Renewable Gas in the UK, National Grid, 2009. Quoted here is our estimated proportion from AD only.

Current UK policy framework

The Government committed to 'huge' expansion of AD in its Coalition Agreement. However, a range of barriers still prevents AD from fulfilling its huge potential – including the low ambition for AD set out in the Feed-In Tariffs consultation.

Power from AD biogas combustion is also supported under the Renewables Obligation (RO). The Government proposes to reduce

future RO support for biogas electricity in line with support for offshore wind, yet the technology is entirely different and delivers cost savings for consumers in other areas, particularly waste disposal and pollution abatement. Heat from biogas is supported under the Renewable Heat Incentive (RHI), but only for plant below 200kWth. REA is pressing for this limit to be removed so that far more plants can benefit.

The injection of biomethane into the gas grid is also supported under the RHI and is environmentally attractive in that it uses the existing gas grid (which has enjoyed £20 billion of investment) to

get 'green' gas to consumers. Under the REAL Green Gas Certification scheme⁵, customers can track the green gas used, preventing double counting on green claims when the gas is used in applications such as CHP with district heating or in dual-fuel trucks.

It is possible to earn double Renewable Transport Fuel Certificates from biogas if it is made from waste but the current incentives do not make this financially attractive compared to the other options.

⁵ www.greengas.org.uk

Innovations for efficient and affordable on-farm AD

Case study: Marches Biogas

Marches Biogas boasts a team of 11 highly skilled AD designers and mechanical and electrical technicians. It recently moved into larger premises in Ludlow, Shropshire. Over the past 25 years it has built broad expertise working with water companies on sewage digestion facilities, the repair and maintenance of existing AD plants, and the design and build of large scale AD plants and R&D facilities.

The team has turned their expertise to solving the lack of interest in small scale on-farm AD, which is given only modest FIT support. It has been awarded the Shell Springboard Award for their Agri Digestore. This innovation allows slurry storage tanks already used by farmers to be transformed into anaerobic digesters. This brings down the cost of implementing AD on farms without sacrificing the



productivity of a conventional digester.

Shown here is their smaller 'Plug and Play' AD system, which can be installed either below or above ground and which also digests on-farm slurry. The Plug and Play digester is a cylindrical insulated tank that is manufactured as a complete unit at their manufacturing facility. The unit is delivered directly to site and can be combined with other units to increase capacity. There is no mechanical equipment within the digester tank apart from the heat exchanger making the system easy to maintain. With policy stability, Marches' innovations mean on-farm AD should take off.

Jobs in AD

Manufacturing: Design engineer; Electrical systems designer; Environmental engineer; Environmental consultant; Power generation engineer; Electrical engineer; Welder; Metal worker; Machinist; Skilled assembler; Materials engineer; Mechanical engineer; Biochemist; Biologist.

Construction and installation: Planning and environmental consultant; Project manager; construction worker; Electrical engineer; Mechanical engineer; Laboratory technician specialising in digestion and digestates; CHP technician.

Plant operation: Waste collector; Farmer; Feedstock loader; Truck driver; Plant operator; Maintenance technician; Laboratory services; Quality Assurance.

Biogas applications: Vehicle design and manufacture; Pump attendant at fuelling stations; Biomethane-injection plant construction and operation; CHP construction and operation; Digestate packaging and distribution.

Pioneering compressed 'green gas' for truckers on the M6

Case study: CNG Services

CNG Services runs the UK's largest Compressed Natural Gas (CNG) filling station. The station in Crewe is ten minutes from junction 16 off the M6. It is open round the clock and has the capacity to fill more than 500 dual-fuel tractors and trucks a day. Crewe is the first station in a proposed network of CNG filling stations that can support the "Organic Waste to Vehicle Fuel" concept.

Natural gas from the grid can be compressed into high pressure storage vessels which can rapidly fill vehicles designed to run on either CNG or on dual-fuel (namely CNG and diesel). CNG is a lower cost, lower emission alternative to

diesel for trucks, offering the prospect of reductions in CO₂ emissions and import costs as natural gas is currently less than half the cost of oil on an energy basis.

CNG Services is now pioneering biogas to vehicle fuel. Biogas produced from AD is upgraded to biomethane and injected into the gas grid. Using the Green Gas Certification scheme

equivalent gas can be extracted and dispensed to vehicles at Crewe. CNG Services can track its green gas from anaerobic digester to the filling station to their customer vehicles. To increase their green gas offer, it is now working with a number of anaerobic digester plants that are developing the capability to inject biomethane into the gas grid.



Key facts (2010/11)

Employment across supply chain:	2,650
Number of UK companies across supply chain:	140
UK sector turnover:	£320 million
Global market value:	£8.8 billion
UK export value:	£28 million

Mixed waste-to-energy technologies

(combustion, pyrolysis, gasification, landfill gas for CHP, heat and power)

Background, current status and outlook

The UK generates nearly 32 million tonnes of household waste and 58 million tonnes of commercial and industrial waste each year¹. Waste needs to be minimised and as much useful material recycled as possible. The different types of residual waste can then safely be dealt with through a range of technology options, which are at very different stages of maturity and deployment. Landfill gas, sewage gas and controlled combustion of residual waste are well established technologies, whereas gasification and pyrolysis are emerging. The Institution of Civil Engineers and REA collaborated on a report back in 2005, which estimated that residual wastes could contribute as much as 17% of total electricity consumption in 2020, and 10% of the UK's total energy needs by 2020².

The experience of other EU countries demonstrates energy generation is a vital part of waste management. Too often recycling and waste-to-energy are perceived to be in conflict in the UK, but this is not borne out by the evidence; Sweden, Denmark and several other EU countries have very high proportions of both waste-to-energy and recycling/composting.

“Strong performance in waste management and recycling can go hand in hand with the use of energy from waste as part of an integrated strategy.”

Professor Jan Bebbington
St Andrews University

The UK's historical reliance on landfill has at least resulted in a successful landfill gas sector. There are 334 landfill gas power generating sites in the UK, which today contribute nearly 20% of total renewable power production³. Output is now declining as waste is increasingly diverted away from landfill.

Modern waste-to-energy plants using controlled combustion are achieving good levels of efficiency in terms of waste to energy conversion and emissions control. Overall efficiency can be improved further if plants are operated in combined heat and power (CHP) mode.

Gasification and pyrolysis technology is still evolving and the first plants are just being built. The UK is at the forefront of the development of these new technologies and has an opportunity to achieve a market lead in this area, with global investors looking to invest and develop the technologies here. A

number of home-grown companies are looking to manufacture, build, and operate patented technologies in the UK, and they are already attracting interest from other countries. These technologies can not only generate heat and power today but have the potential to produce biomethane, chemical feedstocks, biofuels and even hydrogen. The first projects will prove the technologies and provide investors with confidence. We can then expect the more innovative second generation projects to follow. REA estimates that in excess of 800MWe of capacity is currently under development in the UK.

¹ Industry estimates, REA 2011, Energy from Waste: Guide for Policy Makers.

² Quantification of the Potential Energy from Residuals (Efr) in the UK. The Institution of Civil Engineers and the Renewable Power Association, March 2005. (The Renewable Power Association was rebranded as the Renewable Energy Association in December 2005).

³ Calculated from DUKES 2010 data.

Current UK policy framework

The policy framework for energy from mixed wastes has been challenging and uncertain. Thermal waste plants are difficult to take through planning and permitting. Uncertainty with the current support mechanism has not helped investors take on the added risk of a plant, particularly for the emerging technologies. Conventional combustion only receives support for power generation when combined with heat recovery. Government proposes to halve this to 0.5ROC/MWh from 2013. This low level of support combined with the challenge of demonstrating the biomass fraction in waste residues

provides little incentive for the industry. Mechanisms and incentives for delivering CHP from waste-to-energy facilities are weak and impractical – yet half of waste-to-energy facilities on the continent are CHP.

New definitions for gasification & pyrolysis were introduced in 2009 but less than three years later a new definition has been proposed which changes qualifying criteria and potentially cuts support by 75%. It is an unnerving development for an important emergent industry, even for those not directly affected by the proposed changes.

Support for landfill gas was reduced by 75% in 2009 and it is proposed to withdraw all support for new projects from 2013. This is a mature technology, but there is still potential in smaller sites, which should be optimised to prevent

methane emissions. Furthermore heat from the combustion of landfill gas for power generation is currently being wasted, yet a significant quantity could potentially be captured⁴. Projects at locations with a potential market for the heat would be incentivised if landfill gas were made eligible for the RHI; whereas at sites with no potential heat market (as is often the case at landfill sites) the waste heat could be used to generate extra electricity. The Organic Rankine Cycle is a waste heat to power technology, which could boost electricity output from landfill gas engines by around 10%⁵.

⁴ REA estimate around 6,000GWh.

⁵ The RO does not currently facilitate the expansion of waste heat to power generation from landfill gas projects.



Jobs in waste-to-energy

Manufacturing: Design engineer; Boiler engineer; Welder; Electrical engineer; Metal worker; Quality assurance; Chemist.

Installation and maintenance:

Planning consultant; Environmental consultant; Project manager; Construction worker; Electrical engineer; Boiler engineer; Pipefitter; Welder; Electrician; Heating engineer; Electrical/electronic technician; Plant operator; Mechanic; Waste collection operative; Ash supervisor; Site supervisor.

Pioneers in pyrolysis and gasification

Case study: DPS & Ethos Energy

DPS is a major global innovation and process engineering group. Its Bristol based group and Ethos Energy have recently launched the ST150 – a small scale compact and innovative technology based on a pyrolysis, gasification, and high temperature oxidation process. It can be located in

close proximity to the waste arising and used in combination with an existing boiler to provide heating, hot water or absorption chilling.

The technology has been demonstrated for eight years in trials on many difficult wastes including: clinical, pharmaceutical & hazardous waste; sewage sludge; tyres and meat products. The unit can process over 1,200 tonnes of waste per annum to produce a clean synthetic gas.

It is in use on HMS Ocean to handle mixed solids waste, reducing the ship's

reliance on shore side facilities and time spent in port off-loading stored waste. Four units were supplied to the Queen Elizabeth Aircraft Carriers and one containerised version for the US Army.

The development of the unit has already created 12 jobs locally and expansion is likely to double this. In addition, a number of jobs will be created in the operation and maintenance of the units, as well as in manufacture and assembly.

Getting maximum value out of waste

Case study: Viridor

Part of the FTSE 250 Pennon Group, Viridor transforms over two million tonnes of materials into high quality recycle each year, and yet more into 130MW of renewable energy. In total it safely manages over eight million tonnes of recyclables and waste materials for customers from all sectors across the UK.

Viridor employs over 3000 employees and operates more than 320 facilities across the UK including 26 Material Recycling Facilities, three Energy from Waste Plants with a further four in construction and 83 household

waste recycling centres. The company plans to invest a further £1.5 billion in UK infrastructure investment in the next five years.

Runcorn EfW CHP facility will be one of the largest and most efficient in Europe with a total capacity of 70MW of electricity and 51MW of heat, treating up to 850,000 tonnes of SRF from residual waste each year. The plant will provide heat and power to the adjacent INEOS ChlorVinyls chlorine manufacturing site, significantly reducing its reliance on fossil fuels.

Investment in the Runcorn facility, during a recession and at a time when



manufacturing is in decline, is helping to secure much-needed jobs for the region. The construction project has employed a daily average of 325 people, rising to 700 at its peak.

Key facts (2010/11)

Employment across supply chain:	6,020
Number of UK companies across supply chain:	330
UK sector turnover:	£786 million
Global market value:	£23 billion
UK export value:	£99 million

Heat pumps (air, water and ground source heat)

Background, current status and outlook

Heat pumps extract heat from the environment via a heat exchanger. Typically, for every one unit of electricity used to run the pump another three units of renewable warmth (or coolth) can be extracted from the ground, air or water. The greener the power they run on, the better their environmental performance. They must be accurately sized to meet the heat demand of a building, and buildings need to be highly energy efficient to ensure the heat pump can work efficiently.

Air source heat pumps have been extensively used in the commercial sector where day-time occupation suits air temperature patterns. Ground source heat pumps use the more stable temperature of the earth, a fairly constant 11°C at depths of just a couple of meters. Their installation is more labour-intensive, (typically 10 man-days¹) however, they are well suited to domestic needs.

Professor David MacKay, Chief Scientist at DECC, is a notable heat pump enthusiast and heat pumps feature among DECC's eight key technologies for meeting the UK's 2020 renewable energy target – and in its recently published Heat Strategy². It is expected that 100,000 new heat pumps could be installed by 2020³.

A future where buildings are largely heated by heat pumps is one of the scenarios in DECC's 2050 Roadmap. That is already the case in Sweden where the great majority of new build homes incorporate heat pumps. Sweden has lower average temperatures than the UK and it has the largest heat pump market in Europe. The oil shocks



“Heat pumps are future-proof, allowing us to heat buildings efficiently with electricity from any source.”

**Professor David MacKay,
Chief Scientist, DECC**

of the 1970s, and heat pumps' suitability in off-gas grid locations, led to strong growth. Across the EU the number of installed heat pumps passed the one million mark in 2010 and around 100,000 are installed per annum in an EU market estimated at £2.7 billion⁴.

Heat pumps have been in use in the UK since the 1950s. The technology is mature and widely available, sharing many components with the refrigeration and air-conditioning industries. Major manufacturers are based here including Calorex, Carrier, Daikin, Danfoss, Danyo, Dimplex, Eaton-Williams, Fujitsu, Hitachi, Kensa, Midea, Mitsubishi Electric, Nibe, TEV, Toshiba, Trane, Viessman, Worcester Bosch, and many others. The traditional boiler manufacturers are also starting to design and build heat pump products for the sector.

The commercial/industrial market has grown steadily over the last 15

to 20 years. However, the domestic market is seeing more rapid growth due to tighter Building Regulations and local planning requirements. Over 21,000 domestic heat pump units were installed in the UK in 2010⁵. The quality of installers is already recognised as an important issue for the sector – the Sector Skills Council is close to finalising a new professional standard. The industry is making strenuous efforts to improve the knowledge of the installer base to ensure best-practice is followed.

¹ Annual Survey on GSHP market growth 2010, Geo Trainet, Feb 2011.

² The Future of Heating, DECC, 2012.

³ UK Renewable Energy Roadmap, DECC, 2011. However confusingly, please note we are advised BSRIA data shows the UK commercial market is estimated to already have a legacy of over 1 million terminals already installed, illustrating the need for better data and more ambition.

^{4,5} The State of Renewable Energies in Europe, 11th EurObserv'ER Report, 2011.

Current UK policy framework

The Renewable Heat Incentive (RHI) currently only covers commercial/industrial buildings and includes only ground source heat pumps. It is hoped that air source

heat pumps will be added in 2013.

In the meanwhile, domestic air and ground source heat pumps receive support from the Renewable Heat Premium Payment scheme in off-gas grid areas. Overall take-up under the premium payment scheme has been disappointing, but heat pumps accounted for over half of grants

provided as of February 2012.

As the regulatory environment for new build drives us towards zero carbon developments, heat pumps will become increasingly wide-spread. They also have a vital role to play reducing carbon from the existing building stock, potentially through the Green Deal, but vitally through the RHI.

Fast-growing complete-service provider

Case study: Myriad CEG

Myriad CEG Ltd typifies the new breed of smaller, fast growing companies within the renewable energy sector. Formed in 2010 from the merger of three smaller companies the business now turns over £23 million and employs over 100 people. Myriad is one of the UK's leading installers of onsite renewable energy systems.

Based in Melton Mowbray, Leicestershire, the company provides all the key onsite renewable technologies including biomass boilers, ground and air source heat pumps, solar PV and wind turbines. For example, Myriad has recently installed a 240kW ground source heat pump, using 18 boreholes, in the prestigious £80 million Fitzrovia Apartments redevelopment in London. The company has grown rapidly over the last few years and expects to see continued strong growth in revenue



and employees over the coming years. The business is backed financially by the Wates family, owners of Wates Construction.

The company operates mainly in the commercial sector and has completed over 1200 installations to date comprising; 400 biomass systems; 250 ground source heat pumps; over

500 small and medium wind turbines; and 150 PV installations. With industry leading capability in each technology Myriad offers a complete solution to its clients. Myriad deals with all aspects of the design and installation process from initial feasibility through to installation, commissioning and aftercare services.

First class training for high professional standards

Case study: Worcester, Bosch Group

Founded in 1962, Worcester, Bosch Group is a market leading manufacturer of domestic heating and hot water systems. Pioneering the latest in energy-efficient boiler solutions, its passion for renewable energy has led to the development of a wide range of innovative and sustainable heating products.

Worcester's long standing commitment to the professional development of the heating industry's installers, specifiers and merchants led to a £1.5 million investment in a new, Training and Assessment Academy at its headquarters in Worcester in 2011. The state of the art facility enables over

17,000 industry professionals each year to benefit from a number of advanced features geared towards offering an authentic training experience.

Dedicated training bays ensure delegates are guaranteed first rate training on every model of Worcester's award-winning Greenstar boiler range as well as its growing range of



renewable technologies, including its Greensource ground source heat pumps and its Greenstore air source heat pumps. As well as offering domestic courses, there is also an extensive range of training courses available on commercial products, including gas absorption heat pumps and CHP technologies.

Jobs in heat pumps

Manufacture and design: Design engineer; Heat pump engineer; Electrical engineer; Skilled and semi skilled assembler; Welder; Machinist; Metal worker; Hydrogeologist; Geologist; Mechanical engineer.

Installation and maintenance: Project manager; Construction worker; Electrical engineer; Pipefitter; Electrician; Heating engineer; Electrical/electronic technician; Plant operator; Plumber; Drilling engineer; Drill rig operative; Operations maintenance engineer; Heating engineer; Pipefitter; Service engineer.

Key facts (2010/11)

Employment across supply chain:	7,320
Number of UK companies across supply chain:	380
UK sector turnover:	£935 million
Global market value:	£23.4 billion
UK export value:	£69 million

Biomass CHP (heat and power)

Background, current status and outlook

Combusting biomass to produce heat and power (CHP) delivers an energy conversion upwards of 75%¹ making CHP a highly efficient use of biomass resources. However, CHP technology has long suffered from a lack of political support in the UK, largely because of an historic neglect of supply-side efficiency given decades of abundant North Sea gas. Furthermore our relatively mild climate has also meant that district heating networks, which broaden the potential for CHP, have not been routinely constructed from the outset in urban development as they have been in Scandinavia, for example. Heat networks are well established on the continent where they are enjoying major growth – the volume of heat generated from biomass into heat networks increased by nearly 25% between 2009 and 2010 across Europe².

CHP plant are designed to meet a particular heat load, with surplus power exported to the grid. Industries that are suited to CHP are those with a high demand for heat, including oil refineries, chemical plants, paper mills, breweries and greenhouses (which can further benefit from the CO₂ output). Suitable buildings include prisons, hospitals, universities, hotels, leisure centres and residential flats.

District heating networks provide less than 2% of the UK's heat demand³. These networks are currently estimated to supply 172,000⁴ domestic buildings (predominantly social housing, tower

"This highly efficient method of biomass use is specially promoted by the EEG [Renewable Energy Sources Act]."

German Environment Ministry



blocks and public buildings), and a range of commercial and industrial applications.

There is tremendous potential to deploy CHP in areas where there is a high density of heat demand. DECC's new Heat Strategy⁵ offers welcome recognition of the potential for heat networks to facilitate the expansion of CHP. District heating infrastructure has a long life-time, facilitates many sources of renewable heat and offers a solution to limited space in urban homes. However, while DECC identifies its 'potential to play a significant role', cost is flagged as a barrier.

Developing CHP projects is more difficult than power-only projects. If

heat customers reduce or cease their demand, unlike with electricity, there is no automatic alternative customer. This makes it all the more important that the policy framework is supportive and flexible. This is far from the case, and the exceptionally complex policy framework for biomass CHP needs urgent attention. Perversely this highly efficient use of biomass is the least incentivised.

¹ Renewable Heat (RHI decision document), DECC, March 2011.

² The State of Renewable Energies in Europe, 11th EurObserv'ER Report, 2011.

³ Poyry (2009): *The Potential & Costs of District Heating Networks*, April 2009.

⁴ BRE (2008) *Heat Metering Cost Benefit Analysis*.

⁵ The Future of Heating, DECC, March 2012.

Current UK policy framework

An extra incentive for CHP was introduced under the Renewables Obligation in 2009 to encourage heat capture alongside power generation; biomass heat received a CHP 'uplift' of an extra 0.5ROCs/MWh. It is proposed to withdraw this uplift in 2015 for new projects and instead heat from CHP will be

rewarded under the RHI. However, support levels proposed for plant over 1MW under the RHI are lower than the current RO 'uplift'. There are further fears as to whether there is sufficient budget available under the RHI, given its relatively small overall budget. The CHP uplift under the RO therefore needs to remain in place until 2017 to allow current projects, which have a long lead-in time, to proceed. This destabilising policy framework is causing many REA members to abandon

biomass CHP and develop gas CHP projects instead.

There is no additional payment under the RHI for heat produced via CHP, compared to production of heat alone. In addition, the RHI is paid out only on heat *delivered* to buildings rather than generated – any heat lost in pipes is deducted. While one would not wish to reward schemes with poor energy efficiency, the overall result is that this is effectively a penalty for district heating.

Major player forges ahead with biomass CHP

Case study: RWE npower renewables

RWE npower renewables is the UK subsidiary of RWE Innogy and one of the UK's leading renewable energy developers and operators. RWE Innogy pools the renewable energy expertise of the RWE Group. RWE Innogy has a current pan-European pipeline of 17.3GW. The UK is a significant territory within this. The intention is to have 1GW of operational renewable energy capacity in the UK by the end of 2012.

RWE npower renewables operate 21 hydroelectric power schemes, 25 onshore wind farms and two offshore wind farms, including the UK's first major offshore wind farm, North Hoyle. In 2011 the company invested over £0.5 billion in new renewable energy projects in the UK, and plans to invest a similar sum this year.

From development, to construction and operation, its 453 staff in area offices

across Wales, Scotland and England work in close partnership with local communities and companies. The investments made by RWE in the UK are creating substantial new job opportunities, developing the supply chain and, very importantly, helping the UK Government achieve the target of supplying 30% of electricity from renewables, by 2020.

RWE npower renewables is currently constructing its first biomass CHP power plant in Scotland (shown left). The 49MW biomass CHP plant in Markinch, Fife, due to be completed in early 2013, will be the largest of its kind in the UK. It will provide steam and electricity to the neighbouring Tullis Russell Paper Mill, reducing the fossil fuel carbon emissions of the site by 250,000 tonnes per annum, as well as exporting electricity to the grid. Approximately 40 permanent jobs will be created by RWE npower renewables as a result of the new biomass plant and fuel processing facility, with 400 temporary jobs created during construction.

Jobs in biomass CHP

Design and development: Design engineer; Project manager; Materials engineer; Electrical systems designer; Mechanical engineer; Environmental engineer; Environmental consultant; Fuel handling systems designer; Heat network design engineer.

Manufacturing: Design engineer; Project manager; Welder; Labourer; Sheet metal worker; Chemist; Electrical engineer, Mechanical Engineer.

Construction and Installation: Planning consultant; Rigger; Environmental consultant; Project management and construction workers; Electrical engineer; Power generation engineer; Heat network specialists; Health and Safety manager; Pipefitter; Welder; Electrician.

Operations and maintenance: Agricultural specialist; Microbiologist; Biochemist; Fuel sourcing manager and negotiator; Electrical engineer; Power generation engineer; Heating engineer; Energy trader; Boiler engineer; Welder; Electrician; Service engineer; Electrical/electronic technician; Plant operator; Mechanic; Fuel and ash supervisor; Labourer; Maintenance manager.

Using renewable energy to distil Scotland's finest whisky

Case study: Estover Energy

Scotch whisky accounts for a quarter of UK food and drink exports. It is sold in more than 200 markets worldwide, earning £3.45 billion in 2010 and supporting more than 25,000 jobs across the supply chain.

Energy is typically the largest cost for a distillery. In recent years gas prices have been volatile and distilleries are experiencing interruptions in the gas supply with increasing frequency. Estover Energy is working with some of Scotland's best known whisky brands to heat and power distilleries using locally sourced wood instead of gas. Biomass CHP provides a secure, low-carbon and cost-effective supply of steam for the

distilling process, helping distilleries to expand.

Estover's CHP plants will be exclusively fuelled from wood produced from local sustainable forestry. In Scotland there are millions of acres of commercial forestry but limited local markets. In some areas this wood is being exported due to lack of local demand.

Each of Estover's CHP plants boosts rural economies by creating up to 20 permanent jobs onsite and a further 20 directly related new jobs in transport and forestry, often in remote areas. Up to 100 temporary jobs are created during the two year construction period. Each plant also adds 10–15MWe of renewable electricity to the grid to help Scotland meet its target of 100% renewable power by 2020.



Key facts (2010/11)

Employment across supply chain:	2,190
Number of UK companies across supply chain:	140
UK sector turnover:	£331 million
Global market value:	£9.3 billion
Export value today:	£45 million

Solar thermal (heat)

Background, current status and outlook

A vibrant market in a rudimentary solar thermal system bloomed in California at the end of the 19th century – only to be wiped out by the discovery of natural gas in the 1920s. Cycles of innovation and market development in response to volatile fossil prices have driven the sector forward ever since. Israel turned decisively to solar thermal in response to oil scarcity in the 1950s and over 90% of Israeli households now rely on solar thermal for their hot water requirements. Today 200GWth of solar thermal are installed worldwide¹.

The technology has advanced considerably and the market is broadly split into flat plate collectors, which are relatively cheap and give good performance for lower temperature applications, and evacuated tube collectors which can achieve higher temperatures. Temperatures of 250°C will shortly be achievable for industrial process heating. Intelligent Energy Europe's 'SoPro' project aims to catalyse the take-up of solar process heat in targeted countries. 27% of total EU final energy demand is for heat consumed by industry and at least a third of this could potentially be supplied by solar thermal.

Even in northern climates solar thermal can provide between 50–70% of hot water needs over the year². Rising global temperature is driving a marked increase in summer-time electricity consumption from air

"The technical potential of solar energy for heating purposes is vast."

Intergovernmental Panel on Climate Change

conditioning. Using thermally driven chillers, solar thermal can meet rising demand for cooling without adding to summer electricity peaks and CO₂ emissions.

The European market boasts the most diverse applications of solar thermal including new innovations in solar air-conditioning, heat storage, desalination plant and combi-systems with heat pumps that provide both hot water and space heating. In several EU countries space heating is becoming the most important application. There are around 150 large solar thermal systems with a combined capacity of 160MWth across Europe. The largest is a 13MWth system in Denmark feeding in to a district heating network.

The oil shocks of the 1970s stimulated domestic enterprise and AES, the UK's oldest manufacturer based in Scotland, began manufacturing solar thermal systems in 1979. Today other UK manufacturers include Atmos, Viridian Solar, Kingspan and Solartwin. System prices have fallen over recent years and innovations will enable this to continue. Manufacturers are increasingly making key components out of

cheaper aluminium rather than copper and individual modules are growing larger. Efficiency gains have led to cost reductions per unit of energy. There has been significant R&D to enable easy installation. Finally costs can be further reduced when volume increases to a level where the supply chain can be fully optimised.

Across Europe major markets in solar thermal have contracted in recent years as the economic crisis caused a slow-down in the construction sector – and because solar PV enjoys stronger incentives. Nevertheless the EU sector had a turnover of €4 billion in 2010 and employs around 50,000 people³. The market is believed to have grown again last year as gas and oil prices rose. Germany has the largest area of solar thermal collectors in Europe with over 14 million m², displacing the equivalent of 500 million litres of heating oil⁴.

¹ IEA Solar Heating and Cooling Programme, Newsletter January 2012.

² Building Research Establishment. *Viridian Solar – Clearline solar thermal field trial*, 2008.

³ The State of Renewable Energies in Europe, 11th EurObservER Report, 2011.

⁴ *Renewable Energies; Perspectives for a sustainable energy future*, German Environment Ministry, 2011.

Current UK policy framework

The greatest non-financial barrier to solar thermal is poor awareness and poor understanding of the technology and its diverse applications in the UK. The Solar Trade Association will be seeking to fill this knowledge gap when it shortly publishes a report into the technology's potential here in the UK.

The new-build sector is largely driven by local planning requirements for renewables such as the London Plan⁵, as well as social housing being

built to higher 'Code for Sustainable Homes' standards. Without these drivers building developers would be unlikely to use solar thermal. The cost of large-scale solar thermal systems can be considerably lower so it is surprising that the first phase of the RHI only supports solar up to 200kW in size. Financial support for heat from solar thermal has been capped at the level set by offshore wind, somewhat inexplicably, and it is therefore failing to stimulate the level of growth and innovation needed to bring prices down and to realise the industrial opportunity. Given such poor support for the domestic market it isn't surprising that the UK solar thermal industry

exports over 25% of production. This is the highest proportion of all renewable technologies as a fraction of the UK market value.

In the domestic sector installers of solar thermal can receive a small grant of just £300 – a fraction of public support for solar PV. It is hoped that the second phase of the RHI, which will cover domestic applications, will take a more serious approach to the highly innovative solar thermal industry.

⁵ And 'Merton Rule' policies which specify that developments over a certain size must source a percentage of their energy requirements from renewables

Successful manufacturing innovation

Case study: Viridian Solar

After three years of market research and product development Viridian launched its Clearline range of roof-integrated solar heating panels in 2007. Keen to keep production in the UK, the team came up with an innovative moulded design for rapid manufacture. The product competes well with alternatives imported from countries with much lower labour costs.

Close collaboration with construction professionals during the development led to a product that installs neatly and simply, with excellent aesthetics. Viridian Solar was the first company to test its solar panels as a construction product, achieving the first ever British Board of Agrément certification which assures the roof



weather-tightness, durability, wind resistance and fire safety of the installed product.

The company has grown rapidly, with early success in the UK new-build market followed by strong international sales. Clearline solar panels are currently exported to Sweden, Ireland and the Netherlands with further expansion planned. The story of innovation continues with the launch

Jobs in solar thermal

Manufacturing and Design:

Component manufacture; Solar energy systems designers; Systems engineer; Electrical engineer; Laboratory technician; Quality control technician; Collector assembly worker; Chemist; Surveyor; Materials scientist.

Installation and maintenance:

Roofer; Electrician; Plumber; Instrumentation, controls and electrical systems technician; Scaffolder; Installation engineer; Installation supervisor; Service engineer; Semi-skilled labourer for cleaning collectors.

Logistics: Driver; Packer; Warehouse Staff

of a solar heating system for high rise apartment blocks (Cirrus), a wireless solar thermal energy display (Clearline Aura) and a range of photovoltaic panels to match the roof integration detail and aesthetic of the thermal panels (Clearline PV).

1970s idealism drives a commercial success

Case study: AES Solar Systems

AES began in 1979 in the ecological Findhorn community where its determined founder Lyle Schnadt created his first panels in a small shed. In those pioneering early years few people believed that solar thermal was a viable alternative to traditional heat generation. Dogged perseverance secured success. Today AES manufactures a wide range of light-weight and highly efficient flat-plate collectors from its growing workshop in Forres. It employs 10 people with a turnover of £1.5 million. AES is one of the ten fastest growing companies in the Grampian and Highlands area.

AES can design solar water heating projects for all applications including domestic panels to systems for social housing, schools, swimming pools,

hospitals and commercial offices. Systems can be up to 2,400 square metres in size. AES was selected to install the solar thermal system that supplies 60% of the hot water needs in the prestigious Scottish Parliament building Holyrood.

Today R&D is increasingly important

and this unique Scottish manufacturer continues to bring novel solar thermal products off its production line. However, the fragile support for the domestic industry means expansion plans must be carefully considered. AES have developed often thanks to strong orders from overseas.



Key facts (2010/11)

Current employment across supply chain:	7,550
Number of UK companies across supply chain:	340
Current sector turnover:	£830 million
Global market value:	£28 billion
UK export value:	£215 million

Deep geothermal (heat and power)

Background, current status and outlook

99.9% of the earth's mass is over 100°C, a temperature maintained by natural radioactive decay. This abundant source of heat has been exploited since Roman times, and the UK provides examples today in Bath and Southampton. The technology for power generation has been around for over 100 years and the UK is due to start its first heat and power scheme shortly (see right).

Recent developments in drilling technology and geophysical techniques mean it is now possible to engineer systems in 'hot rocks' at depths of up to 5km. This expands the available resource well beyond that found in shallow resources, such as in Iceland. The REA's Deep Geothermal Group is working with consultants to reassess the UK's potential and will publish a report in the near future.

After a decade of inactivity in the 1990s, the sector is experiencing worldwide growth. Deployment is expected to double over the next 10 years from 10GWe to 20GWe, representing a global investment of \$40 billion. Geothermal power plants are widespread across Europe with over 400MWe of new electricity projects in planning adding to the 1.6GWe in operation.

Geothermal also provides large amounts of heat from an existing 10GWth of installed thermal capacity across Europe. They are ideal for urban locations: Paris, for example, has 17 geothermal heat plants in operation with an installed capacity of 240MWth, sufficient heat for 170,000 homes. Germany, which has similar sub-surface

"All the benefits of nuclear – but none of the problems."

Damian Carrington,
The Guardian



temperatures to the UK, has also invested significantly in the technology. 150 geothermal heat and power plants are in planning in Germany, representing a €4 billion investment, supporting over 9,000 jobs. The German Geothermal Association says geothermal power could meet Germany's electricity needs 600 times over.

DECC has provisionally calculated that, using existing technology, deep geothermal could supply approximately 10% of the UK's baseload electricity supply – this would technically result in renewable heat equivalent to 30% of UK heat demand. However, the UK is lagging behind, with no contribution anticipated from this technology to 2020 in the UK Renewable Energy Strategy.

The UK is well-positioned to develop this sector because of the synergies with oil and gas technology and because of its strong history of deep geothermal research¹. There are substantial opportunities to export both the knowledge and equipment to an ever-expanding global sector. For example, Germany is already manufacturing and

exporting drilling rigs at €20 million each. Kenya has recently announced that Kenya Electricity Generating Company Limited is to raise \$12 billion for investment in new geothermal plants. However, without domestic investment in the UK sector, there is a real danger we will not be in a credible position to export skills or equipment to the booming global market.

US analysis shows deep geothermal has particularly high rates of employment², delivering quality jobs, including in rural areas. The REA is pushing for a target of 200MW of heat and power by 2020, which would deliver 1640 jobs³. Deep geothermal can boost indirect employment in related enterprises including spa and resort management, food processing, district heating installations, aquaculture, horticulture and Heating, Ventilation and Air Conditioning (HVAC) technicians.

¹ The Hot Dry Rock project.

² Geothermal Industry Employment: Survey Results and Analysis.

³ For each MW installed, four direct jobs are created during construction, 1.7 direct jobs and 2.5 indirect jobs during operation.

Current UK policy framework

The deep geothermal industry in the UK had largely been dependent on grant support which was cut in half by Government in 2010, just as activity across Europe escalated. The recent RO Banding Review consultation proposes no extra

support for deep geothermal power. Proposed support is around half of that available in Germany, which already boasts an established industry. The UK industry is at the same stage of development as marine renewables and it requires similar support.

Deep geothermal heat is included in the RHI, but only as part of the heat pump tariff. This is a stop-gap, and Government is looking at giving

it a tailored level of support in the expansion of the RHI due in 2013. Finally, deep geothermal exploration is capital intensive and for initial projects exploration risk insurance is often required for private investment. Such schemes are well developed in France and Germany and it has been suggested the Green Investment Bank could restructure this risk in the UK.



British company set to drill first geothermal power station in the UK

Case study: Geothermal Engineering Ltd

Geothermal Engineering Ltd was founded in 2008 by Dr Ryan Law who has 10 years' experience in geothermal energy, primarily working with the global engineering consultancy Arup. Geothermal Engineering's technical board includes Dr Tony Batchelor who ran the UK's pioneering 'Hot Dry Rock' geothermal research project between 1976 and 1991.

The team has successfully secured grant support, funds and planning permission to develop the UK's first commercial scale geothermal power plant at United Downs, near Redruth in Cornwall. Drilling will start this winter using a drilling rig like the one pictured here. Three wells will be drilled to approximately 4.5km,

where temperatures are expected to exceed 180°C. These will be the deepest on-shore wells ever drilled in the UK. The £53 million scheme is set to be commercially operational by 2016 when it will supply up to 10MW of baseload electricity to the National Grid and 50MW of renewable heat for local use.

Over the next 25 years, Geothermal Engineering Ltd has plans to deliver up to 300MW of clean, sustainable geothermal electricity and up to 1GW of renewable heat for communities across the South West. Geothermal Engineering Ltd also aims to build knowledge and job opportunities with Exeter University by developing a national centre for geothermal excellence.

Jobs in deep geothermal

Manufacture: Design engineer; Electrical engineer; Welder; Metal worker; Machinist; Skilled assembler; Test technician; Chemical engineer; Materials engineer; Mechanical engineer.

Scheme Design and development: Project manager; Planner; Lawyer; Financial planner; Economist; Electrical systems designer; Physical engineer; Reservoir specialists; Geologist; Environmental engineer; Environmental consultant; Drilling engineer; Pump designer; Programmer; Modeller; Communications expert; Academic staff.

Construction and Installation: Project manager; Construction workers; Drilling manager; Geologist; Drilling crew; Hydrogeologist; Electrical engineer; Geophysicist; Power generation engineer; Drilling services manager; Drilling services staff; Generator engineer; Pump installer; Health and safety manager.

Operations and maintenance: Heat and electrical engineer; Power generation engineer; Geologist; Hydrogeologist; Academic staff; Service engineer.

Heating the biggest business park in Europe

Case study: Cluff Geothermal

Cluff Geothermal is a UK company developing geothermal energy projects in the UK and Africa. Cluff's international team is based in London, Nairobi and Addis Ababa. The company has strong links with Newcastle University, the UK's foremost academic centre of geothermal expertise. The photo (left) shows Cluff's Michael Feliks with Professor Paul Younger at the University's Science Central borehole.

Cluff will drill a borehole near the village of Shiremoor, North Tyneside, to supply heat to local homes and businesses. The North East is one of the most promising areas for

deep geothermal energy in the UK, ideally situated to exploit the great quantities of heat produced by the 'Weardale Granite', a huge mass of high temperature rock sited entirely below ground.

Cluff's borehole will be a few kilometres deep and capable of providing continuous, renewable heat to local customers. The borehole should produce sufficient energy to heat (and/or cool) buildings on the adjacent Cobalt Business Park – the largest office park in Europe – and local housing developments.

The company has big plans for its Shiremoor project to be merely the first of many across the North East. Building on this and their Africa projects, Cluff Geothermal intends to establish itself as a leading developer of geothermal projects in the UK and worldwide.

Key facts (2012 estimates)

Employment across supply chain:	200
Number of UK companies across supply chain:	<25
UK sector turnover:	<£10 million
Global market value:	\$3 billion ⁴ power only (growing to around \$40 billion for power in the next ten years)
UK export value today:	<£1 million

⁴ Renewable Energy Generation from Conventional, Enhanced Geothermal Systems, and Co-Produced Resources: Market Analysis and Forecasts, Pike Research, 2011.

Biomass power

Background, current status and outlook

Overall bioenergy¹ is the largest contributor to the UK renewable electricity supply and around 20% of this is supplied by 15 biomass power stations². These range between 1MW and 50MW in size and combust a range of fuels including virgin and waste wood, forestry residues, straw and other agricultural residues. A number of new dedicated biomass power stations are in the development pipeline with outputs from 1MW up to 350MW. It is also possible to convert existing fossil fuel power stations to run entirely on biomass.

Biomass power is set to play an important role on account of its affordability and potential to diversify fuel supply and contribute to energy security. Biomass power provides predictable on-demand generation for base-load or peak-load, complementing the growth of variable renewables like wind, wave and solar.

From 2013, support for biomass power generation will be conditional on meeting sustainability criteria. The fuel used must not come from certain types of land of high biodiversity or land that was formerly high carbon stock, such as primary forests, peatlands and wetlands. The fuel must also deliver a minimum 60% greenhouse gas saving compared to electricity generated from fossil fuel³. The industry strongly supports the development of a mature and sustainable fuel supply chain that



“Sustainable biomass generation... is reliable and cost-effective, and will help us to meet our renewables target.”

**Prime Minister
David Cameron**

delivers significant greenhouse gas savings over the long term.

There are 255 biomass power and CHP stations in Germany, which together generate 11.8GWh per annum⁴ – roughly over five times⁵ current UK generation from biomass power. The UK Renewable Energy Roadmap⁶ anticipates biomass power will be one of the eight key technologies in meeting the 2020 renewable energy targets. It is anticipated that electricity from all bioenergy sources will make a similar contribution to offshore wind⁷.

Securing a reliable and sustainable fuel supply at an affordable price is a particularly significant challenge developers of biomass power plants must overcome.

The Green Investment Bank is looking to invest 20% of its funds in areas other than the five which it lists as

its priorities⁸. Biomass power generation and biofuels are anticipated to form a substantial component of this stream of its £3 billion of funding. The Bank is already in dialogue with a number of biomass project developers and is looking to make its first investments from April 2012.

¹ Bioenergy includes energy from waste, landfill gas and biomass stations.

² UK Renewable Energy Roadmap, DECC, 2011

³ For more details, see www.decc.gov.uk/en/content/cms/meeting_energy/bioenergy/sustainability/sustainability.aspx.

⁴ Renewable Energies; Perspectives for a Sustainable Energy Future, German Environment Ministry, 2011.

⁵ Estimated from DUKES 2011, table 7.4, in 2010 biomass generated 2TWh of electricity.

⁶ Department of Energy and Climate Change, (2011).

⁷ The UK Energy roadmap central view range of deployment in 2020 for offshore wind is between 33TWh and 58TWh, and 32TWh and 50TWh for Biomass Power.

⁸ Its five priorities are offshore wind, waste recycling and infrastructure, energy from waste, the Green Deal, and non-domestic Energy Efficiency.

Current UK policy framework

The policy landscape for biomass power has presented a complex set of challenges to resolve for both industry and government over the past few years. Industry has invested in developing projects and bringing them through the consenting phase with the understanding that Government was in principle supportive, despite the sector often being subject to review. The ambition for biomass power

generation was increased substantially in DECC's Renewable Energy Roadmap, and DECC will publish its Bioenergy Strategy this spring.

Dedicated biomass plants are currently eligible to receive 1.5ROCs/MWh. Government decided to “grandfather” bioenergy plants in 2010, meaning that once commissioned they are guaranteed to receive this level of support for 20 years – bringing them into line with other technologies in the RO. This decision was critical for securing investor confidence in project returns and was welcomed by industry. However, uncertainty still exists over

future support levels and industry is now waiting to find out the level of support for projects commissioned after April 2013. It is proposed that new biomass power will continue to receive 1.5ROCs until 2016, after which new plants will receive 1.4ROCs. Decisions on the banding review of the RO are due this spring/summer.

The industry hopes that the forthcoming UK Bioenergy Strategy will articulate a clearer vision and ambition for the growth of sustainable biomass energy in the UK.

Sustaining British ports with biomass power

Case study: Renewable Energy Systems

RES's two large-scale biomass projects currently in development at North Blyth in Northumberland and Alexandra Dock in Liverpool represent the company's first investment in dedicated biomass power generation in the UK.

Around 200 to 300 employees will be required during the peak of the three-year construction period and around 40 permanent staff once each plant is operational. A wide variety of skills will be required, ranging from specialist steel workers to office administrators, technicians and plant managers. There will be opportunities for local consultants, contractors and engineers, and knock-on benefits to service providers in the area.

Community funds will be established for both projects. For example, at North Blyth the fund is likely to be in the region of £100,000 per annum to be spent on good causes decided on by the local community.



Both Alexandra Dock and North Blyth are located at existing ports which will be used for the transport of the fuel, helping to diversify and secure their economic future. It is expected that each project will cost in the region of £300 million to commission – a significant investment into the local and regional economies of North Blyth and Alexandra Dock.

Jobs in biomass power

Design and development: Design engineer; Project manager; Materials engineer; Electrical systems designer; Mechanical engineer; Environmental engineer; Environmental consultant; Fuel handling systems designer.

Manufacturing: Design engineer; Project manager; Welder; Labourer; Sheet metal worker; Chemist; Electrical engineer, Mechanical engineer.

Construction and Installation: Planning consultant; Rigger; Environmental consultant; Project management and construction workers; Electrical engineer; Power generation engineer; Health and safety manager; Pipefitter; Welder; Electrician.

Operations and maintenance: Agricultural specialist; Microbiologist; Biochemist; Fuel sourcing manager and negotiator; Electrical engineer; Power generation engineer; Energy trader; Boiler engineer; Welder; Electrician; Service engineer; Electrical/electronic technician; Plant operator; Mechanic; Fuel and ash supervisor; Labourer; Maintenance manager.

Managing energy for over 70 years

Case study: Dalkia

By applying energy management services Dalkia has been helping businesses and communities reduce energy consumption and costs for over 70 years. Now a multinational in 42 countries, Dalkia in the UK was started in 1966 by Lord Ezra to provide design, build, operation and maintenance of onsite energy plant, including district heating. It operates over 390 biomass energy plants worldwide saving over two million tonnes of CO₂ per year.

Providing dedicated biomass electricity and heat to communities, commerce and industry is an important

part of Dalkia's business. The Chilton Biomass Energy Centre, shown here, received planning permission in May 2009 and started generating power in October 2011. It delivers electricity to 23,000 homes and reduces CO₂ emissions by 115,000 tonnes per year – equivalent to taking 40,000 family cars off the road.

The plant uses around 120,000 tonnes of waste wood biomass. Opened by Energy Minister Charles Hendry MP, the project created many



local jobs during the construction phase, followed by permanent employment on the site and across the supporting supply chain.

Key facts (2010/11)

Employment across supply chain:	3,330
Number of UK companies across supply chain:	170
UK sector turnover:	£450 million
Global market value:	£18.1 billion
UK export value:	£86 million

Solid biomass fuels

Background, current status and outlook

The total available biomass resource from wheat and barley straw, oil seed rape, miscanthus, short-rotation coppicing, underutilised woodland and non-agricultural land is estimated at around 15 million oven-dry tonnes¹. Wheat and barley straw, once bailing and livestock needs are met, account for over half of this resource. The NFU sees far greater potential for both energy crops and straw to provide new market opportunities for farmers.

Wood-fuel represents only around 8% of biomass energy currently used for renewable energy fuel². This most traditional of fuels is expected to undergo a renaissance under the RHI. Unlike in the past, today it can fuel highly efficient technologies.

Wood-fuel is produced as logs, chips, pellets and briquettes. These can be manufactured from direct forestry, wood processing residues or discarded construction materials. The UK produces around 1.5 million tonnes of green wood-fuel each year. The existing UK forest estate could produce around 5 million tonnes of wood-fuel, while still supplying existing panel mills and saw mills at today's level³.

The quality of fuel is vital to the performance of modern biomass technologies. Fuel quality assurance schemes such as Wood Sure and HETAS's Quality Assured Fuels scheme guarantee low moisture content and the absence of chemical contamination. These marks also clearly list the country of origin

"Getting all our woods working, so that they provide the wealth of renewable resources and rich variety of wildlife they are capable of supporting, is vital."

**Dr Gabriel Hemery,
Our Forests**

enabling consumers to make an informed choice. These schemes build on a range of EU-wide standards⁴ currently under development and dissemination across Europe.

197,000 tonnes of wood pellets and briquettes were estimated to have been manufactured in the UK in 2010⁵. Around 25 pellet mills now operate here⁶. By early 2012 the wood pellet industry had grown to almost 550,000 tonnes of production capacity. With commercial demand in the UK currently well below this capacity, manufacturers have either been exporting to mature European mainland markets or supplying co-firing markets.

The UK wood-fuel supply chain is still fragile and currently serves a small customer base. Low numbers of workers are entering the forestry sector and up-skilling is required. The Forestry Commission is seeking to address this through a Forestry Skills Action Plan including Confor and REA's Wood-fuel Supplier Group. For the rural areas in particular the stimulus provided by the RHI could provide a major boost for local economies and employment.

A fifth of UK forests are managed by the Forestry Commission. Of the remaining 80% in private ownership only half is actively managed⁷. Unmanaged

woods tend to be dark habitats which do little for butterflies or birdlife, for example. A mature wood-fuel supply chain in the UK would bring more woodland back into active management for the benefit of wildlife and the public. The RHI presents a tremendous opportunity not only to breathe life back into UK forests but to create momentum to expand forest cover – the UK is one of the least densely forested countries in Europe. In England the Independent Panel on Forestry is currently considering levels of woodland creation that may be appropriate in the future. The recent Natural Environment White Paper suggests English woodland cover could increase from 9% to over 12% by 2060⁸.

¹ *Addressing the land use uses for non-food crops in response to increasing fuel and energy generation opportunities*, ADAS Rosemaund, 2008.

² DUKES, 2011.

³ Forestry Commission estimate.

⁴ Developed by CEN (the European standards body) in its technical committee 335.

⁵ 37% of these pellets were produced from wood processing residues, 36% from arboriculture, 18% from forestry operations and 9% from recycled wood, UK Wood Production and Trade (provisional figures), Forestry Commission, 2011.

⁶ Woodfuel Implementation Plan 2011–2014, Forestry Commission, 2011.

⁷ Progress report of the Independent Panel on Forestry, December 2011.

⁸ *The Natural Choice*, the Natural Environment White Paper, Defra 2011.

Current UK policy framework

The policy framework for biomass power and biomass CHP needs to stabilise to ensure UK farmers can benefit from long-term supply contracts for straw and energy crops under attractive terms of trade. Despite incentives to grow energy crops, there is insufficient market pull. The NFU would also like biomass technologies included in the FITs.

Significant growth in the demand for wood fuel is expected, especially in the industrial and domestic wood use sectors. Although the UK will still need imports – larger biomass power projects typically rely heavily on imports – it clearly makes sense to maximise the contribution from domestic production, which will also minimise impacts on existing users of forestry products. To ensure that growth can be satisfied, agricultural colleges need to increase levels of training in woodland-based skills.

The RHI was launched in autumn

2011, with a further expansion (including for domestic heat) expected in 2013. Stakeholders are working to ensure the market can have confidence in the quality and sustainability of the wood-fuel supply chain. The Forestry Commission is working with the private sector to test new approaches to woodland management, and is investing in improving skills in sustainable forest management. The UK Forestry Standard is the Government's framework for ensuring sustainable woodland management practices.



Making small private woodlands work

Case study: Wilderness Wood

Wilderness Wood is a privately-owned 62 acre woodland in East Sussex, acquired in 1979. The woodland is run as an example of rural sustainability in action. It is visited by well over 30,000 visitors each year, as well as around 10,000 locals who have free access to the wood.

The evolution of Wilderness Wood has been a key challenge for finding ways to balance the maintenance of productive, responsibly managed woodland (in a market where small-scale forestry is not commercially viable) with attracting, involving and inspiring a broad range of visitors with widely varying interests.

Two thirds of the woodland is sweet chestnut, now restored to the traditional system of coppicing. The remainder was converted from a pine plantation to a

Jobs in solid biomass fuels

Growing and production:

Farmer; Forester; Arboriculturalist; Agricultural specialist; Agronomist; Truck driver; Labourer; Wood recycler.

Manufacture: Wood chipper operative; Mechanical engineer; Heavy machinery operative; Plant operator; Biologist; Chemist; Microbiologist; Quality assurance; Warehouse manager; Distribution manager.

continuous cover mixed species forestry system. This has created woodland that is good for amenity, productivity and biodiversity.

When Wilderness Wood was first established as a business, local planning inspectors stated that it would not provide an income for two people from forestry activity. It is now the largest employer in Hadley Down village, providing employment for 10–25 local people (depending on the season).

UK wood pellet industry ready for significant growth

Case study: Verdo Renewables

Verdo Renewables has production plants at Andover in Hampshire and Grangemouth in Scotland, each with an annual production capacity of 55,000 tonnes of wood pellets and 15,000 tonnes of briquettes. All Verdo products are manufactured from locally sourced timber within the UK, and the wood pellets conform with the latest European Standard ENPlus A1.

At present, approximately 60% of Verdo's pellet output is exported proving the ability of UK producers to sell into markets with tough quality standards. Verdo is well placed to support the rapid growth of pellet-burning biomass systems on the back of the Renewable Heat Incentive. It

has a distribution network in place which can deliver individual pallets of pellets and briquettes anywhere within the UK. It also offers a national bulk "blown" delivery service for

commercial customers.

Verdo currently employs 50 full time staff in the UK. This figure is expected to increase as the demand for wood pellets within the UK increases.



Key facts (2010/11)

Current employment across supply chain:	8,940
Number of UK companies across supply chain:	520
UK sector turnover:	£1.2 billion
Global market value:	£34 billion
UK export value:	£90 million

Liquid biofuels (transport)

Background, current status and outlook

The UK Government recognised relatively early that biodiesel production could deliver a win-win; recycling waste cooking oil and reducing emissions. The 2002 Fuel Duty Rebate for biodiesel stimulated huge investor interest, including in oil seed rape. Innovation in bioethanol production ensued and in January 2005 the Fuel Duty Rebate was expanded to include bioethanol. Following the Bioethanol Declaration in June 2005, investment interest escalated in anticipation of the introduction of the Renewable Transport Fuel Obligation (RTFO) in 2008.

This buoyant start came crashing down in 2008 when the 'B99 splash 'n dash' scandal hit the biodiesel market. This saw biodiesel routed to the UK via the USA where it received American production subsidies, thus undercutting EU producers. This loophole was eventually closed by anti-dumping legislation, but much of the damage was done. Small emerging players were destroyed. At the same time, global vegetable oil prices rose and this, together with technical problems, wiped out some of the larger players in the UK industry.

Just as the RTFO was introduced in 2008, major NGO campaigns targeted biofuels. Many commendable examples of UK production were lost in a media storm that spotlighted only appalling examples of biofuels production from around the world. Yet through the Low Carbon Vehicle Partnership, academics and relevant

"Biofuels have a clear role to play in contributing to energy security, particularly in the transport sector, and in helping to mitigate climate change."

**Nuffield Council
on Bioethics**

industry actors had achieved major progress on developing pioneering sustainability standards for biofuels. The most recent confirmed figures show 84% of biofuels produced from UK feedstock met expected environmental standards, with an average of 69% GHG savings¹.

In the face of the media storm, UK politicians failed to protect and champion their domestic industry. The result is that today the UK imports 78% of its biofuel requirements, many of them with poorer sustainability standards. Government performed a policy U-turn, delaying the date on which the UK hopes to achieve its target of 5% biofuels in road transport from 2010 to 2014.

Government has maintained a non-committal approach ever since, failing to set a clear trajectory for an industry committed to innovation and sustainability. Unsurprisingly investors have focussed on Europe and the US. Bioethanol has the highest market growth rates, but biodiesel still dominates the EU market, accounting for nearly 80% of biofuel consumption². Germany is the

largest consumer of biofuels in the EU, with consumption levels nearly three times that of the UK³. From 2015 Germany will align biofuels support to its contribution to the reduction of GHG. Second generation advanced biofuels, including biomass to liquid and cellulosic bioethanol, will enjoy favourable tax treatment.

The UK sector remains surprisingly innovative (see case studies). The industry could be worth billions of pounds to the UK economy by 2020 if the policy environment encouraged investment in the sector and enabled advanced biofuels, made from waste and non-food materials, to come on stream. A strong biofuels sector would also create significant employment in high value engineering, manufacturing and R&D and could provide long-term growth for parts of the UK that have been badly affected by recession, in particular on the East coast and in the North East of England.

There is still hope that the production of advanced biofuels can start well before 2020. The need for sustainable biofuels for all modes of transport, from road to aviation has been recognised by the Committee on Climate Change's recent Bioenergy Review which states clearly that increasing volumes of sustainable biofuels will be needed for at least the next 20 years.

¹ Figures from Department for Transport, and apply to 2010/11. The average performance for all biofuels over the period was 53% meeting environmental standards and a 57% GHG saving.

² The State of Renewable Energies in Europe, 11th EurObserv'ER Report, 2011.

³ Renewable Energy: Perspectives for a Sustainable Energy Future, German Environment Ministry, 2011.

Current UK policy framework

Investment remains stalled in policy fog. Although the RTFO came into effect in April 2008, Government has not set out a clear pathway for meeting the Renewable Energy Directive requirement for 10% of energy⁴ used in transport to be renewable by 2020, and this may

not be set much before 2014. More than any other renewable the industry story is fiercely political, yet the performance of the UK industry has been exceptional.

As the German example shows, far more can be done to stimulate the domestic production of biofuels within a framework that rewards continuous technological improvement. With robust standards on sustainability today, second generation advanced

biofuel technologies can be developed without impinging on land required to grow food. What is poorly understood in the UK is that expensive innovation requires a viable market today. The UK industry has already proven its commitment to high sustainability standards and exceptional levels of innovation.

⁴ This translates to a volume target of around 13%, as biofuels have lower energy content than the fossil fuels they replace.

Ambitious innovation delivers food, fuel and jobs

Case study: Vivergo Fuels

Based in Saltend, near Hull, Vivergo Fuels was formed in 2007 as a biorefinery for the future. As a joint venture between AB Sugar, BP and DuPont, this new £350 million business will help to deliver about a third of the UK's forecast biofuel demand once fully operational later in 2012.

Vivergo's process will use 1.1 million tonnes of locally sourced, feed-grade wheat (making the company the UK's biggest single tip point) which will be converted into bioethanol and

animal feed products, with no waste. The company will be one of the largest ethanol producers in Europe (producing 420 million litres per year) and the largest single source supplier of animal feed in the UK, producing 500,000 tonnes each year.

Vivergo's bioethanol will offer GHG savings in excess of 50% over standard petrol, the equivalent of removing 180,000 cars from the road each year. Its animal feed production will provide the protein requirement for over 340,000 dairy cows every day, representing about 18% of the national dairy herd.

Vivergo Fuels is creating around 80 permanent, full-time, highly skilled jobs and is expected to support a further 1000+ jobs through the company's supply chain.



Jobs in biofuels

Design and development: Design engineer; Project manager; Economist; Electrical systems designer; Environmental engineer; Biotechnologist; Chemist; Agriculturalist; Environmental consultant; Feed-stock handling systems designer.

Manufacturing: Design engineer; Project manager; Welder; Sheet metal worker; Chemist; Agricultural specialist; Microbiologist; Biochemist, Electrical engineer, Mechanical Engineer.

Construction and installation: Planning consultant; environmental consultant; Project management and construction workers; Electrical engineer; Power generation engineer; Project manager; Health and safety manager; Pipefitter; Welder; Electrician; Service engineer.

Feed-stock production: Farmer; Agricultural operative; Waste operative; Civil engineer; Water engineer; Irrigation engineer; Process engineer; Chemical engineer; Electrical engineer; Field technician; Tanker driver; Warehouse manager.

Operations and maintenance: Chemist; QC Laboratory staff; Electrical engineer; Power generation engineer; Energy trader; Boiler engineer; Pipefitter; Welder; Electrician; Service engineer; Construction worker; Electrical/electronic technician; Plant operator; Mechanic, Project Manager, Fuel and ash supervisor; Labourer; Maintenance manager.

Distribution: Distribution manager; Tanker driver; Blend operative; Forecourt operative.

Pioneering commercial production of biofuels from waste

Case study: INEOS Bio

INEOS has developed a unique biorefinery technology that could position the UK at the forefront of renewable fuels production and waste management. INEOS Bio technology turns carbon-based waste into biofuel and renewable electricity, and contributes towards the Government's zero-landfill objective. Independent consultants Eunomia calculate that INEOS biofuel delivers 100% GHG savings when used instead of petrol.

The technology has been demonstrated in the USA since 2003, and the first commercial plant will be operational in Florida this summer. INEOS now plan to deploy this technology widely in the UK, beginning with a plant at Seal Sands on Teesside. The Seal Sands refinery will create 300 jobs in the construction phase



and 50 skilled, permanent jobs at the plant.

With the right Government support for sustainable biofuels, the UK could potentially have five bioethanol-from-waste refineries operational by 2020 using the technology, producing 500,000 tons/year of bioethanol from waste. Because biofuels produced from waste count as double towards EU targets, this would contribute one million tons/year towards the Renewable Transport Fuels Obligation. It would also save one million tonnes of CO₂ per annum, create 250 skilled permanent jobs, 1500 construction jobs, and safeguard numerous other UK manufacturing jobs along the supply chain.

Key facts (2010/11)

Current employment across supply chain:	3,500
Number of UK companies across supply chain:	200
UK sector turnover 2010/2011:	£485 million
Global market value:	£15.4 billion
UK export value today:	£25 million

Wood-fuel boilers and stoves (heat)

Background, current status and outlook

Heating is our biggest national use of energy, yet the UK has a small renewable heat industry compared to our European neighbours¹. Fortunately the UK market for renewable heat has begun a transformation. The traditional wood-burning stove market has ignited in recent years, stimulated by rising heating bills. But it is industrial and domestic boilers, driven by the innovative Renewable Heat Incentive, which will propel what has been a cottage industry into the mainstream. The proportion of heat generated from renewable sources needs to increase six-fold over the next eight years, in order to meet the 2020 renewable heat target. Wood-fuel boilers will play a key role in achieving this target – it is expected that over 60% of the renewable heat target will come from biomass heating.

Modern biomass boilers are highly efficient, often automated, and use quality-controlled wood pellets, chips or briquettes which offer a consistent burn quality and reduce air-borne emissions. The European boiler market is well developed, particularly in countries like Austria, Sweden and Germany, which boast established and respected names. However, the UK has a significant stake in manufacturing and new opportunities created by the RHI will give the sector a major boost. Growth in the sector presents large employment opportunities for installers, designers and service engineers, as well as in the wood-fuel supply chain (see page 46).



“Cutting emissions from the way we generate heat is essential if we are to meet our climate change and renewables targets.”

**Edward Davey,
Secretary of State, DECC**

The majority of heat generation from wood-fuel boilers is currently in the non-domestic sector, and most installations are commercial scale². The RHI retains this emphasis on the non-domestic sector as it is particularly cost effective³, although it is intended to support domestic-scale pellet boilers and automated log boilers under the RHI in future, and these are steadily gaining market presence. There is also considerable potential for combining biomass boilers with district heating schemes.

Due to the higher cost of oil and LPG than mains gas, rural areas not on the gas grid are particularly suitable for domestic wood fuel heating. Biomass boilers offer a valuable opportunity

to escape volatile energy bills and price rises associated with fossil fuels. The storage need for wood-fuel is typically no greater than the space required for an oil tank, but adequate storage facilities are an important consideration when specifying a biomass boiler so rural installers are likely to dominate. Furthermore, UK sourced wood-fuel and the resulting incremental jobs in the wood-fuel supply chain will come largely from rural areas.

¹ The UK has the lowest contribution from renewable heat in Europe, except for Malta, on nothing.

² AEA 'Biomass Boilers – Market size and direction' – April 2011.

³ In terms of £/subsidy required to give a defined internal rate of return.

Current UK policy framework

The first phase of the RHI for non-domestic installations started in November 2011. Its introduction was delayed due to the proposed tariff for projects over 1MWth not being compliant with European State Aid rules. The tariff had to be reduced substantially, which

undermined many of the projects then in development. Unfortunately there will not be an opportunity to resolve this in the near future given the lengthy timetable for introducing Phase 2 of the RHI. In the meantime the market for mid-scale boilers should take off. Installations over 1MWth are required to report quarterly on the sustainability of their biomass feedstock.

The RHI is due to be expanded in summer 2013 to include domestic

wood-fuel boilers. The interim grant scheme (Renewable Heat Premium Payments) gives some support in the meantime, although uptake to date has been slow and is unlikely to take off until there is clarity on the longer term picture under the RHI. To ensure possible impacts on air quality are minimal, emissions limits will be implemented early in 2013.

Investing for ambitious growth

Case study: Econergy

Econergy is one of the UK's leading suppliers of complete biomass heating. It employs over 40 staff and had revenues of £7.5 million in 2011. Econergy provides design and installation guidance, and supplies wood boilers to a further 20 smaller installation companies. It also subcontracts substantial amounts of work to pipework, electrical and civil contractors. It is estimated that the jobs created in related businesses may be two to three times those employed directly.

Econergy was purchased by British Gas at the end of the 2011 and it has very substantial growth plans for the business. As an example, Econergy received a similar level of orders in



the first three months of 2012 to that received in the whole of 2011. The company also plans to accelerate its training of third party installers using the established British Gas Academies. It recently contracted with Stockport Homes to deliver biomass community heating to 1,050 flats in 18 tower blocks. This solution includes the provision of solid wall insulation to bring substantial heat demand reduction.

Jobs in wood-burning stoves and boilers

Manufacturing: Design engineer; Boiler maker; Welder; Electrical engineer; Chemist; Agricultural specialist; Microbiologist; Biochemist, Building Services engineer, Electrical engineer, Mechanical engineer; Quality assurance.

Installation and maintenance: Project manager; Electrical engineer; Boiler engineer; Pipefitter; Welder; Electrician; Heating engineer; Service engineer; Construction worker; Electrical/electronic technician; Plant operator; Mechanic, Project manager, Technical sales manager; Service engineer; Chimney sweep.

Training apprentices in specialist manufacturing

Case study: Hoval

Hoval Ltd is a leading UK designer and manufacturer of energy efficient heating solutions, including biomass, gas and oil systems. Hoval's investment in new technologies, combined with its legacy of manufacturing boilers and associated products in the UK since 1887, has earned the company a Royal Warrant as Boiler Manufacturers and Engineers to HM the Queen. Hoval boilers are installed at Buckingham Palace, Windsor Castle and Holyrood Palace.

Based in Newark, Nottinghamshire, Hoval currently employs over 130 staff though this number is rising rapidly. In 2011 alone, 34 new members of staff were employed in both manufacturing and office based roles, including apprentices and graduate recruits.

Hoval has recognised the need to develop appropriate technical skills



to take advantage of low-carbon opportunities and focuses on a 'home grown' approach. A total of seven apprentices are employed across the business, each benefitting from a tailored training programme to support their professional development. The advantage of this approach, which

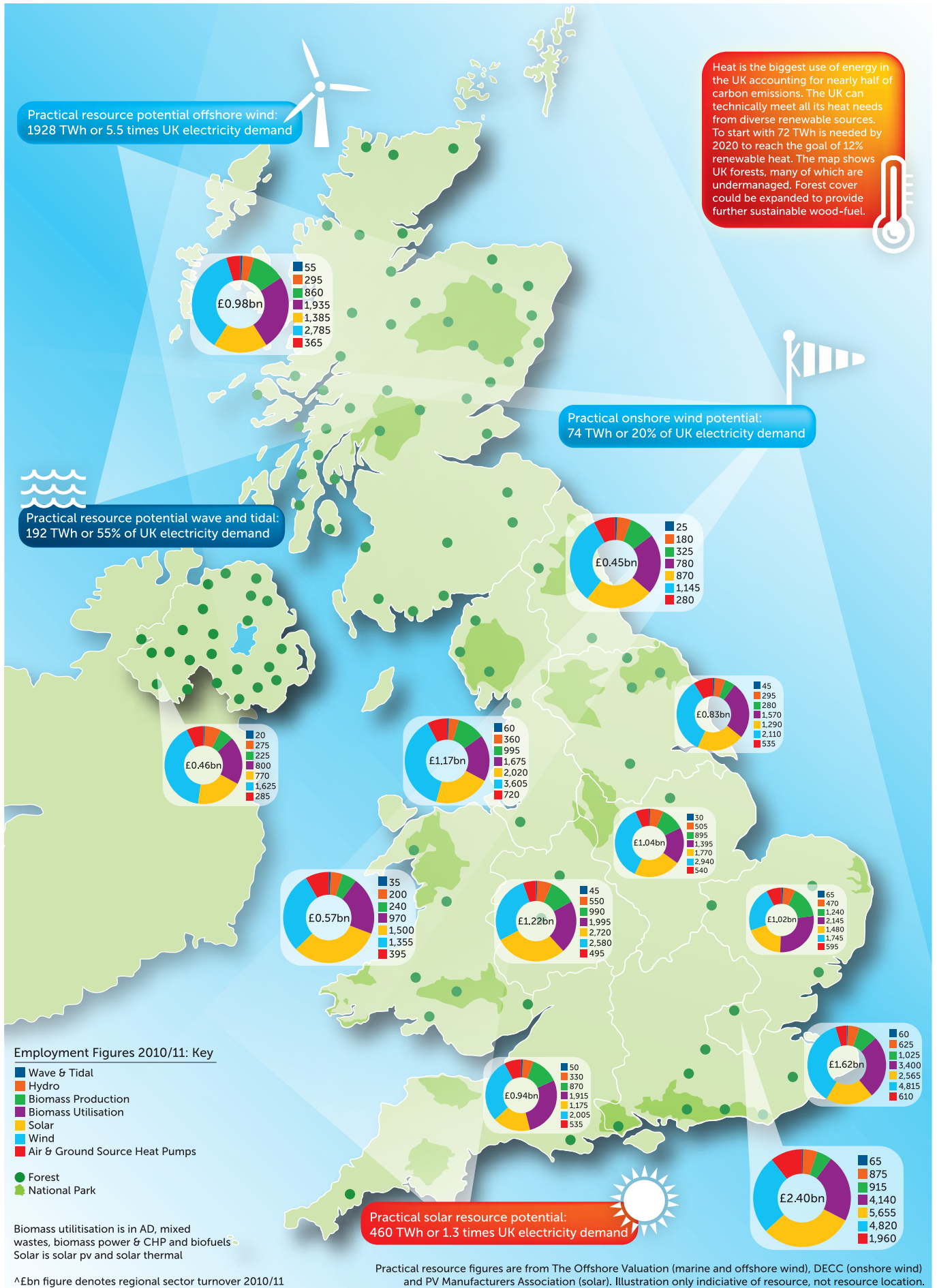
has been sustained for many years, is evidenced by the fact that a number of the company's senior staff initially joined as apprentices. The 'home grown' approach also means that the required specialist skills are passed on when older staff retire, ensuring Hoval's expertise and excellent customer service.

Key facts (2010/11)

Employment across supply chain:	4,530
Number of UK companies across supply chain:	210
UK market turnover:	£540 million
Global market value:	£11.9 billion
UK export value:	£57 million

Made in Britain map

Employment and turnover by region 2010/11



Regional employment and turnover

Analysis carried out by Innovas shows the employment opportunities across the renewable energy sector are distributed nationwide. Each region in the UK represents significant potential for growth across a wide range of technologies and renewable fuels.

Scotland

Scotland has massive natural resources including 60% of the UK wind resource. The Scottish Government has an ambitious target to source 100% of its electricity from renewables by 2020 and it is well on its way to achieving its goal. Jonathon Porritt says the **European Marine Energy Centre** in the Orkneys 'has no parallel anywhere in the world'.

Overall sector turnover in Scotland is nearly £1 billion across over 500 companies. Nearly 8,000 people were employed in renewable energy in 2010/11, with the wind sector the biggest employer. Biomass boilers and biomass fuel also feature strongly. In addition there is significant employment across Scotland's prestigious academic institutions. The soon to be launched **Green Investment Bank** will be located in Edinburgh, making Scotland not only a hub for renewables but also a hub for green finance.

Northern Ireland

DECC figures show exceptional recent growth in renewables in this region. This is expected to continue with the Crown Estate taking bids for a 800MW offshore wind farm and a 200MW tidal stream energy project in the region. The region is also supporting leading research into anaerobic digestion technologies at the **Renewable Energy Centre** at the Agri-Food and Biosciences Institute (AFBI) Hillsborough. The 2010/2011 workforce base is 4,000 in the renewables industry and the regional sector turnover is nearly £0.5 billion.

Wales

In 2010/11 almost 300 renewable energy companies in the region employed 4,700 people with a turnover of £0.57 billion. Wind and solar each employ well over 1000 people in Wales. Wind contributes over £160 million to the economy. Wales boasts the innovative **Anglesey Energy Island** and the **Sharp Solar Centre**, which provides education and training for the community. The Welsh Government won the British Renewable Energy Region Award in 2011 for their pioneering **Arbed** scheme.

East Midlands

There is strong employment in solar PV and wind technologies. The region employs over 8,000 people in over 550 companies, with a regional turnover of £1.04 billion.

It is the home of the **Energy Technology Institute**, a partnership between industry and the UK Government to accelerate the development of clean energy technologies.

East of England

Over 7,730 people are employed across 475 companies with sector turnover of £1.02 billion. This prime agricultural region has the most companies involved in biomass fuels in the UK, employing over 1,200 people. A Regional Woodland Strategy, in place since 2003, has paid off as the region also employs the largest numbers in biomass fuel production. Notable landmarks include crops research at the **John Innes Centre**, an international centre of excellence in plant science and microbiology and the **Tyndall Centre at the University of East Anglia** specialising in climate change research.

Greater London

The capital employs the largest number of people in renewable energy in the UK, with over 18,000 people employed turning over £2.4 billion in 2010/11. Many of these people are involved in professional services. The Greater London Authority's **London Plan** appears to be driving significant deployment of onsite renewables in the region; London boasts the highest figures nationally for employment in onsite renewables like solar, heat pumps and biomass boilers. It also has the highest employment in energy from waste.

North East

Generation from renewables has grown rapidly in this region. However, the region employed the lowest numbers of people in 2010/11 at around 3,600 people across approximately 235 companies, primarily in solar PV and wind technologies. Turnover was nearly £0.5 billion. The region boasts the **National Renewable Energy Centre (NAREC)** which drives technological innovation to advance the development, deployment and integration of renewables.

North West

The region employs over 9,400 people across 611 companies turning over £1.2 billion. After London, the North West employs the greatest number of people in the heat pump sector. After London and the South East it has the strongest employment in wind. The **Joule Centre** for energy R&D is based here and is a collaboration between universities and research establishments within the region and stakeholders in the energy industry.

South East

Energy generation from renewables in the South East more than doubled between

2003 and 2010. Outside of London, this densely populated region leads the UK in employment in many of the renewable energy technologies including: anaerobic digestion, energy from waste and wind. Over 13,000 people are employed in the renewable energy sector in the region, falling just behind London for the top region for employment in the industry. Turnover is £1.6 billion.

South West

The South West employs nearly 7000 people in nearly 450 companies, turning over close to £1 billion. Offshore resources are ample in the southwest which is the home of the **North Cornwall Wave Hub**. The wave hub is the largest wave energy demonstration site with 8km² of seabed capable of producing 20MW of wave energy. This is supported by the **Peninsula Research Institute for Marine Energy** which boasts international researchers and world-class facilities to help advance marine renewables.

West Midlands

After London, the West Midlands employs more people in the solar PV industry than any other region in the UK. Overall the region employs over 9,300 people in 690 companies turning over around £1.2 billion. In March 2012 The Co-operative launched an **Enterprise Hub** to support Renewable Energy Schemes in the West Midlands. The programme has set aside £1 million to help community renewable energy scheme which will see the demand for renewable energy in the region increase.

Yorkshire & the Humber

DECC data shows renewable energy generation in Yorkshire has remarkably almost tripled between 2003 and 2010. Wind is the biggest employer and there are over 20 onshore and offshore wind farms in the region with major schemes under development. The region has a strong show in solar, driven by pioneering councils like **Kirklees** and the dynamic **Yorkshire and Humber Microgeneration Partnership**. Over 6,100 people are employed in nearly 400 companies, turning over £0.8 billion.

Conclusions

There's a major success story to be told for renewables; one of growth, jobs and opportunity for both businesses and individuals. As the costs of energy from non-renewable sources continue their relentless rise, the economic benefits of shifting to renewable sources become ever clearer. For a modest investment in support over the coming years the UK stands to reap significant benefits in the longer term and has good prospects of becoming a major player in the growing international green economy.

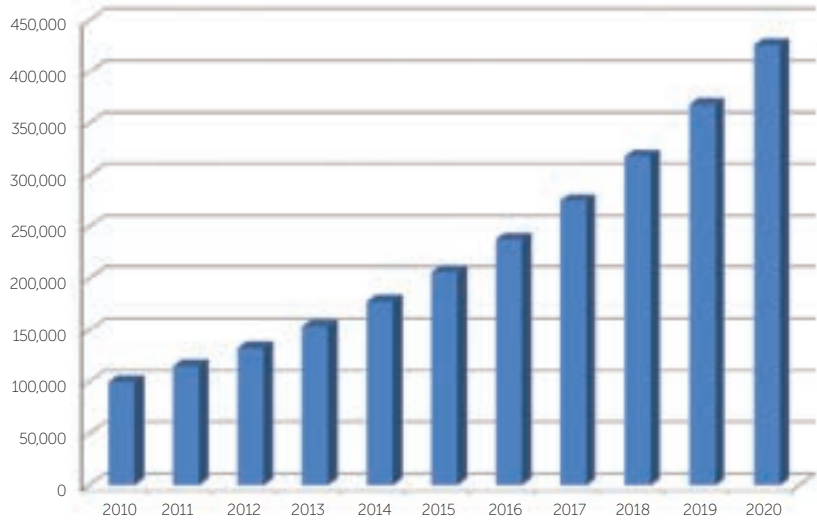
This report calls for a familiar circle of challenges to be vigorously squared: energy security, rising fossil fuel prices, climate change, unemployment, ageing infrastructure, skills shortages and the renewable energy targets.

A much sharper focus is required from Government to transform these individually difficult challenges into a collective opportunity – and if they do so, working with industry and other stakeholders, it will be the opportunity of a generation. The stakes are high. Failure to address these challenges in the round may well result in crises on several fronts. The 2012 Budget document, for example, makes clear oil prices could yet derail economic recovery.

This report has made an initial attempt at quantifying the full-time equivalent jobs across the full range of renewable energy technologies in the UK and concludes that there were almost 100,000 in 2010/11, rising to at least 110,000 today, not least given the recent surge in deployment of solar PV under the Feed-in Tariff scheme. The lead sectors are wind and bioenergy, with solar showing the largest recent growth. If the UK is to achieve its target under the Renewable Energy Directive of meeting 15% of our energy consumption from renewables by 2020, the renewables contribution will need to continue to grow by an average annual rate of 15.7%. It is reasonable to assume that employment will have a similar growth rate, as shown in the diagram here, reaching well over 400,000 in 2020. We estimate that the UK market was valued at £12.5 billion in 2010/11 and that it could reach over £50 billion in 2020 at the above growth rate, though we do expect cost reductions for many technologies.

Renewables deployment is expanding much faster worldwide

Projected UK employment growth in renewable energy sector to meet 2020 target



and the range of opportunities for the UK industry to export its technology and expertise grows daily. Already in 2010/11 exports accounted for 12.8% of UK renewables turnover and the prospects for this to increase over time are excellent.

One of the main attractions of renewables, as this report shows, is the very wide range of skills and jobs that the various technologies require. Renewables touch most areas of the economy and can provide interesting employment to those most in need – those newly entering the workforce, sectors in recent decline (such as heavy engineering and construction) and the rural economy. In addition the decentralised nature of many renewables guarantees that these jobs are spread widely around the UK, with some of the regions most in need of economic growth benefitting from significant renewables potential.

The future is therefore potentially bright but it will not happen on its own. UK renewables policy has made great strides in recent years but there's still a long way to go to achieve the kind of supportive, joined-up approach that is required. DECC cannot do this alone, and certainly not in conflict with other departments. We need a BIS Minister to be given a clear renewable energy remit, to

put renewables at the heart of the UK's growth strategy and to monitor its increasing benefits. We need the Treasury to fully recognise and quantify the many economic benefits of renewables, rather than focusing entirely on their short term costs. We need the ONS to monitor renewables employment to inform a clear focus on developing the training and skills that the sector requires in increasing amounts. We need a positive approach on planning, on building regulations, on transport, on agriculture and on the environment.

Only then will we benefit fully as a nation from the huge opportunities that renewable energy, made in Britain, can offer.



Methodology

Standard Industrialisation Codes (SIC) are used to classify businesses according to the type of their economic activity. New sectors such as renewables are not currently covered by the SIC categorisation in detail and this has led to a lack of robust data on jobs associated with the sector. Headline data on the low carbon sector has been produced by Innovas for government however a detailed breakdown of the renewables sector by technology or geographical area has not been published until now.

The REA is planning to produce an annual update of this analysis and data, although ideally ONS would be providing this information. We would welcome any feedback and comments on the data in this report. Please send any feedback to madeinbritain@r-e-a.net.

Definition of sector

The Innovas methodology uses a broader definition of the renewable sector than other studies, because it includes the contribution from supply and value chain companies. It relies on 'bottom up' data based on what companies actually do, rather than what they are classified as doing under the SIC system. Innovas's definitions are consistent with (but not limited by) SIC and NAICS codes and extend down to eight-digit code classifications which specify activities. Innovas's final data levels go beyond SIC code definitions.

Data sources

The study draws from over 700 sources. It includes activities undertaken by companies across the renewable supply chain including related network activity, commercial R&D¹ only, through manufacturing into distribution, retail, installation, and maintenance services. Companies are included in the supply chain where 20% of their turnover is supplied into the sector, but only the sales activity relating to the renewable sector is included in the analysis. In order to limit the risk and error the numbers are informed by multiple sources. Innovas carry out a sensitivity analysis with the aim to provide a confidence level of 80% within a range of +/- 20%.

Model

The full sector analysis model is a bottom up, multi-staged model that uses econometric techniques sources and methods (such as data triangulation²) to verify and enrich source data drawn from multiple sources. The approach uses data from actual, live and accumulated business cases and computes confidence levels for final reported numbers, based upon a

rigorous assessment of the source data. The model also measures activity in the supply chain for each sub-sector, totals are aggregated from 2,300 discrete individual product group lines for the whole low carbon and environmental goods and services sector. Each of these lines uses specific data sources and can be analysed individually, unlike traditional studies which often group together data sources.

The methodology mitigates against double counting risks by checking and comparing the numbers over a period of years, with multiple validated and verified data sources.

'Key facts'

Employment is a measure of the estimated employment numbers across all aspects of the supply chain – these are direct full time equivalent jobs. National, regional and other economic data sources have been used to estimate current employment levels. Where employment information is scarce, or where Innovas are estimating employment for a proportion of a company's sales, they rely on comprehensive case study materials to provide sensible industry-specific ratios and benchmarks, or for some technologies REA's sector groups have contributed data (these are set out in additional adjustments).

Number of companies is a measure of the total number of companies in the region that match (or fit within) the activity headings for renewables sector. Due to the limitations of using SIC codes the methodology uses a unique analytical process to allocate companies to the renewables activity headings. The total number of companies in this report has been arrived at by a bottom-up analysis of company stock within the country/region using such sources as: Companies House, European credit agencies, British Telecom, institutional listings and UK credit agencies.

Sector turnover estimates are based upon where economic activity takes place i.e. the location of the business rather than the location of the income earner. In the calculation of turnover value Innovas consider: turnover by sub sector within postcode sets; capital asset adjustment by sub-sector within postcode sets; ONS GDP calculations; supply chain procurement value sub-sector by sub-sector by postcode sets; sub-sector specific sales reporting where available.

Global market value uses the same methodology as above for each of the main country markets with the largest 50 markets by market value being analysed to the same level of detail i.e. 2,300 discrete lines.

Regional data methodology: Having identified the total company stock in the region, product and service outputs have been identified and verified by accessing further databases that include: institutional

data sets, Yellow Pages, proprietary databases, Euromonitor, Dun and Bradstreet and Thompson. The methodology measures where the economic activity actually occurs and is reported, rather than just at the headquarters or main facilities.

Consultation with stakeholders: The analysis and data were then sense checked with industry participants, these included some REA sector groups, REA sector heads, developers of certain technologies, and expert members.

Sector adjustments: The adjustments to the data following consultation with stakeholders, or where the Innovas methodology was not used were:

Deep geothermal: The REA's deep geothermal sector group provided the data for this technology using current industry knowledge and detailed analysis of Deep Geothermal employment for the US Department of Energy.

Marine issues: The global definition used by Innovas includes schemes the industry would themselves classify as large hydro. The consequence is that the figure for the global share of the market would be much lower than existing estimates. The Innovas methodology only includes commercially funded R&D, however industry feel that publically funded R&D is very relevant for this sector. This study therefore now uses an alternative study for these estimates.

Solar power: There has been a surge in the growth of solar since the introduction of the small scale Feed-in tariff. The reviews of the scheme have resulted in an increased demand for solar systems, which means that the Innovas data is significantly out of date given 2011 growth. Hence up-to-date REA figures have been inserted in the relevant section.

Heat pumps: The REA has scrutinised the built environment link with heat pumps, where there is a complex overlap with the air conditioning and refrigeration industry. We are satisfied the figures are representative of full time employees. SummitSkills believes this could be an underestimate.

Woodburning stoves: An area of concern for the industry is a lack of reliable data for the wood burning stove industry. It was not possible to separate this technologies data from the wider boilers data, but there is anecdotal evidence of strong growth in this sector, which is taking place outside the UK policy framework.

Onshore and offshore wind data: The supply chains in these two sectors are very closely linked and it is very difficult to separate the two. Innovas have provided their best estimate for 3 Key Data lines.

¹ Government and European funded R&D is not included.

² The gathering of data through several sampling strategies in order to enhance confidence in results.

Acknowledgements

REA would like to warmly thank the sponsors of this report for their generous support and engagement: SummitSkills; EU Skills; RES; RWE npower renewables; Centrica and Myriad CEG. Supporting contributions were also gratefully received from Estover Energy. The contents of this report do not necessarily reflect the views of sponsors.

Design is by Jeff Searle at Mulberry Design. The Made in Britain map is by Sarah Duke at Scruffy Duke. Design template for the 'Technology' pages is by Tamsin Bosch.

The lead author is Leonie Greene, with Tricia Wiley. Contributions to the text have been gratefully received from Dr Michael Hammond (SummitSkills); Robert Murphy (EU Skills); Brittany Vogel; Johanna Doyle (RES); Gaynor Hartnell; Paul Thompson; Mike Landy; Stuart Pocock and Dr Ryan Law (who assembled key data for the Deep Geothermal sections). A large number of people need to be thanked for their contribution to this report, they are; James Beard; Jan Sladek; Steve Roberts; Emma Johnson; Stephanie Merry; Clare Wenner; Stewart Boyle; Gerard Reid; Ray Noble; Anthony Battersby; John Baldwin; Terry Seward;

Kelly Butler; Stuart Elmes; Andrew Raingold; David Atkinson; Dr Jonathan Scurlock; James Sessions Hodge; Stuart Hayward-Higham; Dan Cooke; Richard Stark; Chris Miles; Gavin King-Smith and Louisa Evans, as well as all contributing case studies. Particular thanks must go to; our partner John Sharp at Innovas; Nigel Hollett; Anna Stanford; Alan Simpson for invaluable input; our sponsors at EU Skills and SummitSkills (who patiently helped us make sense of a complex skills landscape); and to Greg Barker for his continually constructive engagement with the REA on this project, among others.

Glossary

AD	Anaerobic digestion
BIS	Department for Business, Innovation and Skills
BSE	Building Services Engineering
CCC	Committee on Climate Change
CHP	Combined heat and power
CNG	Compressed natural gas
CRC	Carbon Reduction Commitment
DCLG	Department for Communities and Local Government
DECC	Department of Energy and Climate Change
DEFRA	Department for Environment, Food and Rural Affairs
DFT	Department for Transport
DPM	Deputy Prime Minister
EMR	Electricity Market Reform.
FIT	Feed-in Tariff
GDP	Gross Domestic Product
GIB	Green Investment Bank
GHG	Greenhouse gas emissions
GW	Gigawatt
HMT	Her Majesty's Treasury
HVAC	Heating, ventilation and air conditioning
IEA	International Energy Agency
IPCC	Intergovernmental Panel on Climate Change
kWh	Kilowatt-hour – a unit of electricity
MW	Megawatt
NASA	National Aeronautics and Space Administration
NPPF	National Planning Policy Framework
NSAET	National Skills Academy for Environmental Technologies
OECD	Organisation for Economic Co-operation and Development
ONS	Office for National Statistics
ORED	Office for Renewable Energy Deployment
PM	Prime Minister
PV	Photovoltaic
REA	Renewable Energy Association
REAL	Renewable Energy Assurance Limited
RPR	Reserves-to-production ratio
RHI	Renewable Heat Incentive

RHPP	Renewable Heat Premium Payment
RO	Renewables Obligation
ROC	Renewable Obligation Certificate
RTFO	Renewable Transport Fuels Obligation
STEM	Science, Technology, Engineering and Mathematics programme
UKCES	UK Commission for Employment and Skills

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About the REA

The Renewable Energy Association represents around 950 renewable energy companies and is the voice of the renewable energy industry in the UK. A not-for-profit industry association, the REA promotes the use of all forms of renewable energy, uniquely representing the full range of renewable energy technologies across power, heat, transport and renewable gas. Ever-increasing corporate membership ranges from major multinationals and manufacturers through to service providers and sole traders. The REA also runs a wide range of highly regarded seminars and workshops. For more information see www.r-e-a.net and for regular up-dates follow us on [@REA_News](https://twitter.com/REA_News).

Demolition expert Civil works personnel Foreman Surveyor
Structural engineer Civil engineer Quantity surveyor Biochemist
Labourer Electrician Plumber Roofer Heavy equipment operator
Sheet metalworker Operations Manager Office administrator
Health and safety officer Shift manager
plant operator Supervisor Accountant
care Communications expert Sales person
Architect Solar system design engineer
Financial planner Economist Forester
CHP plant operator Port hand Physics
engineer Environmental consultant
Aeronautical engineer Agronomist
assembler Marine technology design
Chemical engineer Materials engineer
Architectural technician Planner
collector Turbine specialist engineer
operator Farm worker Power generation engineer Energy trader
Policy expert Underwater diver Biomass power plant operator
Marine engineer Turbine specialist engineer Metal worker
Office manager Ship's captain Rigger Pipefitter Helicopter pilot
Chemist Energy manager Instrumentation engineer Scaffolder
Panel cleaner Hydrogeologist Boiler engineer Reservoir engineer
Environmental scientist Heating engineer Ecologist Subsea
engineer Materials engineer Oceanographer Marketing manager
Woodland manager Fluid dynamics specialist AD systems design
engineer Biochemist Farmer Feedstock loader Truck driver Plant
operator Maintenance technician Laboratory worker Vehicle
designer Hydrologist Pump attendant Microbiologist Fuel
and ash supervisor Labourer Maintenance manager Geologist
Pump designer Geophysicist Drilling services manager Tanker
driver Plant operative Pipeline engineer Product development
manager Biotechnologist Agriculturalist Tanker driver Farmer
Arboriculturalist Wood chipper operative Warehouse manager
Systems engineer Quality assurance manager Marine surveyor

“And what is the cost of a reorientation? We might remind ourselves that to calculate the cost of survival is perverse. No doubt, a price has to be paid for anything worthwhile: to redirect technology so that it serves man instead of destroying him requires primarily an effort of the imagination and an abandonment of fear.”

E.F. Schumacher

"This report
could hardly be
more timely."

Will Hutton



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