2017 REVIEW

RENEWABLE ENERGY VIEW

THE AUTHORITATIVE ANNUAL REPORT ON THE UK RENEWABLE ENERGY SECTOR

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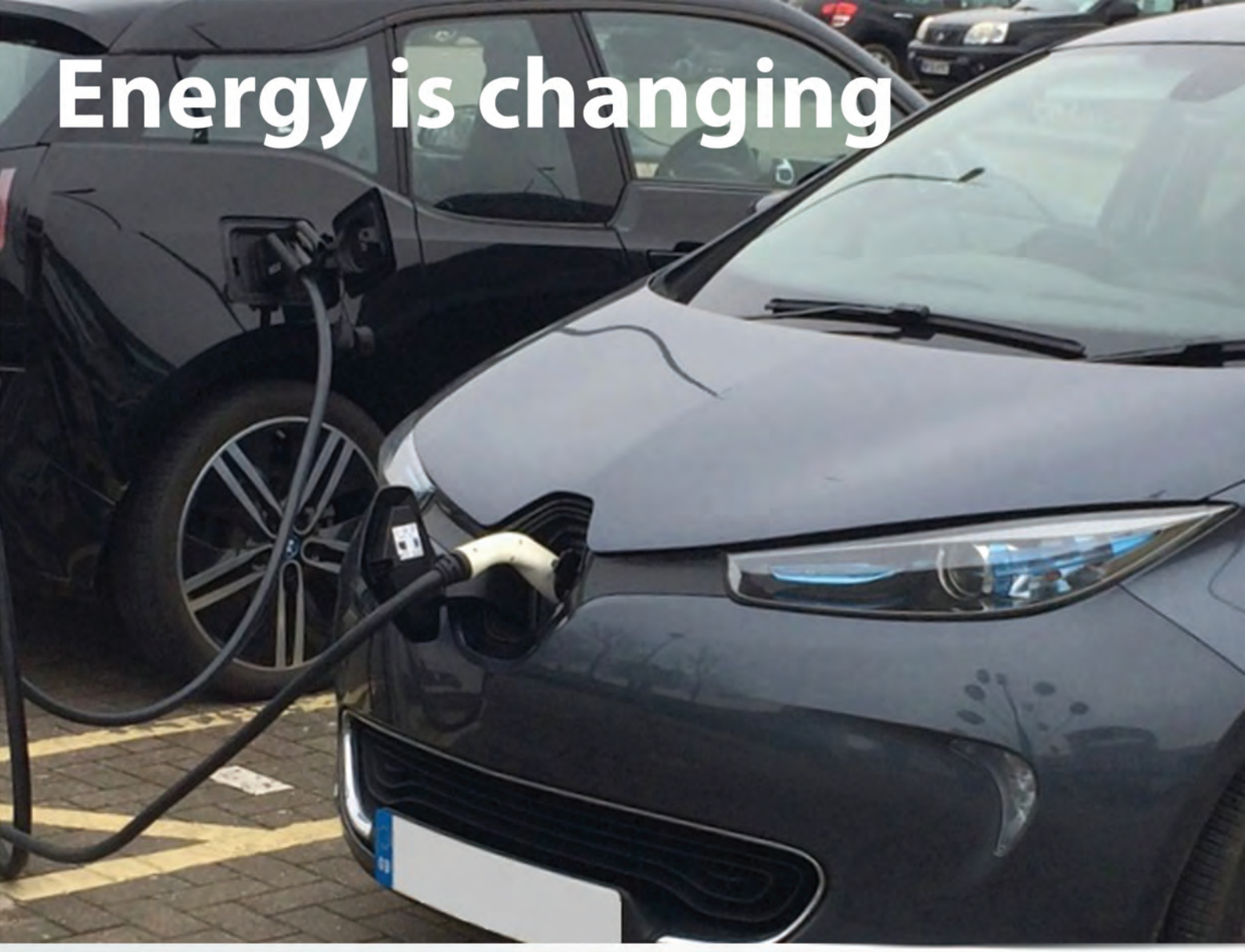

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GROWING THE RENEWABLE ENERGY & CLEAN TECH ECONOMY

Contents

A RENEWABLE ENERGY ASSOCIATION PUBLICATION

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Foreword Dr Nina Skorupska CBE

Chief Executive, REA

Forging a new energy future and the important role for renewables

2016 was an extraordinary year which will live long in the memory. The pace of change in the political landscape was breath-taking, bringing truth to the saying that there are decades where nothing happens; and there are weeks where decades happen.

Across the world there were odds defying results, and here in the UK, we saw the referendum turn the status quo on its head, leading to a swift change of government, and with it new ministers, new departments and a new political direction.

Of course this tsunami of change reaches every industry, and members of the REA were no different. In addition to high level changes, we have contended with further policy changes which have had traumatic affects across the sector. This will not be fully reflected in this year's REview, which looks at the figures before the many policy changes to FiTs, CfDs and the RHI were imposed.

Away from the political and policy area, the industry itself is undergoing radical change. We are seeing a fundamental shift in the business and technology. We are seeing new players such as corporate businesses and local government, stepping up to champion quite radical low carbon energy delivery models "energised" by the prospects of reducing costs and development of smart energy.

We have also seen traditional utilities reinvent themselves as clean energy "service" providers to their customers and ring fence their fossil commitments (of course, still hoping to make money from them ahead of even more significant market transformations).

All of this is underlined with falling technology costs and increased investment. There is no denying that renewable energy and clean tech is one of the fastest growing industries in the world. Here in the UK, there is significant work needed to upgrade our own energy infrastructure and the Government have the ambition to be world leaders in climate change and to have a viable and relevant Industrial Strategy. I believe that renewable energy and clean technology remains a significant business opportunity, and the investment simply has to proceed. The question only remains as to how fast can the UK take advantage of this before others realise this ambition first?

There is no denying that renewable energy and clean tech is one of the fastest growing industries in the world.

The 2017 Renewable Energy View (REview) builds on our previous reports. In order to cover all the important aspects when describing an economy, we believe producing robust *employment* data, broken down by technology and region, is vital to describing how this industry is developing and so we have teamed up with INNOVAS again. *We have also reviewed the methodology for some of our sectors and where they have changed we have highlighted why. We have revamped our transport sector descriptions as well as highlighting jobs linked to the exciting electric vehicle opportunity.* We've also collated official deployment figures recently published by Government Departments and compared them to their shorter-term 2020 projections for the UK. We look into each renewable energy technology and have made an attempt to cover energy storage and how the potential of electric vehicles (EVs) will impact on low-carbon transport future and the wider energy infrastructure. We are pleased to have KPMG join us *once again* to share their insights on historic and projected trends that have influenced investment. Change

in costs of key technologies, such as solar and wind, reveal that renewable energy future is becoming less linked to policy per se than ever before.

In summary, the UK was supplied with 24.4% of its power and 2.9% of its transport fuel from renewable sources in 2016; renewable heat is estimated to have contributed 6.2% of total heat supplies in 2016. The renewable energy industry employed close to 126,000 people. This is a number that has the potential to grow further. In fact, early research by Innovas has found close to 16,000 jobs are now linked with the growing energy storage and electric vehicle industry.

I believe that renewable energy and clean technology remains a significant business opportunity, and the investment simply has to proceed.

As the REA has previously reported, the necessary expansion of clean energy is both possible and affordable, as we have seen with the dramatic decreases in the cost of renewable energy technologies and smart systems, a key enabler for UK's low carbon energy future. The new Government must reconsider how much emphasis it places on technologies such as nuclear and shale gas if it truly wishes to deliver on its ambition set out in the Industrial Strategy Green paper.

We see renewable energy, along with energy storage at all scales, as the approach to deliver what is needed in a balanced way. We hope the new Government is open to debate about both the costs and the benefits of renewable energy and clean technology, including the new jobs being created.

As we have said repeatedly, this not just a new generation of highly skilled engineers, but the biochemists, the legal and financial service providers and the installers and construction workers across the whole of Britain. This sector also attracts a diverse workforce and I am pleased to say more women. The opportunities are vast and can clearly create and provide challenging roles for many of the skilled people that wish to switch from the fossil energy business to the new.

The people and businesses in our industry have risen to many of the extraordinary challenges put to them in 2016. I am confident that even with the new challenges that are inevitably to be added to the 2016 "list", that the extraordinary opportunities continue to far outweigh them. As the REA and industry, we must continue to extol these. The public support us like never before but we must turn them into champions as they increasingly benefit from them.

Our industry is now mainstream and continued, confident investment in UK renewable energy and clean technologies is the clearest way to building the UK economy.

Dr Nina Skorupska CBE

Chief Executive, REA

Post note: Just at the point of going to print the 2016 renewable heat figure estimates were published in BEIS's Energy Trends. For completeness we have included the headline figures in the introductory sections. However, it is an estimate and a different data set (Energy Trends) to that used in the detailed sector-specific charts (DUKES) therefore to ensure consistency we have not changed the sector specific heat charts.

Growing the renewable energy and clean tech ecomony

REA

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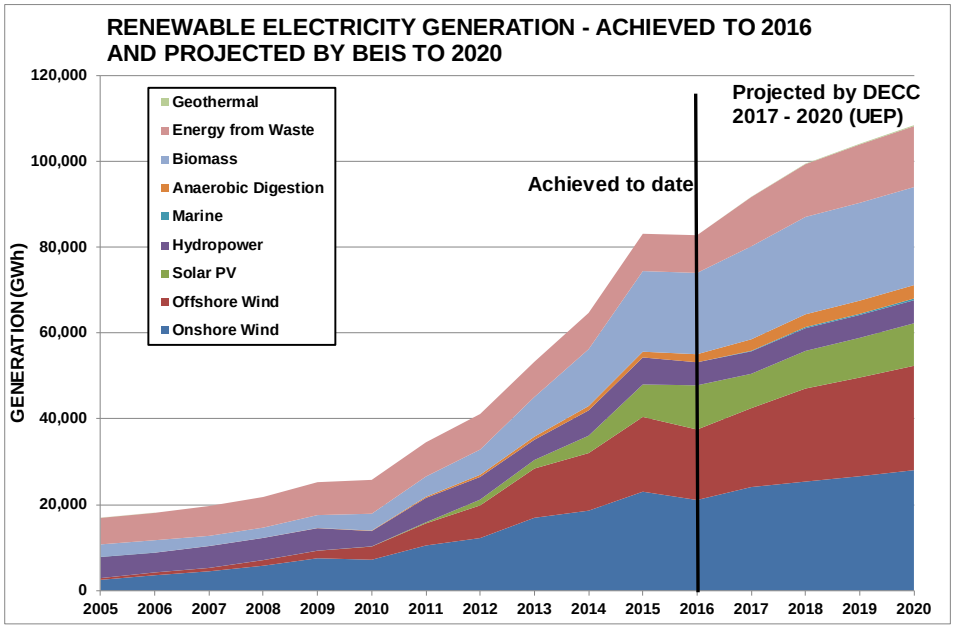
Executive Summary

Renewable energy growth challenged by continuing political uncertainties and future energy relationship with Europe



2016 has been the first year when the contribution from renewable energy to the total UK energy output has plateaued. The various elements: renewable electricity, heat and transport that contribute to the UK's objective of 15% renewable energy by 2020 (Renewable Energy Directive (RED)) still, when combined, would likely give a value in line with the trajectory for the UK to remain on track. The target averaged across 2015/2016 is 7.47%. In 2015 the remarkable growth (>25%) in renewable electricity generation helped the UK achieve 8.3%. The final value for 2016 RED is anticipated to be slightly higher than the 2015 figure, however as the data for heat has yet to be finalised for 2016 and RED "normalised" data for electricity and transport have not been cconfirmed, the final confirmed figure will only be available in quarter three this year. At present only an initial Government estimate is available, at 8.9% of total energy.

The generating capacity and output values quoted in this report describe 2016 actuals for electricity and transport and 2015 heat analysis as quoted by Digest if Renewable Energy Statistics (DUKES). According to the most recent data estimates the UK was supplied with 24.4% of its power and 2.9% of its transport fuel from renewable sources in 2016, renewable heat contributed 5.6% of total heat supplies in 2015 and 6.2% in 2016.

The UK's growth trajectory to meet this ambition for the next 4 years remains very steep - and continues to be one of the highest of any EU member state. Certain groups may argue that the RED target is of less relevance today following the referendum and that the UK Climate Change Act and its drive to reduce greenhouse gas emissions, has taken prominence over meeting such targets. However, it is clear that much of the ability to deliver the 3rd and future Carbon Budgets relies on policies put in place to date including the assumptions that the RED targets WILL be met. It is difficult to conceive that the Government would wish to make such a clear "U-turn" on its legally binding commitments whilst in the throes of broader negotiations with the EU over Brexit, especially when it wishes to continue to demonstrate international leadership in Climate Change (and fulfil its commitment as a signatory of the COP21 Paris Agreement). Notwithstanding the above, there is a growing recognition and concern that the "on track" figure masks stark differences between the sectors and individual technologies.

Looking at renewable electricity in more detail, the closure of the Renewables Obligation (RO) to new solar and onshore wind projects in March 2016 did lead to a surge in new capacity in the first half of the year. However the reduction in support for the Feed-in Tariff in late 2015 has stalled much of domestic deployment of solar and other technologies until the Government returned to make small adjustments for technologies like Anaerobic Digestion (AD). Some developments for roof top solar continued as costs for PV reduced and different business cases were starting to be made for commercial installations. So at the end of 2016, there was 34.7 GW of installed renewables capacity, a 14% (4.2 GW) increase on a year earlier.

During 2016, projects planned for onshore wind in earlier years saw capacity increase by 1.4 GW, with several large sites opening, or continuing to expand during the year (Dunmaglass (94 MW), Dersalloch (69 MW) and the first 156 MW of Wales's largest onshore wind farm, Pen y Cymoedd (256 MW on completion). Offshore wind capacity fell by 10 MW with the closure of the Beatrice Demonstration Project in early 2016.

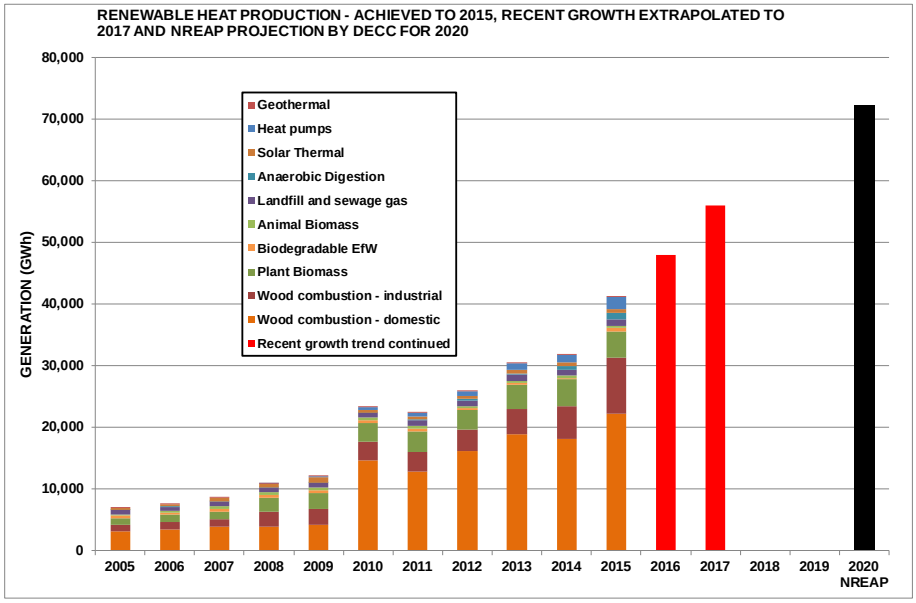
Solar PV capacity increased by 2.4 GW during 2016, with the majority of growth coming from sites supported by the RO, as well as increases in small scale Feed-in Tariff sites that occurred at the end of 2015. The first solar site accredited for a Contract for Difference (CfD), the 14 MW Charity solar farm, became operational in late June. Bioenergy contributed 0.3 GW of the increase, with 0.2 GW of new plant biomass schemes and 0.1 GW from AD schemes.

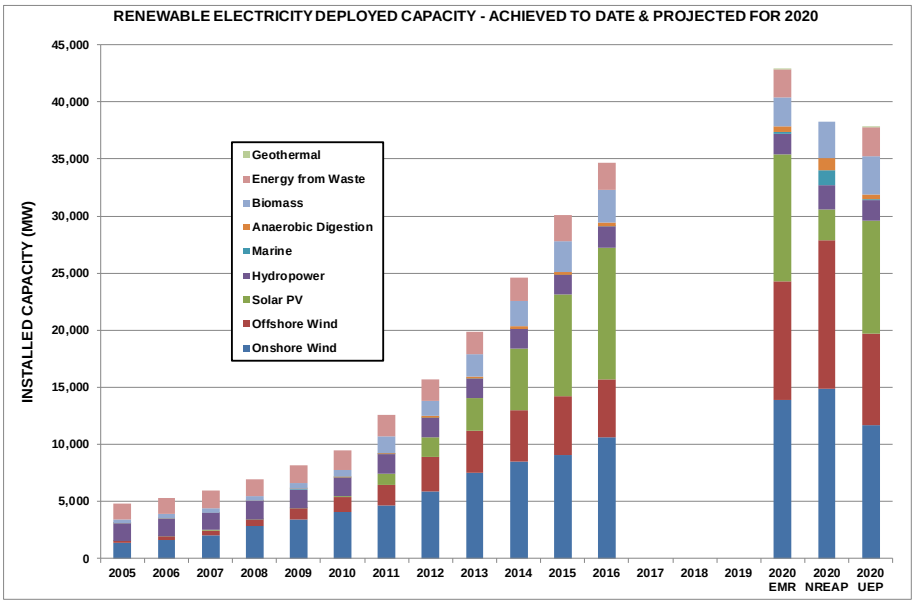
The extra capacity though did not contribute significantly to 2016's output. Offshore wind generation fell by 5.8%, to 16.4 TWh, while onshore wind generation fell by 7.8%, to 21.1 TWh. This was due to much lower wind speeds out-weighing the impacts of new capacity. Average onshore wind speeds in 2016, at 8.0 knots, were 1.0 knot less than in 2015 (which were the highest in the last fifteen years). Hydro generation also fell by 15%, from 2015's record 6.3 TWh, to 5.4 TWh, with lower rainfall levels (in the main hydro areas) in 2016, making it 19% lower than 2015's high levels. Anaerobic digestion was up 31% (445 GWh), due to increased capacity, and biomass generation increased by 1.2% (230 GWh) which was also a result of increased capacity, and despite the closure of Ironbridge station in November 2015. This out-weighed reductions in generation from landfill gas (-5.2%) and biodegradable municipal solid waste (-8.0%).

The most significant generation increase was from solar photovoltaics. It increased by 36%, to a record 10.3 TWh, due to increased capacity.

To summarise for renewable electricity, in 2016, bioenergy represented 36% of renewable generation, while onshore wind had a 26% share, with 20% from offshore wind, 12% from solar photovoltaics, and 6.5% from hydro.

Renewable heat generation grew in 2015. The UK received 5.6% of its heat from renewable sources, against a goal of achieving 12% in 2020. Although only a small portion of the whole heat



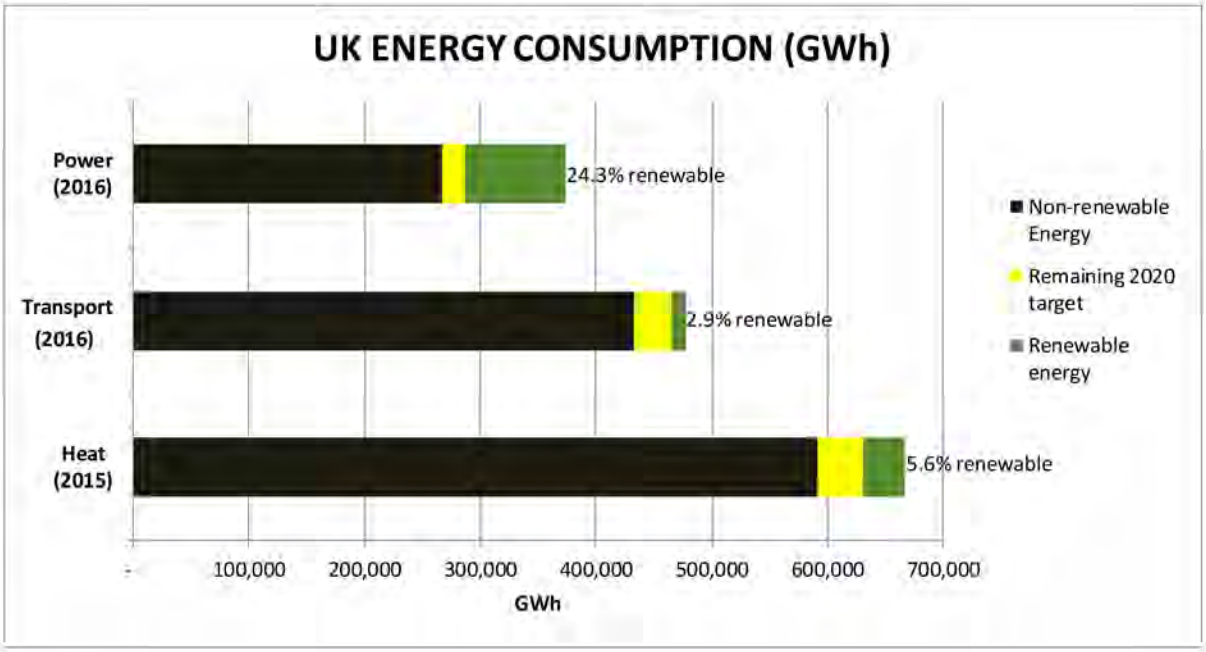


EMPLOYMENT AND TURNOVER SUMMARY FOR RENEWABLE ENERGY SECTORS 2015-2016

Renewable Energy Sub Sectors	Turnover £'millions	Employment Numbers	Company Numbers
Air & Ground Source Heat Pumps	1,249	9,441	473
Anaerobic Digestion	356	2,952	155
Biofuels*	1,500	10,000	608
Biomass Boilers	809	6,353	286
Biomass CHP	382	2,558	156
Biomass Dedicated Power	635	4,377	218
Energy from Waste	930	7,694	392
Hydro	639	5,778	296
Wind Energy	6,152	41,766	1,909
Solar PV	2,037	13,687	1,241
Solar Thermal	1,126	9,637	414
Wave & Tidal	118	723	41
Production of biomass including wood for fuel	1,465	10,935	626
TOTALS	**17,397**	**125,900**	**6,815**

**For 2015/16 the methodology being used for calculating jobs and turnover in the biofuels sector has been amended to reflect the usage in transport fuels, rather than simply looking at unblended uses for the product. Using this revised methodology, for 2015/16 the turnover for the sector is forecast as being £1.5bn, with an estimated 10,000 people working in the sector.*

Executive Summary



generation, the UK's Renewable Heat Incentive has driven renewable energy generation to grow rapidly since its launch. The number of non-domestic installations is 16,661 and is dominated by biomass boilers and biomethane injection to the grid, while the domestic policy has seen 28,555 installations spread more evenly across biomass boilers, heat pumps and solar thermal.

The Government, in late 2015, finally recognised that this Sector, along with energy efficiency, needed serious "attention". Since that time the Government has launched and closed several consultations on heat; resulting in considerable reform of the Renewable Heat Incentive (RHI), minor reform of the Combined Heat and Power (CHP) support; wider upgrading of required domestic heating control and equipment; and the outlining of support for deployment of heat networks. It is unlikely that these strategies and initiatives will bring to bear the significant uptake in renewable heat that is needed if the UK is to meet its ambitions.

The UK renewable transport fuels market continues to be dominated by liquid biofuels, with 50% of supplies coming from bioethanol. The trend towards using waste feedstocks has increased to 59% (from 50% in 2014/15), with all biodiesel (47%) now supplied from waste. A quarter of the UK's renewable fuels are domestically sourced - 17% of bioethanol comes from UK feed wheat and 19% of biodiesel comes from UK sourced waste. Waste-based biofuels earn double rewards under the UK's Renewable Transport Fuel Obligation (RTFO) which means paradoxically that a lower volume of actual biofuel has been supplied at 2.9%, giving an overall 4.3% in accounting terms for 2014/15. Even with this normalisation it is still a step backwards for Renewable Transport as 4.6% was the equivalent in 2013/14. The case for biofuels remains very clear as the greenhouse gas savings from biofuels has now reached 74% compared to fossil fuel sources.

Jobs and market value continue to grow albeit at a slower pace than hoped and still unevenly across the sectors

From data provided by Innovas, almost 126,000 people were employed across the UK renewable energy value chain in 2015/16, a "like-for-like" increase of 2.5% on the previous year. Innovas have stayed as true to their definitions of the sector and have included more completely the supply chain element linked with CHP.

The number of companies working in the Sector has decreased by 5%, largely as a result of the contraction of the solar PV sector, although in 2015/16 it still had the largest number of companies active in any of the sectors we report.

The industry's market value has increased over that time by 3.2% to £17.6 billion. The analysis forecasts this increasing to £22 billion by 2019/20. If employment numbers increase at a similar rate to the possible increase in market value over that time, this would imply an additional 40,000 people employed, bringing new skills, capabilities and opportunities to the UK employment market to rival other energy technologies. These jobs too are distributed in all regions of the UK.

Investment in renewables grew albeit at a lower rate in 2016 than 2015 and significantly more is needed.

In last year's REview, KPMG, referencing Bloomberg New Energy Finance data, reported that in 2015 £15 billion was invested in UK renewables, with a further £30 billion required to 2020. In this report KPMG reports that investment in renewable energy fell in 2016, not just in the UK but globally. This is surprising given levels of deployment internationally but it also reflects the

falling costs of solar and wind across the globe. In the UK investment in offshore wind has continued. Large scale ground mounted solar investment has dried up following the closure of the RO to new projects in 2016. The secondary market though has been buoyant, spurred on by low interest rates and higher inflation as a result of Brexit. Institutional Investors have become more comfortable with both off shore wind and solar as an asset class and this is being reflected in the implied discount rates on the secondary transactions.

In the last year Investors are taking the time to learn what the opportunities for energy storage can be and the price points for the business models linked to a more decentralised energy market model. Ground breaking tenders run by the system operator, National Grid are helping understand the market opportunity but early comments are that contract periods and stacked revenue streams are still proving tricky to embrace by all but the bravest investors in these early days.

Looking forward

This will be the second year since REview was first published in 2014 that we have not provided a growth forecast for the technologies covered in the publication. In the sections from KPMG and REA's analysis of historic and current UK Government policy development, we conclude that there is much work to deliver before we can have more confidence to be able to do so. Internationally it is clear that renewables deployment is forging ahead with the significant reductions in cost of the technologies and advent of smarter technologies. We have seen countries such as China and India leap forward to deliver, or aim to deliver 100's of GW of renewable energy in part to deliver on their commitment as signatories of COP21 but also because it makes sense to embrace decentralised energy solutions that overcome historic energy infrastructure challenges. We are also seeing large international Corporates with a socially responsible vision, take the lead to drive for ambitious renewable targets. They can see the business opportunities that renewable energy gives them and in many cases do not wait for Governments to act.
The UK's referendum in June 2016 has unsurprisingly led to delays to key consultations as well as the plan to deliver the 4th & 5th Carbon Budget (now known as the Green Growth Plan). The Conservative government restructured to create new departments that could deliver on Brexit. The new Department for Business, Energy and Industrial Strategy (BEIS) took some time to reengage with industry and started to introduce a new approach for energy as part of its Industrial Strategy though the issuing of the Green Growth Plan has now been delayed further.
The Department for Transport finally issued its consultation that will hopefully move the Biofuels sector out of its state of flux of the last two years and which will hopefully decide in 2017 whether the sector's potential will be realised.
Providing a forecast with this degree of policy change either enacted or proposed and when the industry is still digesting the implications would be foolish.

With all that is happening it is still possible to say that it is not all bad news for the renewable energy and clean tech sector here in the UK. There are still significant concerns about the viability to deliver a nuclear solution both from a cost point of view as well as in the timescales needed. There remains a lack of investors willing to come forward to fund new large gas generating plant. This is providing opportunities for renewable energy to be deployed at scale. Particularly for technologies such as solar and wind and biomass, their costs continue to fall even here in the UK, so that we are seeing renewable energy being deployed through investor and consumer choice rather than Government policy. Historically neither the government plans made in 2009 to deliver the UK's RED ambitions nor views of the Climate Change Committee when suggesting a plan to deliver the 3rd Carbon Budget had any expectations of the dramatic reduction of costs of solar and wind, nor the extraordinary development in complimentary technologies such as energy storage, spurred on by lower battery costs.
These can seriously challenge to deliver a lower cost secure power system accommodating variable renewable electricity generation and even optimising the efficiency of fossil assets currently deployed. Electric vehicles are also becoming serious contenders to start to transform transport and address not only carbon but also the challenges of air quality. These smarter technologies both in hardware and software terms are truly putting the control of energy in homes and businesses in the hands of the consumer. One of the most important government consultations the "Call for Evidence on a Smart, flexible energy system" finally recognises that we could be at a tipping point on how we generate and use our energy.

Over the coming months we believe a clearer picture will emerge on the both the short term impact on generators' revenues and the longer term plans for the UK's energy, following the election. Brexit and how the UK's energy relationship with Europe will develop and influence the UK's role in energy trading and future emissions trading systems will take longer and possibly through to the end of this decade.
The REA will continue to monitor the situation carefully and will provide updates over the course of the year. It is clear to us that the next two-three years will be some of the most important years for the future of the renewable energy and clean technology economy here in the UK and internationally.

Policy Overview

Renewables Obligation (RO)

The RO was the main driver behind UK renewable electricity growth. Launched in 2002, it was closed for remaining new applicants in April 2017, having previously closed for solar and on-shore wind in April 2016.

Renewables Obligation Certificates (ROCs) were awarded to renewable generators, who then sell them to suppliers. It obliged electricity suppliers to source a proportion of their electricity from renewable sources, with support lasting for 20 years.

When introduced, all renewable electricity received the same level of subsidy, regardless of the technology used. This changed in 2009, when 'banding' was introduced - meaning that support varies depending on the cost of the technology.

Contracts for Difference (CfD)

CfDs are the mechanism replacing the RO - although they are also available for nuclear and carbon capture and storage projects.

Unlike ROCs, CfDs set a figure for the total income for a project - i.e. both the renewables subsidy and the value of the electricity. This total figure is called the 'strike price'. Government takes a market average for the power price, known as the 'reference price'. Rather than being a fixed price, the subsidy paid to the generator is the difference between the strike price and the reference price. In theory, this gives the best of both worlds, as the generator has certainty over total income and the subsidy - and therefore the impact on consumers - is no higher than necessary.

CfDs are split into three 'pots'. Pot 1, established technologies such as solar and onshore wind and Pot 2 for less established technologies, such as offshore wind, marine technology and advanced waste to energy technologies. Pot 3 is for biomass conversion, which has had no budget allocated to it in previous rounds.

BEIS committed to allocating a total of £730m of annual support for three CfD auctions in the life of the 2015 parliament to 2020, with £290m committed to an auction for Pot 2 technologies in the second quarter (Q2) 2017, no funding was allocated to Pot 1 in this round.

BEIS committed to allocating a total of £730m of annual support for three CfD auctions in the life of the 2015 parliament to 2020

Feed-in Tariff (FiT)

The FiT started in April 2010. It supports anaerobic digestion (AD), onshore wind, hydro and solar PV up to 5MW, as well as small scale fossil CHP up to 10,000 units.

The FiT pays a fixed income on all generation with no need to enter into complex commercial negotiations and is comprised of a generation tariff and an export tariff. The generation tariff is paid by energy suppliers at a set rate for each kWh of electricity generated, with the export tariff an additional rate for units exported to the electricity grid. This is deemed at 50%, but this may change with the introduction of smart meters.

The Government introduced significant changes to the FiT scheme at the end of 2015, with significant tariff reductions, strict quarterly deployment caps and changes to the degression triggers.

Renewable Heat Incentive (RHI)

The RHI builds on a similar approach to the FiT, although is available at all scales. Unlike electricity, excess heat generation cannot simply be exported onto a grid, so the policy aims to ensure that only useful heat is supported. It is also funded by general taxation, rather than through consumer bills.

The RHI opened for non-domestic installations in November 2011, initially only for ground source heat pumps, biomass, solar thermal, small-scale biogas and injection of biomethane to the gas grid.

The scheme was opened up to domestic consumers in 2014 and included solar thermal, biomass boilers and air and ground source heat pumps.

The government confirmed significant changes to the RHI in December 2016, which included large cuts in tariff rates for small scale biomass, the introduction of heat demand limits, new degression triggers and the limiting of support for crop-based feedstock in AD.

Renewable Transport Fuel Obligation (RTFO)

The RTFO was introduced in April 2008. It is similar in principle to the RO, in that it obliges fuel suppliers to replace a proportion of their fossil supplies with renewable fuels.

Targets were scaled back in 2009. The Government has yet to set out a trajectory to meeting the binding 2020 transport target contained in the Renewable Energy Directive, having made this conditional on EU-level resolution of controversy over sustainability. Although a resolution was reached in 2015, consequential changes to the RTFO will not be introduced until 2017. The Government launched a consultation on changes to the RTFO, such as the crop cap, and before the 2017 election announcement, were expected to make final decisions in Q2 2017.

Policy and Politics

Industrial Strategy

The words "Industrial Strategy" have now entered the political lexicon in the same way as "Brexit means Brexit", "Long term economic plan", "no more boom and bust", "tough on crime, tough on the causes of crime", "back to basics" and "the lady's not for turning". This conveniently brings us back to the 70's and the last time the UK had an Industrial Strategy.

The May Government, in their pre-election Green Paper, were more than aware of the historic legacy of a UK industrial strategy, conjuring up distant memories of three day weeks and doomed attempts to prop up companies such as British Leyland. They referenced more than once that they are not in the business of 'picking winners', which is a political insult without parallel to a modern Government. Clearly, for the energy industry this does not ring true, where they are not only picking winners, but in the case of solar and onshore wind, blocking winners too.

In the broader economic picture, the needs behind an Industrial Strategy are pressing. The UK faces a historic productivity problem, lagging behind nearly every other major western economy. The "Northern Powerhouse" is another famous political soundbite, and whilst its main champion, George Osborne, is now doing his bit to single-handedly increase the productivity gap, he left behind the basic framework to rebalance the UK's economic geography with a host of new 'Metro-Mayors' elected in May. These new super Mayors will be amongst the loudest wanting to advance regional plans to bring much needed investment and jobs to their areas following the snap General Election in June.

Away from these structural economic problems, the UK faces an even larger challenge in terms of Brexit. It is hard to take any area of government right now that is not being seen through the prism of life after the EU. Whilst the previous government where fixated by inward investment and infrastructure, something that is still required, Brexit now adds the need to drive exporting and trade too. "Balance of Payments" is another political phrase from a bygone age than is set to return, and as a result getting British manufacturing and services geared up to be at a new global trading vanguard is of paramount importance.

In the broader economic picture, the needs behind an Industrial Strategy are pressing.

The Industrial Strategy tries to cover all of these bases, yet without being prescriptive or spelling out exactly what interventions the government would be willing to make. It is clear that 'Regional Deals' will be a main conduit, with areas such as the North East and the West Midlands in particular running for government attention and resource. 'Sectoral Deals' will be the second method, with industries like pharmaceuticals and car manufacturing at the front of the queue in terms of national importance.

Where does this leave REA members and the wider low carbon economy? Well, the Green Paper states that reducing carbon as one of its 'Ten Pillars', along with 'upgrading infrastructure', which is hugely positive. However, the only technologies featured were off-shore wind, nuclear and batteries. This is not altogether surprising considering the policy changes in the past two years, but it does give the industry an opportunity to present itself as the answer to the Government's questions.

The paper urges industry to group together and present a plan to BEIS, and the REA will be working with other trade bodies and organisations to bring together this united vision. It also clear that, for example, the challenges and opportunities of the wood heat industry and onshore wind could not be more different. With the Industrial Strategy looking more at the means rather than the ends, it is hard to put together a holistic 'energy' or even 'renewable' sector plan, so different are the industries. As such, we will be leaning towards building separate 'Bioeconomy' and 'Cleantech' sectors which will cover REA members as well as other associated industries, such as agriculture for bioeconomy and construction and built environment for cleantech.

We live in interesting times, and the accepted norms and political rule books are being ripped up. In the year since Brexit, the REA has been committed to talking up the positives of renewables. The Industrial Strategy gives us the perfect opportunity to do just that, and with politics in such flux we should aim high, be bold and drive for the change our members want to see and that the UK needs to happen.

Policy and Politics

The Olive Branch in Brexit Negotiations

It would be impossible to produce an annual review of any UK industry in 2017 without addressing the aftermath of the June 2016 referendum, which has been at the forefront of the national conversation for nearly a year.

Despite this, and after a number of Government white papers, there remains little definitive clarity about exactly what Brexit will mean for the UK renewables industry. Yet, as we enter into the complex negotiating process, energy and environmental policy should now be promoted as a key issue for fostering goodwill between the negotiating parties. Loosely speaking, what is best for the UK in terms of energy policy is also best for the EU. The more in sync the UK and European energy systems are the better both sides chances of achieving decarbonisation, keeping prices low and ensuring security of supply. Much will now depend on how a newly elected UK Government and the EU come to the negotiating table; whether political point scoring takes precedent over agreeing mutually beneficial arrangements.

Given the Government is not currently seeking membership of the single market or the customs union; it now seems unlikely that the UK will remain members of the Internal Energy Market (IEM). This has taken years to develop through a number of EU Directive packages, the latest of which was released at the end of 2016 and will be coming into force just as the UK are supposed to depart the union in 2019. The IEM, which the UK has played a leading role in developing, allows for more efficient cross-border energy trading by developing standardised network code regulations, trading arrangements and climate obligations. It is projected that the further delivery of the IEM will provide €2.5-4bn annual benefits to European electricity customers. The loss of the UK within the IEM could undermine much of this positive work, both within our own domestic market and within the pan-European system. As such, while full membership of the IEM may be off the table, and our influence within EU energy bodies like ACER will be diminished, it is our existing interconnectors, historical involvement and thought leadership that provides the incentives for the development of a mutually advantageous agreement.

> It now seems unlikely that the UK will remain members of the Internal Energy Market (IEM)

Tied to our energy system integration is also our obligations and commitments to decarbonisation. The UK's Climate Change Act has increasingly taken prominence over the targets set out in the EU's Renewable Energy Directive, a situation now further accentuated by Brexit - although it remains possible that the EU could seek infraction proceedings given the UK's limited progress on transport. This reflects that it remains in the Government's interest to maintain a strong decarbonisation agenda. For one, our Carbon Budgets remain legally binding in UK law and we are signatories to the COP 21 Paris Agreement. In addition, being seen to u-turn on existing commitments would damage the UK's image as a global leader on climate, as well as possibly undermining investor interest in growing UK markets in innovative renewable technologies, such as energy storage and electric vehicles, which will be a valuable export opportunity in the future.

A further area for common ground is the EU Emission Trading Scheme (EU ETS). Clarity about the nature of the UK's future involvement in the trading scheme is essential for hundreds of UK factories, power plants and heavy industries that currently operate within the trading scheme. Timing is a significant issue, as things stand; the UK could leave the EU in 2019 while Phase Three of the current EU ETS runs to 2020. If the UK leaves before the end of this phase the scheme could well be destabilised as member state obligations would need to be reconsidered and UK firms could potentially further flood the saturated market by offloading their allowances. For the UK, there is the additional issue that our ability to account for our own carbon emissions, and therefore meet

our legally binding Carbon Budgets, is currently predicated on our obligations under the EU ETS. As such, a sudden withdrawal would mean a very complicated separation that would undermine the market in Europe and see the UK having to make accounting adjustments that will increase the cost of decarbonisation.

While it is impossible to ignore the poor performance of the EU ETS to date, it is still widely recognised that an operational pan-European carbon price is the most cost effective way of decarbonising - and the UK has been a key driver in pushing through the reforms that could see this delivered in the early 2020s through Phase Four. There is evidently more to be gained by both parties working together on the EU ETS, than for the UK to be jumping ship. Indeed, it is assumed that, if a transitional arrangement is on the table, the EU will require the UK's involvement in the trading scheme up-to 2020; a requirement we would be wise to participate in.

The good news is that early signs suggest the UK Government is not aiming to rock the boat on energy or environmental policy during negotiations. The Government's Brexit White Paper, released in February, did stress the importance of maintaining coordinated trading arrangements on energy. Equally, within the Great Repeal Bill White Paper, released in March, they confirmed that

Good news is that early signs suggest the UK Government is not aiming to rock the boat on energy

in copying existing EU laws into UK legislation at the moment of departure, they will not be making any changes to policy beyond what is necessary to ensure the law in functional from day one. They even make a particular example of environmental law where they commit to ensuring the 'whole body of existing EU environment law continues to have effect in UK law'.

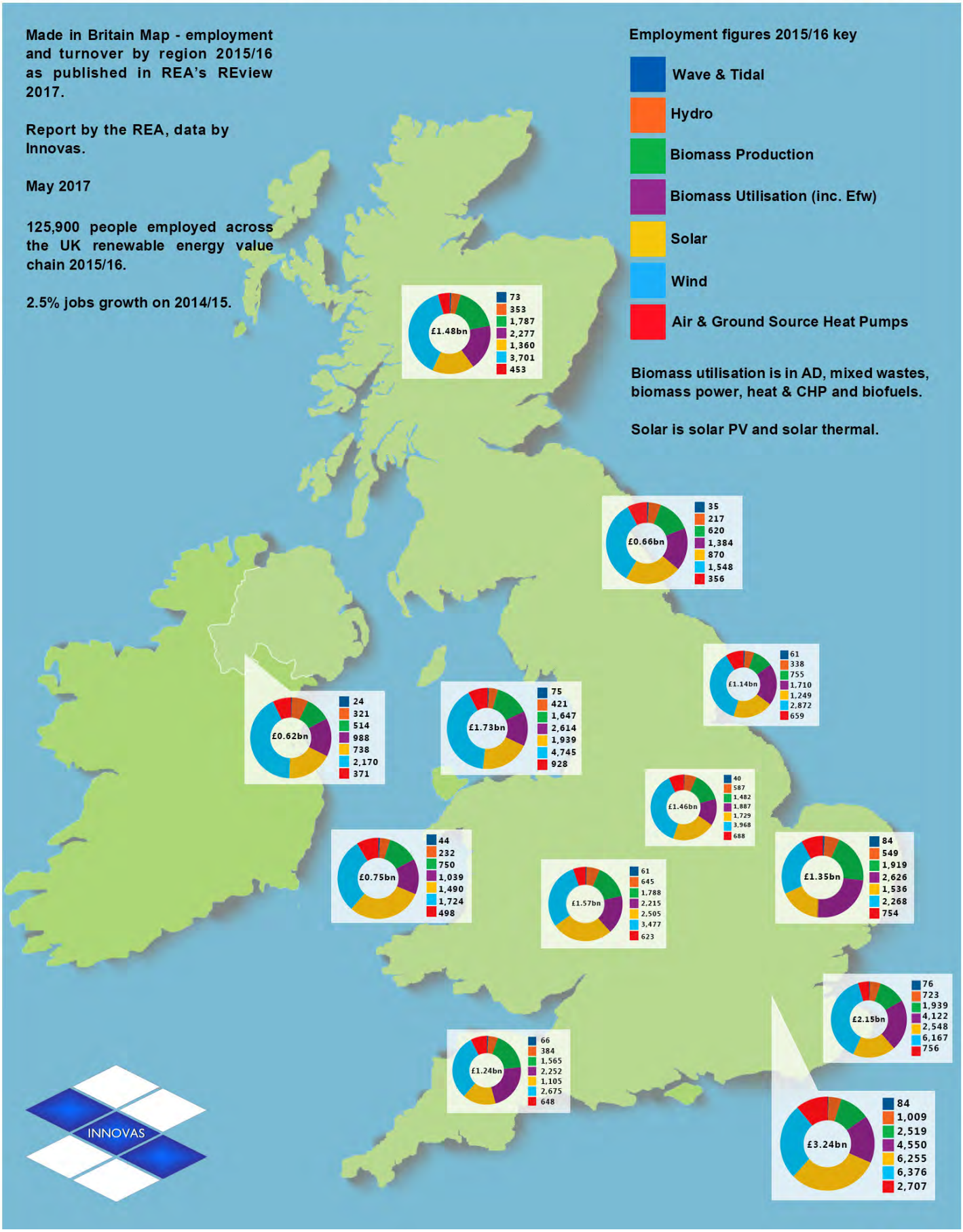
There is much to be ironed out in order to understand how this transfer will actually take place. This includes understanding exactly what UK institutions will replace EU enforcement bodies and ensure that the use of secondary legislation, which requires little parliamentary scrutiny, is not used by ministers to water down policy objectives. However, it looks like maintaining stability in EU policy is currently a primary objective during the UK's departure and, as such, should not be an area of contention during negotiations.

Despite the clear benefits of a collaborative approach, macro-level political issues on either side of the negotiation could be the fly in the ointment. The UK has set out clear red lines on immigration and sovereignty. The current demand to be free of all jurisdiction of the European Court of Justice could well be a sticking point when it comes to our continued involvement in the EU ETS and Internal Energy Market, even if there are clear advantages to remaining as closely aligned as possible. Equally from the EU side, they could fear the UK advancing domestic policy in order to help undercut rivals on the continent, and can be expected to prescribe strict standards as part of any possible future EU-UK trade deal. The difficulty, therefore, will be squaring the circle and, as with any negotiations, this will require compromise on both sides. As demonstrated, it would appear that energy and the environment is one issue where both sides should find beneficial agreement and in doing so, should foster goodwill between the parties to help achieve a broader advantageous EU-UK deal.

Renewable Energy
MADE IN BRITAIN

Employment and turnover by region and technology 2015/16

RENEWABLE ENERGY ASSOCIATION



Green Gas Certification Scheme

Biomethane to Grid Sector Continues to Grow

The UK biomethane market exceeded expectations in 2016 with 40 more plants completed and the energy sector starting to pay increasing attention.

Over the past year the REA has reported that the UK was in fact the fastest growing biomethane to grid sector in the world.[1]

There is now widespread recognition that injecting renewable gas into the grid enables biomethane producers, suppliers and consumers to utilise the UK's established gas infrastructure to help support decarbonisation goals, at lower cost than alternatives such as moving towards fully-electrified heating and transport systems.[2,3]

At the end of 2016 the Government confirmed its support for the sector in its Renewable Heat Incentive (RHI) consultation response, resetting the biomethane tariffs back to a higher rate to encourage further development. The industry expects this move will support the connection of up to 100 plants over the next four years.

The Government also announced changes which will require adaption, such as the 50% "crop cap" limit for new plants.[4] However, with companies such as ReFood, who are now expanding their food waste fed plant at Widnes while developing a new site in Dagenham, and Clearfleau, who are developing dairy and distillery waste fed plants, the sector is showing that with the right planning, this will not stand in the way of growth.

Furthermore, while England awaits policy developments that will encourage more extensive food waste collection, Wales and Scotland continue to make progress, providing more potential feedstock for biomethane plants in those regions.

Demand

As supply of biomethane is increasing

so has demand from suppliers and customers with several developments during the year boosting the sector. In addition, the increasingly prominent debate around air quality has raised the potential for biomethane to offer a low carbon-low emissions transport solution. Operators in Nottingham, Merseyside and Reading have all won funding from the Office for Low Emission Vehicles (OLEV) to support the purchase of biomethane powered buses, while Waitrose, John Lewis and Argos started running fleets of biomethane fuelled HGVs out of Compressed National Gas (CNG) filling stations in Crewe (Cheshire) and Leyland (Lancashire).

There is increasing interest in how biomethane producers can use Green Gas Certificates to evidence a mass balance approach to fuelling vehicles with biomethane and expand their involvement in the Renewable Transport Fuel Obligation (RTFO). The sector is awaiting the Government's RTFO consultation response on whether there will be a development fuel sub target for biomethane. If there is, it will only drive further demand.

In the domestic energy sector four suppliers are now providing more than 50,000 households with biomethane tracked through the Renewable Energy Assurance Limited (REAL) Green Gas Certification Scheme (GGCS).

In the large corporate sector GGCS has been working closely with standard bodies, such as the WRI and the CDP, to show how Green Gas Certificates can be used to demonstrate CO_2 reductions as part of corporate GHG reduction strategies. As a result of this, companies such as Sainsbury, Kingspan, Land Securities and Unilever are now using biomethane to meet their ambitious emissions reduction targets, with more expected to follow.

[1] http://www.r-e-a.net/blog/growing-the-uks-green-gas-sector-01-08-2016

[2] https://www.energynetworks.org/assets/files/gas/futures/KPMG%20Future%20of%20Gas%20Main%20report%20plus%20appendices%20FINAL.pdf

[3] https://policyexchange.org.uk/publication/too-hot-to-handle/

[4] https://www.gov.uk/government/consultations/the-renewable-heat-incentive-a-reformed-and-refocused-scheme

www.greengas.org.uk

Anaerobic Digestion (AD) (Biogas)

(Power, Transport, Biomethane Injection and CHP)

Development of AD in the UK has come a long way in recent years, with over 540 plants now operational. 82 of these inject biomethane into the gas grid, and the remainder are CHP plant with a total electrical capacity of almost 400 MWe. The prospects for continued growth in power generation from AD are limited, as the Feed-in Tariff is capped at 5MW per quarter. Due to the way the queuing system works, very little of this 5MW/quarter is likely to materialise. The Renewables Obligation is now closed to new entrants and, as most AD plants are well below 5MW in size, CfDs are not an option. An exception to this picture is biomethane injection, which is more buoyant. The tariffs under the Renewable Heat Incentive are due to be increased, probably by August 2017, and there is growing interest in using biomethane in transport. The concept of green gas is also gaining increased traction among domestic and corporate consumers. Last September the GHG Protocol recognised that Green Gas Certificates, issued by the REAL's[1] Green Gas Certification Scheme, can support a business's reporting of onsite GHG emissions.

Biomethane is widely recognised as being a key means of decarbonising heat, particularly in areas where this is otherwise hard to achieve, such as densely populated areas. It's role in transport goes beyond carbon reduction, as it brings additional benefits, in terms of cleaner vehicle tailpipe emissions. Given the crisis in urban air quality this is clearly advantageous.

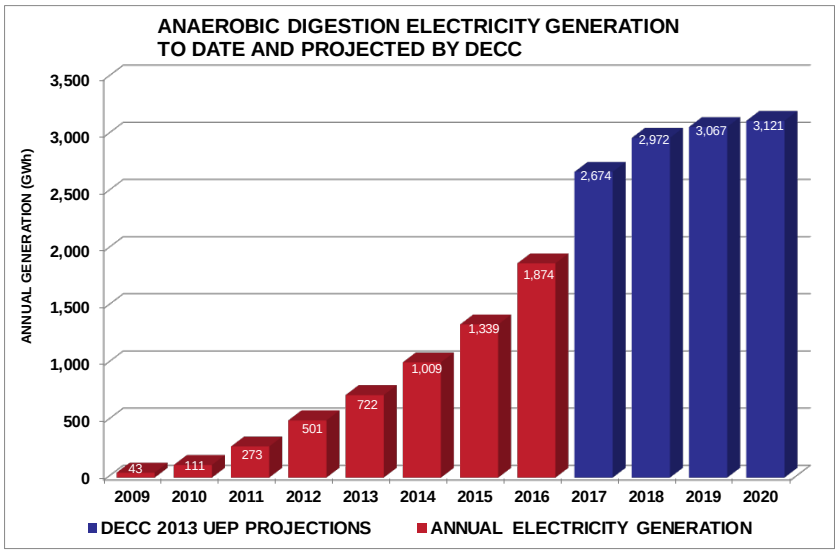
ANAEROBIC DIGESTION CONTEXT

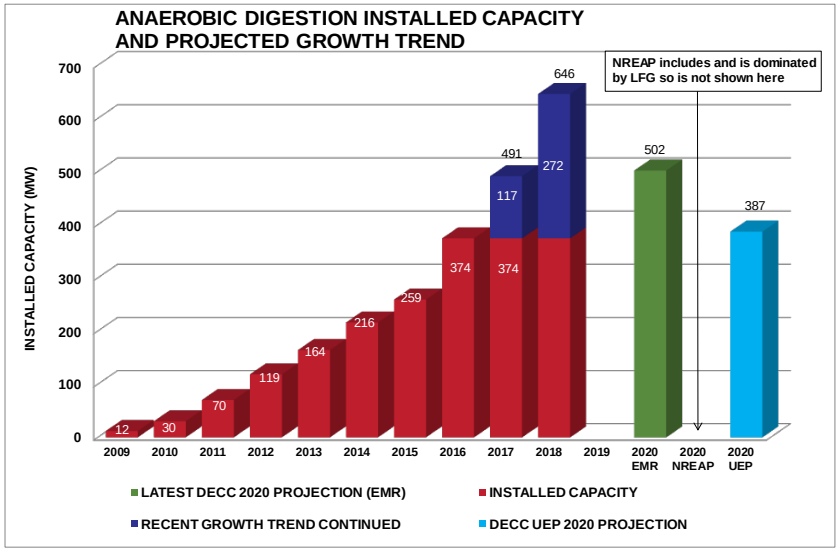
- Unique in that eligible for all the financial incentives for power, heat and transport fuel.
- Biogas can also be cleaned up and injected into the gas grid as 'biomethane'. Green Gas Certification Scheme tracks sales of the gas to support green claims by end users.
- Implementation of RHI reform (under consultation at the time of writing) may see restrictions on the use of energy crops for anaerobic digestion.
- Can use food waste, animal manures and slurries, residues from food processing and agriculture and crops.
- Feed-in Tariff is seeing dramatic reductions in support, particularly hurting smaller-scale developers.
- Solid and liquid outputs ('digestate') can replace mineral fertiliser, providing nutrients and improving soil fertility. Biofertiliser Certification Scheme certifies digestate so farmers can be confident in quality and safety.

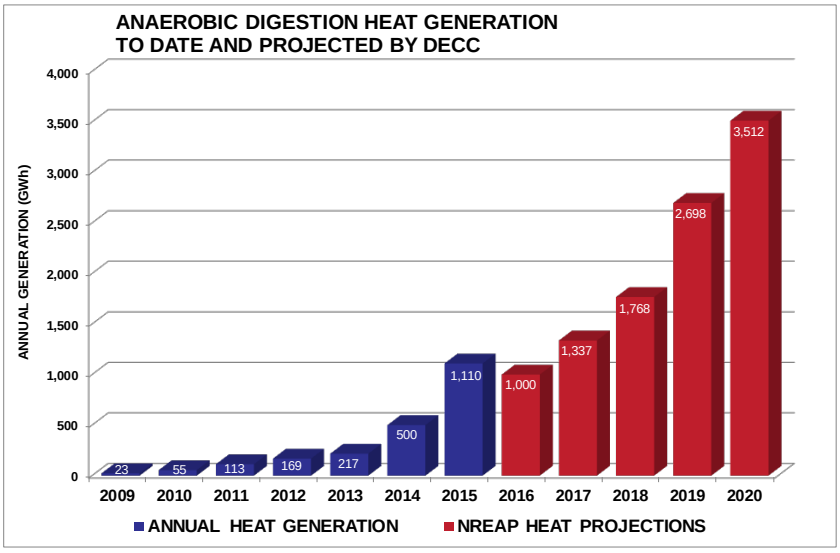
REA CONTACT

Jeremy Jacobs, Technical Director

Gaynor Hartnell, Senior Advisor







JOBS IN ANAEROBIC DIGESTION

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.

[1] REAL (Renewable Energy Assurance Limited a subsidiary of the REA)

SIZE OF THE UK ANAEROBIC DIGESTION SECTOR

	2011-2012	2012-2013	2013-2014	2014-2015	2015-2016
Sector Turnover (£'millions)	340	358	340	347	356
No. of people employed across UK supply chain	2,650	2,635	2,828	2,865	2,952
No. of UK companies across supply chain	140	141	148	148	155

Liquid Biofuels

(Transport)

The UK renewable transport fuels market continues to be dominated by liquid biofuels, with 50% of supplies coming from bioethanol. The trend towards using waste feedstocks has increased to 59% (from 50% in 2014/15), with all biodiesel (47%) now supplied from waste. A quarter of the UK's renewable fuels are domestically sourced - 17% of bioethanol comes from UK feed wheat and 19% of biodiesel comes from UK sourced waste. Waste-based biofuels earn double rewards under the UK's Renewable Transport Fuel Obligation (RTFO) which means paradoxically that a lower volume of actual biofuel has been supplied - an overall 2.9% in 2015 as against 3.4% in 2014. Greenhouse gas savings from biofuels has now reached 74% against fossil fuel.

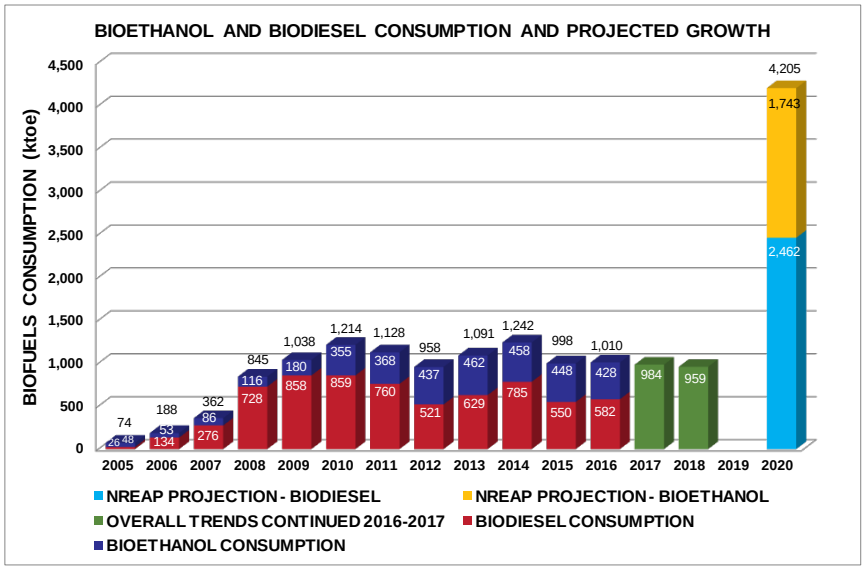
Following the final European agreement in 2015 on Indirect Land Use Change, and the recommendations of the DfT's specially convened Task Force on Transport Energy, DfT published their long-awaited Consultation on amending the RTFO at the end of 2016. The Government response will be published later in 2017, paving the way for UK biofuels policy to be set to 2020 and out to 2030. The final details of the new legislation will be critical for the future of UK biofuels production, particularly for bioethanol and for the potential to increase the use of biodiesel and biomethane for use in heavy goods vehicles.

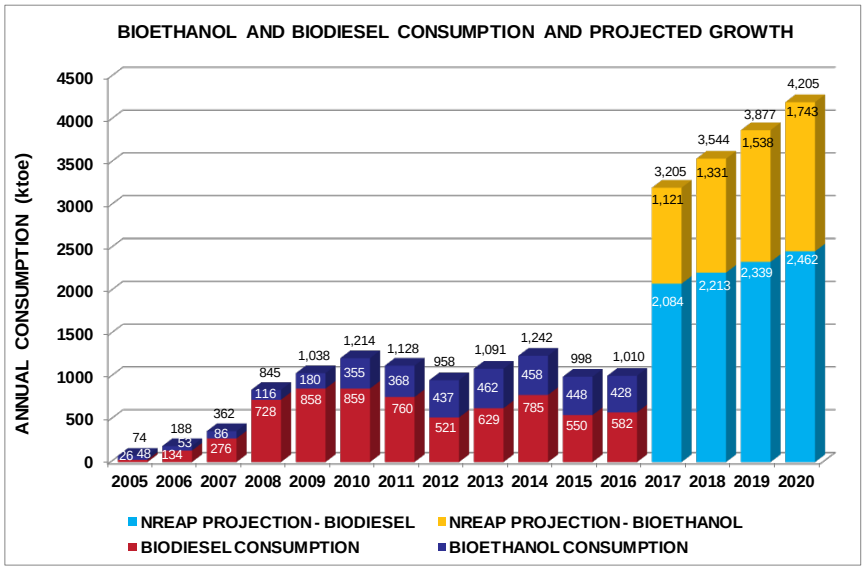
Of great importance will be the overall biofuels target to meet the UK's Climate Change Act ambitions, the volume of crops that will be permitted in UK biofuels and the biofuels feedstock candidates for a new sub-target specifically for development fuels considered to be of strategic importance to the UK. As we approach the negotiations for the UK's departure from the European Union, fostering our own domestic biofuels industries will become increasingly important as part of the UK's industrial strategy.

LIQUID BIOFUELS CONTEXT

- Renewable Energy Directive imposes sector-specific requirement for 10% of energy used in land transport to be renewable by 2020.
- Although the indirect land use change issue was resolved in 2015, UK has not set out how it will meet target. The Indirect Land Use Change Directive, which includes increased support for advanced biofuels and electrification of road and rail transport, has to be implemented in 2017.
- UK-produced fuels have excellent sustainability record, significantly exceeding expectations in environmental protection and greenhouse gas savings. Average GHG saving of fuels supplied was 70%.
- Biofuels are traded globally, unlike power and heat which can only be transported shorter distances. Consumption in UK is therefore no guarantee of economic benefits to UK. These will only occur if there is confidence in UK market and policy supporting this.
- UK Government currently consulting on the Renewable Transport Fuel Obligation, the key issue being, the raising of the crop cap, currently 2% but EU maximum allows for 7%, which would allow greater use of biofuels.

The new RTFO and parallel regulations on the greenhouse gas emissions permitted from all fuels used in transport, fossil as well as renewable, should be in place by the end of 2017.





JOBS IN LIQUID 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.

REA CONTACT

Clare Wenner, Head of Transport Fuels

Lauren Snoxell, Executive Assistant

SIZE OF THE UK LIQUID BIOFUELS SECTOR

	2011-2012	2012-2013	2013-2014	2014-2015	2015-2016
Sector Turnover (£'millions)	340	358	340	347	1,500
No. of people employed across UK supply chain	3,500	3,509	3,829	3,914	10,000
No. of UK companies across supply chain	200	200	211	211	608

Need to turn up the Renewable Heat

Before securing the RHI budget and subsequently leaving DECC / BEIS, Amber Rudd revealed in a leaked letter that the UK is far behind on its ambition to decarbonise its heat supply.

In 2015 the UK only received 5.6% of its heat from renewable sources (with an estimate of 6.2% in 2016), compared to a goal of achieving 12% in 2020, and the Committee on Climate Change state that the heat supply has to be almost completely decarbonised by 2050 to meet our carbon reduction targets. So far, at least 70% of our heat is fossil fuel based (the remainder is from electricity which itself is mostly derived from fossil fuels), so there is quite a long way to go.

Since the leaked letter, several reports have been published on heat from various think tanks, industry bodies, and consultancies, each detailing their particular silver bullet. The Government has launched and closed several consultations on heat; resulting in considerable reform of the Renewable Heat Incentive (RHI); minor reform of the Combined Heat & Power (CHP) support; wider upgrading of required domestic heating control and equipment; and outlining support for deployment of heat networks.

It is worth understanding the size of challenge: Of all energy we use in the UK, for driving our cars, powering our lights and computers, heating our homes, propelling our industrial processes, shipping goods, just under half is in the form of heat. Heat demand is an order of magnitude greater than electricity demand, and the short-interval and seasonal variations are much greater. Peak demand for heat is roughly six times higher than peak demand for electricity.

The RHI has incentivised 57,848 installations in homes, 17,616 installations in schools, farms, hospitals, and blocks of flats, and over 14,6TWh of generated heat.

It is furthermore estimated that a third of all carbon emissions are related to heating. It is, therefore, clear that the heat challenge is that much greater than decarbonising the power supply.

It is, consequently, both prudent and necessary to accelerate this transition now rather than delay. We need to change the heating of our homes by stopping using fossil fuels such as oil, LPG, natural gas, and coal, and instead use wood pellets, biogas, heat pumps, solar thermal, geothermal sources, and miscanthus.

The Renewable Heat Incentive was the first major scheme in the UK to crank up low-carbon heating, and it has now been running since 2011. Despite some faults, it has incentivised 57,848 installations in homes, 17,616 installations in schools, farms, hospitals, and blocks of flats, and over 14,6TWh of generated heat. This is a fantastic achievement for the scheme and the industry. However, it fails in comparison with how much is needed, as stated earlier. This is a great first step, but a marathon still needs running.

The Department for Business, Energy, and Industrial Strategy (BEIS) consulted on reforming the RHI in 2016 and is implementing the changes in 2017. For biogas and biomethane, this means tariffs being increased back to previous levels and limitations on the use of energy crops. In combination with tariff guarantees that will protect projects from tariffs degressing before they can commission, the new support levels should encourage the steady deployment of new biomethane plants that will inject green gas into the UK's gas grid.

The support for domestic heat pumps will be increased in line with the Department's desire to further increase the deployment of air- and ground-source heat pumps (GSHP) compared to other renewable technologies. This is likely to boost air-source heat pump installations, which receive the largest tariff increase, but unlikely to have the same effect for GSHPs, which received a minor tariff increase and have been constrained by a heat demand limit which caps maximum payments for any households. This is unfortunate as GSHPs work particularly well in larger properties with higher heat needs.

The domestic biomass tariff has been increased slightly; however, there is a lack of a level playing field between the renewable heat technologies in the domestic scheme, as the rate of return differs from 7.5% for biomass compared to 12.5% for air-source heat pumps. This reflects the Government having 'picked winners', as there is a clear preference for heat pumps and biogas over the use of biomass in the RHI. This is also reflected in the reduction in the non-domestic support for biomass heat, where the tariffs for systems below 1MW were reduced drastically to refocus the overall scheme towards biogas and heat pumps and only foster deployment of large biomass systems. This will have a large impact on the industry which has spent the last few years investing in the supply chain and skills. Although there is a potential for large biomass deployment, time will tell whether it will be at the scale the Department anticipates.

Before 2020, BEIS will need to assess their scheme reform to ensure that they are meeting their targets for the RHI. There are concerns that they have been over optimistic on deployment of heat pumps in retrofitted properties and of large biomass in industrial processes. The Government must be flexible enough to reconsider whether it was sensible to reduce the support to one of the most cost-effective and popular technologies: medium- and small-scale biomass heat.

The rate of return differs from 7.5% for biomass compared to 12.5% for air-source heat pumps. This reflects the Government having 'picked winners',

Looking beyond the RHI and 2020, the deployment of renewable heat needs to be turned up. The importance of completing the transition is immense, and as heat has often been overlooked in the debate on decarbonising the energy system, we are much further behind than on electricity. The two previous administrations signalled their intention to end subsidies for renewable heat after 2020, but in the REA's view this would be a mistake if not replaced with another form of support. There have been a myriad of reports published in the past year on decarbonising heat and it is clear that no single policy is sufficient in itself to deliver the transition to low carbon heating. Ideally we'd like to see the continuation of a Feed-in Tariff mechanism for renewable heat, but in combination with other policies such as stamp duty and property tax rebates, building standards, a carbon tax for heat, the phasing out of oil boilers, and achieving a minimum energy efficiency rating prior to the sale of properties. These would stimulate the uptake of low-carbon heating in homes, but would not address larger-scale projects. An RHI-type mechanism would still be needed for the latter and it is hard to envisage an improvement on the RHI, particularly for biomethane injection. It is a fallacy of the recent heat reports that one policy can drive the change, when the challenge is so much bigger than decarbonising the grid. All of the above are likely to be needed in order to truly ignite the flame of renewable heat from a small glimmer to a blaze of a transition.

Biomass Boilers & Wood Stoves

(Heat)

The biomass heating industry was a niche market prior to the Renewable Heat Incentive. The sector has since experienced a boom and bust growth cycle, caused by the RHI degressions.

The 200kW-1MW market was growing after the sub-200kW market collapsed, but is expected to reduce significantly following Government reform. Some growth is expected in the +1MW market.

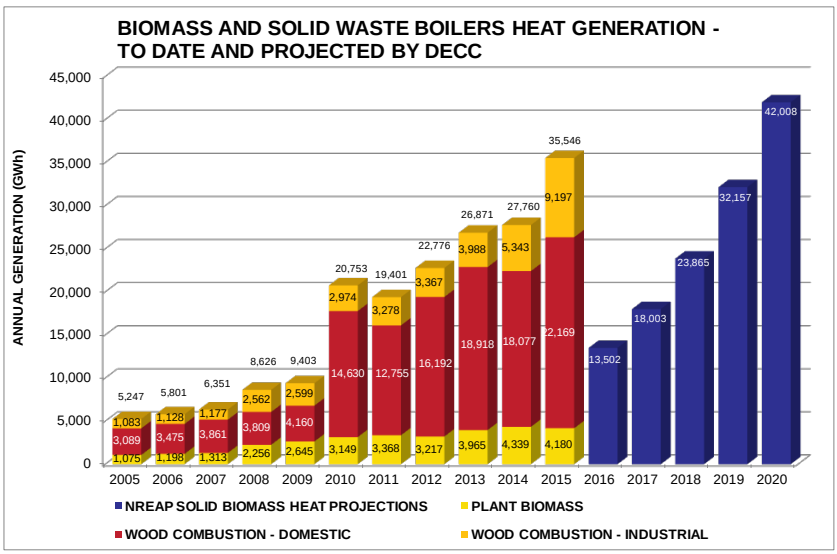
Biomass heat systems are already highly cost effective, with further cost reductions possible as the UK supply chain matures, but unlikely without renewed policy support.

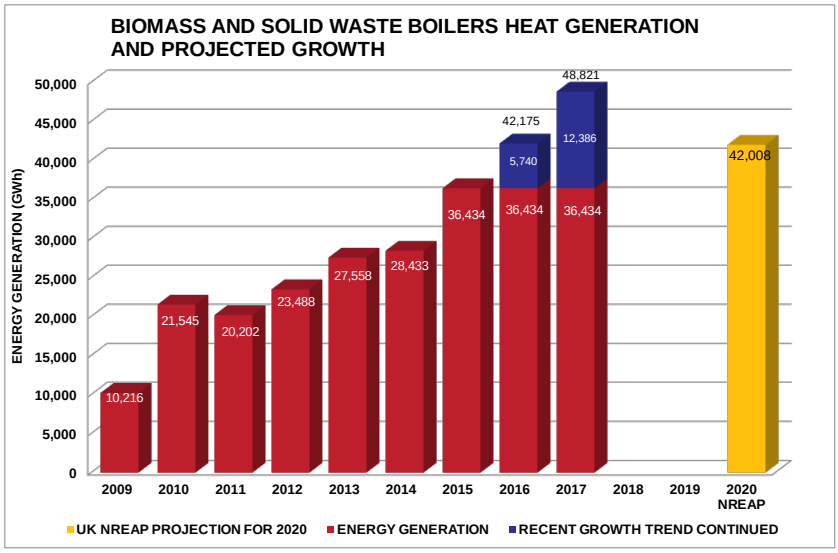
BIOMASS BOILERS CONTEXT

- RHI reforms severely cut levels tariff levels, even though it remains the most cost effective heat technology.
- Wood stoves already popular without subsidy, particularly off gas grid.
- Previously very strong take up in Renewable Heat Incentive, particularly in the sub 200kWth market and domestic market, but aggressive degression has halted market.
- Sustainability criteria introduced October 2015 and life-cycle analysis of fuels show over 87% GHG saving compared to 60% Government requirement.

REA CONTACT

Frank Aaskov, Policy Analyst





JOBS IN BIOMASS 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.

GROWING AND PRODUCTION

Farmer; Forester; Wood recycler; Wood chipper operative; Drivers; Mechanical engineer; Plant operator; Agricultural specialist; Biologist; Chemist; Microbiologist.

SIZE OF THE UK BIOMASS BOILER SECTOR

	2011-2012	2012-2013	2013-2014	2014-2015	2015-2016
Sector Turnover (£'millions)	540	600	684	735	809
No. of people employed across UK supply chain	4,530	4,510	5,379	5,650	6,353
No. of UK companies across supply chain	210	210	244	246	286

Biomass Sustainability

Biomass is delivering the goods - but it needs more support

On 21st April 2017, the UK went a day without using coal for electricity for the first time since the industrial revolution.

There were a range of policies and a host of technologies that made this possible. But for biomass power, the milestone is a particularly proud occasion. Few other technologies can claim to displace coal so directly. Few can claim to have made such a practical contribution to the removal of coal.

It is the conversion of power stations like Drax and Lynemouth that makes it possible to slash demand for coal without worrying about a reduction in generating capacity. Such powerhouses are needed for a stable economy. Converting them to biomass maintains their function while dropping their emission by up to 90%.

In biomass, we have a technology that can be transported long distances. It can be stored when not needed, or mobilised when demand is high. It is scalable, used in small household boilers, farms and industrial facilities, medium-sized plant on the distribution networks, or major generators that supply multiply cities at once. It can be drawn from a range of sources: wood, miscanthus, straw, even agricultural waste such as olive pits or nut shells. Eco2, an REA member, sources unwanted straw from local farms and uses any extra heat generated to warm sports facilities and council buildings in nearby villages.

This flexibility means biomass doesn't just replace coal in short-to-medium-term conversion projects, but it offers a long-term reliable back-up to variable energy sources. It is the perfect complement to its low-carbon cousins. This is not just true in terms of supply and demand over time, but also geographically. The UK is moving to more distributed sources of energy, taking advantage of its varied topography. Yet there are places where wind or solar will always be less available. Placing biomass facilities in these locations lowers the cost of transmitting energy across the country, which means lower energy bills.

Geographical flexibility isn't just a way to cut transmission costs. It also means boosting jobs across the country, a central plank in the Government's industrial strategy. The conversion of Drax to biomass saved over 900 jobs. Thousands more are supported in the North East through its supply chain. International supply to UK biomass power stations has led to massive investment in our ports and freight infrastructure – a huge boost to our post-Brexit trade capacity.

In the same week as that coal-free Friday in April 2017, the UK Government launched the world's first research programme into Negative Emissions Technologies (NETs).

In the same week as that coal-free Friday in April 2017, the UK Government launched the world's first research programme into Negative Emissions Technologies (NETs). The £8.6million programme looks at the potential and feasibility of removing carbon from the atmosphere at scale. If we are to meet the Paris Agreement's hope of staying well below a 2˚C rise in global temperature, we need to learn how to remove carbon from the atmosphere at an enormous scale. It isn't enough just to emit less - we need to capture atmospheric carbon and lock it away. Doing so means mobilising the forestry sector and the industries it supplies, which reinvest in sustainable forest management and net forest growth. Bioenergy is one such industry; investments and research in biomass now will make the deployment of NETs

far easier in the future.

This role in supporting forests is key to sustainable biomass. The UK has led the world in developing its Sustainability Criteria, which regulate the entire supply chain to ensure lower emissions, avoid land use change and support local protection for ecosystems and communities. These regulations are backing up an economic model that values asset growth. That is, the owners of forests are incentivised to maintain and grow their forests. They supply high-value wood to the construction industry, lower-value wood to the furniture industry and so on down the chain. What's left goes to biomass, creating another revenue stream for the forest owners. This system isn't just defending against deforestation; it has seen massive forest growth in the USA. In the Southeast USA, where the UK sources a large volume of its feedstock, forest inventories have nearly doubled since the 1950s. Around 2-3% of the forest inventory is harvested each year to supply various industries. Pellet exports, mostly to the UK, account for less than 0.1% of forest inventory. Net growth after all these removals is around 0.7% per year. But only if we invest in sustainable forest management.

The Sustainability Criteria also require a minimum 70% cut in emissions compared to the EU fossil fuel grid average. Replacing coal can mean a like-for-like cut of up to 90%. This is only possible because the stack emissions of a biomass power station are absorbed by the continuous growth in a forest. That net 0.7% mentioned above means that there is no need to wait for trees to regrow - the forest as a whole absorbs emissions almost immediately.

The Sustainability Criteria also require a minimum 70% cut in emissions compared to the EU fossil fuel grid average. But replacing coal can mean a like-for-like cut of up to 90%.

Biomass is a complicated sector and scrutiny is intense, which has led some to draw the wrong conclusions. A wide community of academics from leading institutions around the world have put their backing behind biomass. Extensive and repeated studies (including for the UK Government) have found that, done properly, biomass is a highly effective way to cut carbon emissions.

If we want to see more days without coal, we need to support biomass further. Recognition of its value to the world's forests is key to this. So is understanding the contribution biomass makes to managing a low-carbon energy system. Transparency of the wider energy framework will also be essential - a carbon price trajectory, a timetable for CfD auctions.

To date, the UK has led the world in its development of the international biomass market. We should not let this emerging market run ahead without us. Demand in places like Japan is drawing the market's focus to the East, but we have great expertise and infrastructure here in the UK. We should make the most of it and continue our leadership towards a coal-free world.

Biomass Power

(Power)

Biomass power usually involves a small number of relatively large projects, so projecting future deployment from historic patterns is less meaningful.

Significant expansion beyond conversion of existing coal powered stations is unlikely in the current policy environment. With no confirmed budget, this is a significant missed opportunity for 2020 targets and longer-term carbon reductions as it is highly cost-effective.

Given high load factors for bioenergy technologies, the actual generation is far higher than for an equivalent amount of installed capacity from wind or solar PV.

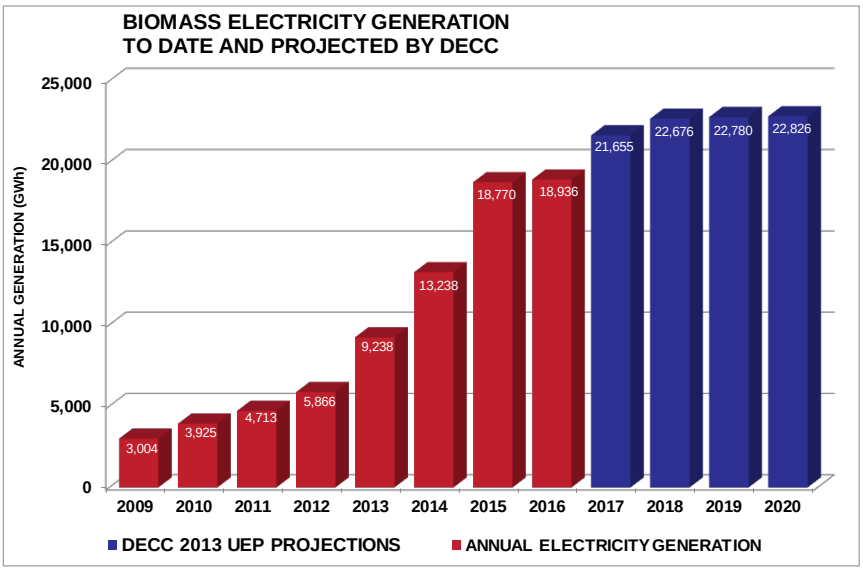
BIOMASS POWER CONTEXT

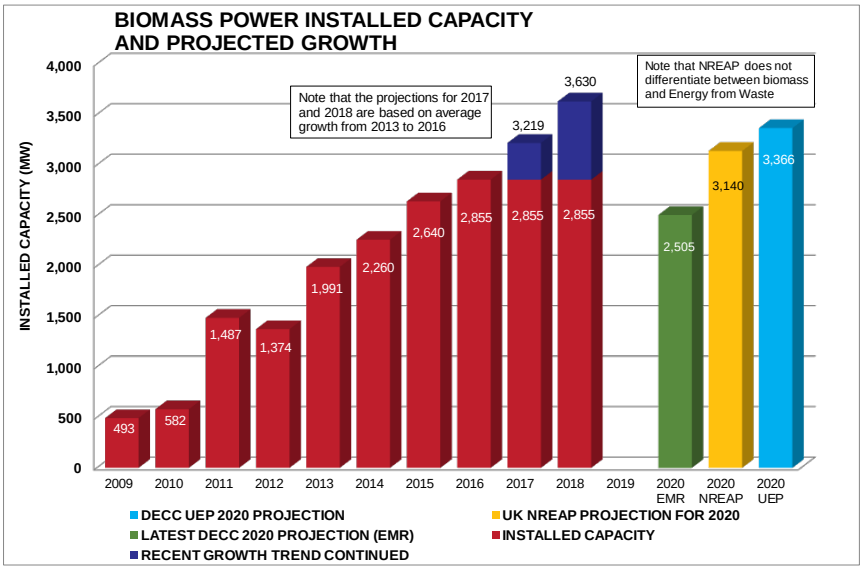
- Sustainability regulations introduced in October 2015 provide mandatory independent assurance to the public.
- Cost-effective compared to other options. Like other bioenergy technologies, provides power that can be delivered when needed - complementing technologies such as wind and solar.
- Coal conversions not currently funded by CfD pot 3. Government not supporting stand-alone new projects with deployment capped in the Renewables Obligation and not included at all in Contracts for Difference. Deployment likely to be far below potential in medium term.
- Wide range of applications from small scale to conversions of existing coal-fired power stations.

REA CONTACT

Benedict McAleenan, Head of Biomass UK

Frank Aaskov, Policy Analyst





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.

SIZE OF THE UK BIOMASS POWER SECTOR

	2011-2012	2012-2013	2013-2014	2014-2015	2015-2016
Sector Turnover (£'millions)	450	498	546	586	635
No. of people employed across UK supply chain	3,330	3,320	3,830	3,999	4,377
No. of UK companies across supply chain	170	166	187	189	218

Biomass CHP

(Heat & Power)

For full explanation of terms, methodology and growth projections see pages 68-70

Combined heat and power (CHP) projects have generally been seen as electricity-led. They are therefore sensitive to the policy environment on power-only projects and tend to be more challenging to develop.

As well as the straightforward costs, there is the added need to ensure a long-term heat customer - both for direct income and to guarantee enhanced levels of Government support.

The Renewable Heat Incentive has a special tariff for CHP, which may be effective if there is sufficient policy stability.

BIOMASS CHP CONTEXT

- Combined Heat and Power can have significant energy savings compared to generating heat and power separately.
- Financial support linked to demonstrating those savings, which can often be very complex.
- Finding a customer for the heat is a big challenge - not just initially but for the lifetime of the project. Although eligible for Contracts for Difference, deployment unlikely to occur until this issue is addressed.

REA CONTACT

Frank Gordon, Policy Manager

Frank Aaskov, Policy Analyst

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.

SIZE OF THE UK BIOMASS CHP SECTOR

	2011-2012	2012-2013	2013-2014	2014-2015	2015-2016
Sector Turnover (£'millions)	450	498	546	586	382
No. of people employed across UK supply chain	3,330	3,320	3,830	3,999	2,558
No. of UK companies across supply chain	170	166	187	189	156

Deep Geothermal

(Heat & Power)

For full explanation of terms, methodology and growth projections see pages 68-70

Commercial deployment for power remains difficult in current policy environment, although there are opportunities in the medium term for heat. These are dependent on relatively large heat loads such as industrial users or district heating schemes. The latter is particularly relevant, as both district heating and deep geothermal have high upfront costs but last a long time once built.

There remains inconsistency in the planning system between deep geothermal and hydraulic fracturing which needs to be resolved.

DEEP GEOTHERMAL CONTEXT

- Very limited experience in UK, although more widely used elsewhere in Europe.
- Planning regime remains the biggest barrier to deployment.
- Easier to deploy for heat only as electricity generation requires higher grade heat. Several projects being developed for heat, but deployment for power generation unlikely before 2020.

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; Academic staff.

CONSTRUCTION AND INSTALLATION
Project manager; Construction workers; Drilling manager; Geologist; Drilling crew; Hydro geologist; 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; Hydro geologist; Academic staff; Service engineer.

REA CONTACT

Stuart Pocock, Chief Operating Officer

SIZE OF THE UK DEEP GEOTHERMAL SECTOR

	2011-2012	2012-2013	2013-2014	2014-2015	2015-2016
Sector Turnover (£'millions)	10	10	10	10	10
No. of people employed across UK supply chain	200	200	200	200	200
No. of UK companies across supply chain	<25	<25	<25	<25	<25

Heat Pumps

(Air, Water and Ground-Source Heat)

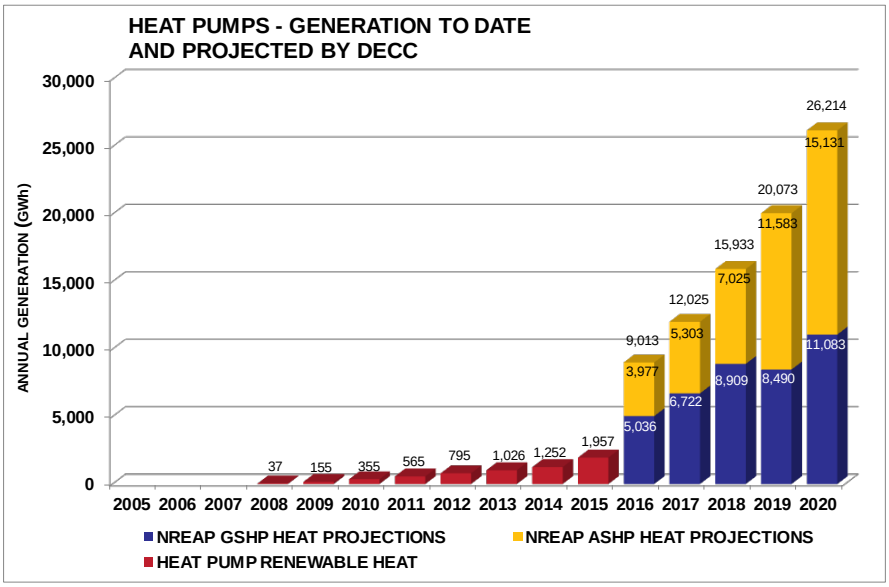
A much favoured technology by policy makers with huge potential to contribute to decarbonising the heat sector. There was been significant growth in the domestic market, as heat pumps are 60% of all domestic RHI accreditations, although still behind that originally envisaged for 2020, which were overly ambitious. The small increase in tariff under the domestic RHI may further increase deployment. Not all the output from heat pumps is counted as renewable. Since they require electricity to operate, the Renewable Energy Directive essentially nets off this input electricity - this explains the reference to 'renewable heat' in the accompanying graphs and that these do not match the gross output figures used in the Renewable Heat Incentive (RHI).

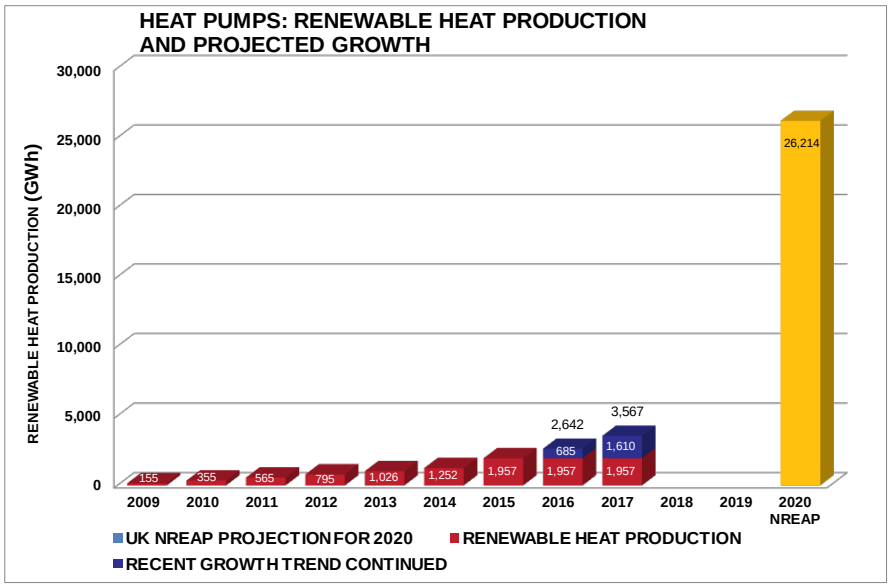
HEAT PUMPS CONTEXT

- Good deployment in Renewable Heat Incentive, with proposed changes and tariff increases further incentivises deployment.
- Renewable Energy Consumer Code and Microgeneration Certification Scheme working to ensure good practice in installers and equipment. Critical to long-term reputation.
- Installation requires sophisticated understanding of heat demands of building and existing heating systems. Without this, consumer electricity bills and GHG emissions will be far higher than expected.

REA CONTACT

Frank Aaskov, Policy Analyst





JOBS IN HEAT PUMPS

MANUFACTURE AND DESIGN

Structural design engineer; Surveyor; Heat pump engineer; Electrical engineer; Skilled and semi-skilled assembler; Welder; Machinist; Metal worker; Hydro geologist; 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; Labourer.

SIZE OF THE UK HEAT PUMP SECTOR

	2011-2012	2012-2013	2013-2014	2014-2015	2015-2016
Sector Turnover (£'millions)	935	1,058	1,097	1,158	1,249
No. of people employed across UK supply chain	7,320	7,345	8,315	8,611	9,441
No. of UK companies across supply chain	380	381	417	421	473

Hydropower

(Energy Storage, Power)

As the graphs show, there is a substantial contribution from historic plant but recent growth rates have been low.

Activity is focusing on smaller-scale schemes and potentially large energy storage projects. Given the build time, the overall picture looks unlikely to change significantly to 2020.

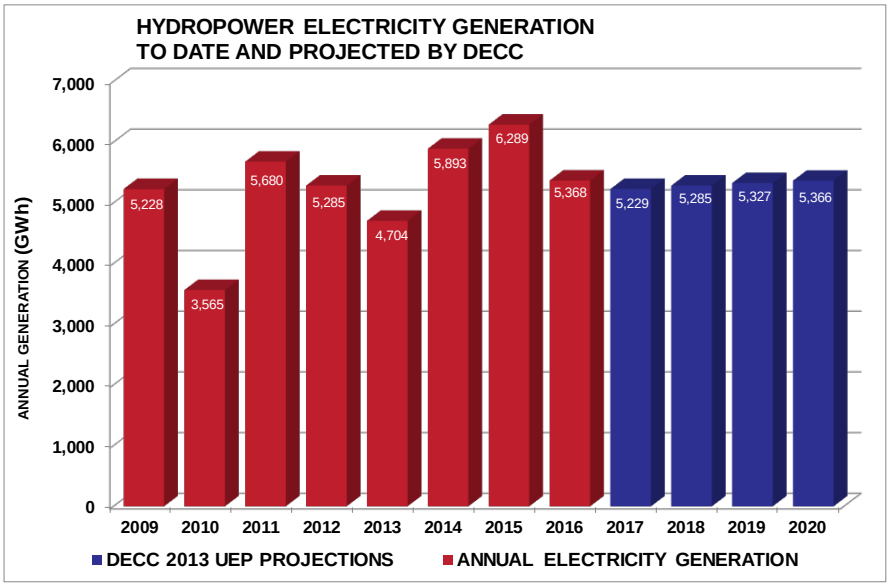
HYDROPOWER CONTEXT

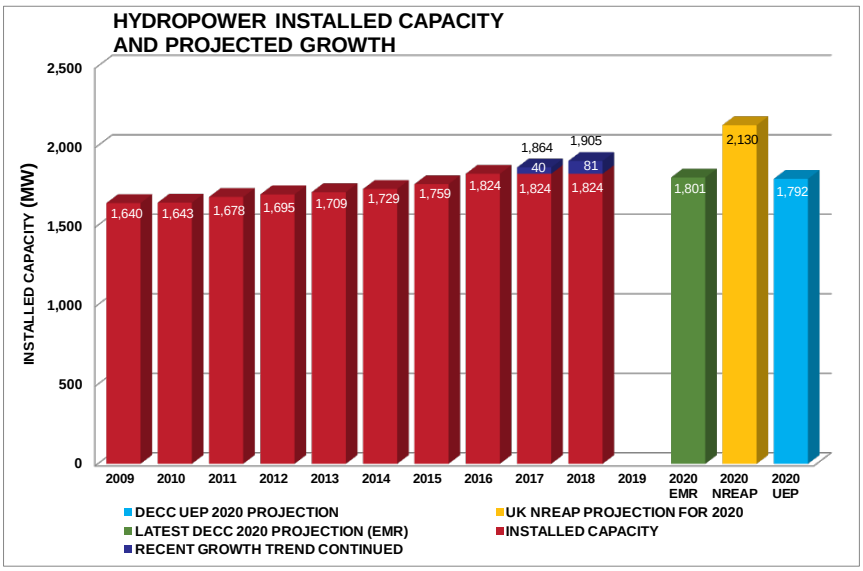
- Significant contribution from historic installations. New deployment mostly small-scale.
- Limit to cost reductions that can be achieved as no two installations are identical.
- New potential storage sites are being proposed and may start development work in 2017.

REA CONTACT

Frank Gordon, Policy Manager

James Court, Head of Policy & External Affairs





JOBS IN HYDROPOWER

MANUFACTURE AND DESIGN

Design engineer; Hydro geologist; Marine biologist; Electrical engineer; Machinist; Welder; Metal worker; Structural engineer; Marine engineer; Reservoir engineer; Resource manager; Surveyor; Educator.

INSTALLATION AND MAINTENANCE

Project management; Construction worker; Project manager; Electrical engineer; Power generation engineer; Operation maintenance engineer; Installation technician; Supervisor; Environmental and planning consultant; Environmental scientist; Ecologist; Service engineer.

SIZE OF THE UK HYDROPOWER SECTOR

	2011-2012	2012-2013	2013-2014	2014-2015	2015-2016
Sector Turnover (£'millions)	560	577	595	615	639
No. of people employed across UK supply chain	4,970	4,955	5,390	5,508	5,778
No. of UK companies across supply chain	260	261	276	278	296

Mixed Energy from Waste

(Combustion, Pyrolysis, Gasification, Landfill Gas - CHP, Heat & Power)

Waste to Energy includes a number of different technologies and feedstock's, ranging from thermal combustion for energy recovery to Advanced Conversion Technologies (ACTs), which have the added potential of producing green chemicals and renewable transport fuels.

Technologies are, to some extent, in competition for the same raw material, although much of this resource continues to be exported rather than used within the UK.

Landfill gas continues to make a substantial contribution to renewable electricity generation, but is likely to decline rather than grow as policy has moved away from supporting new projects, and existing sites produce less gas over time. These technologies offer a range of benefits beyond electricity generation, including enhanced greenhouse gas savings from avoided methane emissions from landfill.

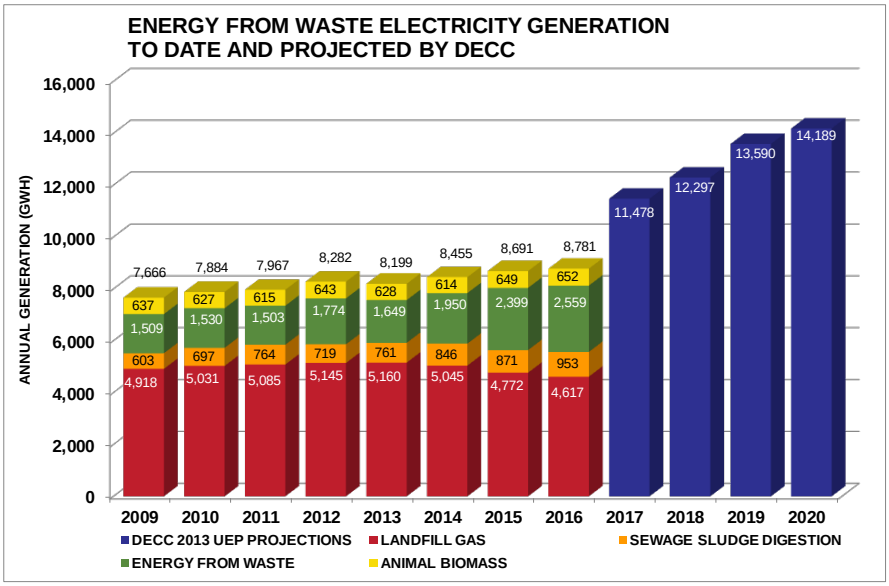
MIXED ENERGY FROM WASTE CONTEXT

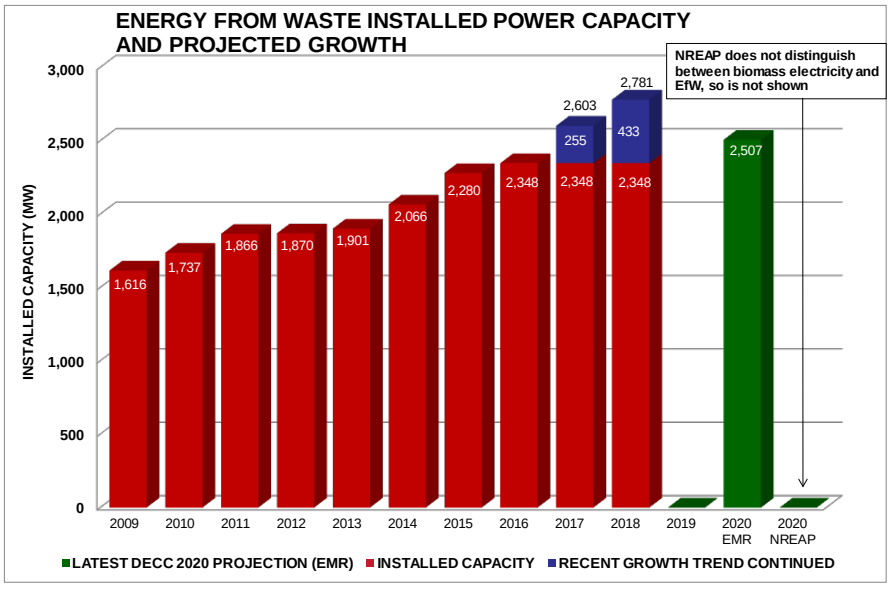
- Includes landfill and sewage gas, conventional incineration and advanced treatments such as gasification.
- Availability of feedstock an issue, with concerns over impact of exports of UK waste to Europe.
- Planning issues remain a significant barrier.
- Financial incentives for renewables pay on the renewable content of waste. Difficult to demonstrate for solid waste without being overly burdensome.

REA CONTACT

Mark Sommerfeld, Policy Analyst

Frank Gordon, Policy Manager





JOBS IN ENERGY FROM WASTE

MANUFACTURING

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

INSTALLATION AND MAINTENANCE

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

SIZE OF THE UK ENERGY FROM WASTE SECTOR

	2011-2012	2012-2013	2013-2014	2014-2015	2015-2016
Sector Turnover (£'millions)	809	832	866	895	930
No. of people employed across UK supply chain	6,020	6,545	7,109	7,316	7,694
No. of UK companies across supply chain	330	341	363	366	392

Decentralised Energy

DECENTRAL
RENEWABLE ENERGY ASSOCIATION

Take back control?

Being in control of one's energy should be a good thing, shouldn't it?

Recent Ofgem statistics[1] say that the average dual fuel energy bill costs households £1,165 per year, while the cheapest available tariff was £834 per year. Being "in control" of how much you pay could mean just "switching" to the cheapest tariff and yet 45% of people don't recall ever switching. (Note: one of the easiest ways to save some money, of more than a hundred pounds, is to switch from any "Standard" rate to the best in the market!). From this you could hopefully imply that 55% of consumers are engaged even if just from a financial perspective. The next question then is to ask what proportion of engaged consumers are concerned enough to choose "where" their energy comes from, for example, is it from renewable sources from their retail supplier or from generating the energy themselves - making them a Prosumer? Looking at the first option, there are now 48 active suppliers competing in the domestic market with many of the relatively new small suppliers offering a low carbon or completely renewable offering. So you can be in control of where your energy comes from just by switching suppliers to one such as Good Energy, Ecotricity or even Bulb.

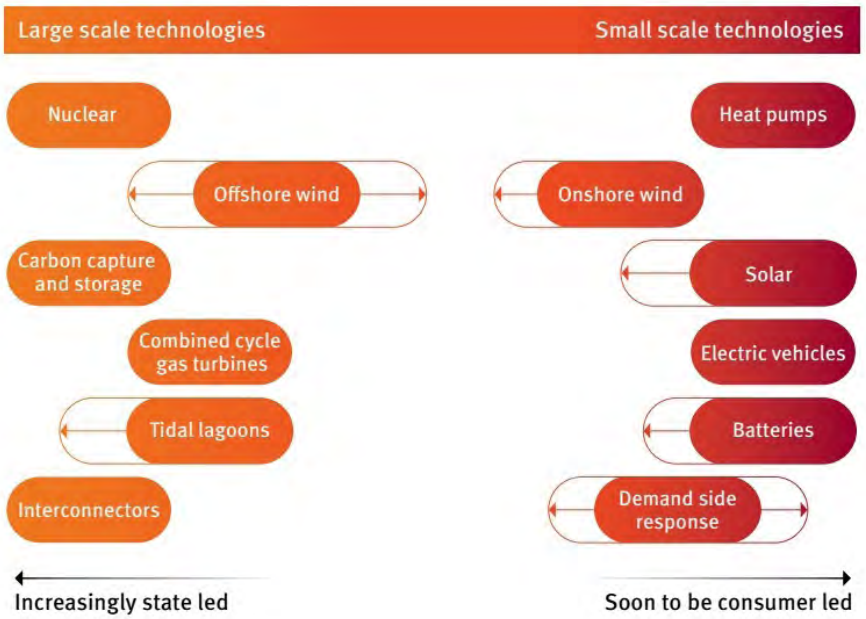
Engaged prosumers though have taken advantage of renewable energy support schemes and there is no better example than the million plus homes and offices with solar PV now installed[2]. Communities have come together to own or support local renewable schemes that benefit not only climate change but the local people socially and economically. Local Authorities are the more recent organisations that have stepped up to the plate to deliver energy solutions. They have developed new business models that take advantage

Communities have come together to own or support local renewable schemes that benefit not only climate change but the local people socially and economically.

of their locally-owned technologies (such as energy from waste and solar). Interestingly, one of the key reasons for embarking on such a venture, of moving away from and competing with "traditional utilities", is to address wider social challenges such as neighborhoods trapped in fuel poverty as well as addressing their low carbon and air quality goals. Whilst Local Authorities see the opportunity to commercially benefit from national government support schemes, their ambitions are prevailing even through the recent bonfire of renewable energy subsidies. The business case can remain attractive when bundled with their relatively low risk cost of financing.

Businesses, including many leading brand names such as Unilever, Proctor and Gamble and IKEA, have positively taken control of their energy choices. For example, they have gone so far as to publically state a 100% renewable energy future as their aim. Starting with a focus on renewable electricity, many are now turning their attention to tackle their low carbon heat requirements and transport concerns. Organisations such as the RE100[3], which bring together like minded committed organisations, have been a valuable voice to ensure that the UK does not fall behind and lose control of the important stages needed to tackle climate change.

In last year's REview, we stated that the prospect of further decentralisation of energy generation is revolutionising the energy market[4]. One year on this revolution is accelerating. What is driving this acceleration? The answer is all of the above, PLUS the tumbling costs for solar, wind and energy storage. This is combining with the real prospect that electric vehicles finally cut through as the car of choice for tackling air quality, while facilitated by demand side management technologies and the burgeoning array of improved energy management options for consumers in new affordable, efficient zero carbon homes. Many more people engaged in energy are now aware of these developments and are embracing the opportunities. Ofgem have stated that 38GW of electricity generation capacity is connected to the low voltage grid, demonstrating the volume of small scale decentralised technologies entering the system. In the past, many of the "authoritative voices" argued that a secure future energy market can only be met by large scale energy technologies, yet they too are coming round to the fact that these developments will radically change the way the energy market can be regulated and operated. The Green Alliance[5] in a very recent report called "People Power: How consumer choice is changing the UK Energy System" highlighted that the biggest difference between small and large scale technologies is that "small scale assets will be driven by unsubsidised choices of individual consumers and non-power sector businesses that results in a system that features multiple buyers and multiple



sellers that will look much more like other markets for goods - (cheap and everywhere!), in contrast with the current energy market where individual consumers have almost no choice over what sort of power generation is built". There is no question that we are close to this tipping point, as the majority of the traditional utilities have already taken steps to reinvent their offerings in order to position themselves as service providers in this evolving market. There are different views, though, as to when this will occur and even how the system can be controlled.

So what is causing the different views? Refreshingly both Ofgem and the Department for Business, Energy and Industrial Strategy (BEIS) have started to ask the right questions. The "Smart Flexible Energy System" call for evidence and key chunks of the BEIS Industrial Strategy Green Paper focused on this opportunity[6,7]. The feedback to them from stakeholders ranges from doom-laden messages of "connect too many EVs to the system and we will see rolling black-outs so we must reinforce all the networks" and "nuclear and gas are THE low carbon fuel combination and answer-to-everything", through to more positive views. Such as creating the right regulatory frameworks that enable an energy market free of the constraining legacy "rules", that provides clear and easy access to networks via proactive Distribution System Operators, to ensure the UK is at the forefront of benefiting from these new smart technologies. Of course, in a perfect world all homes/businesses will have the smartest meters NOW and consumers will have a clear understanding of how Time of Use Tariffs can truly benefit them and be in control of their energy choices.

The REA has always argued that decentralised renewable energy for electricity, heat and transport is complimentary to any core low carbon centralised generation that is needed to replace coal and old nuclear in the future. Such systems must be coupled with smart energy storage solutions placed in a system that can adapt and reflect new developments. Such an approach gives control to the engaged consumer, as well as the regulator and Government to deliver a low cost clean energy future. This is what the REA said in the consultation responses to both the regulator and government[8]. During conversations over the last year with influential groups and developers as part of the REA's DECENTRAL activity, we also believe that these opportunities will move from pilot/demonstration to mainstream in the next three years. You will have to read REview 2018 to know whether what we have predicted here really starts to come true.

Refreshingly, both Ofgem and Department for Business, Energy and Industrial Strategy (BEIS) have started to ask the right questions.

[1]Ofgem, March 2017, Energy Prices Infographic, https://www.ofgem.gov.uk/publications-and-updates/infographic-bills-prices-and-profits

[2]Ofgem Future Insights Series, March 2017, 'The future of domestic energy consumption', https://www.ofgem.gov.uk/system/files/docs/2017/03/ofg958_future_insights_series_4_0.pdf

[3]RE100 is a collaborative, global initiative of influential businesses committed to 100% renewable electricity, working to massively increase demand for - and delivery of - renewable energy, http://there100.org/

[4]Renewable Energy Association, May 2016, REview 2016 'To be centralised or DECENTRALised: that is the question...'

[5]Green Alliance, April 2017, 'People power: How consumer choice is changing the UK energy system' http://www.green-alliance.org.uk/people_power_consumer_choice.php

[6]Ofgem/BEIS, November 2016, 'Call for Evidence on a Smart, Flexible Energy System', https://www.gov.uk/government/consultations/call-for-evidence-a-smart-flexible-energy-system

[7]BEIS, January 2017, 'Building our Industrial Strategy' a Green Paper, https://www.gov.uk/government/consultations/building-our-industrial-strategy

[8]REA responses to the above ([6] & [7]) consultations:

http://www.r-e-a.net/resources/pdf/273/170112_REA_Response_to_Flexibility_CfE.pdf

http://www.r-e-a.net/resources/pdf/285/170328_REA_response_to_Industrial_Strategy_Green_Paper.pdf

Infographic; A polarised energy market - The Green Alliance, People Power report

Solar Photovoltaics

(Power)

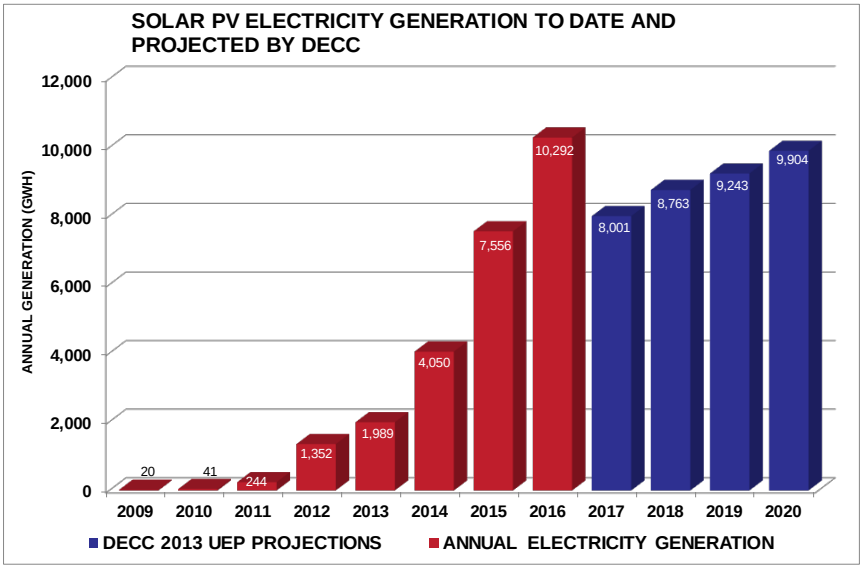
Of all the technologies featured, solar PV's track record for exceeding expectations in terms of cost reduction and deployment is second to none. Much of the recent growth has been driven by larger-scale projects but there has also been significant growth in rooftop installations. Government responded to this by making significant cuts to the FiT and closing the RO to all solar PV projects since April 2016. Solar PV will also see no funding in 2017's Contracts for Difference auction.

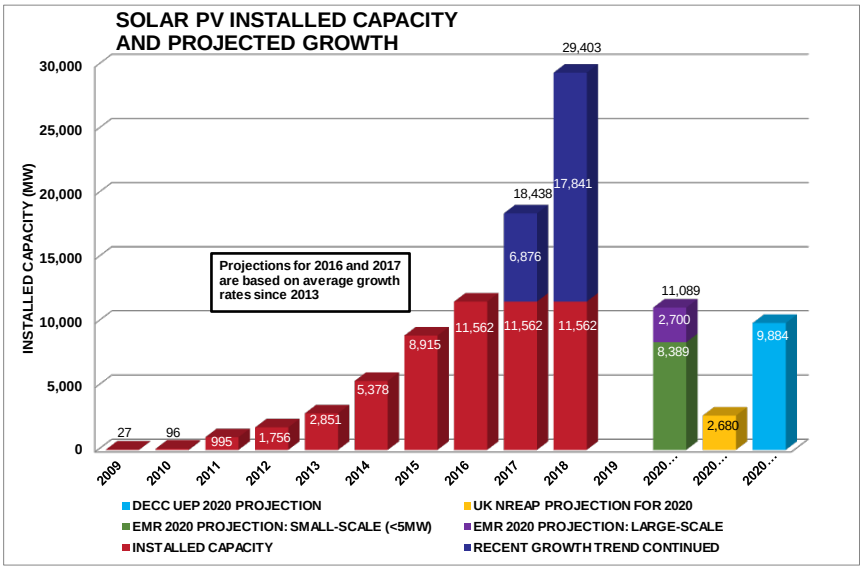
In order for solar PV to become attractive without subsidies there is a need to unlock deployment on buildings in the commercial sector and for solar to continue to reduce its installed costs. Tax incentives such as Enhanced Capital Allowances (ECAs) or Enterprise Investment Scheme (EIS) would go some way to helping this without direct subsidy.

For comparison purposes, it is worth looking at the generation figures rather than installed capacity, as load factors for solar PV are lower than for other non-baseload technologies, such as wind.

SOLAR PV CONTEXT

- Solar PV deployment was boosted dramatically by the introduction of the FiT, especially for rooftop systems. Meanwhile large ground-mounted projects benefitted from the Renewables Obligation (RO) scheme.
- Alongside onshore wind, solar PV is struggling to find a route to market, with no funding for Pot 1 technologies, CfD tariffs slashed to unsustainable levels and the open PPA market difficult to finance projects.
- A dramatic cost reduction has occurred over the last 6 years, and is now competing with onshore wind as the cheapest generation technology.
- Solar PV is the renewable energy technology most likely to benefit from the anticipated rise of behind the meter energy storage.





JOBS IN SOLAR PV

MANUFACTURING AND DESIGN

Design engineer; PV and solar systems designers; 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.

GENERAL MANAGEMENT, SALES AND ADMIN

Sales/purchase administrators; Sales and business development team; Logistics - drivers, packers, warehouse staff; Marketing team.

REA CONTACT

Ray Noble, Senior Policy Advisor

Stuart Pocock, Chief Executive Officer

SIZE OF THE UK SOLAR PV SECTOR

	2011-2012	2012-2013	2013-2014	2014-2015	2015-2016
Sector Turnover (£'millions)	2,027	2,166	2,307	2,477	2,037
No. of people employed across UK supply chain	15,650	15,620	16,103	16,880	13,687
No. of UK companies across supply chain	2,200	2,178	2,088	2,005	1,241

Solar Thermal

(Heat)

Analysis for the Renewable Heat Incentive has consistently predicted minimal deployment of Solar Thermal, yet moderate deployment has continued.

Keeping its status within the RHI avoided a sudden brake, on deployment but it is unlikely to see a huge improvement in deployment rates under the current policy framework.

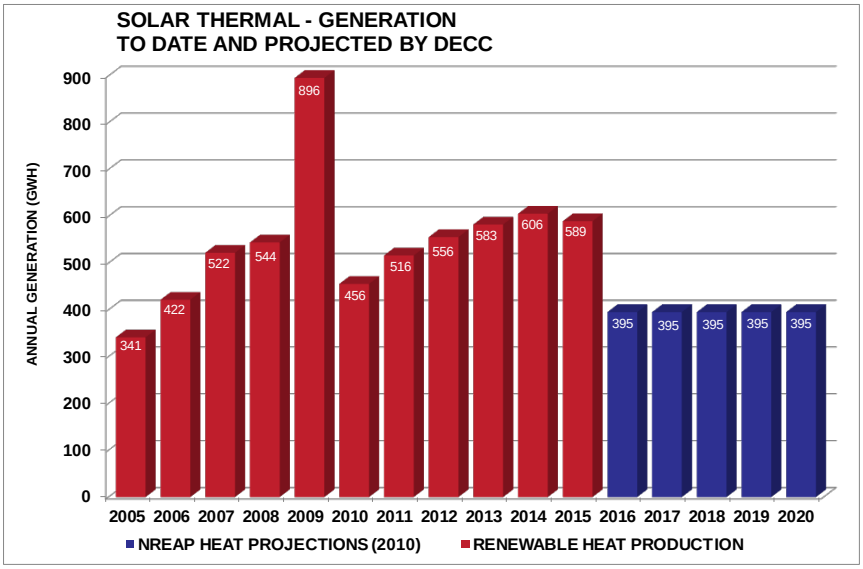
SOLAR THERMAL CONTEXT

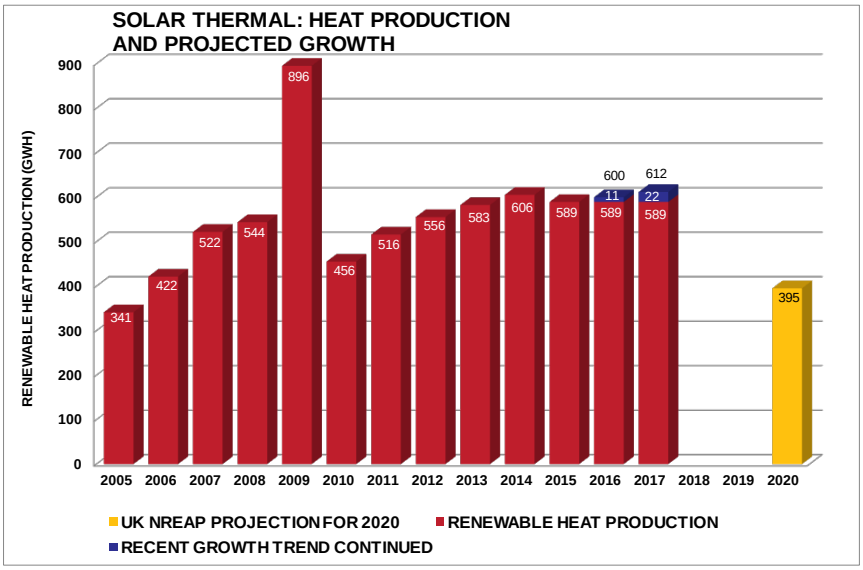
- Deployed in the UK for many years, but growth slowed since 2010. Government proposed to exclude technology from Renewable Heat Incentive last year.
- Initial Government proposal to remove from RHI was reversed.
- Main UK market likely to be domestic, but has been used in other countries at larger scale and in district heating.

REA CONTACT

Ray Noble, Senior Policy Advisor

Frank Aaskov, Policy Analyst





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.

GENERAL MANAGEMENT, ADMINISTRATION & SALES
Sales/purchase administrators; Sales and business development team; Marketing team

LOGISTICS
Driver; Packer; Warehouse staff.

SIZE OF THE UK SOLAR THERMAL SECTOR

	2011-2012	2012-2013	2013-2014	2014-2015	2015-2016
Sector Turnover (£'millions)	885	941	1,008	1,058	1,126
No. of people employed across UK supply chain	7,550	7,533	8,639	8,926	9,637
No. of UK companies across supply chain	340	337	372	375	414

Energy Storage

Energy Storage - A Year in Review

This will be the third REview featuring energy storage in the UK market. We are still excited and enthused by the potential opportunities, and for the first time we can point to new projects on the ground, as well as policy achievements for the sector.

Most people know the benefits by now, but to recap, energy storage allows the UK to balance out variable power generation and avoid costly reinforcement of the electricity grid, two issues that could be a serious brake on renewables. Domestic and business users can benefit from increased self-consumption and therefore keep energy bills down. When combined with renewables, storage can help provide stable, balanced energy supplies that reduce strains on the network and therefore lower balancing system charges for generators and suppliers, and also help regulate frequency and voltage rises on the network.

We have of course had the (world's!) first ever 'Enhanced Frequency Response (EFR)' auction tender, which procured 200MW of battery storage but attracted bids from six times that capacity. This can be pointed to as an example of the UK Grid Operator leading the world in procuring flexible new capacity and must be encouraged. A lot has been written about the auction already, but what was also notable was the very low prices achieved. The reasons for this can be speculated on, but National Grid projected the EFR auction will save consumers £200 million as a direct result, which serves to validate some of the other often quoted figures in the storage sector in the past year. This includes that of the National Infrastructure Commission's projected £8 billion savings by 2030 compared to 'business as usual' on the system as a direct result of deploying storage and other flexible forms of capacity. As of spring 2017 some of the Distribution Network Operators (DNOs) are in discussions regarding procuring similar capacity as the transition to more localised versions of grid system operators, representing a significant opportunity for the sector. In addition, this year saw the first new-build storage project contracts procured in the Capacity Market, a development which was arguably directly linked to the success of the EFR tender (allowing for stacking of revenue streams).

National Grid projected the EFR auction will save consumers £200 million

In the UK, until around a year and a half ago, the Government positioned energy storage firmly in the 'R&D' bracket – indeed the then DECC's initial office in charge of energy storage included responsibility for five other technologies as the 'Future Networks' team – the name saying it all. However, BEIS deserve some credit for stakeholder engagement and for beginning to recognise the real immediate benefits of storage and, late in 2016, launched with Ofgem the long-awaited Call for Evidence on energy storage (as part of the broader 'smart networks' transition). This was the other major milestone to date this year, with the REA submitting its detailed response in January, and once again thank you to all members who participated in this process.

The Call for Evidence was one of the widest-ranging reviews for several years, encompassing everything from grid use of system charges to the barriers to deploying hydrogen.

The Call for Evidence was one of the widest-ranging reviews for several years, encompassing everything from grid use of system charges to the barriers to deploying hydrogen.

While it is not possible to summarise our full position here, broadly speaking our preferred approach remains to target the quick wins and areas of mutual agreement across industry - but to do so in a timely way. Many of these areas (for example ending the double charging of grid levies) have had near consensus agreement for over a year now, so let's take action sooner rather than later. There seems little point in waiting over 18 months for a new Energy Bill to introduce changes, when some could be enacted via adding clauses to related legislation going through Parliament beforehand. It has been encouraging to see Ofgem launch the process of ending the double charging of grid levies for storage projects, even before the official response to the Call for Evidence, and is an example of the kind of steps which can be taken without a lengthy delay.

Meanwhile, the REA has been continuing to work on attempting to pre-empt many of the problems the industry could encounter while growing. We're very pleased that the behind the meter battery storage installation standards REA developed with the IET should be published this summer, delivering guidance to installers and homeowners. REA has also suggested rule changes to the Capacity Market that would benefit storage, continued discussions on battery sustainability and fire guidance, and published our updated annual report on the barriers in the market and project databases. In addition, at the time of going to press, new guidance with the DNOs was close to being agreed which would dramatically improve the process for connecting small domestic storage devices to the network - work led by REA members themselves, notably Powervault.

The REA also launched the Energy Storage and Connected Systems (ESCS) event this year with Reed Exhibitions, the first dedicated forum for discussing storage and the related equipment and services in the UK. The All Party Parliamentary Group on Energy Storage, which the REA provides the secretariat for, welcomed several international delegations and held a series of very successful events.

In the coming year, REA hopes for greater deployment as costs continue to fall and revenue stacking becomes easier. New market segments could be co-location with Electric Vehicle charging points and on-site at solar carports. One aspect the industry should seek to highlight this year, and as this report shows, are the clear industrial opportunities from energy storage and the services and equipment deployed alongside. The Industrial Strategy, currently in development, offers a greater opportunity to highlight these benefits.

There are two main remaining market barriers to energy storage in the UK - cost and policy - costs are rapidly falling across the globe and policy barriers must be addressed quickly to maximise the low-carbon and industrial opportunities from storage. If done in the right way, the UK can genuinely lead the world in many aspects of the smart energy system, including energy storage, we're already at the top table and a push can get us to the head of the table.

The behind the meter battery storage installation standards REA developed with the IET should be published this summer, delivering guidance to installers and homeowners.

Energy Storage

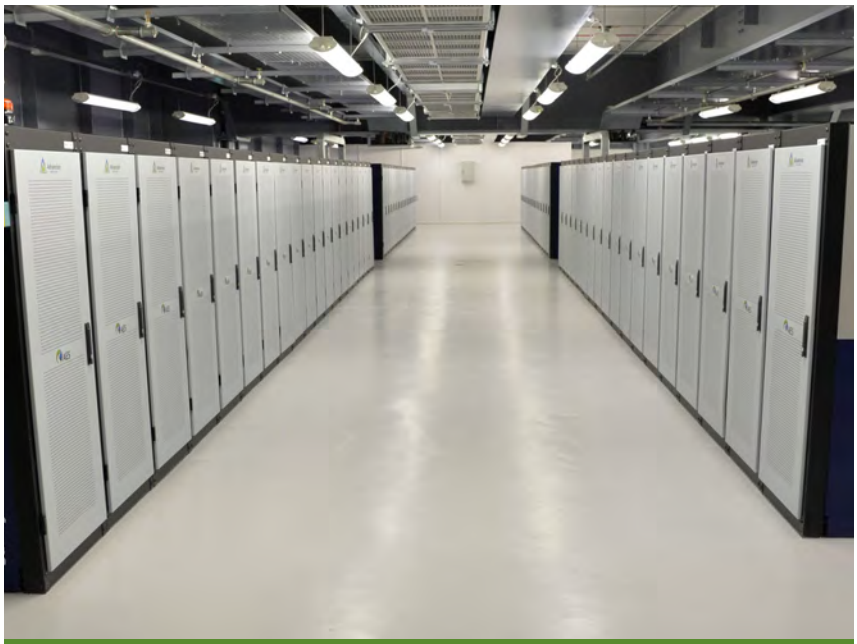
(Heat, Power, Transport)

Energy storage represents a range of technologies, including many types of batteries, pumped hydro, compressed air, liquid air, and at the very large scale, pumped hydro.

Storage technologies operate for power as well as heat and new technologies are being developed regularly. Once seen as being at the R&D stage, energy storage technologies are being deployed rapidly as increasingly commercially viable.

Driving this in the UK has been the Enhanced Frequency Response (EFR) and Capacity Market policies, which deployed several MW of capacity in 2016 and early 2017 and these policies are expected to deliver more capacity in 2017.

At the behind the meter scale, there is no direct support and technology costs and electricity prices may largely determine likely deployment, as will Electric Vehicle roll out. Potential changes to the grid charging regime could heavily influence uptake in the short term.

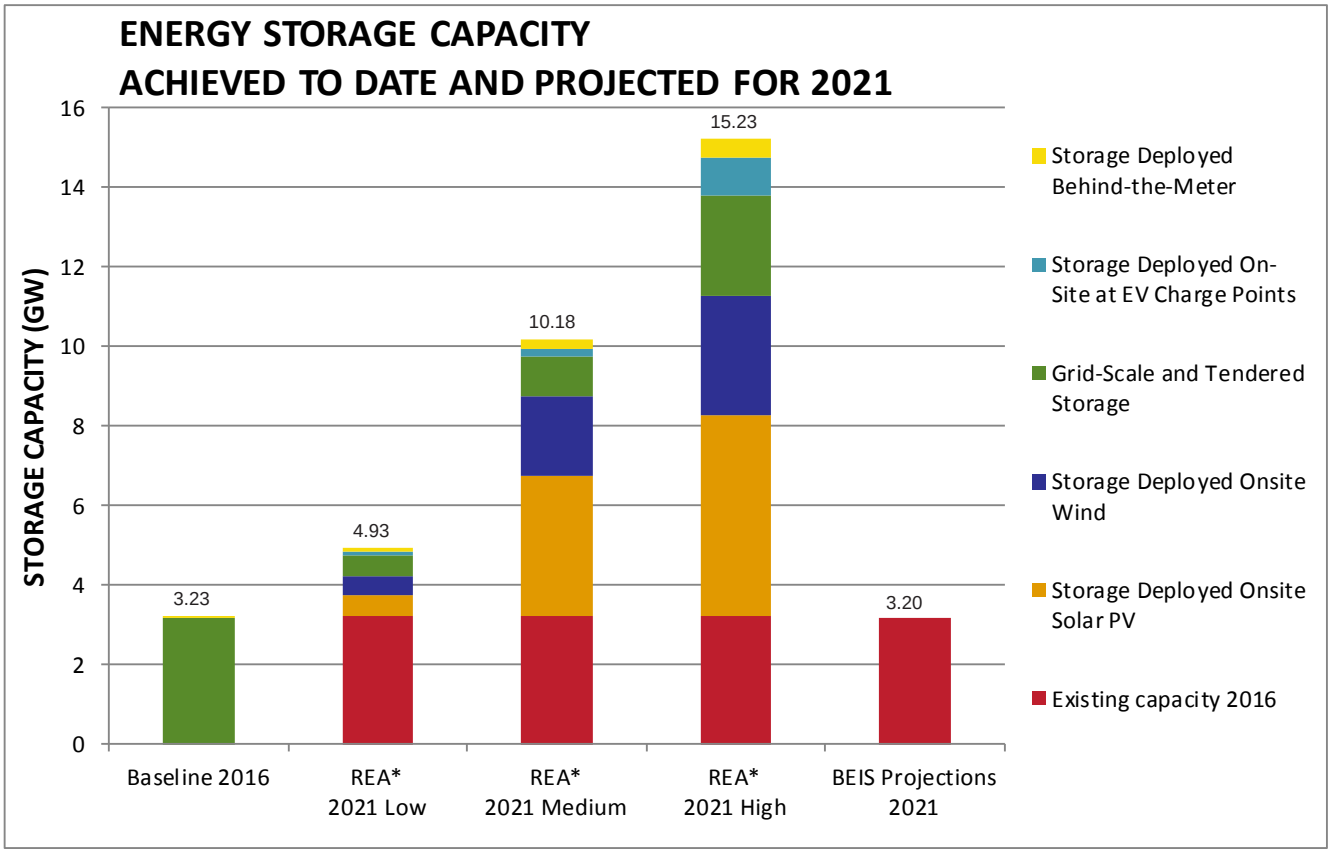


ENERGY STORAGE CONTEXT

- Energy storage is a key future technology, with benefits such as balancing variable renewables, providing services to grid, and helping households and businesses utilise more on-site generation.
- Energy storage is one of the featured technologies in the Government's Industrial Strategy and the UK has the chance to be world leaders in this sector.
- The Government launched the flexibility call for evidence in November 2016 which looks at the barriers faced by energy storage. This is expected to report in summer 2017.

REA CONTACT

Frank Gordon, Policy Manager

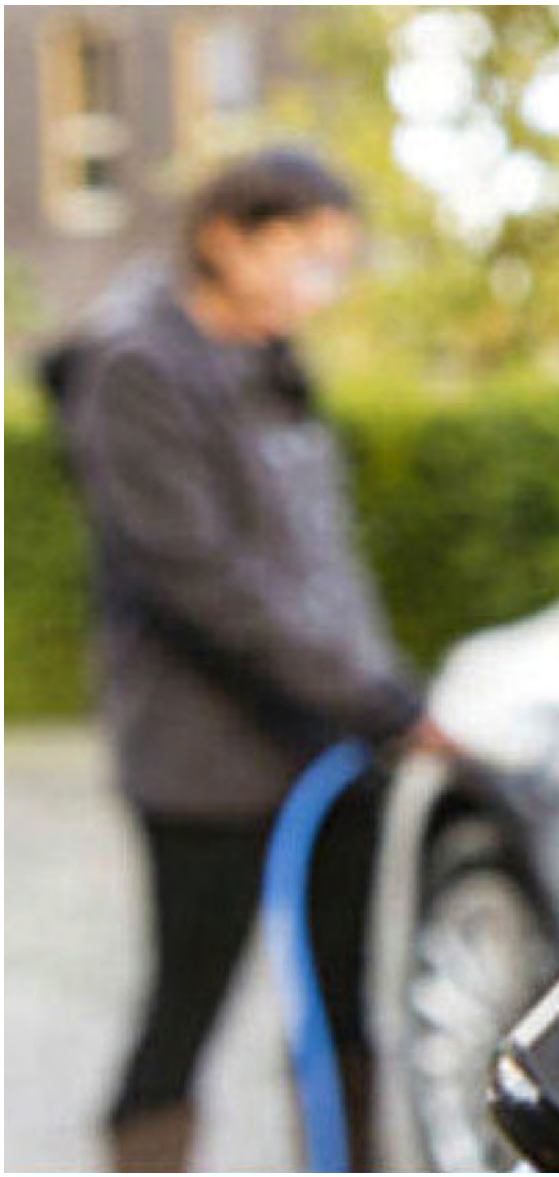


SIZE OF THE UK ENERGY STORAGE SECTOR

	2010	2011	2012	2013	2014	2015	2015-2016
Sector Sales (£'millions)							1,231
No. of people employed across UK supply chain							10,061
No. of UK companies across supply chain							507

Electric Vehicles

Electric Vehicles - Driving Real Change



The Electric Vehicle (EV) marketplace is still a relatively young one, with the first models only having come to market late in 2010. However, the UK is asserting itself as a key global market

for the introduction, or rather **re**-introduction, of electrified drivetrain vehicles. This has been demonstrated by the creation of the Office for Low Emission Vehicles (OLEV), cross-pollinating DfT and the former DECC & BIS, which seeks to not only lead in the adoption of vehicles but also in creating value in the supply chain.

Having now topped 100,000 new EV passenger car registrations, the EV market is continuing to grow with an ever-widening choice of Plug-in Hybrid Electric Vehicles along with longer-range Electric Vehicles & EVs with Range Extenders. By March 2017, pure-electric EV registrations saw a 46.5% year-to-date increase. New vehicle manufacturers, previously not offering any kind of alternative drive train, are bringing plug-in (and non-plug-in hybrid) models to market, expanding customer choice.

Normal battery capacity for a Battery Electric Vehicle (BEV) or EV with Range Extender is now in the order of 30 - 40kWh, with an homologated (New European Driving Cycle) range figure of between 150 and 250 miles. This advance has been possible mostly due to the increasing energy density of their lithium ion batteries, providing more storage in a battery pack of the same volume. This has given such vehicles much more appeal to a widening section of the public, including those with more challenging commutes or, simply, those desiring greater flexibility and comfort margin.

General Motors' Chevrolet brand has recently brought the much anticipated Bolt EV to market in the US, on a new platform, with a 60 kWh battery and an EPA range rating of 238 miles. This is the first time that such a large capacity battery has been seen in a vehicle from a volume manufacturer, at a price starting under $30k (after incentives) as opposed to the likes of Tesla luxury models costing significantly more.

> Having now topped 100,000 new EV passenger car registrations

This will come to select European markets in the summer of 2017 as the Opel Ampera-e, resurrecting the Vauxhall/Opel Ampera moniker from their Extended Range EV of 2012, although the UK will not be getting it due to Left Hand Drive only production. For Europe, the slightly over-optimistic 'NEDC' range figure will top 300 miles. Nissan are expected to release a new version of the ubiquitous LEAF, produced in Sunderland for the whole of Europe, in late 2017 or early 2018, with a similar capacity and range.

The Light Commercial Vehicle sector is also seeing improvements to driving range from the advancing energy density of the family of lithium ion batteries. This means an increased range on small vans, which should find favour in a plethora of local service roles with both the public sector and private sector, along with added practicality for larger panel vans and smaller Heavy Goods Vehicles particularly aimed at urban delivery duty cycles: the so-called 'final mile' deliveries.

Innovative projects are looking to establish the value of exerting control over when EVs charge to benefit the local DNO grid. They aim to avoid peaking demand on local transformers and distribution cabling by time-shifting charging with minimal, or no, impact on the charging of the EV by the time it is required for next use. This may prove

necessary to allow the mass adoption of EV, especially where clustering occurs as neighbours neighbours follow suit. Down at a building scale, several brands of domestic and commercial charging points are now promoting the capability to intelligently interface with embedded generation or limit supply capacity to regulate charging.

Whilst the increased potential driving range of the vehicles will no doubt attract more drivers to adopt the vehicles, especially when incentivised with nil Vehicle Excise Duty (only Zero Emission vehicles from April 2017) and low company car tax, the energy required each day will still generally be quite low. This will allow for increased flexibility to charge these vehicles when renewable energy is plentiful. Enabling this will require a combination of the IT control mechanisms to make this a reality and tariffs to encourage consumers to engage. BMW are about to launch such a project in Germany and the Netherlands, dubbed their 'Digital Charging Service.'

Especially when incentivised with nil Vehicle Excise Duty (only Zero Emission vehicles from April 2017) and low company car tax

With a potential of stored energy far exceeding a daily driving requirement, the ability to extract the energy on demand will create additional value in an EV as a mobile storage medium. Nissan are promoting their readiness for Vehicle-to-Grid (V2G) and Vehicle-to-Building/Vehicle-to-Home (V2B/V2H) compatibility, including a demonstration project at their European Technical Centre at Cranfield with several vehicles being used extensively on 10kW bi-directional charger/inverters.

The growth of the EV market, Demand Side Response (and other grid services) and Energy Storage will continue to converge.

Electric Vehicles

(Energy Storage, Power, Transport)

According to latest figures around 106,000 electric vehicles and variants have been registered in the UK since 2010. Given the wide range of vehicle prices calculating an average selling price (asp) is difficult. However, assuming a retail list price of about £30,000 before any government grant gives a market value of at least £3,180 million over the 6 years.

In the period 2015/16 there were approximately 29,700 electric vehicles sold, therefore a market value for 2015/16 of about £891,000 is estimated if the aforementioned asp is used.

Government grants remain available for electric vehicles and with most manufacturers having added, or in the process of adding an electric vehicle offering to their range, sales are expected to steadily increase. Measures to curb poor air quality in cities are also expected to encourage the adoption of ULEV's.

The cost of charging point hardware and the total cost for an installation can vary significantly. An average price for a 'standard' 2 position charging unit installed is we estimate to be around £6k. The cost of a Rapid Charger installation is estimated at £50k inclusive of the hardware, civils, connection etc.

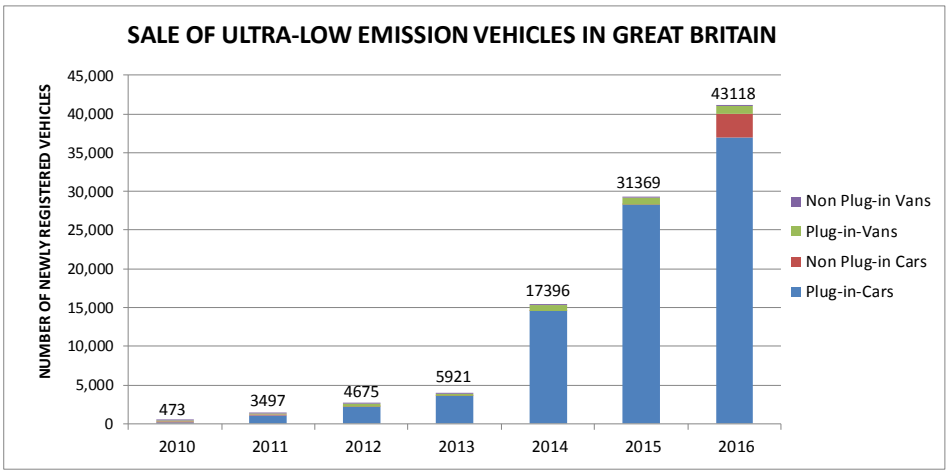
As of early-2016, there are approximately 719 Rapid Chargers (with varying number of connections) out of the 12,000 charging positions i.e. the number of connectors/sockets installed. There were approx. 6,500 charging devices (what we describe as 'charging points' here) total so Rapid Chargers made up around 11% of devices with a total installed value of approximately £35M, while Non-rapid Chargers were estimated to have a total installed value of £36M.

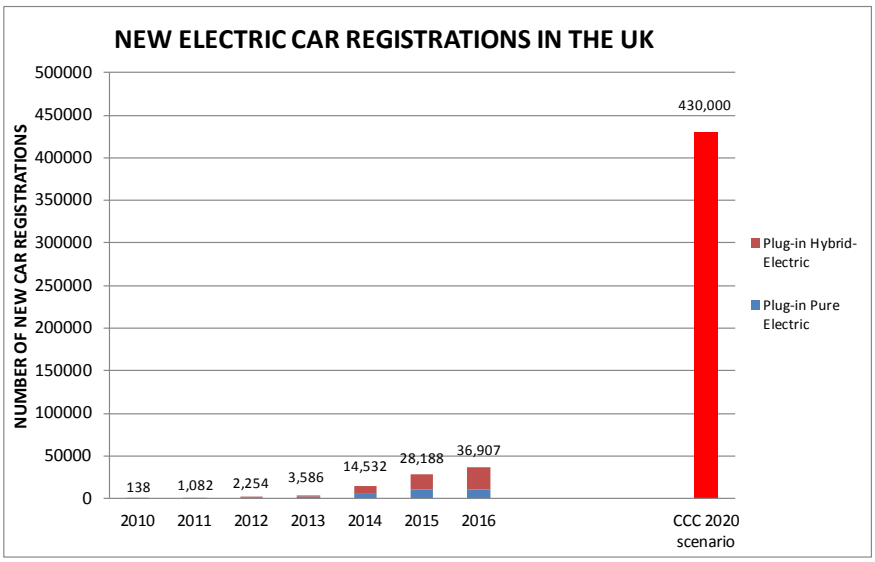
ELECTRIC VEHICLE CONTEXT

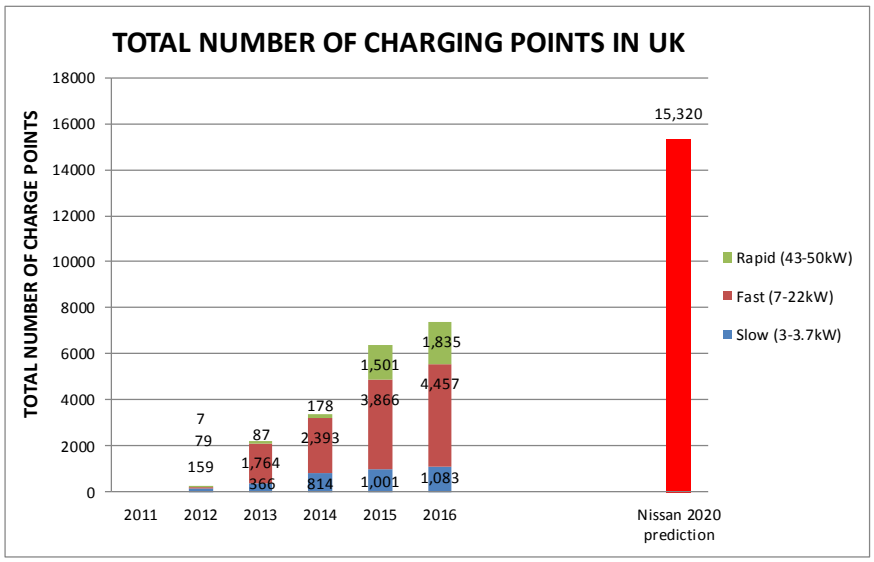
- EVs have grown in popularity, with greater options and models being released and many major car manufacturers now with some hybrid or pure electric offering.
- Charging point infrastructure is increasing, with there now being over 7,500 charging points (and at least 12,000 sockets) charging units in the UK.
- The Government plug-in car grant is available and gives up to £4,500 towards new electric or plug-in hybrid models.

REA CONTACT

Matthew Trevaskis, Head of Electric Vehicles







SIZE OF THE UK ELECTRIC VEHICLE SECTOR

	2010	2011	2012	2013	2014	2015	2015-2016
Sector Sales (£'millions)							919
No. of people employed across UK supply chain							6,195
No. of UK companies across supply chain							374

Offshore Wind

(Power)

There is continued recent growth in the sector.

Continued support is dependent on further cost reductions being achieved, with a number of government/industry initiatives to remove barriers and drive improvements across the supply chain.

Offshore wind remains a favoured technology by the Government, with the majority of the £290m allocated to Pot 2 CfD expected to go to offshore wind.

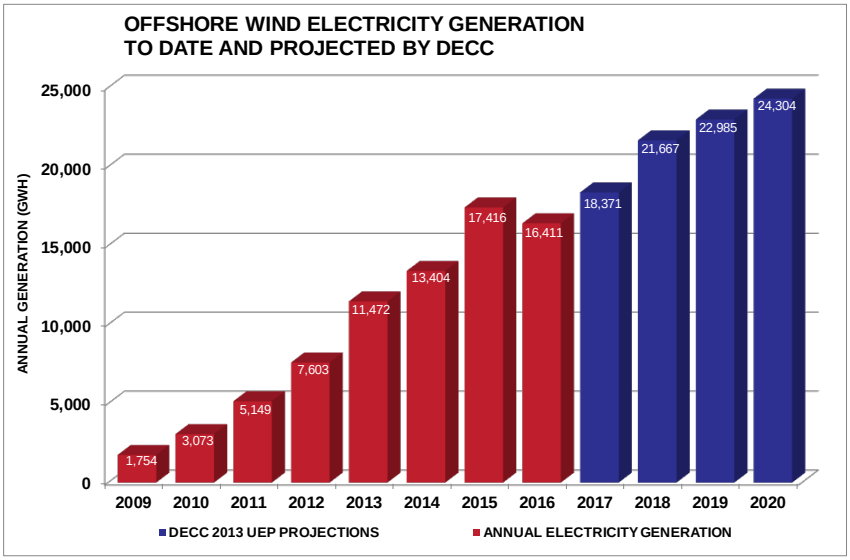
OFFSHORE WIND CONTEXT

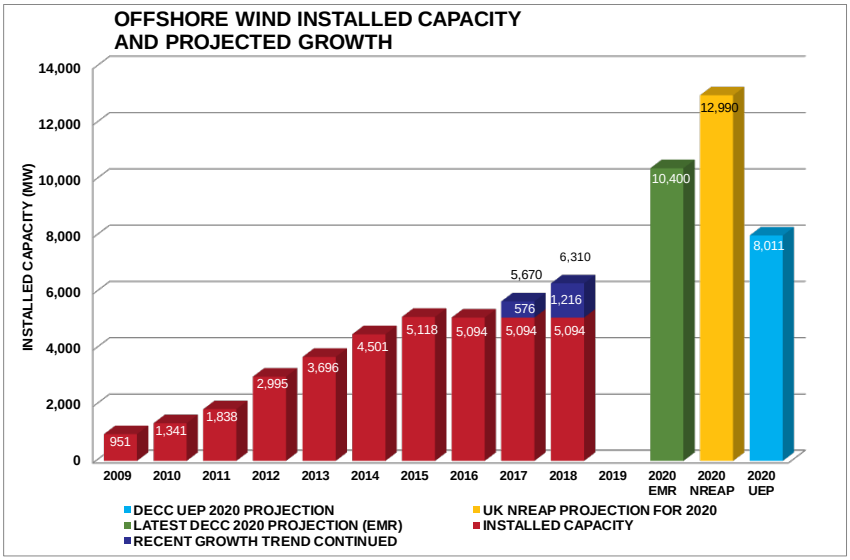
- Strategic industrial priority, given opportunity to build UK leadership and domestic supply chain.
- Contracts for Difference mechanism vital to delivering intended deployment and cost reductions.
- Administrative strike prices for delivery in 2021-22 are £105 for offshore wind, with the previous auction achieving prices of £117MWh.

REA CONTACT

Frank Gordon, Policy Manager

James Court, Head of Policy & External Affairs





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.

SIZE OF THE UK OFFSHORE WIND SECTOR

	2011-2012	2012-2013	2013-2014	2014-2015	2015-2016
Sector Turnover (£'millions)	2,100	2,469	2,693	2,929	3,185
No. of people employed across UK supply chain	16,200	18,280	19,478	20,570	21,557
No. of UK companies across supply chain	790	790	913	924	976

Onshore Wind

(Power)

Onshore wind has grown well over several years, with impressive cost reductions meaning it can make a strong claim to be the cheapest form of new generation.

The geographical spread is not even, with a particularly strong concentration in Scotland.

If recent trends were continued, it would be well on course for the 2020 deployment anticipated by Government. However, growth has slowed recently: rates of planning consent have fallen significantly and changes to the RO and CfDs following the election have had a substantial impact on further deployment.

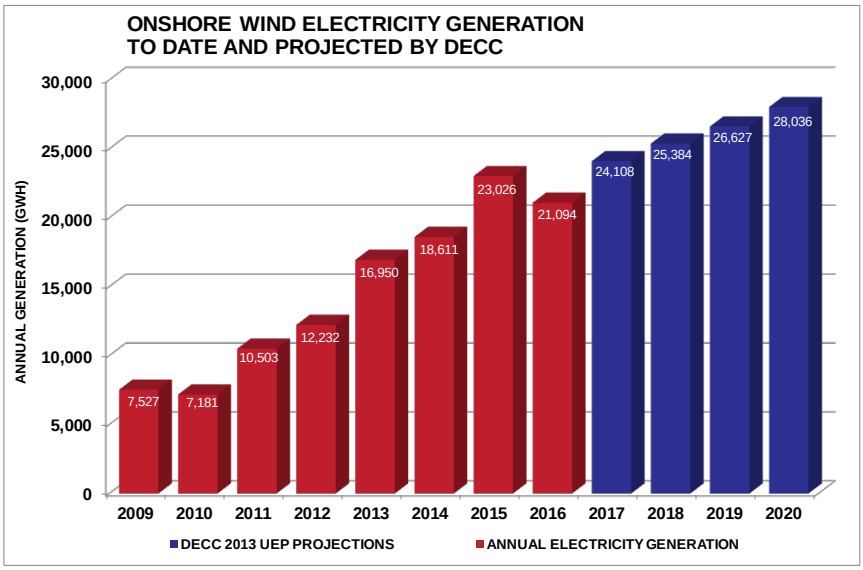
ONSHORE WIND CONTEXT

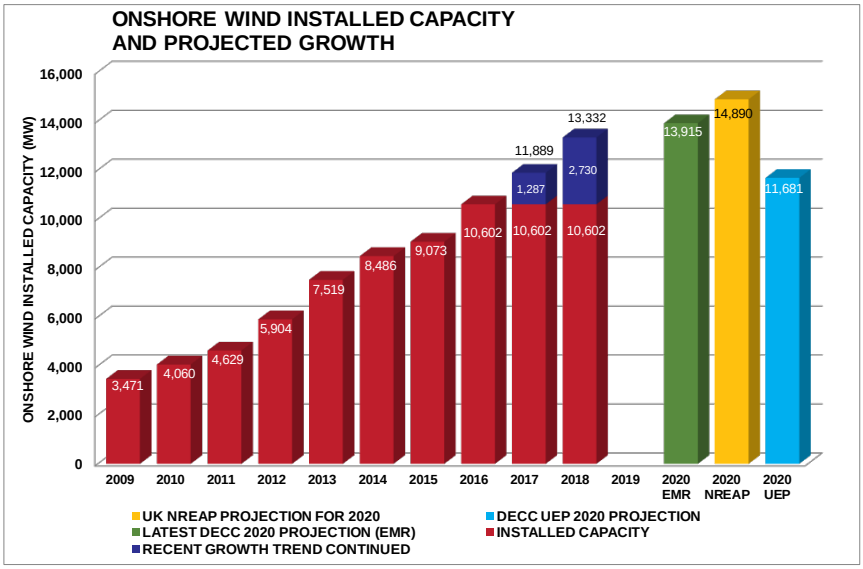
- Cost-effective technology, should continue to play key role with policy focussed on value for money.
- Politically controversial, with the 2015 Conservative manifesto banning any new subsidy.
- Significant contributor to Renewables Obligation, but now barred from mechanism. Also supported in Feed in Tariff and potentially in Contracts for Difference Pot 1, although no funding currently for Pot 1 technologies.

REA CONTACT

Frank Gordon, Policy Manager

James Court, Head of Policy & External Affairs





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.

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

SIZE OF THE UK ONSHORE WIND SECTOR

	2011-2012	2012-2013	2013-2014	2014-2015	2015-2016
Sector Turnover (£'millions)	2,110	2,278	2,493	2,712	2,967
No. of people employed across UK supply chain	15,200	17,071	18,191	19,210	20,209
No. of UK companies across supply chain	730	726	844	863	933

Wave and Tidal

(Power)

The industry is moving from technology development to on the ground deployment. Much of the Government's support has been directed at funding innovation, with progress in commercial-scale deployment not being as rapid as Government anticipated.

Although there has been some high profile investment, some major players have reduced their involvement or stepped away from the industry altogether. Removal of the CfD minima feels like another last minute moving of the goalposts, especially for companies who were expecting to bid into the 2017 auction.

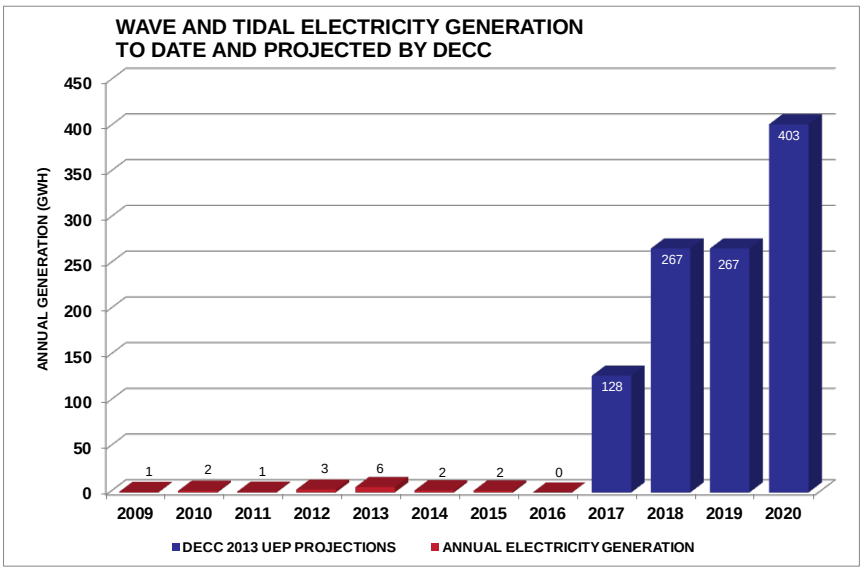
WAVE & TIDAL CONTEXT

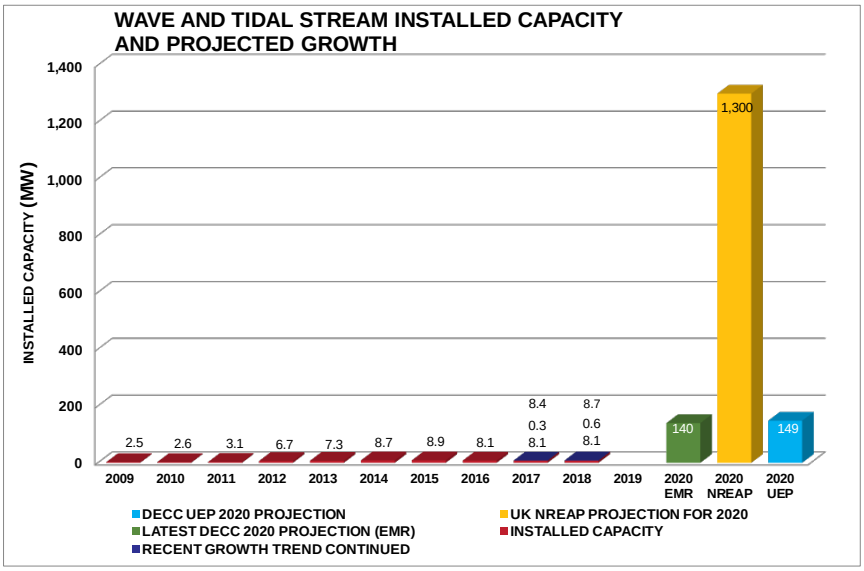
- Still at an early stage of deployment, with the first commercial projects possible in the upcoming CfD auctions.
- Major challenges in creating Government policy that enables the industry to deploy at scale.
- Relatively high levels of support from Renewables Obligation and Contracts for Difference, but the minima which guaranteed 10MW in the auction have been withdrawn.

REA CONTACT

Frank Gordon, Policy Manager

James Court, Head of Policy & External Affairs





JOBS IN WAVE AND 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 engineer; Environmental consultant; Oceanographer; Programmer and modeller; 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.

SIZE OF THE UK WAVE & TIDAL SECTOR

	2011-2012	2012-2013	2013-2014	2014-2015	2015-2016
Sector Turnover (£'millions)	91	397	103	109	118
No. of people employed across UK supply chain	570	570	635	660	723
No. of UK companies across supply chain	33	30	36	40	41

Glennmont Partners

Renewables, decentralisation, and opportunities in UK energy investment

The UK energy market is as diverse as it has ever been with new technologies and new market structures offering investors a wide range of opportunities for investment and for creating value.

But development and innovation in the market also brings a new level of complexity that requires investors to demonstrate expertise in a wider range of areas than had previously been the case.

Changes in power asset finance

The past decade has seen a significant increase in the financing of power generation from previously unconventional forms of asset financing. The fragmentation of the generation stock into small distributed units has attracted institutional and other private investors who previously had limited exposure to the power generation industry through various investment vehicles. Most of these new investors were attracted by a low-risk investment model where exposure to power markets was limited by Feed-in Tariffs or by the seemingly stable pricing of green energy certificates. As technology has further matured and technology providers offer secure performance guarantees, the market brought in further investment attracted by confidence in the performance of new generation assets.

Impacts of renewables deployment

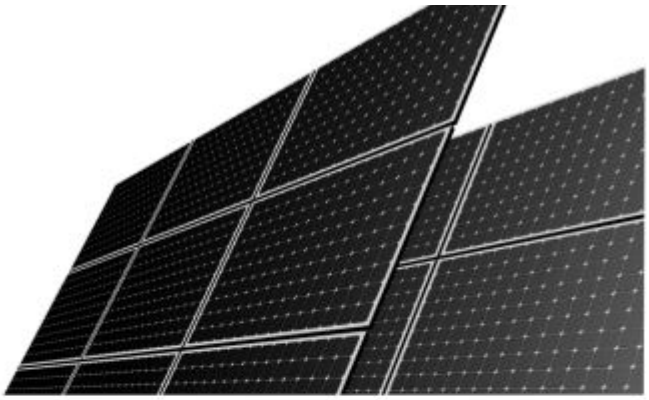
Although largely successful, the rapid development of a large fleet of renewable energy assets has had some less predictable impacts. The low marginal cost of production from renewable technologies and an ever-greater proportion of power coming from such sources has pushed wholesale power prices to a generational low point. While this may be welcomed by regulators who have a goal of reducing the overall cost of power within the UK, it is not such good news for investors – it is now not possible to construct any generation capacity, of any sort, without subsidy.

Although largely successful, the rapid development of a large fleet of renewable energy assets has had some less predictable impacts.

New opportunities and market responses

Issues such as this create new opportunities and new market responses, after all the demand for investment in the UK power sector remains large. The trilemma of decarbonisation, energy security and maintaining value for consumers' money remains as acute as it has been in past years, but is now somewhat complicated by the need for regulatory support for any new capacity.

Also the success of decentralised variable generation has created a need for demand side response technologies. In the past it was sufficient to ensure security of supply merely by managing the capacity margins, but now we need a more sophisticated response. New arrangement have been designed to ensure that schedulable power remains attractive to investors such as Short Term



Operating Reserve, Enhanced Frequency Response and Capacity Market contracts that work with new technologies such as energy storage systems. Many of these new market mechanisms do not offer investors the luxury of long term secure price support but instead try to compensate investors for taking merchant risk and therefore require a view to be taken on technological developments and power price trends. The power market is moving away from the security of long term fixed price contracts towards a more market driven model and the investors attracted by Feed-in Tariffs now must assess a new range of risks.

That said, 2016 saw something of a slowing of investment in decarbonised energy in the UK. The surge in investment that marked the end of the Renewables Obligation in 2015 has somewhat inevitably been followed by a slower 2016. Investors remain rightly reluctant to commit to conventional power due to a concern over assets becoming stranded as the market moves away from carbon. In parallel with the investment in demand-side response technologies, further investment in generation is a necessity, and in current circumstances this will largely be in renewables.

There remain many investors in the UK energy market seeking investment opportunities and the UK continues to enjoy a reputation as a well governed and stable environment for investment. As long as a consistent approach is taken to the main tenets of policy, such as decarbonisation and cost reduction, the UK power sector can continue to attract large volumes of inward investment.

2016 saw something of a slowing of investment in decarbonised energy in the UK.

While the market is not as simple as it was some years ago and investment targets are more diverse, there are a number of experienced managers who are able to find value without taking undue risk. Investors with a long-term well-informed view on the direction of travel of the market and of power prices can continue to find both volume and value in the new market.

Peter Dickson is the Chair of the REA Finance Forum. He is a Partner and Technical Director of Glenmont Partners, one of Europe's largest fund managers focusing exclusively on investment in clean energy infrastructure. He has over 14 years experience working in finance and the renewable energy industry.

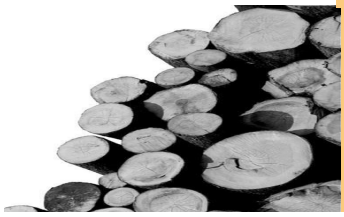
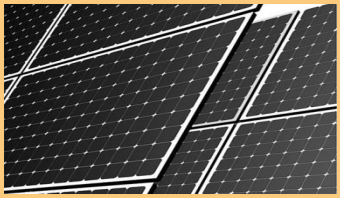
GLENNMONT PARTNERS

Alternative energy investme
Absolute returns

Glennmont Partners Overview
Alternative energy investment
Absolute returns

Leading independent infrastructure manager with strong track record

- Glennmont Partners is one of Europe's largest fund managers focusing exclusively on investment in clean energy infrastructure.
- We raise long-term capital to invest in alternative power generation projects, such as wind farms, biomass power stations, solar parks and small-scale hydro power plants.
- Glennmont manages for more than 40 institutional investors including blue chip European, Asian, Middle Eastern and American investors.
- Founded in 2007 by 4 Partners, Glennmont has successfully completed 24 investments totaling 849MW.
- With a highly experienced multinational European team with an impressive network of industry contacts, Glennmont's investment strategy is to diversify investments across geography and technology.
- Target technologies include bioenergy, offshore wind, onshore wind and solar PV.
- Glennmont has completed investments in France, Ireland, Italy, Portugal and the UK and invests in both construction and operational assets.

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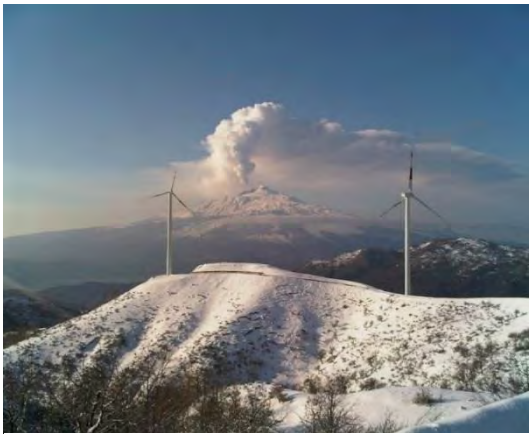

Glennmont's 245 MW wind farm portfolio in Italy

Part of Glennmont's 48 MW solar park portfolio in Portugal

Glennmont's 38 MW straw-fired biomass plant in the UK

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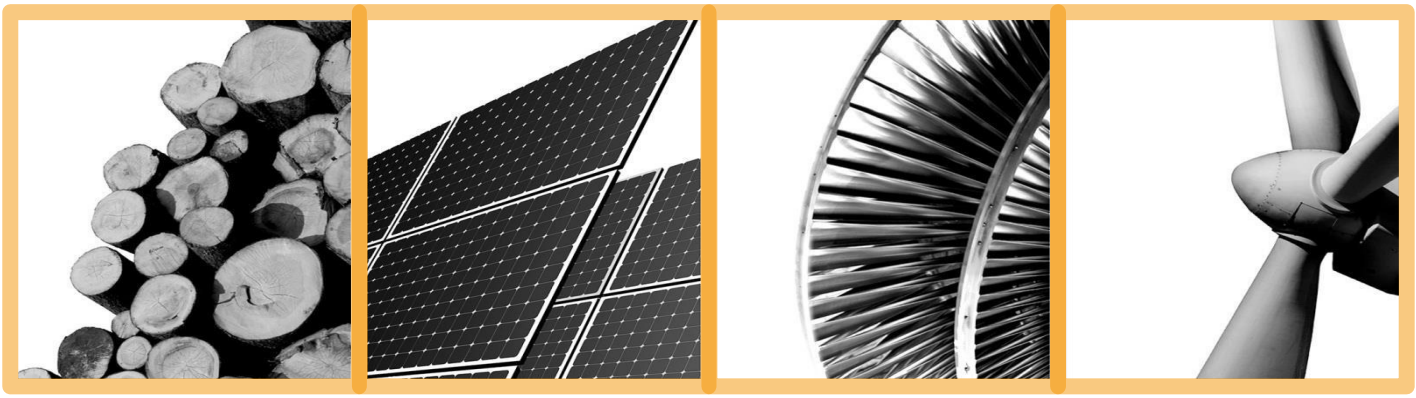

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KPMG

Renewable Energy Review

1. Summary

It has been an extraordinary year of political change. The UK has voted to leave the European Union and now triggered 'Article 50'. A 'new' Government was formed following the Brexit vote, with changes in almost every Cabinet position and a new Department created - BEIS - to bring together energy, business and industrial strategy. And we now face, at the time of writing, the prospect of another general election on 8 June. Further afield, we have seen President Trump seek to reverse the Clean Power Plan introduced by President Obama, question the science of climate change and promise a return to coal.

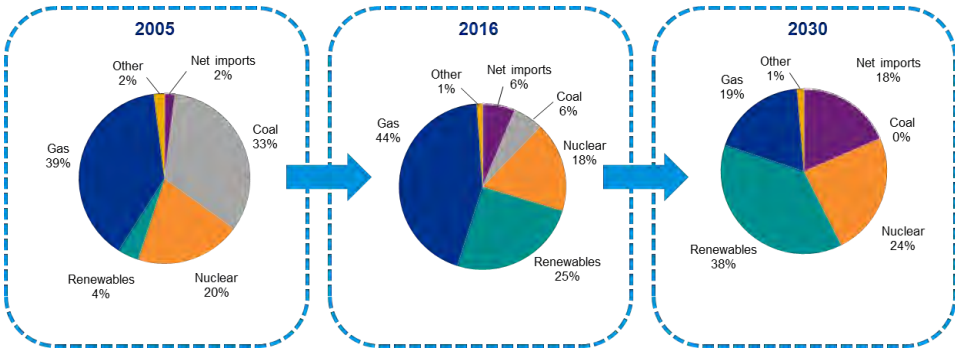
Despite all this turbulence, the renewables sector in the UK has continued to move ahead with record levels of capacity and deployment. Renewables reached 25% of power generation in 2016 and we saw the equivalent of £7bn worth of investment in renewable power projects commission during the year.

Crucially, the remarkable cost reductions in technologies like solar and wind have continued across the globe, bringing ever closer the prospect of renewables being deployed in the power market *without* the need for Government subsidies.

Indeed, the latest UK Government forecasts suggest that renewables will continue to grow in the 2020s as a share of GB power generation, even without further subsidies beyond the £730m already committed for future CfD (Contracts for Difference) auctions.

Outside the power sector, there has been less rapid progress on the take-up of renewable fuels. Biofuels in the transport sector have been broadly flat

Figure 1: Progress in the power sector: coal closures and increasing renewables penetration[1]



in 2016, compared to 2015. By contrast, the falling costs of battery technologies has accelerated the take-up of electric vehicles. On heat, renewable fuels have continued to deploy under the Renewable Heat Incentive. But big questions remain on how to decarbonise the UK's heating system, which remains overwhelmingly dependent on natural gas.

What is becoming clear is that, whilst Government policy has been the main driver of the growth in renewables in the GB power market over the past 10 years, it will be the falling costs of technology that provide the main impetus to continued growth over the decade ahead.

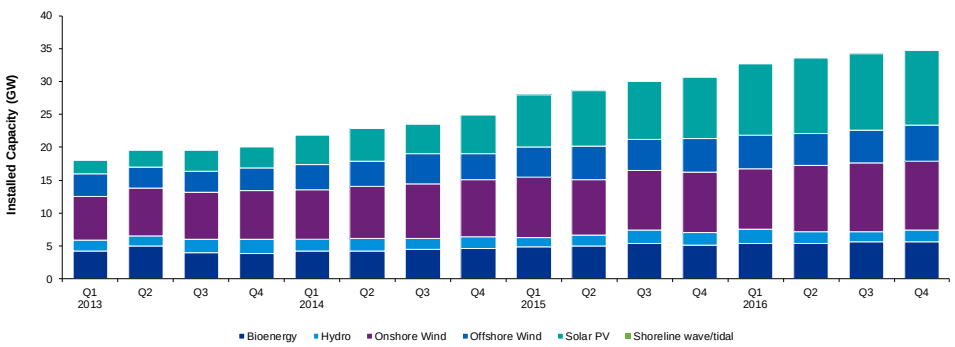
2. Power

In the power sector, renewables deployment continued to increase, reaching 25% of power generation for 2016 as a whole. This compares to 4% in 2005. Coal's share of generation continued to shrink (to about 6%), and we saw some days in 2016 with periods where there was no coal generation at all for the first time since the 1880s.

The closure of the Renewables Obligation (RO) to new projects led to a surge in new capacity in the first half of 2016.

Looking ahead, the next auction for CfDs (Contracts for Difference) is due to take place in the summer of 2017. Strike prices for offshore wind are expected

Figure 2: Renewable Electricity Capacity 2013-16[2]



to fall significantly from the levels seen in the first auction held in 2015 (lowest clearing bid £114/Mwh). In recent European auctions, clearing prices have been below €50Mwh in some auctions, although these projects are generally near shore and there are differences in what the prices cover (for example, grid connection costs are generally excluded in European markets). DONG Energy and EnBW recently committed to build 3 offshore wind farms in Germany in the mid-2020s without any Government subsidy.

In terms of policy developments over the past year, the 'new' Government led by Theresa May has confirmed the £730m allocated to future CfD auctions. Decisions on the future of carbon pricing in the 2020s, and the future of the Levy Control Framework (LCF), have been delayed, and won't now be made until the Autumn of 2017 at the earliest.

3. Transport

There was less rapid progress on renewables outside the power sector. Biofuels volumes were broadly flat in 2016 compared to 2015. As a result, the UK remains well behind the 10% target for renewable fuels set out in the 2009 EU Renewable Energy Directive.

By contrast, the take-up of electric and hybrid vehicles is starting to accelerate. This reflects both the falling costs of these vehicles, spurred by lower battery costs, but also continued Government support through innovation funding and support for charging infrastructure. The electrification of the vehicle fleet now seems likely to make a significant contribution to the decarbonisation of the transport sector over the next decade.

Figure 3: Liquid Biofuels for Transport Consumption[3]

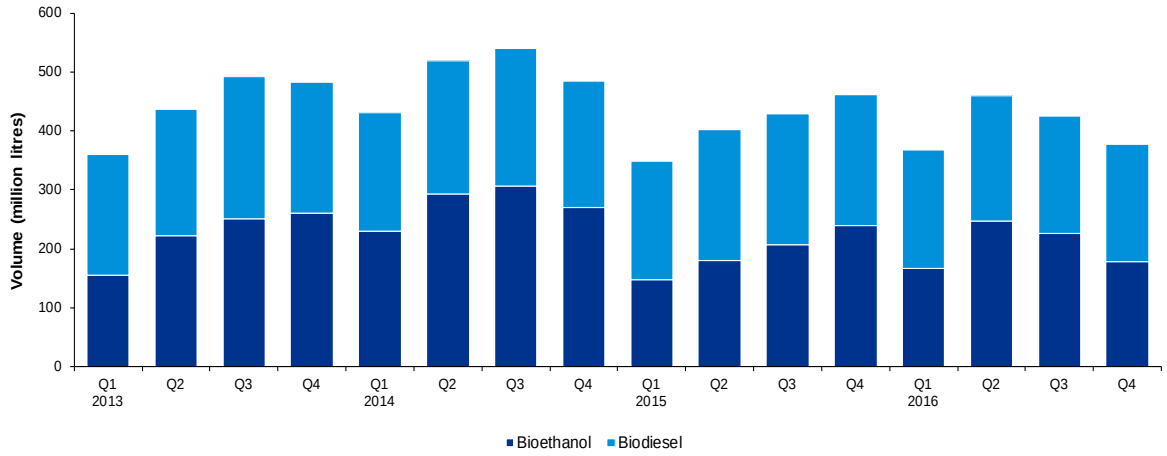
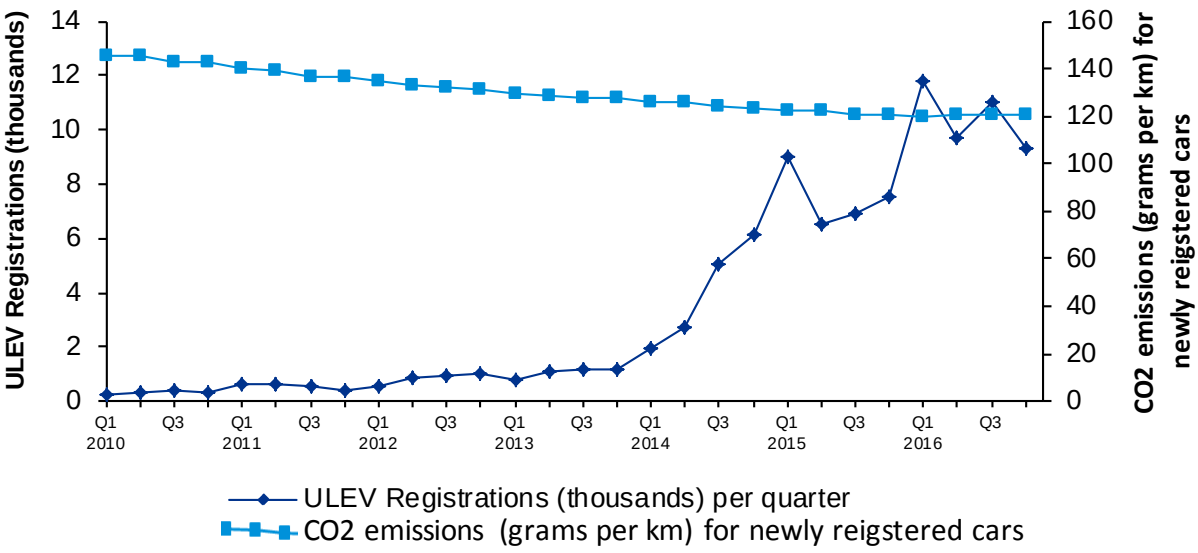


Figure 4: Registration of new ULEVs (Ultra-Low Emission Vehicles) in the UK versus average CO_2 emissions for all newly registered cars[4]



4. Heat

Heat is responsible for almost one half of total greenhouse gas emissions in the UK. There has been some continued deployment of renewable sources of heat under the Renewable Heat Incentive (RHI). This has mainly gone towards biomass boilers.

However, the UK is expected to fall well short of the 12% share of heat coming from renewable sources that would be required to meet the 2020 Renewable Energy Target. Moreover, longer term, there remain big questions about the how the Government intends to decarbonise the heating system in a way consistent with the UK's own legally-binding Carbon Budgets.

Significant progress has been made in improving energy efficiency in the domestic sector over the past two decades. For example, the average UK household has reduced CO_2 emissions by 4.7 tonnes between 1990 and 2014. But a further reduction of 3.6 tonnes by 2030 is needed to keep the UK on track in meeting 2050 targets set by the Climate Change Act 2008.

Figure 5: Renewable heat generation[5]

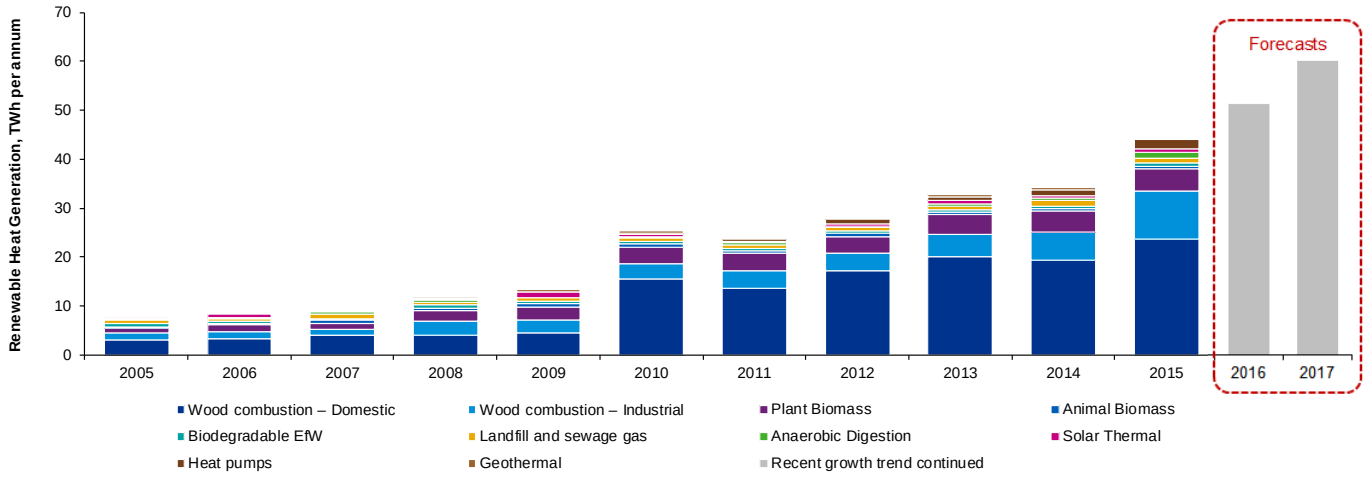
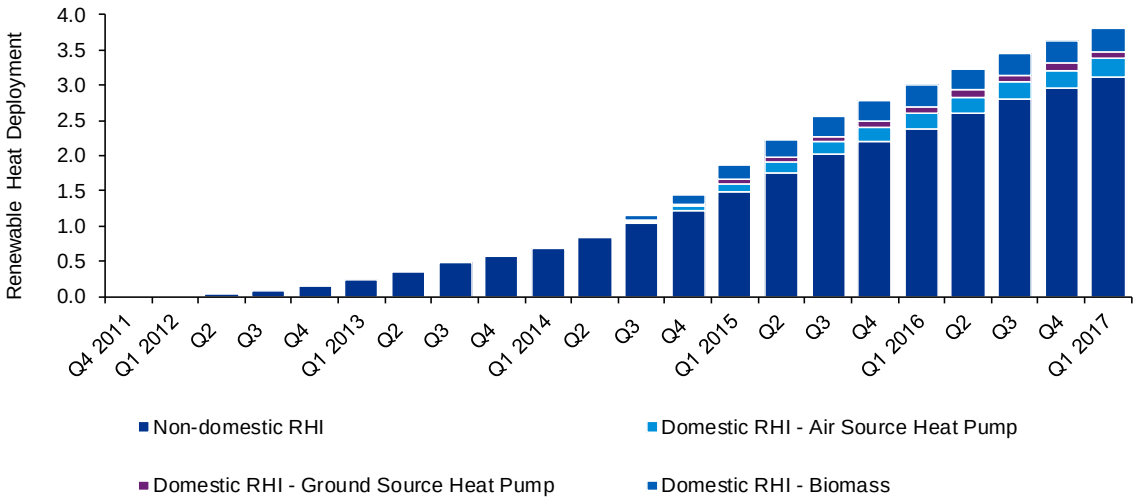
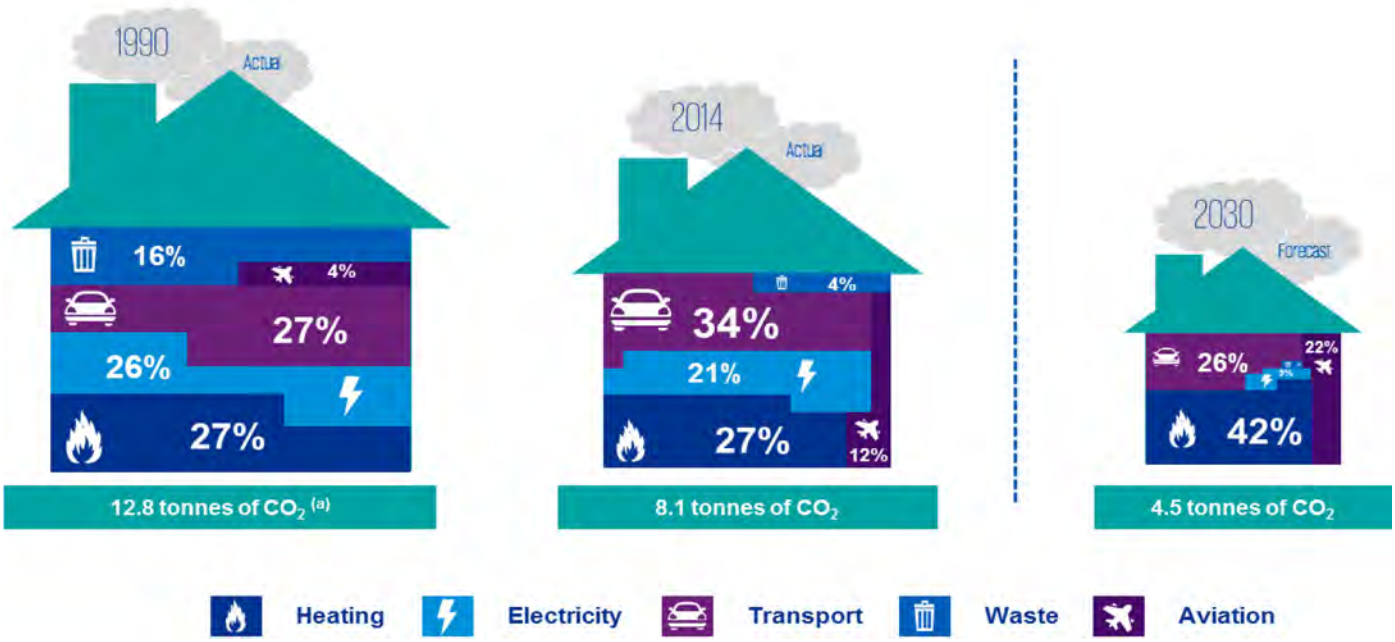


Figure 6: Deployment of Renewable Heat under the Renewable Heat Incentive[6]



Note: The Non-domestic RHI scheme began in 2011, while the domestic RHI started making payments in 2014. Domestic RHI installation has been estimated using Ofgem and BEIS data on the cumulative number of installations per technology and the average capacity per installation; solar thermal, which comprises 15% of domestic RHI installations, has been excluded from this chart, as average capacity per installation data was unavailable.

Figure 7: Heat is expected to remain a significant part of the average household's energy usage[7]



5. Total Renewable Energy

In summary, the UK has continued to make good progress on renewables in the power sector, but has made less progress with renewables deployment in transport and heat. Overall, the UK is still behind on where it needs to be to meet its 2020 EU target. However, with the UK now leaving the EU before 2020, it is not clear how important this 2020 target will now be. Indeed, there is some speculation that it could be one of the pieces of EU legislation that gets repealed as part of the Great Repeal Bill post-Brexit. Irrespective of the EU target, further deployment of renewables will be needed to meet the UK's own targets under the 2008 Climate Change Act.

Figure 8: Share of renewables in gross final energy consumption, 2014 and 2020[8]

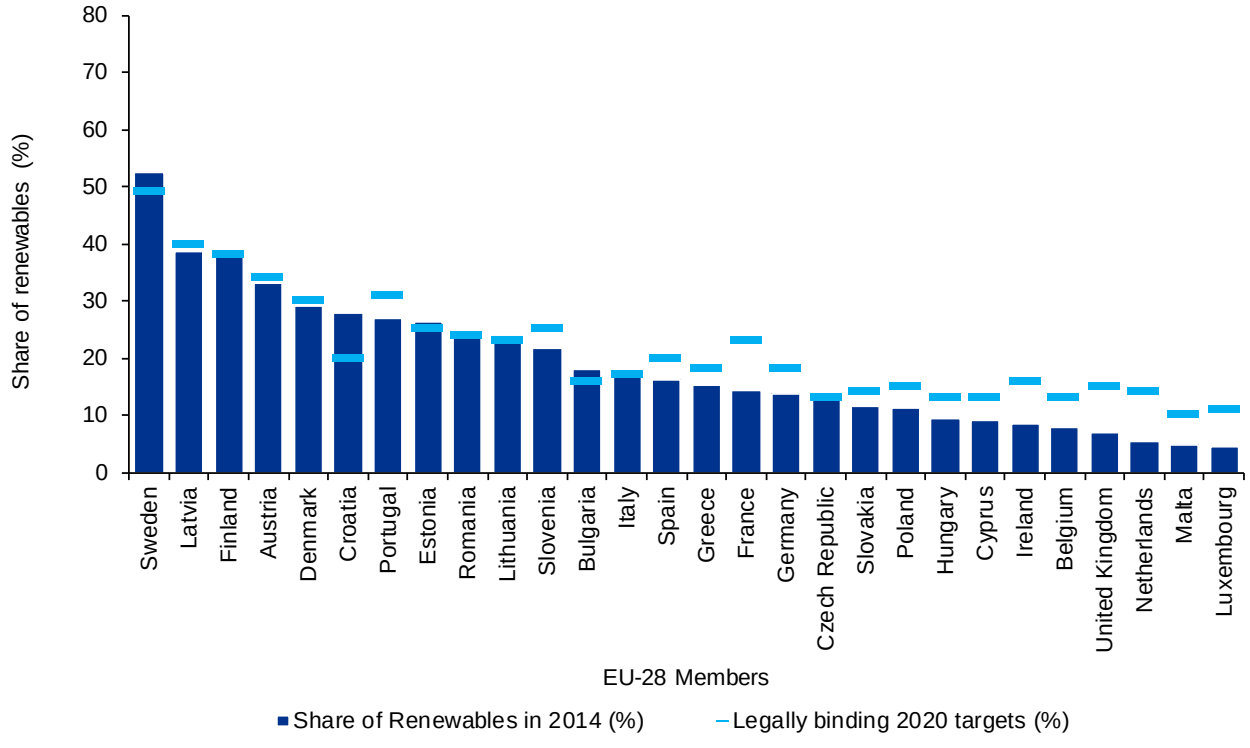
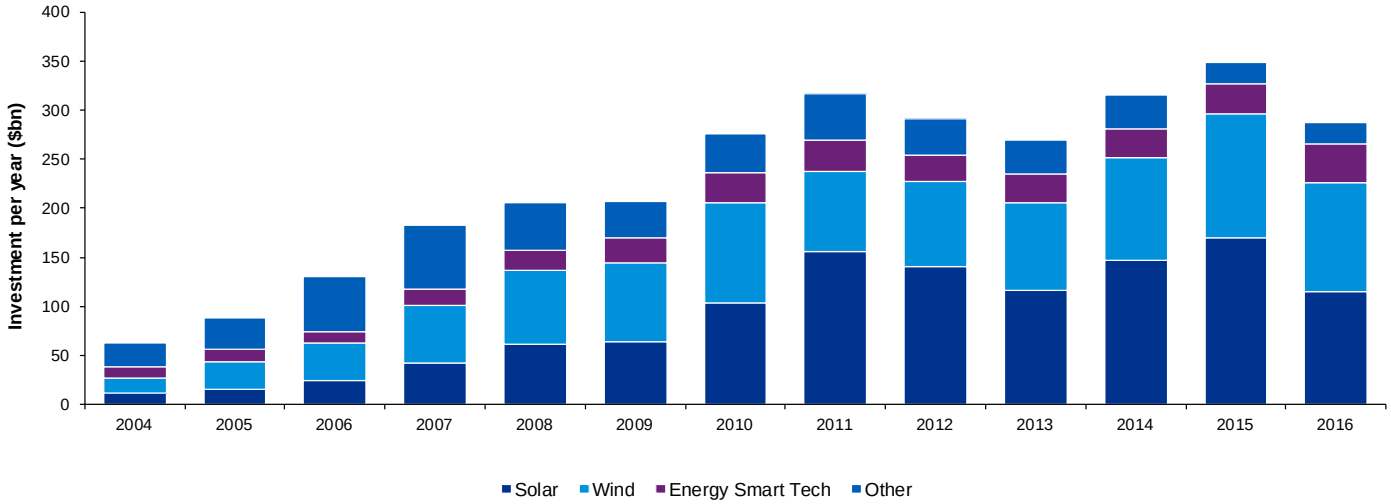


Figure 9: New investment in the global clean energy sector[9]



6. Investment

Globally, investment in clean energy fell last year compared to the records set in 2015. In part, this reflects the falling costs of solar and wind across the globe; but also reductions in Feed-in Tariffs in key markets like China and Japan reflecting those falling technology costs.

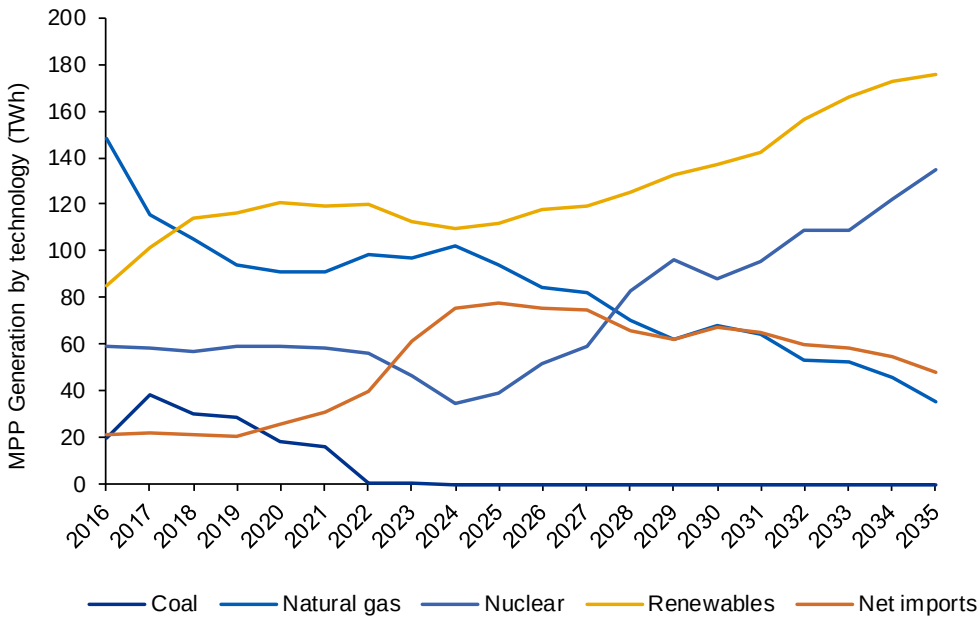
In the UK, investment in offshore wind continued to move ahead, including a number of projects reaching Final Investment Decision (FID). In the secondary market, we have seen a significant number of transactions in 2016, with new entrants into the offshore wind market, like China's SDIC buying into the Inch Cape and Beatrice projects. Institutional investors are also becoming more comfortable with offshore wind as an asset class and this is being reflected in the implied discount rates on secondary transactions.

Investment in new onshore wind projects in the UK has now slowed following the closure of the RO and the absence of any CfD ('Pot 1') auction for onshore projects. However, there has been a steady stream of secondary transactions, such as the sale of the Infinis Onshore Wind portfolio.

In solar, investment in large-scale ground mounted projects has also dried up following the closure of the RO to new projects in 2016. However, the secondary market has been buoyant, spurred on by low interest rates and higher inflation as a result of Brexit. We are now also seeing the development of business models for solar and storage that do not depend on subsidy through the Feed-in-Tariff (FIT).

In total, the renewable power projects commissioning in 2016 were the equivalent to an investment of around £7bn in the sector.

Figure 10: UK Government forecasts for the power sector[10]



7. Looking ahead

The latest Government projections published in March 2017 show continued growth in renewables in the power sector throughout the 2020s, with renewables reaching almost 40% of power generation by 2030.

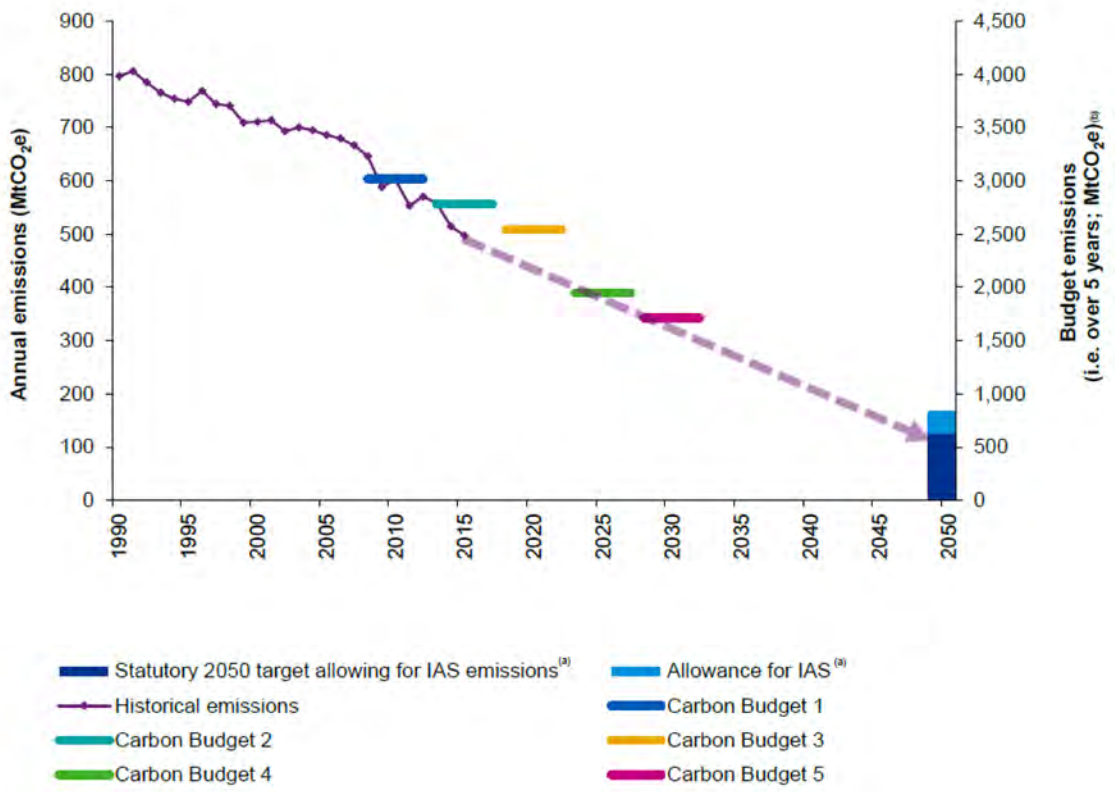
This is despite recent subsidy cuts and no commitments from Government to any further subsidy support beyond the £730m already committed. This reflects the fact that key technologies, like solar and wind, are assumed to be cost competitive and deploy *without* subsidy in the second half of the 2020s.

This continued growth in renewables will be necessary if the Government is to meet the fourth and fifth Carbon Budgets which are now legally-binding. The Government's Emissions Reduction Plan, due in the summer of 2017, is expected to set out the policy framework for meeting these targets at least cost to consumers, and maximum benefit in terms of jobs and investment.

The second CfD auction is also due this summer. If the recent trends in European auctions are followed, then this could see a significant reduction in the cost of offshore wind compared to the first auction in 2015.

Falling technology costs in solar, on- and offshore wind offer the prospect of renewables being able to deploy without Government subsidy in the UK market in a few years' time. Despite the political turbulence the sector faces, this means a bright and exciting future for renewables in the years' ahead.

Figure 11: UK Greenhouse Gas (GHG) emissions against legislated budgets and 2050 target[11]



[1] Department for Business, Energy and Industrial Strategy (BEIS) 2016 Updated Energy and Emissions Projections
[2] Department for Business, Energy and Industrial Strategy (BEIS) Energy Trends, March 2017
[3] Department for Business, Energy and Industrial Strategy (BEIS) Energy Trends, March 201.
[4] Department for Transport. Note: Ultra Low Emission Vehicles (ULEVs) are vehicles with fully electric powertrains and cars and vans with tail pipe emissions below 75 g/km. The ULEV figures are for Great Britain in 2010 and for the United Kingdom from January 2011 onwards.
[5] Renewable Energy Association (REA) analysis, DUKES
[6] Department for Business, Energy and Industrial Strategy (BEIS)
[7] Committee on Climate Change. Note: The figures displayed are in 'tonnes of CO_2 equivalent' since they also include other greenhouse gases, like methane.
[8] Eurostat, 2016
[9] Bloomberg New Energy Finance 2016
[10] BEIS 2016 Updated Energy and Emissions Projections
[11] Committee on Climate Change; Notes:
(a) International Aviation and Shipping (IAS) emissions are the only non-negligible source of emissions currently excluded from carbon budgets. In order to remain within international goals supported by the UK, IAS emissions are, however, anticipated to eventually be taken into account in meeting 2050 objectives.
(b) Axis figures on RHS are five times that of LHS figures, as carbon emissions are measured for budgets using five-year intervals.

Simon Virley CB FEI
Head of Power & Utilities
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Policy and Campaigns

2016 - A year of Parliamentary events

As the REA navigated the political shocks of the past year we continued to host a wide range of parliamentary events designed to raise awareness of members key issues and create momentum for action.

Such parliamentary work revolved largely around the two All-Party Parliamentary Groups (APPGs) that the REA serves as secretariat for. Both groups bring together MPs and Peers from across the political spectrum to discuss issues and act as a forum for parliamentarians and industry.

Bringing biomass to the fore

The APPG on Biomass hosted events highlighting the sustainability of biomass, the benefits derived from CO_2 emissions reduction compared to fossil sources, and how the dispatchable power produced can complement variable renewable electricity.

A diverse range of individuals came to the group's events. In September at a parliamentary reception we welcomed Andrew Percy MP (Con), Minister for the Northern Powerhouse who gave a rousing speech about the economic benefits of biomass and its supply chain to northern England, including a boost to ports and shipping. Angus MacNeil MP (SNP) spoke to the importance of emissions reductions and the role that biomass can play in phasing out coal. Greg Houlahan, Minister-Counsellor at the High Commission of Canada to the UK spoke to the fresh opportunities for international trade and cooperation between the UK and Canada because of the growing biomass supply chain. As ever the group was led by the Chair Nigel Adams MP (Con), a longstanding biomass supporter and champion.

Energy storage opportunities

The APPG on Energy Storage hosted five parliamentary events in 2016/17. Each event was unique and profiled the various opportunities that storage presents for grid decarbonisation, energy security, and international export. Discussions ranged from the benefits of battery storage in homes to the construction of pumped hydro dams in the Scottish Highlands and in Welsh quarries. Over the year a few key messages emerged; with a supportive policy regime significant domestic deployment is possible, and such domestic deployment will be largely privately funded, rolling out energy storage at all scales can help address energy security concerns, and supporting the growth of a healthy domestic industry is an important step towards the UK exporting storage-related technology and expertise.

The group's September event highlighted many of these themes as it welcomed representatives of the Confederation of Indian Industry and the Foreign and Commonwealth Office

From left: Dr Daniel Bradley, FCO; Bridgit Hartland-Johnson, Siemens; Dr. Bhupendra Kumar Singh, CII; Peter Aldous MP; Stephanie Ordan, Eaton; Dr. Nina Skroupska CBE, REA.

to speak alongside major industrial forces such as Siemens and Eaton. Britain was spoken about as one of the top global markets for storage and one of the best places to invest and develop experience around this technology due to the strength of our universities, manufacturing base, and high renewables deployment to date. The CII outlined the opportunities to export storage technologies and expertise into India as the country pursues an ambitious programme of solar PV and wind deployment to 2030.

In December the group's Winter Parliamentary Reception was a success with over 75 representatives of the NGO, industry, public sector and parliamentary communities in attendance. The APPG will continue its activities in 2017 under the on-going leadership of Peter Aldous MP (Con) as its Chair.

New collaborations

In June the APPG on Energy Storage worked with the All-Party Parliamentary Climate Change Group to host a joint event highlighting the role of energy storage in addressing climate change and we look forward to working with other groups in the year ahead.

Making Food Waste Count
Renewable Energy Association

Food waste counts – the campaign for UK-wide separate food waste collections

The REA leads the Food Waste Counts campaign for UK-wide separate food waste collections. Beginning with a public and industry-focused petition in September 2015, then building into a report on the economics of separate food waste collections (concluding that businesses and local authorities can save money) in the past year the campaign moved into a parliamentary phase. At present over 7 million tonnes of food waste goes to landfill each year. This is a wasted opportunity to feed people, to produce green energy, and to reduce greenhouse gas emissions from landfill.

Background

The last twelve months have seen a stalling in the national recycling rates with the latest figures showing that the UK recycling rate is stuck at 44%. This is a slight reduction from the previous year, clearly indicating the need for fresh action if the UK is to meet its 2020 recycling targets. Polling appears to support such action. Data released in Spring 2017 by think-tank Bright Blue indicated that Conservative voters are overwhelmingly supportive (91%) of strengthening or maintaining household recycling targets post-Brexit.

From the left: Jeremy Jacobs, REA and Kerry McCarthy MP

Although there has been some growth in food waste collections from local authorities within the last 12 months, growth has been painfully slow with any new food waste collection initiatives offset by those stopping collecting food waste due to cost constraints posed on them through funding cuts from central government.

Green waste collections (which are offered to 90% of English households) have been slowed by a significant number of Local Authorities now charging for this service. This is a retrograde step resulting in the collection of less green waste for subsequent treatment. It is anticipated that the remaining 45% of local authorities not charging for green waste collections will do so shortly as a means of raising funds.

Scotland, Wales and Northern Ireland have implemented a mandatory food waste collection regime with Wales now offering food waste collection to 95% of residents. In England less than 50% of households have the opportunity to have their food waste recycled.

A number of local authorities are moving to three weekly residual waste collections. If this initiative is combined with weekly food waste collections then we may see some growth in the future, as a result of re-allocation of resources at a local level.

Theresa Coffey MP has recently made it clear that she does not support a policy change to mandate food waste collections but that change should be initiated by Local Authorities working in conjunction with industry.

While collaboration between industry and Local Authorities is certainty taking place, due to a lack of direction and leadership from Defra recycling has stalled. This will only be jump-started through policy change and strong leadership.

REA actions

In November the REA's Food Waste Counts campaign (www.foodwastecounts.co.uk) worked with the APPG on Food Waste to host a roundtable in Portcullis House highlighting the importance of, and opportunity of, UK-wide separate food waste collections. A range of voices contributed to the discussion, including representatives from West Sussex County Council, Eunomia Consulting, the Local Authority Recycling Advisory Committee, WRAP, and industry players such as Biogen. The discussion was Chaired by parliamentary food waste champion Kerry McCarthy MP and attended by parliamentarians from both Houses, civil servants, and political aides.

Methodology

METHODOLOGY - INNOVAS (JOBS DATA)
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 and clean tech sector by technology or geographical area had not been published until REview.

For the first time this year we have also included data on the energy storage and EV sectors.

The REA produces 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 email any feedback to; review@r-e-a.net

Definition of sector

The research undertaken by Innovas is based upon a data methodology developed by Knowledge Matrix Ltd and used widely in the UK. This 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&D[1] 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 triangulation[2]) 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 the 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:
Biofuels: For 2015/16 the methodology being used for calculating jobs and turnover in the biofuels sector has been amended to reflect the usage in transport fuels, rather than simply looking at unblended uses for the product. Using this revised methodology, for 2015/16 the turnover for the sector is forecast as being £1.5bn, with an estimated 10,000 people working in the sector.
Deep geothermal: The REA's deep geothermal sector group provided the data for this technology using current industry knowledge.
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 an acceleration in the growth of solar since the introduction of the small scale Feed-in Tariff in 2010. Changes to the FiT and RO policy in 2015 lead to a surge in deployment. Due to the lag in official figures reflecting this activity, actual deployment might be higher than is stated in this edition of REview.

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 the 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.

METHODOLOGY - REA (DEPLOYMENT DATA & GROWTH PROJECTIONS)

The intention of this report is to present both historic data and forward projections for renewable energy capacity and generation from authoritative sources, so that the reader can judge progress to date as well as the government's view of the contribution that might be made in 2020, the year by which the Renewable Energy Directive (RED) requires the UK to have achieved a 15% contribution to energy consumption from renewables. The RED also has a subtarget for all Member States to achieve a 10% renewable energy contribution in the transport sector.

We have therefore chosen to draw on official government sources for the graphs in each technology section. The one exception to this is where the average annual capacity growth rate achieved since 2009[1] has been used to extrapolate what further growth would be achieved in the following two years if this average growth rate were to be maintained: a "trends continued" projection. *It must be stressed that this extrapolation is for indicative purposes only - there is no suggestion that future performance will follow that of the recent past*, but the purpose is to show what could be achieved if recent trends were to continue and to further allow comparison with Government's various projections for 2020.

The Renewable Electricity Sector

Renewable electricity deployment statistics are published by BEIS quarterly in Energy Trends and annually in its Digest of UK Energy Statistics (DUKES)[2]. The first full data for 2016 were published in Energy Trends on 30th March 2017 and were used to produce the graphs for historical capacity and generation from 2009, as shown below. For capacity deployment in 2017 and 2018 we have shown the 2016 deployment plus the additional capacity that would be deployed if the average annual growth rate over the period 2009 to 2016 was maintained.

In order to compare past performance with projections for 2020, we have drawn on three BEIS sources, the first of which we consider to be the most authoritative:

1. As part of its Electricity Market Reform Delivery Plan, the then DECC published National Grid's EMR Analytical Report in December 2013[3]. The report provides modelled capacity and generation projections for 2020 for a number of scenarios - we have used the reference scenario (described as 'Scenario 1'). In order to present UK data by technology we undertook the following calculations: a) Data for Great Britain were combined with those reported separately for Northern Ireland to produce UK totals for 2020; b) We obtained from DECC a breakdown of the data classified as "Other renewables" and were therefore able to distribute the capacity and generation by technology. We consider these to be the most authoritative projections as they form the basis of forward planning under EMR.
2. Under the RED, each Member State was required to publish a National Renewable Energy Action Plan and the UK's was published by DECC in 2010[4]. Although somewhat dated now, it provides the Government's official statement of how it plans to fulfil the UK's obligations under the Directive. In particular Tables 10 - 12 provide year-by-year indicative projections of deployment, broken down by technology, from 2010 to 2020 for electricity, heat and transport.
3. Finally, every year BEIS publishes Updated Energy Projections (UEPs), analysing and projecting future energy use and greenhouse gas emissions in the UK, based on assumptions of future economic growth, fossil fuel prices, electricity generation costs, UK population and other key variables. Renewables are only one part of the UEP, indeed the technology breakdown for renewables was only published in November 2013 following a special request, two months after the initial publication[5]. We have included the UEP projections for comparative purposes. As for the EMR projections, a significant share of deployment is classified as 'Other renewables' and this has been broken down by technology using the same split as used for the EMR data. BEIS is keen to emphasise that none of its projections constitute targets and they should not be viewed as such. Nevertheless, particularly the most recent ones provide a useful view of how BEIS envisages each technology contributing to deployment in 2020 and a benchmark against which to judge progress to date. It must be remembered that the 2020 renewables target is expressed as a percentage share of energy consumption, so the amount of renewable energy required in 2020 will vary according to changes in energy demand; at present BEIS is projecting demand to fall between now and 2020.

The Renewable Heat Sector

Just at the point of going to print the 2016 renewable heat generation figures were published in BEIS's Energy Trends[6]. For completeness we have included the headline figures in the introductory sections. However it is a different data set (Energy Trends) to that used in the detailed charts (DUKES) therefore to ensure consistency we have not changed the sector-specific heat charts, as Renewable heat consumption statistics are only published annually in DUKES (in late July) so the latest year for which data exist is 2015[7]. There are no data currently published for capacity however these could be inferred by using average load factors. With the advent of the Renewable Heat Incentive (RHI) BEIS has started to publish monthly data on the capacity of accredited installations, however this still forms a small share of the UK's total renewable heat capacity. Future annual updates of this report will continue to monitor progress of deployment under the RHI, as this will be the Government's main measure in support of achieving its ambitious goal of achieving around 72 TWh renewable heat in 2020. As renewable heat consumption data are only available to 2015, the two year 'trends continued' extrapolations only cover the years 2016 and 2017. We will need to wait until the data for 2016 are published in late July 2017 to see whether the RHI has had a noticeable impact on growth. However, it must be noted that renewable heat consumption is, like heat consumption generally, strongly dependent on seasonal and annual temperature variations. Annual fluctuations in demand will therefore be superimposed on any growth in uptake of renewable heat technologies.

In order to compare past performance with projections for 2020 there is only one source to draw on: the National Renewable Energy Action Plan published in 2010.The NREAP's heat projections to 2020 (Table 11) however, do not correlate well with the original DUKES data for NREAP's year of publication (6.0 TWh in NREAP versus 13.6 TWh in DUKES for 2010) and there is no clear explanation given for the discrepancy. Equally, the renewable heat production in NREAP does rise to 72 TWh in 2020, equivalent to the 12% figure set out in the 2009 UK Renewable Energy Strategy. For the latest year (2015) DUKES suggests that

Methodology

with 31 TWh achieved, the UK is well ahead of the NREAP trajectory (9 TWh) but this comparison needs to be treated with great caution. We will continue to engage with BEIS in the hope that an updated trajectory for renewable heat to 2020 can be provided.

The Renewable Transport Sector

Statistics on the UK consumption of liquid biofuels for transport are published quarterly by BEIS as part of Energy Trends, drawing on HMRC's Hydrocarbon Oils Bulletin[8]. The data in Table 6.2 of Energy Trends published on 30th March 2017 include annual consumption data for bioethanol and biodiesel from 2005 to 2016. The Department for Transport in turn publishes quarterly reports under the Renewable Transport Fuel Obligation, including the national origin of the biofuels supplied under the Obligation[9], from which it can be seen that UK sourced biofuels have varied between 8% and 22% of the total supply since 2008.

Projections for 2020 again rely on the National Renewable Energy Action Plan published in 2010 (Table 12). Projected growth is based on achieving the RED's sub-target of a 10% renewable contribution to transport by 2020 and includes a small but growing contribution from renewable electricity.

The Energy Storage Sector

Deployment figures are from the REA's forthcoming Energy Storage: Market Overview report, 2017 edition. There is no central Government source of data for UK energy storage projects. Baseline 2016 figures comprise projects identified from the REA's research and verified projects on the US Department of Energy's global project database.

The future deployment projections (REA 2021 Low, Medium and High scenarios) are taken from a forthcoming 2017 REA report on possible UK energy storage deployment in 2021. The scenarios make a series of modelled assumptions regarding policy and regulatory changes and their resulting impact on storage deployment figures.

The BEIS future deployment projection for 2021 is taken from the 'BEIS Updated Energy & Emissions Projections', published 15 March 2017[10].

The Electric Vehicle Sector

Department for Transport (DfT) Vehicle Licensing Statistics- Table VEH0170[11].
The DfT uses the term 'ultra-low emission vehicles' to refer to vehicles with significantly lower levels of tailpipe emissions than conventional vehicles. In practice, the term currently refers to electric, plug-in hybrid and hydrogen fuel-cell vehicles. For the purposes of this indicator, all vehicles with fully electric powertrains, and cars and vans with tail-pipe emissions below 75 g/km of CO_2 have been included.
Data is available for Great Britain only.
The data includes all vehicles of models that are eligible for the Plug-in Car and Van grants at the date of latest table update. Therefore earlier data in the series may be changed retrospectively as models are added to the eligible list.

New electric car registrations utilises extracts data from The Society of Motor Manufacturers and Traders[12] (SMMT). Please note: Since the launch of the Plug-In Car Grant in January 2011, there have been 104,197 eligible cars registered. Additionally, please note: this data includes only new car registrations and not commercial vehicles.

The National Charge Point Registry[13] (NCR) was established by the UK Government in 2011 to provide a public database of publicly-funded charge points across the UK in support of the Government's objective to promote the use and sales of Ultra Low Emission vehicles (ULEVs) in the UK.

The New EV registration 2020 scenario is taken from the Committee on Climate Change[14]. The prediction for 2020 charge points is based on Nissan GB's forecast[15] . Nissan manufacture the UKs largest selling EV, the Leaf.

1 2009 was the year that the Renewable Energy Directive was implemented and the UK's Renewable Energy Strategy published.
2 Energy Trends can be accessed at http://bit.ly/2tQm1FB and DUKES at http://bit.ly/1kJJj4W. Data in this report were taken from Table 6_1 of Energy Trends, published 31st March 2016. Data for the Biomass Power chapter are the sum of 'Plant Biomass' and 'Co-firing'. Data for the Mixed Waste to Energy chapter are the sum of 'Landfill gas', 'Sewage sludge digestion', 'Energy from waste' and 'Animal Biomass (non-AD)'.
3 National Grid's report and other documents relating to the EMR Delivery Plan are available at http://bit.ly/19nj6pn
4 The UK's National Renewable Energy Action Plan is located at: http://bit.ly/1m6i9bd
5 DECC's main 2013 UEP page is http://bit.ly/2thkv2i and the renewable energy breakdown is published at: http://bit.ly/1VVKDXZ
6 BEIS's Energy Trends statistics are at http://bit.ly/2ueaiU6
7 DUKES is located at http://bit.ly/1yp8PnP. Data in this report were taken from Table 6.6, published 28 July 2016. Data for the Biomass Boilers chapter are the sum of 'Wood combustion - domestic', 'Wood combustion - industrial' and 'Plant biomass'. Data for the Mixed Waste to Energy chapter are the sum of 'Landfill gas', 'Sewage sludge digestion', 'Animal Biomass' and 'Biodegradable energy from waste'.
8 The Bulletin is available at http://bit.ly/1weoBBn
9 RTFO statistics are at http://bit.ly/1NAzp8K
10 BEIS statistics are at http://bit.ly/2mTDatk
11 ULEV statistics are at http://bit.ly/1I9Zx5J
12 SMMT statistics are at http://bit.ly/2sU0zOh
13 NCR statistics are at http://bit.ly/2tOL7ru
14 Committee on Climate Change projections of EV registrations, December 2013: http://bit.ly/2tZRLeE
15 Nissan forecast over 7,000 EV charge points (15,900 charging positions) by 2020: http://bit.ly/2txPAfq

IMAGE ACKNOWLEDGEMENT / CREDITS

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