2018

REVIEW

RENEWABLE ENERGY VIEW

THE AUTHORITATIVE ANNUAL REPORT ON THE UK RENEWABLE ENERGY SECTOR

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GROWING THE RENEWABLE ENERGY AND CLEAN TECH ECONOMY

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Foreword Dr Nina Skorupska CBE

Chief Executive, REA

Reframing our energy future

What will I remember the most as Chief Executive of the Renewable Energy Association in 2017?

I think I would have to say a strange sense of relief and vindication (of all the REA and its members' efforts in the last years) when I read the Clean Growth Strategy. It stated so clearly that growth in the UK's economy is not hindered by the need to decarbonise, but central to future economic growth. What an important message! All the way through the document you could also see the growing recognition that renewable energy is not what will make our energy unaffordable or less secure, but how it will be even more instrumental, to meet the 5th Carbon budget by 2032.

Can we therefore say that the "Trilemma" is dead and shout "long live low carbon energy"! The Industrial Strategy followed hot on the heels of the Clean Growth Strategy, with it being anchored as one of its Grand Challenges, would suggest so! Backed up by august institutions such as the Bank of England that pointedly challenge financial institutions and corporates alike to recognise they need to do more to understand the risks posed by Climate Change. Important ratings agencies will assess how effective the measures that they are taking are (if any) to mitigate the impacts of climate change on their business and stakeholders' interests, as well as society as a whole.

Following the political upheavals of previous years, we certainly needed clearer frameworks for the future and these strategies help. Whilst the REA team and I have criticised what is in them (or more importantly, what is not… such as recognition of the importance of enabling solar, the need for a bioenergy strategy, etc.) and the Government still continues to back its uneconomic "favorites", we at least have something to work with in 2018 and beyond. We now need actions and not just words and we are seeing some. The Industrial Strategy

is making a strong push to make the most of our academic prowess with the formation of new innovation hubs for key sectors and new collaborations such as we have seen with the Faraday Institute and battery technology development. The Smart Systems Flexibility Plan (published in July 2017) is also evidence of an action-orientated framework to enable energy storage and other smart technologies to play their part in the UK energy market.

> "Trilemma" is dead and shout "long live low carbon energy"!

All of this is overshadowed by Brexit and there is no denying that it is clearly impacting everything. Whether it is getting time to progress important legislation in Parliament that can unlock the next phase of renewable deployment for heat and transport, through to having the chance to meet with knowledgeable civil servants that are key to putting the flesh on the bones of these new strategies. Many have left their original departments to feed the insatiable appetite for staff of the Department for Exiting the EU (DexEU). I am clear that we have to be able to navigate the breadth and complexity of challenges that Brexit will bring. It is only by working with like-minded organisations that have created EURIS (a coalition of bodies to shape clean technology trade post-Brexit) and the support of our own members that we can hope to try to influence and make sense of decisions being made at the highest political levels.

Away from the political and policy arena, we saw the industry itself continuing to radically change. We started to see the shift in business models and how technology is deployed in 2016, continued in 2017, but there are still many changes yet to happen. Even the Industrial Strategy recognises the burgeoning "energy revolution" that renewable energy and clean technologies are enabling and aims to see consumers from all walks of society prosper, and the UK to lead the charge. The "Independent Cost of Energy" Helm Review commissioned by the Government ("as a no-holds barred look at how we deliver more affordable energy, to look at how we keep the lights on, while decarbonising, how we create innovation, and how we balance those relationships and those responsibilities between the public sector and the market" to quote BEIS Minister Claire Perry MP) also recognises that the energy market is becoming increasingly consumer-driven and "the pyramid of supply and distribution is turned upon its head" such that we ARE now realising some of the potential of the investments UK Government supported over recent years in new clean energy technologies.

All of this continues to be underlined by falling technology costs from increased deployment and investment internationally. There is no denying that renewable energy and clean tech is one

of the fastest growing industries in the world. Here in the UK the question only remains as to how fast the UK can take advantage of this? How, other than stating it in strategies and plans, can we demonstrate UK leadership?

The 2018 Renewable Energy View (REview) looks across what has been achieved in 2017 and reveals whether we are on track to demonstrate UK leadership, as well as our commitment to our current EU partners. It again builds on our previous reports. Any growth in the economy is measured in a number of ways and needs important and robust employment data. Our work with Innovas again allows us to breakdown the figures by technology and region. We've also collated official deployment figures recently published by Government Departments and compared them to their shorter-term 2020 projections for the UK as an important milestone. We look into each renewable energy technology and also cover energy storage and the potential of electric vehicles (EVs) to support the drive for a low carbon transport future and its impact on the wider energy infrastructure.

Our investment article has been prepared for us by a leading expert in finance: (Fernando Valda of Pachamama Ventures). Whilst sharing insights on historic and projected trends that have influenced investment, we are excited to include the views and perceptions of some of our important Finance Forum members. The most notable technology cost reduction trajectories are for solar, wind and energy storage as highlighted by the important Bloomberg New Energy Finance (BNEF) study commissioned by Eaton in partnership with the REA looking forward to 2040. All conclude that our renewable energy future is becoming less linked to Government intervention per se than ever before, although government intervention in the energy market is still key for the immediate years ahead. The question now becomes what dispatchable forms of generation will complement the growth in solar, wind and storage to deliver the energy system of the future? For the sceptics out there, the results from the latest UK CfD auction round - with off-shore wind costs crashing down to £57/MWh for delivery in 2021/22 and therefore way below agreed costs for new efficient gas-fired power stations, never mind nuclear - reinforced the view that modelling forecasts will materialise in this sector too.

In summary (using RED accounting assumptions), the UK was supplied with 28.1% of its power from renewable sources in 2017. The latest figures we have for renewable heat and transport are for 2016 and they are 6.2% and 2.0% respectively. The renewable energy industry employed close to 127,100 people. This is, undoubtedly, a number that has the potential to grow further. Innovas has also found close to 17,750 jobs linked with the growing energy storage and electric vehicle industry.

It is pleasing to see that the Government in some respects recognises the benefits of renewable energy and clean technology, including the opportunity for further innovation as well as 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. We are also reporting 2017 performance in a very important year with respect to diversity in our workforce. We are celebrating the 100th anniversary of (certain) women having the vote, a notable achievement after the extraordinary efforts of women that never gave up campaigning for the rights of all women. There is no doubt in my mind that delivering renewable energy and clean technology solutions to tackle climate change is now accepted at all levels of society as one the most important issues we face. The industry continues to enjoy the support of the general public here in the UK (a fantastic 85% positive support in the last Government survey). As your trade association we will though never stop campaigning for its support … whether to hold the government to account on their promises, through to attracting more people to enjoy a career in our sector. 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, as well as those starting out their careers. Many of the members of the REA know that it is my passion to encourage more girls and women to enjoy a career in energy and clean technology through my role as Deputy Chair of the Board of WISE, support of Entrepreneurial Women in Renewable Energy (EWIRE) and also importantly POWERful women, initiated by REA Board Member, Baroness Sandip Verma, when she was Minster for Energy during the coalition Government.

I hope that 2018 will be the year of delivery for not only power again - breaking even more records - but that we see a breakthrough for renewable heat and transport. The REA will champion the work of people and businesses in our industry that are trading despite political and policy challenges, as well as those who are coming new to the sector. We urge the Government and other key stakeholders to accelerate the changes necessary to create market structures and regulation so that the UK is one of the leading destinations for energy investment. Without clarity of regulatory structure, confidence will wane. There is also no denying that we must have well-regulated, competitive markets that deliver value and service for customers and that markets work for customers in a way that all consumers or prosumers perceive they should.

Dr Nina Skorupska CBE

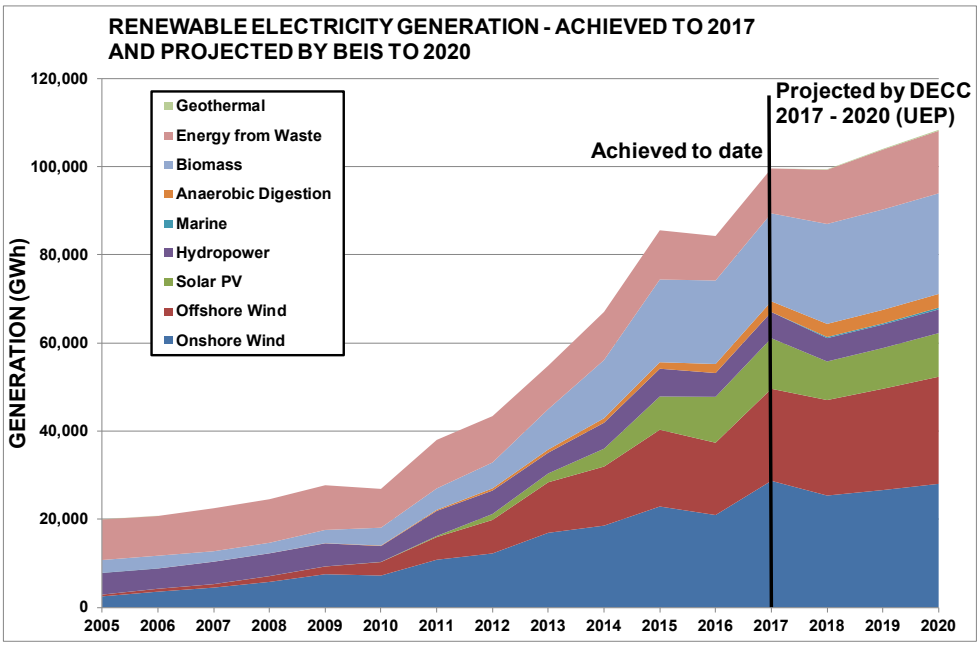
Chief Executive, REA

Growing the renewable energy and clean technology economy

RENEWABLE ENERGY ASSOCIATION

Executive Summary

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



2017 has seen a number of "firsts" when it comes to the contribution from renewable energy to total UK CO_2 emissions, UK energy output and policy developments. In addition, 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)), when combined, would likely give a value in line with, if not exceeding, the trajectory for the UK to remain on track.

Provisional estimates show that carbon dioxide emissions fell between 2016 and 2017 by 3%; the key factor leading to this decrease was the switch in generation from coal and gas to renewable sources. (A separate BEIS statistical release published at: www.gov.uk/government/statistics/provisional-uk-greenhouse-gas-emissions-national- statistics-2017 provides more detail).

Turning to look at how we are performing against the UK's 2020 targets, last year's REview reported the averaged target for across 2015/2016 (the third interim target) of 7.47% for the UK would not only be on track but likely to be exceeded and be as high as 8.3%. DUKES[1] published later in the year, confirmed that the value was actually 8.5% - beating expectations. The main reason for this was the exceptional performance from renewable power, delivering at high levels across the two years. It was clear that power essentially masked the disappointing contributions from renewable heat and transport.

The fourth Interim target measuring the average across 2017/2018 should be 10.2%, a considerable increase, and in this year's report we can only describe the performance against the first part of this date range. The value for 2017 RED is anticipated to be slightly higher than the 2016 figure, however, as the data for heat has yet to be finalised for 2017 and RED "normalised" data for heat and transport have not been calculated - the figure that will be reported to Brussels (via EUROSTAT) will not be available until quarter three this year.

The generating capacity and output values quoted in this report describe 2017 actuals for electricity and 2016 for heat and transport, as quoted in the DUKES publication by BEIS.

Looking at renewable electricity in more detail, the renewable share of electricity generation was a record 29.4% in 2017, an increase of 4.9% on the 24.5 % share in 2016. This reflects the higher renewable generation (98.9 TWh, a record high, and an increase of 18.8% on 2016) and slightly lower overall electricity generation in 2017. Renewable electricity capacity was 40.5 GW at the end of 2017, a 13.3 % increase (4.8 GW) on a year earlier, largely due to increased wind (both onshore and offshore) and solar PV capacity. This increased capacity, plus the increased wind speeds compared to the year before, gave rise to the record generation output. Onshore wind had the highest share of capacity at 32 % (12.9 GW), followed by solar photovoltaics (PV) at 32 % (12.8 GW), offshore wind (17 %), bioenergy (15 %) and hydro (4.6 %).

It is important to note that, on the 2009 EU Renewable Energy Directive (RED) basis, normalised renewable generation (accounting for variable weather) in 2017 was also a record with 28.1 % of gross electricity consumption, an increase of 3.5 percentage points on 2016's share. Renewable electricity generation is almost at the 2020 target levels. The RED measure uses normalised wind and hydro generation, to account for variable generation due to weather conditions. Under this measure, normalised net wind and hydro generation were lowered (due to higher than average load factors in 2017), a reversal of 2016.

Solar PV capacity increased by 0.9 GW

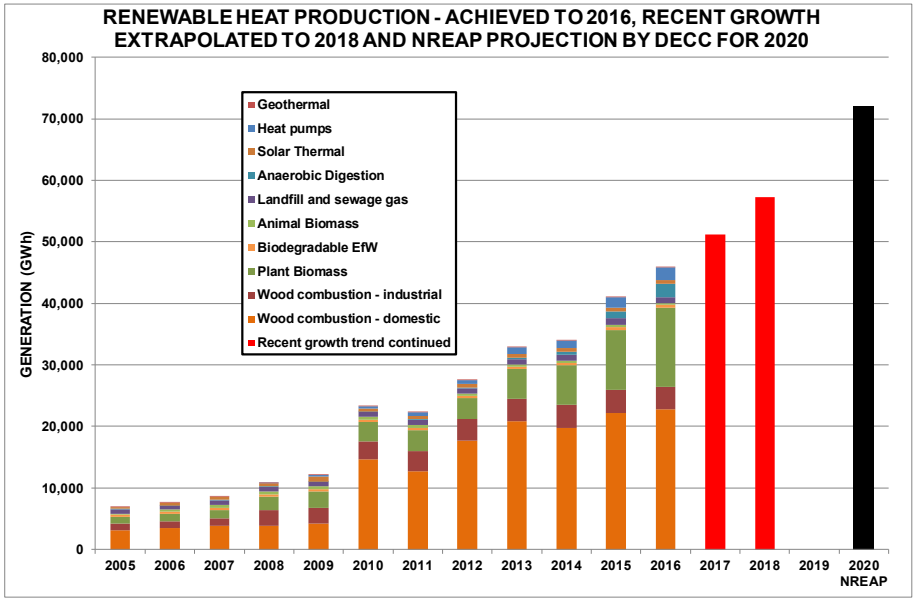
during 2017, compared to a 2.4 GW increase during 2016. The majority of growth came from sites accredited under the Renewables Obligation (RO), mainly in 2017 Q1, ahead of the final closure of the RO. The exception being grace period qualifying RO projects, as well as an increase in small scale Feed-in Tariff sites, and a second solar farm under Contracts for Difference (CfD).

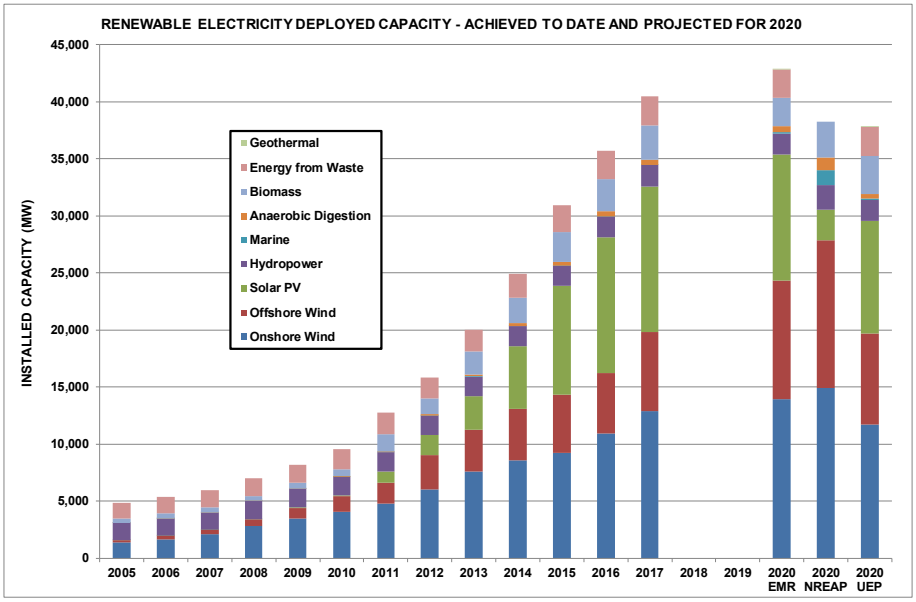
Bioenergy capacity increased by 4.2% (241 MW), mostly due to a 145 MW capacity increase in biomass (including the 40 MW Margam plant in Wales).

It is important to note that for 2017, 32% of renewable power generation was from bioenergy, 29% from onshore wind, 21% from offshore wind, 12% from solar PV, and 6.0% from hydro because of load factors of the different technologies. Without bioenergy sources of renewable power, the amazing performance from renewable power would be almost one-third lower and the UK would be unable to remain on track to deliver its low carbon targets.

Renewable heat generation grew in 2016. The UK received 6.2% of its heat from renewable sources, against a goal of achieving 12% in 2020. It increased by 13% in 2016 to 3,408 ktoe. Solid biomass equals 86%, anaerobic digestion 4.5%, with energy from waste, landfill gas, and sewage gas makes up 3.3%. Solar thermal makes up 1.3%. Renewable energy generation from heat pumps now sits at 4.6% in 2016, due to an increase in capacity. Around 15.1% of renewable heat was supported by the Renewable Heat Incentive (RHI) or Renewable Heat Premium Payment (RHPP). The RHI-supported heat has furthermore grown from 589 ktoe (6,852 GWh) in 2016 to 737 ktoe, (8569 GWh) in 2017. Most of this increase can be accounted for by biomethane injected into the gas network, and demand for biomass driven by the increase in medium biomass boilers in the non-domestic sector.

2018 saw the final set of reforms to the Renewable Heat Incentive scheme come into force. This now sets the scheme on a sound footing through to 2021. The



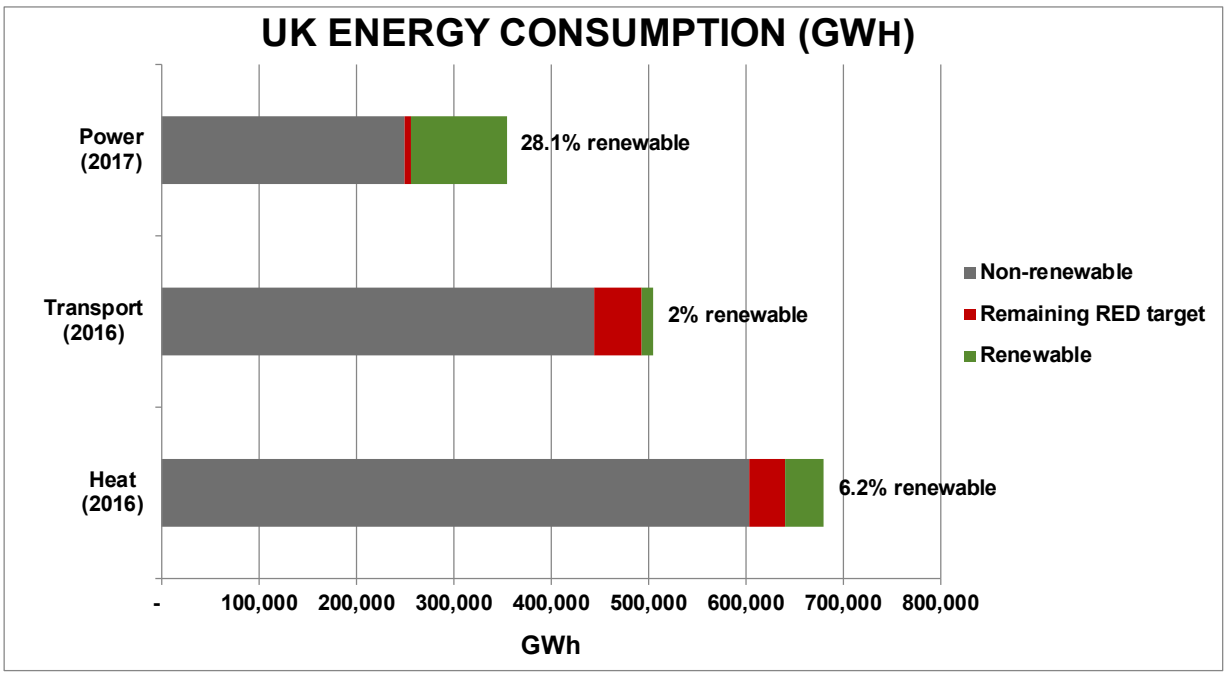


EMPLOYMENT AND TURNOVER SUMMARY FOR RENEWABLE ENERGY SECTORS 2016-2017

Employment	2015/16	2016/17	% Change 15/16 to 16/17
Air & Ground Source Heat Pumps	9,441	9,796	3.8
Anaerobic Digestion	2,952	3,002	1.7
Biofuels	10,039	9,989	-0.5
Biomass Boilers	6,353	6,663	4.9
Biomass CHP	2,558	2,605	1.8
Biomass Dedicated Power	4,377	4,473	2.2
Energy from Waste	7,694	8,084	5.1
Hydro	5,778	5,864	1.5
Offshore Wind	21,557	22,605	4.9
Onshore Wind	20,209	21,535	6.6
Solar PV	13,687	10,911	-20.3
Solar Thermal	9,637	9,497	-1.5
Wave & Tidal	723	772	6.8
Production of biomass including wood for fuel	10,935	11,305	3.4
	125,940	**127,101**	**0.9**

**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



amendments include the ability to guarantee a tariff ahead of installation, which is a welcome addition to the scheme, particularly for the biomethane and large biomass sectors. However, the support for biomass has been lowered, which may stifle this sector. The non-domestic RHI scheme was launched in 2011, and there are now more than 19,500 installations. The scheme produces enough renewable heat for more than 640,000 homes. The domestic RHI was launched in 2014, and more than 67,000 homes are now using it to make the transition to low-carbon heating. Before the RHI started, only 1% of our heat came from renewable energy sources.

The UK renewable transport fuels

At the time of going to press official figures for the RED are only available for 2016. They show a market dominated by liquid biofuels, with 49% of supplies coming from bioethanol, 47% biodiesel and 4% biomethanol .

A look at liquid biofuels (as reported in Energy Trends March 2018) shows that in 2017, 1,460 million litres of liquid biofuels were consumed in transport, a decrease of 0.5 per cent on 2016. Bioethanol consumption increased, by 0.6%, from 759 million litres to 764 million litres. Biodiesel consumption fell by 1.7%, from 708 million litres in 2015 to 696 million litres in 2017. Bioethanol contributed to 52% of biofuel consumption, compared with 48% from biodiesel. This split is almost equivalent to that recorded in 2016. In volume terms, bioethanol accounted for 4.5% of motor spirit , and biodiesel 2.3% of total diesel; the combined contribution to total road fuels was 3.1%, only a 0.2% increase on 2016. The contribution has remained low and is not on track to deliver the 2020 RED target of 10% for UK land transport.

The trend towards using a higher percentage of waste feedstock continued with 2017 increased to 66.3%, up from 59% in the previous year. Almost a quarter of the UK's renewable fuels feedstocks 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 4.94% in accounting terms for 2015/16. The case for biofuels remains very clear as the greenhouse gas savings from biofuels has now reached 74% compared to fossil fuel sources.

In 2017 the industry finally saw the long awaited Renewable Transport Fuel Obligation review move forward and the amendments came into force in mid-April 2018, marking the end of stagnation for this sector. It also introduces a new incentive for the production of novel fuels from wastes, as well as one for hydrogen and for renewable fuels from non-biological sources (e.g. CO_2). Biomethane use for heavy goods vehicles is slowly growing in importance. This attempt to finally get into gear has been jump started following the shocking recognition that transport now accounts for 27% of the UK's Greenhouse Gas emissions (GHGs), overtaking power generation as the largest emitter in 2017 as reported by the Committee on Climate Change (CCC).

The contribution from switching vehicles to electric and other renewable sources such as biomethane and hydrogen derived from renewable sources is at the start of its journey so has had little impact on meeting renewable transport targets in 2017. Yet with EV car sales growth rates at 26% and around 2% of the UK's vehicle fleet now with a battery element, (Department for Transport data reported that in 2017 over 53,000 new Ultra Low Emissions Vehicles (ULEVs) were registered in the UK), 2017 was hailed as the year that kick-started the EV charge. The CCC have also released key reports calculating how many EVs would

need to be on the road by 2020 to contribute significantly to a reduction in emissions and this is a "not insignificant" 400,000 vehicles.

General comments about deployment and policy

The UK's required growth trajectory to meet the 2020 ambition over the next three years remains very steep - and continues to be one of the highest of any EU member state. Certain groups have clearly argued that the RED target is of less relevance today following the EU 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, and more action delivered. Looking even further forward through to 2030, the Clean Growth Strategy itself admits that when calculating all the measures the government have put in place to date, that there are significant gaps to understanding how the 4th and 5th budgets can be achieved. Whilst there is clear commitment for the UK to not only embrace but lead the Smart energy revolution and progressing low carbon transport by supporting EV's (as referenced in the Industrial Strategy and the smart flexible systems plan), it may be too little too late in delivering on not only the binding agreements with its EU colleagues but to meet our own UK environmental legislation. A clear example for this lack of confidence is the Government's difficulty in pulling together a cohesive heat strategy that not only addresses renewable heat source alternatives but also tackling the legacy of UK's poorly insulated homes and improving energy efficiency in Industry. Even plans for new builds have not embraced the dire necessity to wean the built environment off gas. The earliest date for any semblance of a heat plan for the on-gas-grid area is not expected until into the 2020s. The Government has instead decided to decarbonise heat off the gas grid first.

More will be needed in addition to making statements that "all UK coal-fired power stations will close by 2025", particularly when there is no clear strategy of how the UK economy will truly consign fossil fuel gas to be a transition fuel. In addition, there is a lack of joined up thinking on the benefits of truly embracing a circular economy, such as focusing on using the waste we will still unfortunately produce as a valued resource, rather than send it to landfill.

Maybe there is light at the end of the UK's climate change tunnel as there is now a growing recognition and concern that the "on track" renewable energy and CO_2 figures mask stark the under performance of the transport sector in meeting it RED target.

Jobs in renewables and market value

continue to grow albeit at a slower pace than hoped and still unevenly across the sectors. A major concern is the continued contraction of jobs in the solar PV industry.

From data provided by Innovas, just over 127,000 (Table 1) people were employed across the UK renewable energy value chain in 2016/17, a "like-for-like" increase of only 0.9% on the previous year.

If there was one highlight to pick from the analysis of the data, it is that the change in policy on Feed-in Tariffs alongside early closure of the Renewables Obligation has seen a decrease in employment of the solar sector of 20.3%, 2900 jobs lost in one year. These are mainly in "installation" related roles and a further reduction are likely to be seen in next year's data.

The highest percentage levels of employment growth are seen in wave and tidal (albeit from a very low base), onshore wind energy (6.6 %), biomass heat (4.9%), energy from waste (5.1%) and offshore wind (4.9%). The employment growth rate is now below growth in market value.

The number of companies working in the sector has decreased by 2.3%, largely as a result of the contraction of the solar PV sector. Solar PV has also fallen from its top position of having the largest number of companies. This has been overtaken by those linked with off-shore wind.

The industry's market value has increased over that time by only 2.1% - the lowest rate the REA has reported to date - to £17.9 billion. The analysis forecasts the potential to increase to £22 billion by 2019/20, a 22.9% increase. If employment numbers increase at a similar rate to the possible increase in market value over that time, this would imply an additional 30,000 people could be employed. However, a more cautious forecast reflecting decreased confidence of the previous year (following the abrupt and unexpected changes in UK support and policy in late 2015 and early 2016 now bearing fruit) would suggest a potential increase of about 14,000. Even at this lower number, this is still bringing new skills, capabilities and opportunities to the UK employment market to rival other energy technologies. These jobs are also distributed across all regions of the UK. If there was ever a clear demonstration of the impact of abrupt policy changes then employment in the renewable energy industry illustrates this.

Clean technology developments around energy storage and electric vehicles have seen a slight increase in jobs these technologies, although continued constraints on deployment has seen a slight reduction in energy storage roles.

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

According to Bloomberg New Energy Finance investment fell from 23.4$bn in 2016, to 10.3$bn in 2017. However, there is room for optimism with 2018 seeing unsubsidised solar projects start to become investable without subsidy, policy changes finally being laid in Parliament giving stability for the Renewable Heat Incentive (RHI) through to 2021 and regulations to increase the amount of renewable fuel blended into the transport fuel mix.

Alongside opportunities for investing in renewables, the wider clean energy sector is also providing attractive

propositions for investors. Falling battery costs mean the economics of battery storage continue to improve, innovative business models for supply and demand side response continue to evolve and the rapid growth in electric vehicles mean significant investment in the infrastructure for charging will be required.

So, looking forward there are very good reasons for optimism in the finance sector; albeit to unlock its full potential Government still needs to be clear on the long-term ambitions for the sector especially up to 2030, a sentiment shared by respondents to a short survey the REA conducted.

Looking forward

As was the case in the previous two editions of REview we have not provided a growth forecast for any of the technologies covered in the publication. With Brexit discussions still ongoing, our future relationship with the European energy market to be confirmed and the UK's renewable energy ambition to 2030 unclear, we conclude that projecting forward at this time would be largely guesswork. Within Europe it is clear renewable energy deployment is forging ahead with clarity just around the corner on a renewable energy target for 2030 which we expected to be above 30% and is now agreed at 32%. Further afield we have seen countries such as China and India continue to deliver 100's of GW of renewable energy, in part to deliver on their commitment as signatories of Climate Change Agreements, but also because it makes sense to embrace decentralised energy solutions to avoid being encumbered by old fashioned energy infrastructure and thus avoid some of the historic challenges they bring.

Large international corporates with a socially responsible vision; continue to take a lead in reducing their carbon footprint by generating or buying in renewable energy. They can see the business opportunities that renewable energy gives them and with many operating internationally do not wait for Governments to act.

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 in cost, timescale terms and public opinion; in contrast renewables remain the publics generator of choice and can be deployed at scale today. 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, wind and biomass with their costs continuing to fall even here in the UK. It is extremely heartening to see the first solar projects being deployed through investor and consumer choice rather than, or even despite, Government policy. However, the closure of the Feed-in Tariff in 2019 does cast a shadow over future deployment in the residential market where continued support is needed until costs fall sufficiently for it to be financially attractive subsidy free.

Historically, neither the Government plans made in 2009 to deliver the UK's RED ambitions, nor the Climate Change Committee in the 3rd Carbon Budget had any expectations of the dramatic reduction of costs of solar and wind, to which can also be added the extraordinary development in complimentary technologies such as energy storage, spurred on by lower battery costs. Indeed, as mentioned in this report, the cost for these technologies are expected to fall further over the coming years. On cost grounds alone, these technologies are serious challengers to the incumbent technologies as well as new gas and nuclear plant. Energy storage solutions also address solar and winds variability of generation seeing an energy storage system deployed alongside a solar or wind installation will become the norm.

Electric vehicles are also becoming serious contenders in the transformation of the passenger car and light commercial vehicle markets to lower carbon alternatives. They not only address carbon emissions but also the challenges of air quality blighting many of our towns and cities. Electrification only addresses a part of the issue and will take time. That is why a greater use of biofuels and renewable gas in the transport sector during the transition in the passenger car and light commercial vehicle sectors is essential as well as being the long-term solution in the heavy vehicle, aviation and much of the marine sectors.

Across the world smarter technologies both in hardware and software terms are putting the control of energy in homes and businesses in the hands of the consumer. It really is a case of when, not if, decentralised energy becomes the new norm. This seismic shift in energy will provide the UK with opportunities to play a major roll in supplying the kit and expertise needed to deliver the transformation, we just need Government to develop the framework to allow this opportunity to be realised.

Over the coming months we hope for clarity around Brexit, UK's position in relation the EU energy market, what comes after the closure of the Feed-in Tariff and Government's intentions regarding a 2030 renewable energy target. 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.

Innovas

Taking a Closer Look at the 2016/17 Numbers: Employment, Companies and Turnover

Employment

Data and comment by Innovas

The change in policy on FiTs for solar PV has seen a decrease in employment of 20.3%, mainly in installation related roles. Early views of the 2017/18 energy production figures suggest that this decrease is likely to continue in 2017/18.

The fast growing sub sectors of biomass boilers, biomass dedicated power and heat pumps along with the continuing growth in the wind energy sector have driven the overall growth in employment in the renewable energy sector. There are a number of uncertainties facing the renewable energy sector and it is not possible to determine just how they will affect the sector in the next few years. The employment rate growth is now below the growth of the market value. Possibly reflecting the uncertainty in the market due to potential destabilising influences, such as Brexit, the Trump administration in the USA and UK government policy such as the changes which hit the solar PV sub-sector.

When there is a potential change in government and therefore potential change in policies, employment growth tends to slow to below market value growth. The general election had been set at specific periods of time, providing the companies in the sector with plenty of advanced warning of potential changes. However, the UK government has now changed the timescales for the elections and with uncertainty over the terms of Brexit, it is likely that they will again show a degree of caution as to employing people to expand their business, at least until they are certain of the support landscape for the next few years.

In the past the caution has been proven to be sensible as the UK government has changed its focus and sub sectors such as solar PV, solar thermal and onshore wind energy have seen far reaching changes recently, which have negatively impacted on them. The renewable energy sector is one heavily reliant on government policy and support. Changes in that support can see investment increase or decrease rapidly, with subsequent changes in confidence by the companies and end users.

Headline changes:

* The highest percentage levels of employment growth are seen in wave and tidal (from a low base), onshore wind energy at 6.6%, biomass boilers at 4.9%, energy from waste 5.1% & offshore wind at 9.5%
* Overall increase in employment across the sector was about 1,200 people
* The wind energy sector employs the largest number of people with a total of about 44,000 people in the supply chain and specialist companies
* The Solar PV sub sector has seen a further decrease of about 2,900 jobs in one year

There were 127,101 employed in the sector in 2016/17. Employment numbers include direct and indirect employees.

Companies

The overall number of companies in the sector has decreased but this is being driven entirely by the decrease in companies in the Solar PV and solar thermal sub-sectors.

Most other sub sectors have seen an increase in the number of companies involved with sub sectors such as heat pumps seeing companies who had been involved in solar PV installations trying to move across to diversify their business. There are about 1,960 companies involved in the wind energy sector, many in the supply chain.

There were 6,651 companies in the sector in 2016/17.

Turnover

The overall growth from 2015/16 to 2016/17 is 2.1%, which is considerably lower than the previous 4 years when growth above 6% had been achieved in all but the last year when 3.2% growth was achieved.

This is partly as a result of changes in UK government support and certain sub sectors such as solar PV, which had previously seen high levels of growth their market share decrease as a result of the change of feed in tariff support and subsequent lower levels of deployment. In the year 2015/16 there were about 180,000 solar PV installations carried out with installed capacity of 3.2GW, however in 2016/17 there were only 43,000 installations with 1.4GW capacity installed. This has seen a drastic decrease in market value with numerous companies leaving the solar PV sector with a resulting loss of employment. The uncertainty around solar thermal has also seen a decrease in activity there as well. The change in support can be seen as a clear reason for the slow down in installation. Early figures for 2017-18 from the UK governments own sources suggest that deployment of solar PV has pretty much ground to a halt.

However, there is also positive news with onshore and offshore wind continuing their rapid growth along with energy from waste, biomass dedicated power, biomass boilers and air & ground source heat pumps have driven growth in the overall renewable energy sector. Offshore wind energy is also forecast to grow quickly over the next few years with deployment off the east coast of the UK being particularly strong.

Total sector market value 2016/17, £17,913 million.

Renewable Energy
MADE IN BRITAIN

Employment and turnover by region and technology 2016/17

RENEWABLE ENERGY ASSOCIATION

Made in Britain Map - employment and turnover by region 2016/17 as published in REA's REview 2018. Report by the REA, data by Innovas.

"REview: Renewable Energy View, The Authoritative Annual Report On The UK Renewable Energy Sector." Jobs, deployment & investment, by technology.

June 2018

127,101 people employed across the UK renewable energy value chain 2016/17.

2.1% growth on 2015/16.

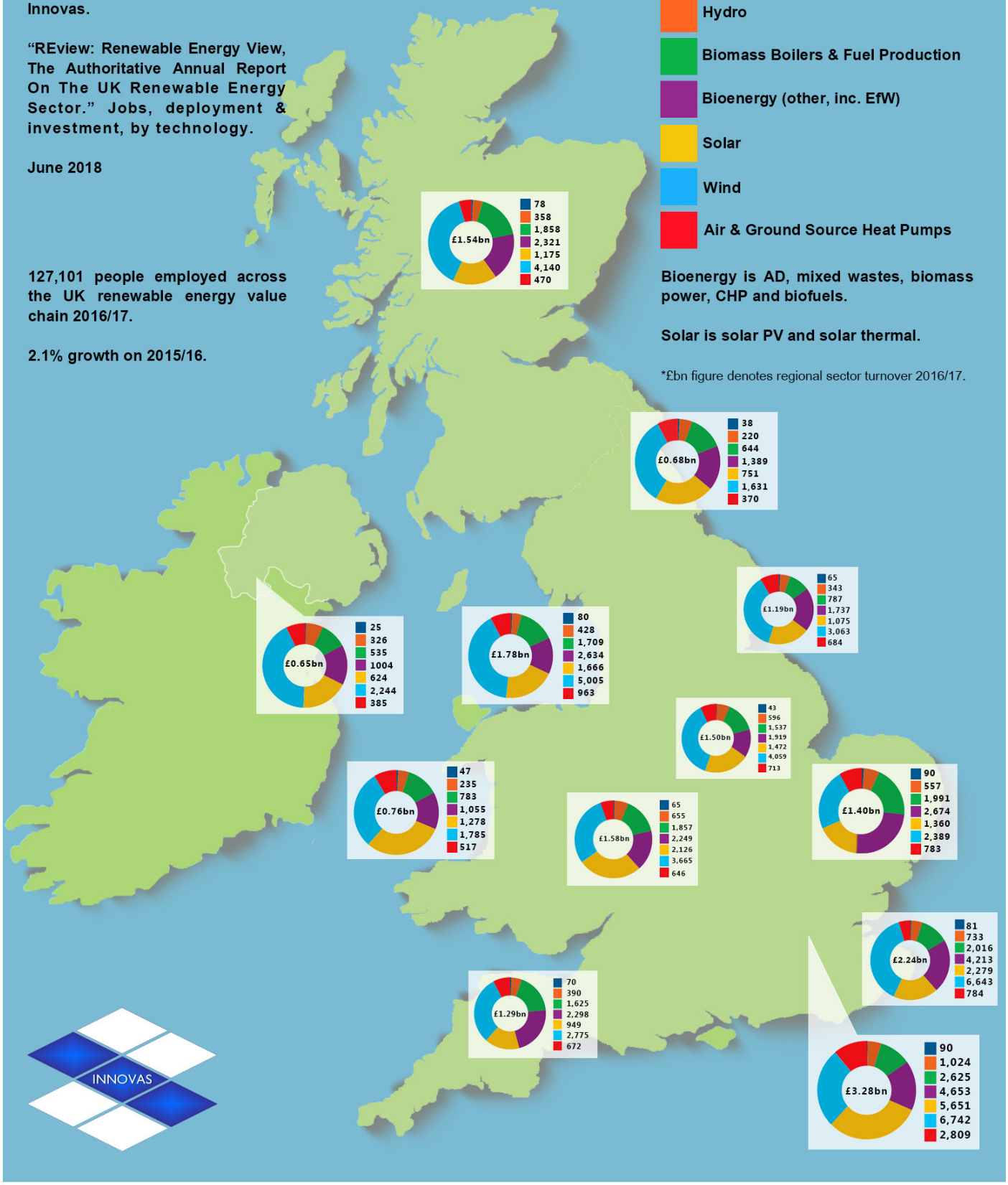
Employment figures 2016/17 key

- Wave & Tidal
- Hydro
- Biomass Boilers & Fuel Production
- Bioenergy (other, inc. EfW)
- Solar
- Wind
- Air & Ground Source Heat Pumps

Bioenergy is AD, mixed wastes, biomass power, CHP and biofuels.

Solar is solar PV and solar thermal.

*£bn figure denotes regional sector turnover 2016/17.



Policy & Politics

Policy Overview

Renewables Obligation (RO)

Closed to new projects as of April 2017, and closed early to new onshore wind and solar PV projects in 2016, the RO delivered considerable renewable electricity growth. Renewables Obligation Certificates (ROCs) are 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. Some legacy 'grace period' RO projects will continue building out, providing they meet certain criteria, until autumn 2018 at the latest.

Contracts for Difference (CfD)

The CfD replaced the Renewables Obligation and is also available for nuclear and carbon capture and storage projects. The allocation of CfDs is entirely different to predecessor schemes and is via an auction mechanism split into two 'pots' (formerly three, with a standalone pot for biomass conversion projects now abolished). Pot 1 is for 'established technologies' such as solar, onshore wind and biomass and Pot 2 for 'less established technologies', such as offshore wind, wave & tidal and advanced waste to energy technologies. The most recent CfD auction contracts were allocated in autumn 2017, with record low prices, but only for Pot 2, as Pot 1 was not funded. The auction process can be complex and one contract has already been handed back as the project calculated that they would be unable to deliver at the low price awarded. The same happened after the first auction - highlighting how not all companies are yet familiar with the ins and outs of the mechanism.

Feed-in Tariff (FiT)

Due to close to new capacity from 31 March 2019. The Government introduced significant changes to the FiT scheme applying from February 2016, with significant tariff reductions, strict quarterly deployment caps and changes to the degression triggers. The FiT supports anaerobic digestion (AD), onshore wind, hydro and solar PV up to 5MW, as well as micro-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.

FiT due to close to new capacity from 31 March 2019

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 more widespread adoption of smart meters. A wide ranging consultation on the FiT after scheme closure in 2019 is overdue and was expected to be published shortly as of spring 2018.

Renewable Heat Incentive (RHI)

Launched in 2011 (for non-domestic applications) and 2014 (domestic), the RHI policy aims to ensure that only useful heat is supported, and is run on similar lines to the Feed-in Tariff (FiT). Unlike renewable electricity support schemes, the RHI is funded by general taxation. The policy supports ground source heat pumps, biomass, solar thermal, small-scale biogas and injection of biomethane to the gas grid. In December 2016 significant changes were confirmed, but the implementation was delayed. These were expected to be implemented finally as of spring 2018. The changes include 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 feedstocks in AD. Tighter CHP efficiency requirements were also introduced in 2017 for relevant projects.

Renewable Transport Fuel Obligation (RTFO)

The RTFO is similar in principle to the RO, in that it obliges fuel suppliers to replace a proportion of their fossil supplies with renewable fuels. Progress towards meeting the binding 2020 transport target contained in the Renewable Energy Directive had been severely stalled, whilst concerns about sustainability were addressed. With carbon emission from transport moving inexorably upwards and local air quality becoming a critical concern, things had become critical. Happily progress has now finally resumed. New RTFO legislation takes effect from mid-April 2018, which increases the obligation level to 9.75% in 2020. It also introduces a new incentive for the production of development fuels from wastes, and brings in sectors of transport that are hard to decarbonise, such as aviation. The Obligation supports the established renewable fuels - bioethanol and biodiesel - as well as gasses such as biomethane and renewable hydrogen. The next important step for the sector will be the introduction of E10, petrol with a 10% bioethanol blend. At present with UK forecourts supplying only the 5% (E5) petrol, the "blend wall" has been reached, and without the switch to E10 suppliers will have to resort to more expensive means of fulfilling their obligation.

Capacity Market

A component of the 2014 EMR package of energy policy measures, the Capacity Market is a key revenue component for energy storage projects, but is not available to renewable energy projects in combination with other forms of support. The mechanism has run regular auctions since its introduction (unlike the CfD mechanism), with record low prices of £6 and £8.40/kW/Year respectively in the auctions run in February 2018.

Top Government & Industry Publications 2017/2018

NAME OF DOCUMENT	ABOUT THE DOCUMENT	DATE RELEASED	SECTORS IMPACTED
Air quality plan for nitrogen dioxide (NO_2) in UK; Defra and DfT	The Government's plan for reducing roadside nitrogen dioxide emissions in the UK, including through the use of 'Clean Air Zones.'	July 2017	Transport (renewable fuels & electric vehicles)
Smart Systems and Flexibility Plan; BEIS & Ofgem	A joint plan with clear actions and timelines from BEIS and Ofgem on how they intend to increase electricity system 'flexibility,' particularly as the power system becomes more decentralised, digitised, and decarbonised.	July 2017	Electricity (including solar, energy storage, electric vehicles, wind, demand response, large-scale generation) & finance
Clean Growth Strategy; BEIS	The Government's flagship low-carbon strategy outlining how it intends to achieve its legally binding 4th and 5th Carbon Budgets.	October 2017	Impacts across heat, power, transport, and finance
Cost of energy: independent review (known as 'Helm Report'); independent via BEIS	Independent report investigating the cost of energy led by Professor Dieter Helm which concluded widespread reforms and simplification of the UK's energy market is needed.	October 2017	All
Industrial Strategy - white paper; BEIS	Following consultation this white paper lays out the principles and pillars for the Government's flagship Industrial Strategy, which includes 'prospering from the energy revolution' as a 'Grand Challenge.'	November 2017	All
25 Year Environment Plan; Defra	The Government's long-term vision for protecting air, water, soil, and species. Provisions for the growth of the circular economy, improvements in recycling, and reductions in plastic waste.	January 2018	Circular economy (including biogas, recycling, composting), transport, heat, power
An independent assessment of the UK's Clean Growth Strategy; Committee on Climate Change	A review of the Government's Clean Growth Strategy by the independent Committee on Climate Change, which investigated if the policies proposed by the Government in the Strategy were sufficient to achieve the 4th and 5th Carbon Budgets (2028 and 2032).	January 2018	All
Green Finance Taskforce; independent via BEIS	The independent Green Finance Taskforce set out recommendations to Government to boost green growth. Key policies include a Green Investment Accelerator for early stage technologies and a dedicated public-private green venture capital fund, in addition to increased climate-related corporate disclosures.	March 2018	Finance, all sectors (heat, power, transport)
'Road to Zero' Strategy; DfT	The Government's strategy for how it will achieve its goals of banning the sale of 'conventional' new petrol and diesel cars by 2040.	Summer 2018	Transport, finance
BILLS			
The Repeal Bill White Paper; DExEU and the European Union (Withdrawal) Bill 2017-2019	The Government's proposals and the following Bill for ensuring a functioning statute book once the UK has left the EU.	May 2017, present	All
The Renewable Transport Fuels and Greenhouse Gas Emissions Regulations; DfT	The Renewable Transport Fuel Obligation (RTFO) order regulates biofuels used for transport and non-road mobile machinery. In 2017 an amended RTFO was passed which increases the obligation on fuel suppliers to blend renewable fuels into fossil diesel and petrol.	May 2018	Transport (particularly fuels)
Environmental Principles and Governance Bill (consultation); Defra	Launch of a consultation on a new independent environmental regulator post-Brexit.	May 2018	All
Automated and Electric Vehicles Bill; DfT	Bill which proposes definitions around electric vehicle charging, empowering Government to regulate the 'smartness' of charge points, and to compel fuel retailers to install charging points, amongst other issues.	Ongoing throughout 2018, likely completion summer 2018	Transport (electric vehicles)
Ones to watch out for:	• National Infrastructure Commission annual assessment (summer 2018) • Waste and Resources Strategy • Bioeconomy Strategy • Electricity Market Reform and Capacity Market review • Consultation on the future of the Feed-in Tariff	June / July 2018	

Energy & Environment Policy

A Rumsfeldian Brexit

In 2002 Donald Rumsfeld, then US Secretary for Defence, infamously talked of having "Known knowns, known unknowns and unknown unknowns".

This speech, despite being derided at the time for covering up evident deficiencies in US Government intelligence, provides a useful framework for understanding where the UK has got to on Brexit with less than a year to go before our departure.

The Prime Minister, since triggering Article 50, has attempted to present a calm methodical Government in possession of a strong and principled negotiation position. This, naturally, has been regularly undermined by a questioning media, a strong EU negotiation team and, not infrequently, her own Cabinet ministers. However, despite the dysfunctional process, we are not without any 'known knowns' as we start to get an image of what the future EU-UK relationship could be. However, perhaps most importantly, the industry must now focus on the 'known unknowns', as it is by analysing these that we will be able to mitigate the risks and realise the opportunities of Brexit.

To begin with, we can be confident that on energy issues and climate ambitions there are strong incentives for the EU and UK to maintain close alignment. For one, the EU's Clean Energy Package will create new EU targets at the same time as UK Ministers have made clear that they will look to maintain, and even advance, our own ambitions around decarbonisation. Secondly, given the UK's geographical proximity, existing interconnectors and historical involvement in the Internal Energy Market, it is a 'known known' that there are some clear advantages to both sides agreeing to continued integration.

What is less clear is how this close alignment will work. It is now accepted, barring any changes of plan, that the Government is aiming to achieve a 'deep and comprehensive' Free Trade Agreement, without membership of the single market. On the Internal Energy Market, the Prime Minister has committed to "securing a broad energy co-operation with the EU… exploring options for the UK's continued participation in the EU's internal energy market". However, the actual legal basis for such alignment is yet to be fleshed out. It is now assumed that such a relationship will rely on the development of a new independent arbitration body that pays due diligence to, but doesn't tie us to, the European Court of Justice. However, there is precious little information about what this body would look like and little to help us understand the legal basis for any further future alignment.

> The Internal Energy Market, it is a 'known known'

A yet further great 'known unknown', is the impact on UK trade. It is now essential that UK developers get to grips with the geographical spread of their supply chains. Once out of the EU, trade issues which we have not needed to consider in the last 40 years could become substantial bureaucratic headaches and increase project costs. Chief amongst these are issues like Rules of Origin, which determine if preferential tariffs can be applied to a product based on where it can be certified as being from. Another is the loss of existing trade remedies which protect domestic industries from unfair competition due to the dumping of products from subsidised foreign markets (unless replicated at the national level). For your company, understanding where the components of your projects come from, and what non-domestic players might now seek to undermine your domestic market, could become fundamental to how you manufacture or install renewable technologies in the UK.

Completing the 'Rumsfeldian Framework' is the 'unknown unknowns'. As we get further into negotiations, and nearer to our departure, we can be sure that more of these will start to become evident. However, it should be noted that these are just as likely to represent opportunities as they are to be problems. For UK renewable and clean tech companies preparing for Brexit, it is essential that they now engage with these, and other, 'known unknowns'; understanding their implications and costs. The REA is working hard with our members, other trade associations and Government departments to unpick these issues so that the UK renewables and cleantech industry can ensure the best possible Brexit.

Politics

Political Review of the Year

If it wasn't for the extraordinary, poll defying, and paradigm breaking 2016, the last year would have been the most shocking in recent political memory.

The Snapped Election

Pollsters, political experts and journalists were left looking like frustrated bookies at a racetrack, wondering how the form book and their odds-setting could have been so wrong. This type of thing shouldn't happen at all - let alone two years running.

Rules and established truths were trampled over: The short campaign in elections doesn't change the result - Wrong. It's the economy stupid - Wrong. Jeremy Corbyn could never win a general election - well, that one is now at least debatable.

There may have been worse outcomes following a Welsh hiking trip, but it's hard to think of a quicker descent than a loss of a government majority and the reputation of the Prime Minister left in tatters.

For Theresa May, the days after the election were crucial. With a leader on life support any slight move against her would almost certainly have been successful. However, some old political truths still run true, and the maxim that he who wields the knife never wears the crown weighed heavy on any would be assassins. A new state of being for the Conservative Party took over, with unity achieved through just how disunited the cabinet were. May was being kept in power with the spectre of the viable alternatives enough to keep party discipline.

The Reshuffle

The resulting reshuffle brought back an unexpected old face, with Michael Gove returning to the Cabinet as Environment Secretary. There was initial consternation within green circles. With a reputation built on winning the Brexit campaign and fighting teachers unions, you may have felt justified in fearing the worst - yet Gove has been a pleasant suprise at DEFRA. Leading a department that other ministers may have looked down their noses at, Gove has been arguably the most active cabinet member, with policies on plastics, banning electric dog collars, a new 25 year environment strategy and laying the groundwork for the farming industry post-Brexit. He has been winning plaudits from across the spectrum, and is obviously enjoying the new challenge. However, his second year will need to have more delivery to match the early rhetoric and promise.

> Rules and established truths were trampled over

In BEIS we saw Nick Hurd and Jesse Norman leave, with Richard Harrington and Claire Perry come in. Harrington was new to the energy world, and came in with fresh eyes. Disappointingly, he didn't hold the brief for even a year, moving sideways in the department to leave Perry with a beefed up portfolio, and a promotion to attend Cabinet.

Clean Growth Plan

Perry was tasked with leading the stalled Clean Growth Plan, the subject of cross-departmental negotiations, with a keen interest from Treasury and Number Ten. Rumours and counter-rumours about the plan were swirling around, and even after it came out, whether it had been a victory for green Tories.

With No. 10 weakened, and with the team of advisors to the PM gone, there is a consensus that the paper was significantly stronger than it might have been. For that we must be grateful. However, by the time it was published it had become a Strategy rather than a Plan, and is a long way short of what the industry would have wanted. While the rhetoric and vision is strong, it contains very little protein to sustain a strong and growing sector that will be needed to deliver the targets.

Incentives for renewables are slim pickings, which is especially galling considering there is still support for gas through the Capacity Market, not to mention new budgetary measures for upstream oil and gas.

The strategy is also lacking in terms of long-term heat solutions. Now, this is a difficult one to criticise too heavily, with heat having been in the 'too difficult' pile for quite some time. The answers aren't quite so obvious or as numerous as they are on the power side. However, whilst the answers may be tough, the questions will almost certainly include 'how can we insulate our homes better', or 'how can we ensure new build homes are fit for the future'. The exam sheet may also have questions on what support systems should there be for renewables, although the Clean Growth Plan consultation did have every student's favourite, 'Hydrogen: Discuss', but for now the industry is still waiting.

With Perry a previous transport minister, and with Jessie Norman now in DfT, the transport section could also have been stronger, indeed in reality we have seen the electrification of trains removed, the installation of electric charging points

stalled, E10 for biofuels delayed and no increase in the fuel duty escalator for nearly a decade. However, much like as for power, the transport sector is looking like innovation and cost reductions of disruptive technologies may provide timely interventions. Namely, electric vehicles (EVs) are getting cheaper.

The buzz around EVs has grown quickly, indeed it would have been unthinkable, even two years ago, that a British PM would announce the ban of fossil-fuel powered car sales. The timing has since been one-upped around Europe, with Norway even announcing internal flights will be electric by 2040. It is a long way away, but no-one can deny that 2017 will be remembered for the year politicians started taking EVs seriously.

The B Word

Of course it's hard to recap this year in Parliament and not mention Brexit. It is both everywhere, everything, yet never seemingly progressing. A Sisyphean task, but instead of a boulder, Sisyphus is rolling a ticking time bomb up a hill, only to see either the Lords, the Cabinet, the Irish Border, or Jacob Rees-Mogg send it hurtling down once again.

There is an in-depth piece that goes into what we know, or don't know, about Brexit elsewhere in this publication. However, the realpolitik of it is behind nearly every move in the Government and Conservative Party. The real question is . . . can Theresa May exit the EU, whilst keeping the United Kingdom, and the Tory party, together. We have a year to find out.

Oh Jeremy Corbyn

Whilst Brexit is the number one issue in Tory circles, Jeremy Corbyn is the burning topic in Labour. Phenomenal election results almost saw Corbyn propelled into Number Ten, having been written off at the start of the campaign. Predictions of electoral wipe-out were common, with the only unknown being how bad the doomsday scenarios would be. As it turns out, Labour won the highest share of the vote in 60 years, with stunning victories in places such as Canterbury and Kensington.

Suddenly, everyone had to take a Labour government seriously. Manifesto promises of renationalisation have to be discussed, with promises of returning energy to public ownership, causing anxiety across the industry.

The Labour manifesto was a smorgasbord of ambitious populist promises. Local energy cooperatives to rival private companies coupled with locally run grids. 60% low-carbon energy targets by 2030, with a separate 40% renewable heat target in that timeframe. The banning of fracking, the insulating of 4 million homes and tidal lagoons were also included.

All of it was laudable, but have many wondering if it is possible. This combined with the feeling that there are many private companies and SMEs employing tens of thousands of people who have been at the forefront of the research, innovation and delivery that has already seen the start of a renewables revolution. Can the goals and aims of the Labour party be achieved with private companies? This question will become increasingly important to answer before the next general election.

One thing is clear, industry and interest groups will ensure they are much more engaged with the Labour Party going forward. The polling and electoral outlook meant the opposition were not taken seriously, but it should also be said that the internal party mechanisms may also take the manifesto more seriously next time. Too many policies were included without consultations, feasibility studies, and public or industry engagement, with few genuinely believing they would have to be delivered in Government. A party genuinely preparing for Government cannot let that happen again.

Energy and renewables remain a priority for many of the newer Labour party members, with a younger outlook that takes the environment and climate much more seriously. That being said, there are still some dinosaurs in the party, coal is still part of their DNA and antediluvian stances from Unions like the GMB remain huge hurdles to policy formation. The Tories have never had the monopoly of climate change deniers imagined in the public's eye and respected MPs such as Alan Whitehead, a stalwart supporter of renewables, have a fight on their hands.

That fight needs to be taken across all of parliament, public support for renewables has never been higher and is growing, but that pressure is not being felt at the ballot box. As we have seen, the political world is unpredictable, has never had so much flex and potential change. If we were to predict what we will be writing in next year's political review, there is nothing of which we could be certain. We live in interesting times, while that often leads to good poetry; it rarely leads to good politics.

Bioenergy

Bioenergy: the backbone of the renewables revolution

There is no doubt about it, bioenergy is the ugly duckling of the low carbon gang, not as gleaming as solar, nor as symbolic as the wind turbine.

Nuclear is still the famous, but divisive bad boy of the group, the love it or hate it marmite option, with hydrogen the prince across the water, full of promise.

None of them are perfect, they all have pros and cons, with devotees and detractors vociferously making their case. Bioenergy is no different. Similar to nuclear in the way that it splits the 'green community', but unlike nuclear, it is not as well known by the wider general public, although it does have support, 69% according to public attitude trackers, which is above nuclear (35%), but below solar (84%).

Bioenergy is certainly more complex than other technologies, it requires more understanding than solar and wind and the details can't be easily fitted into a tweet. "When done well bioenergy is good, when done badly it isn't" doesn't quite capture the nuance needed, nor would it easily convince someone faced with the barrage of negativity biomass and biofuels gets thrown at them. "Dirtier than coal" is an excellent strap line, even if the science and thinking behind it has been proved to be deeply flawed.

The sustainability of biofuels is of course a crucial issue, and one that the industry in the UK takes more seriously than anyone. The tracking standards, supply chain and providence are scrutinised more than any other technology. However, the industry is forced to talk defensively rather than of its achievements to date, and more importantly, its future potential.

In the UK, biotechnologies are the biggest renewable contributor across power, heat and transport. Nearly 10% of electricity comes from biomass, 6% of transport comes from biofuels, and 4% of heating also comes from biomass. Without bioenergy the UK would have no chance of meeting its 2020 targets, and would be struggling to ever meet the next two carbon budgets, let alone the more challenging budgets after 2027. Globally, 14% of the 18% of renewable energy comes from biofuels. These are phenomenal achievements that should be celebrated, yet in the UK you would be hard pressed to find MPs or journalists shouting from the rooftops about them.

Nearly 10% of electricity comes from biomass, 6% of transport comes from biofuels, and 4% of heating also comes from biomass

Without bioenergy the UK would have no chance of meeting its 2020 targets, and would be struggling to ever meet the next two carbon budgets, let alone the more challenging budgets after 2027

Back in 2012, the time of the last government Bioenergy Strategy, it was estimated that excluding biomass from the energy mix would significantly increase the cost of decarbonising our energy system by £44 billion and would be a significant contributor to 2050 targets. Since then, the energy market is almost unrecognisable, with 30% of electricity now renewable. We are seeing coal free days with increasing regularity, costs of solar and onshore wind have

dropped quicker than even the most optimistic supporter could have hoped, and are now competitive, if not cheaper, than building new gas stations. Even offshore wind has seen spectacular decreases in cost, and is now cheaper than the significant milestone of Hinkley nuclear station.

The public have jumped on solar, smashing the 2GW expectation of DECC in 2010, with around 13GW now installed, and over a million solar rooftops now in the UK.

Understandably, there is huge excitement about this, with a genuine belief that the once daunting climate targets can be achieved. This is hugely satisfying, and whilst the wider industry needs to do better in spreading this phenomenal news so that more people know that renewables are now mainstream and affordable, we can't do it with wind and solar alone. Energy storage is coming online, but is mostly not designed for longer duration periods, and the grid will still need dispatchable power for a long time to come.

The same is true in transport. The dizzying spread of awareness and policy support for electric vehicles in the past two years is remarkable. From being a footnote in government documents, to a commitment from the Prime Minister to ban new fossil fuelled cars by 2040. Some governments have gone further, and the Norwegian commitment to have all internal flights go electric by 2040 is truly breathtaking, and hard to believe even as a green campaigner. However, whilst the politicians have gone from scepticism towards EVs, into believing it is the silver bullet, a dose of realism needs to be introduced.

The last government Bioenergy Strategy was written in 2012, and whilst it had solid proposals and vision for the sector, the world has moved on hugely from even six years ago

Biofuels contribute much now, but importantly still have a hugely significant part to play in the transition away from fossils, that will take place in the coming decades. Not just in cars, which will obviously see a continuing growth in EVs and hybrids, but in the long term future of heavy freight, shipping and even with the Norway target, aviation.

The last government Bioenergy Strategy was written in 2012, and whilst it had solid proposals and vision for the sector, the world has moved on hugely from even six years ago. The industry needs to kick start itself, starting with an industry-led new bioenergy strategy which will detail the possibilities of the technology and what part it could play in meeting the 2030 and 2050 targets.

Bioenergy can provide jobs, ensure secure and low-carbon energy and would support other renewables technologies in the robust energy mix the UK needs, but needs support and vision, something the REA hopes to be a driving force for.

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 550 plants now operational (NNFCC, 2018). Of these, 85 plants inject biomethane into the gas grid. The remainder are CHP plants with a total electrical capacity of almost 400 MWe.

The prospects for continued growth in power generation from AD are limited, as FiTs are capped at 5MW per quarter and will come to an end by April 2019. The RO is now closed to new entrants and, as most AD plants are well below 5MW in size, CfDs are not an option. In addition, protracted delays in implementing the RHI reforms and re-instating economic tariffs for biogas and biomethane have meant that many projects have been kept on hold over the past year. With the new RHI legislation enacted, we are likely to see a new wave of AD plants being developed, especially in the biomethane sector, but this risks being a boom and bust cycle, caused by future RHI tariff degressions and a very short window available for commissioning plants under the new tariff guarantees.

There is also growing interest in using biomethane in transport and with the future closure of the existing RHI (in April 2021), the new Renewable Transport Fuel Obligation support could become the driving force for the deployment of new biomethane plants. However, more needs to be done to unlock this market. Using Green Gas Certificates that can support a business's reporting of onsite GHG emissions within the GHG Protocol (there are now 100,000s of households on green gas tariffs) is a possible growth area for biomethane plants.

ANAEROBIC DIGESTION CONTEXT

- Unique in that it generates renewable power, heat and gas that can be injected into the grid and used for heat or as a transport fuel.
- Can play a key role in abating GHG emissions from the agricultural and waste sectors, mainly by capturing methane from animal slurries and from food wastes.
- Feed-in Tariffs have seen dramatic reductions in support, and are due to come to an end by April 2019.
- Protracted delays in RHI reform have meant many projects have been on hold and little time is left for new development within the lifetime of the scheme.
- Digestate can replace mineral fertiliser, providing nutrients and improving soil fertility.

REA CONTACT

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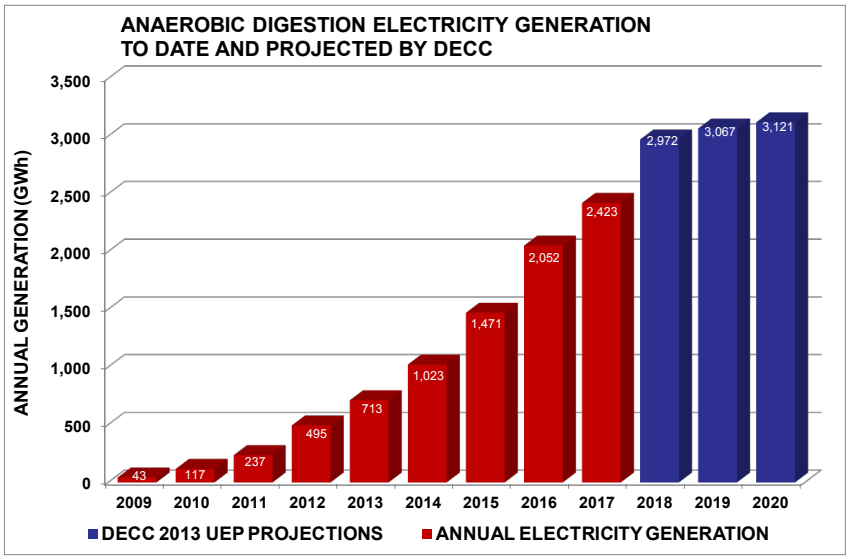
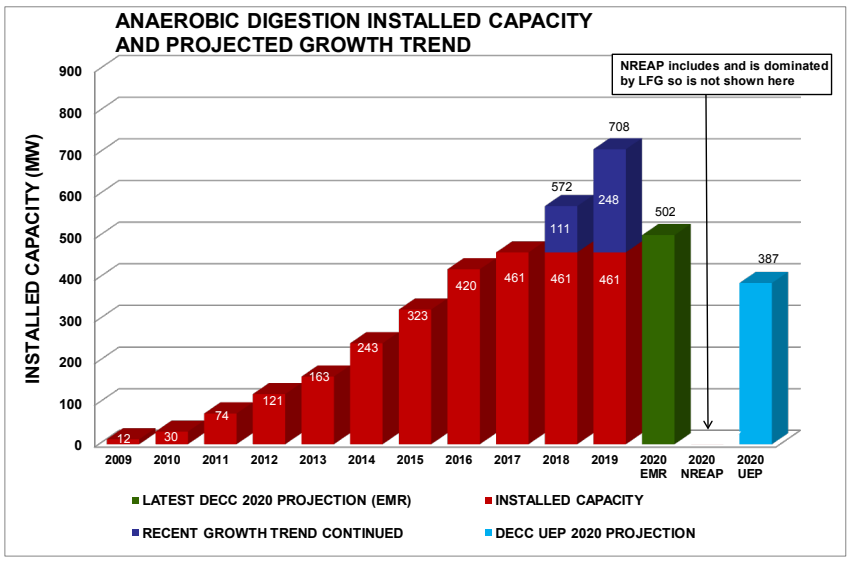
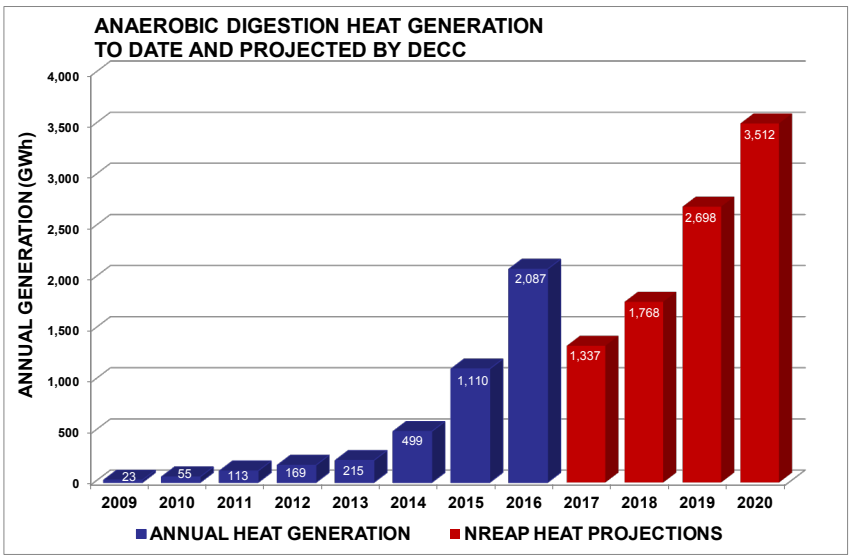






JOBS IN ANAEROBIC DIGESTION

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.

SIZE OF THE UK ANAEROBIC DIGESTION SECTOR

	2011-2012	2012-2013	2013-2014	2014-2015	2015-2016	2016-2017
Sector Turnover (£'millions)	340	358	340	347	356	371
No. of people employed across UK supply chain	2,650	2,635	2,828	2,865	2,952	3,002
No. of UK companies across supply chain	140	141	148	148	155	158

Liquid Biofuels

(Transport)

Transport now accounts for 27% of the UK's Greenhouse Gas (GHG) emissions, overtaking power generation as the largest emitter only last year. Unlike other sectors, its contribution is growing rather than decreasing.

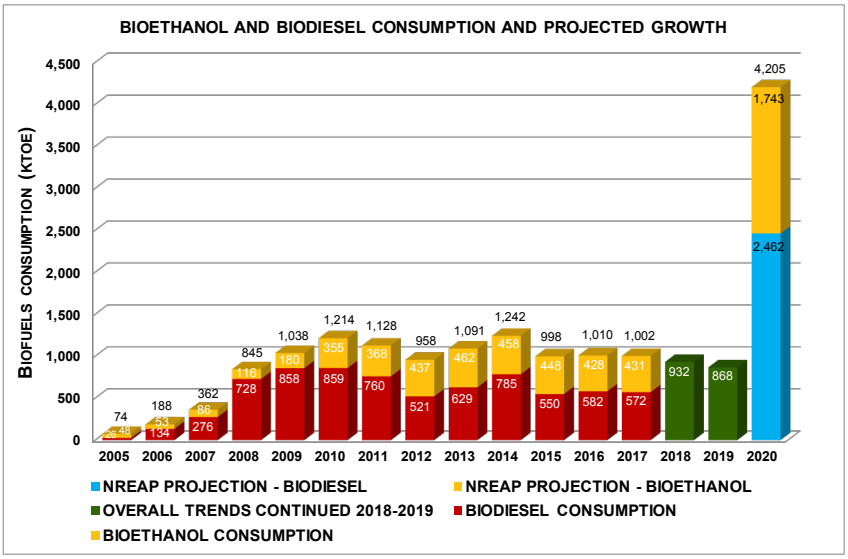
The UK renewable transport fuels market continues to be dominated by liquid biofuels, with 49% of supplies coming from bioethanol, 47% biodiesel and 4% biomethanol. The trend towards using waste feedstocks continues, reaching 66.3% in 2017 (up from 59% in 2015 – 16). Biodiesel continues to be produced entirely from waste. Almost a quarter (23%) of the UK's renewable fuels are domestically-sourced with used cooking oil, category 1 tallow and feed wheat comprising 40.1%, 8.5% and 42.0% respectively.

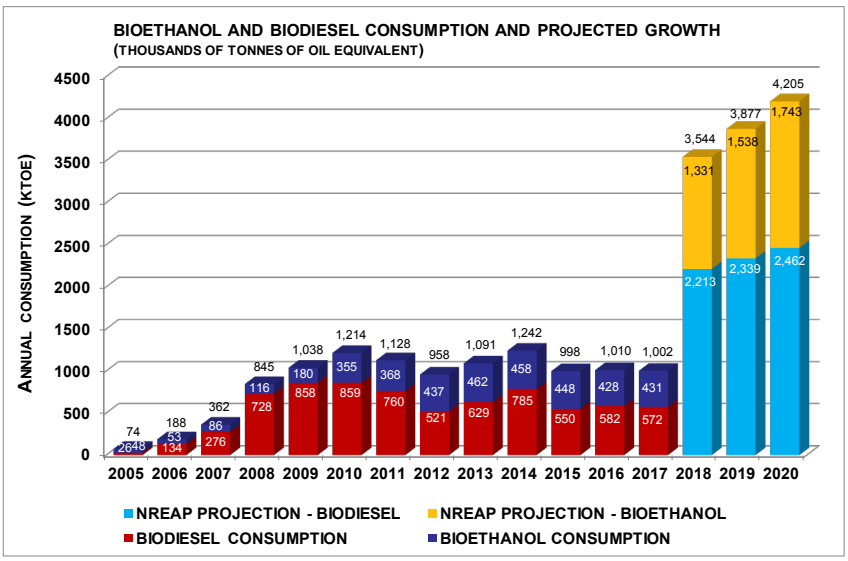
Amendments to the Renewable Transport Fuel Obligation came into force in Mid-April 2018 marking the end of several years of stagnation whilst the target remained at only 4.75%. The new obligation will require fuel companies to more than double the amount of renewable fuel they supply by 2020.

It will also introduce a new incentive for the production of novel fuels from wastes. Hydrogen and renewable fuels made from non-biological sources (e.g. CO_2) are now supported. With the obligation set out until 2032, and the impending closure of other policies for renewables, the RTFO is now becoming one of the most interesting of the available renewable incentives.

LIQUID BIOFUELS CONTEXT

- The EU Renewable Energy Directive imposes a sector specific requirement for 10% of energy used in land transport to be renewable by 2020.
- Biofuels are traded globally, unlike power and heat which can only be transported shorter distances. Consumption in the UK is therefore no guarantee of economic benefits to the UK. The balance of payments is poor for biofuels, and it is important to increase domestic production in order to bring greater benefit to the UK economy. A move to E10, a 10% blend of bioethanol in petrol will help address this; at present no more bioethanol can be accommodated whilst UK motorists only have the choice of E5 petrol.
- UK-produced fuels have an excellent sustainability record, significantly exceeding expectations in environmental protection and GHG savings. The average GHG saving of UK produced fuels was 70%.
- The UK has set a limit for the amount of crop-derived biofuels which may be counted towards meeting the target, starting at 4% from 15 April 2018 and decreasing year-on-year from 2021 to 2% by 2032. In future years this has the potential to constrain the amount of domestically-produced ethanol consumed in the UK.





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
Gaynor Hartnell, Head of Renewable Transport Fuels

SIZE OF THE UK LIQUID BIOFUELS SECTOR

	2011-2012	2012-2013	2013-2014	2014-2015	2015-2016	2016-2017
Sector Turnover (£'millions)	340	358	340	347	566	1,676
No. of people employed across UK supply chain	3,500	3,509	3,829	3,914	4,103	9,989
No. of UK companies across supply chain	200	200	211	211	225	617

Renewable Heat

With no silver bullet, heat policy needs to take a silver buckshot approach

Decarbonisation of heat is behind the pathways to decarbonise the power sector or the transport sector.

Just over 28% of gross electricity consumption in 2017 was renewable, and biofuels made up 3.1% of road fuels in the same year. The latest figures for heat from 2016 show that 6.2% of our heating and cooling was renewable. But unlike power and transport, there is no broad consensus on how to decarbonise heating.

For the power sector, there is now a general agreement that renewable power sources will be able to decarbonise the grid, as solar and wind have rapidly come down in price, biomass and bioenergy have provided dispatchability, and energy storage will support grid stability. It is not to claim victory too early with just over a quarter of power decarbonised, but there is a clear pathway for decarbonisation.

A similar story is emerging in the transport sector: the rise of Electric Vehicles with longer range, lower prices, and wider charging networks is rapidly transforming our transport sector. And this happens in combination with renewable transport fuels to blend in with fossil fuel including for heavier transport and airfreight. Although transport is further behind than heating, percentage-wise, there is the beginning of a vision for how to decarbonise our transportation without minimising mobility.

Heat is different. At least in the UK. There is no wide-held agreement on how to lower the carbon emissions from the generation of heat and cooling, apart using from less fossil fuels, and even that is not broadly agreed upon. The Government is currently consulting on how to decarbonise the rural, low-density areas that are currently not connected to the gas grid, where it is considering a wide range of options, with the main aim of trying to create a consensus around a set of agreed policies. For the 80% of domestic households connected to the gas grid, most decisions have been postponed until 2025, such as what to do with the gas grid, whether to rely on biogas or hydrogen, install heat networks, or electrify heating.

There is no wide-held agreement on how to lower the carbon emissions from the generation of heat and cooling

This perhaps in part, comes down to the fact that there is no single technology that can deliver all heat demand, as heat (and cooling) demand varies in terms of high-/low-grade heating, load factors, and delivery form. A Victorian house in the countryside will not be heated the same way as a new build house in a suburban area. Heat systems for space and water heating are not utilised to the same degree that heat systems for process heating are. Yet, although hot water in radiators can heat a room, it cannot provide the heating needed for industrial heat. There is no single answer to solve the decarbonisation of heat.

This is also evident from the lessons learned from the Renewable Heat Incentive (RHI). The scheme is aimed at retrofitting off-gas-grid properties, which usually are older, less energy efficient, more likely to be in fuel poverty, and have a higher heat demand. Heat pumps have been shown to be particularly suitable for homes with lower heat loads, where there might already be underfloor heating or larger radiators. They are a convenient solution for consumers that do not want to deal with fuel deliveries and require less maintenance but cannot always deliver the higher heat loads efficiently and face grid constraints in certain areas. Biomass boilers were initially very popular, before the support was reduced, as the technology can deliver higher heat loads and have been most successful in replacing oil boilers. In addition, using biomass supports the forestry industry and forest growth, however, biomass boilers do require storage space, fuel deliveries, and are less suitable in urban areas due to emissions. In the non-domestic scheme, biomass has been the most successful technology in decarbonising commercial buildings, schools, hotels, and agricultural processes.

Separately, the RHI has been successful in incentivising the development of biomethane plants that can inject green gas into the grid, which helps decarbonise the gas grid. However, there are limitations on the feedstock, as England, for example, does not yet mandate the collection of food waste. Although not evident in the RHI, geothermal has developed well across Europe and has the potential of decarbonising urban heating but do require heat networks to be laid and heat offtake settled up front.

You get the picture by now.

However, in combination, biogas, heat pumps, biomass boilers, geothermal, solar thermal, and reduced heat demand can decarbonise our heat supply. This will also require heat networks, a decarbonised gas grid, and some electrification of heat. Not only does the process of decarbonising heat require more than one technology, but more than one policy will also be needed to deliver the wider decarbonisation of heat. The UK cannot solely rely on a subsidy scheme such as the RHI, but will most likely need to implement a collection of different regulations, support schemes, and taxation, such as a phase-out of oil boilers, variable stamp duty, carbon taxation, building regulations, an energy efficiency scheme, an boiler scrappage scheme, variable council tax rates, and minimum energy efficiency ratings for property sales/lettings. For commercial heating, policies such as Enhanced Capital Allowances, business tax relief, and the Enterprise Investment Scheme could be helpful.

From the industry's point of view, the Government need to create stable policies with clear direction and stop picking winners

In less than three years, the RHI will close to new applicants, and there will be no direct policies to support the uptake of low-carbon, renewable heating. A combination of the above policies and policies not listed here will need to be implemented to avoid a cliff edge and implement a pathway to widespread deployment of low-carbon heating.

At present, there is no consensus on what technology or policy is the best or most efficient to deliver low-carbon heating. From the industry's point of view, the Government need to create stable policies with clear direction and stop picking winners. From the Government's point of view, the industry needs to understand that the Government will not be able to subsidise every single heat system in the UK as we transition to a new heating paradigm. The industry needs to reduce costs to a lower gap between fossil fuels and renewables. But this won't happen without clear direction and many different policies that enable all low carbon technologies. There is not one single silver bullet that will allow the UK to decarbonise its heating and cooling, so seeking a broad agreement on which one is the best is less helpful. A buckshot of silver might just do the job instead.

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 reductions in RHI tariffs. The 200kW-1MW market was growing after the sub-200kW market collapsed, but this has now also collapsed, and many companies have had to restructure and consolidate. The Government expects growth in the +1MW market, but it is not guaranteed that the RHI will foster sufficient deployment.

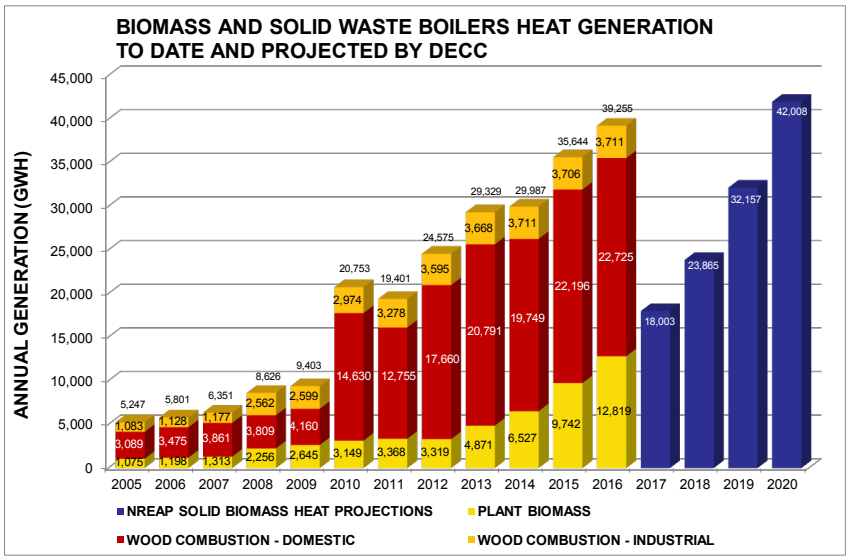
Biomass heat systems are already highly cost-effective, with further cost reductions possible as the UK supply chain matures, but unlikely without renewed policy support.

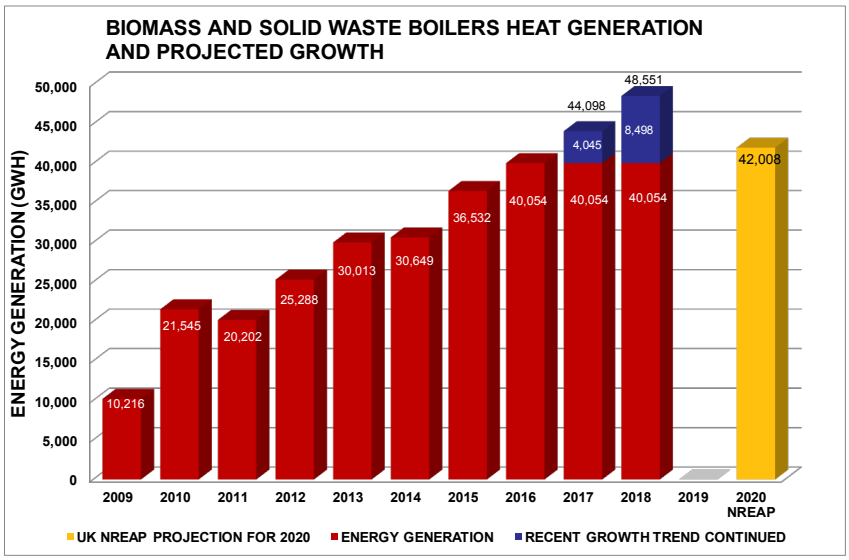
BIOMASS BOILERS CONTEXT

- RHI reforms severely cut tariff levels in September 2017, even though it remains the most cost-effective heat technology.
- Reduction in support has halted growth in both domestic and non-domestic markets.
- Wood stoves are already popular without subsidy.
- Sustainability criteria introduced in October 2015 and life-cycle analysis of fuels show over 87% GHG saving compared to fossil fuel values.

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	2016-2017
Sector Turnover (£'millions)	540	600	684	735	809	889
No. of people employed across UK supply chain	4,530	4,510	5,379	5,650	6,353	6,663
No. of UK companies across supply chain	210	210	244	246	286	313

Biomass Power

(Power)

The growth of the biomass power sector has slowed down, but a number of new plants are expected to commission soon, such as in Teesside, Lynemouth, and Drax's fourth unit.

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

When including whole system costs biomass is considered much cheaper, as it contributes to grid stability, is dispatchable, and has lower associated transmission costs.

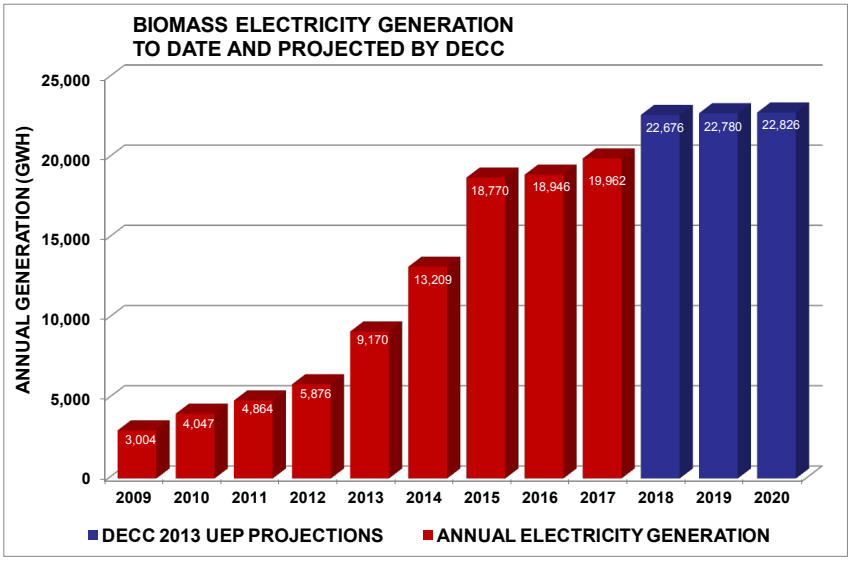
BIOMASS POWER CONTEXT

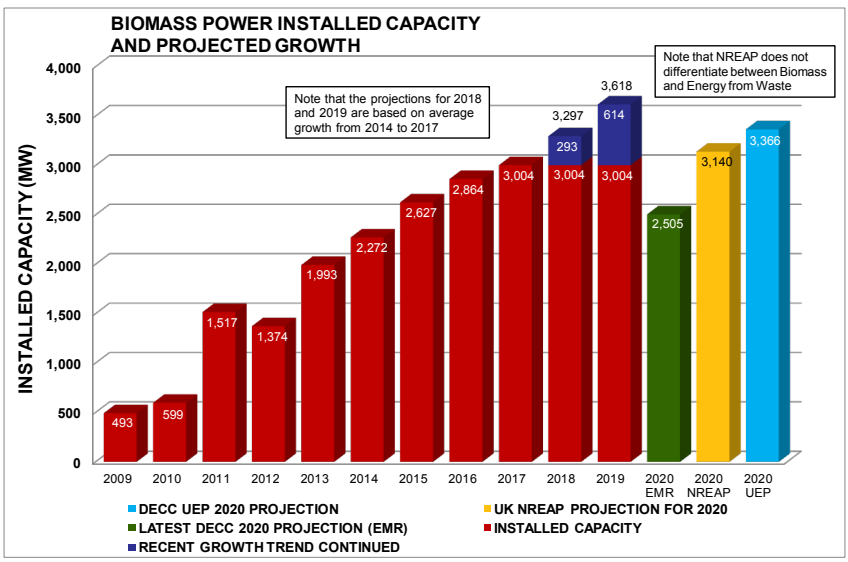
- Sustainability regulations introduced in 2015 provide mandatory independent assurance of forest management and carbon emissions to the public.
- Government not supporting standalone new projects, as biomass power is not an eligible technology for a Contract for Difference. Deployment likely to be far below potential in medium term.
- Cost-effective compared to other options.
- Like other bioenergy technologies, it provides power that can be delivered when needed - complementing technologies such as wind and solar.

REA CONTACT

Benedict McAleenan, Head of Biomass UK

Frank Gordon, Policy Manager





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	2016-2017
Sector Turnover (£'millions)	450	498	546	586	635	697
No. of people employed across UK supply chain	3,330	3,320	3,830	3,999	4,377	4,473
No. of UK companies across supply chain	170	166	187	189	218	225

Biomass CHP

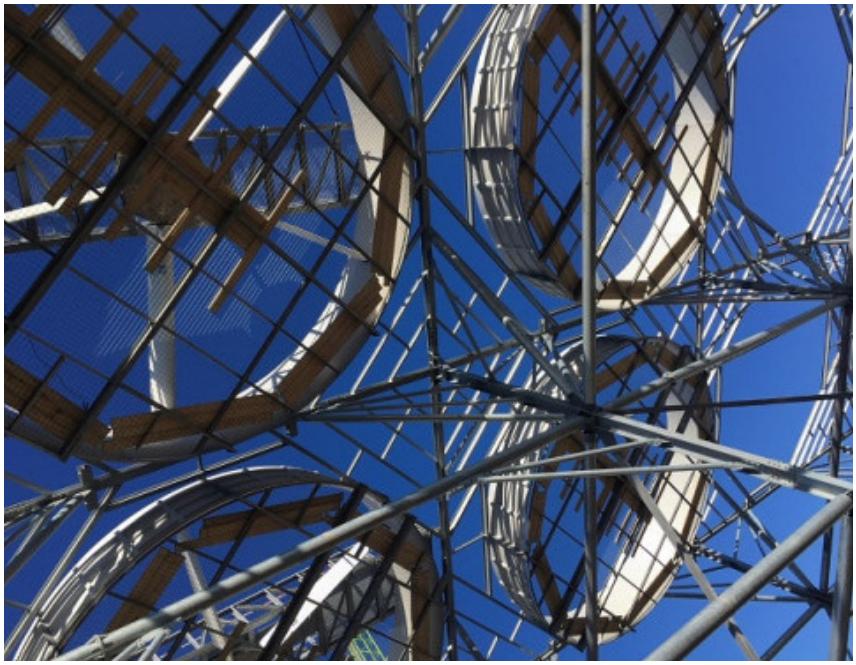
(Heat & Power)

For full explanation of terms, methodology and growth projections see pages 71-73

Biomass combined heat and power (CHP) plants can lead to significant fuel, cost and emissions savings over conventional fossil fueled, separate forms of power production and heat-only boilers.

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 has supported many smaller scale CHP systems.



BIOMASS CHP CONTEXT

- Combined Heat and Power can have significant energy savings compared to generating heat and power separately.
- The timescale for the CfD scheme does not link up with the timescale in the RHI.
- 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	2016-2017
Sector Turnover (£'millions)	450	498	546	586	586	394
No. of people employed across UK supply chain	3,330	3,320	3,830	3,999	3,999	2,605
No. of UK companies across supply chain	170	166	187	189	189	159

Deep Geothermal

(Heat & Power)

For full explanation of terms, methodology and growth projections see pages 71-73

Deep Geothermal energy is a natural form of renewable energy generated from the heat of the earth's core. This heat continuously travels through the earth's layers, warming rocks and aquifers and extracted from a depth of at least 500 metres. It is also clean and has the potential to be a reliable cost effective form of baseload energy. Once built, a deep geothermal plant can be expected to continue in production for 100 years or more.

Deep geothermal energy can be used for electricity production, or to provide heat for commercial, industrial and residential buildings. It is ideal for providing heat to district heating schemes, universities and hospitals. It can also be used in industrial processes, such as cooling, or in aquaculture and horticulture.

Boreholes are drilled to access natural reservoirs of hot water and transferred to heat exchangers for use as direct heat.

In the case of 'hot rocks' or 'EGS' schemes, water is pumped from the surface into rock formations where it is heated and returned to the surface. The heat is then used to generate electricity via a turbine/engine and if a heat load is present, the residual heat can be used via a CHP process. After the heat has been exploited the water is recycled back down into the ground via a second borehole. The benefits of deep geothermal energy are available 24 hours per day, 7 days a week, and produces baseload electricity.

DEEP GEOTHERMAL CONTEXT

- Eligible for CfDs but strike price seen as too low to be viable under that scheme.
- RHI sufficient to bring projects forward and tariff guarantees have helped investor confidence.
- Planning policy has been amended to make deep geothermal easier to develop but there are more amendments needed to streamline the process.
- First deep geothermal scheme should start development in the next 12-18 months.

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	2016-2017
Sector Turnover (£'millions)	10	10	10	10	10	10
No. of people employed across UK supply chain	200	200	200	200	200	200
No. of UK companies across supply chain	<25	<25	<25	<25	<25	<25

Marine and Deep Geothermal

The Forgotten Technologies

The rise of renewables in the past eight years has been a huge success, outperforming even the most optimistic supporter, both in terms of cost and deployment.

In 2010, the expectations were that wind and biomass were going to a big part of the mix, solar has defied those projections, yet marine and geothermal have been in stasis. In a country that has more tidal resource than sun, this is both a surprise, and a disappointment.

Things could, and should, have been different, but it's not too late to change the fortunes of these technologies.

Hydropower is nothing new in the UK, especially in Scotland were there is still 4.5GW of hydro and pumped storage installed. Countries such as Norway, Costa Rica and China have huge advantages in terms of natural resource for hydro, something that was always going to be a limiting factor for us. Yet, the UK has enormous potential for wave and tidal. Alex Salmond famously said we are the Saudi Arabia of marine, with us being blessed with some of the best tidal resource in the world.

We were also leaders in the intellectual property too, with world leading research and developers. Marine Current Turbines were the first company to install a commercial tidal turbine globally, launching in Strangford Lough in 2008, with MayGen the world's largest tidal scheme now in operation.

Yet the industry has faced huge setbacks. Firstly, the environment they work in is incredibly hostile and the learning curve is high, and costly. Offshore wind already had learning, financial backing and a supply chain off the back of the more established onshore sector. This has given them more staying power as a sector, and they have ridden the rough times.

Secondly, the changing government policy shifts and incentives have had a significant impact on a technology that is still in development trying to find finance. From the Marine Renewable Development Fund to ROCs to CfDs, the support mechanisms have not suited a technology that is on the cusp, but not yet commercialised.

Lastly, and sadly, some of the leaders in the industry have folded and the momentum of the industry has suffered with it. Yet the potential is still huge, both for UK power generation, and the global export potential.

Unlike marine, the UK is not a leader in geothermal deployment nor natural resource, yet the potential is still there to make significant impact in heat, one of the toughest to decarbonise areas.

> There are strong strategic reasons why marine and geothermal are still important

For years, Southampton was the beacon of geothermal in the UK, with a scheme installed in the 1980s. Since then the industry has inched forward with other smaller schemes, but ultimately, in a country with a unique Rolls Royce gas network providing cheap, but fossil based, heating, and a dearth of district heating compared to other countries, progress has been tough. However, both of those things have to change. The UK cannot meet our climate targets by relying on gas, simultaneously, we have to get serious about developing heat networks.

There is hope, and progress, that the UK can show. Work has started on a new deep geothermal scheme in Stoke, and the potential for both heat and power projects in Cornwall is high. Planning legislation has been amended to make it easier for Deep Geothermal exploration, and funding under the RHI is sufficient to get the first plant developed. However, funding under CfDs for Deep Geothermal power is woefully inadequate and needs urgent attention if this baseload resource is to be tapped.

Of course, all this is happening whilst other renewables have reached commercialisation, with solar, biomass and both offshore and onshore wind now all cost competitive with fossils and nuclear.

So have these technologies missed the boat? In many ways, they have been punished by the other technologies beating expectations and coming down in cost much quicker than forecast. But there are strong strategic reasons why marine and geothermal are still important. As offshore wind has shown, there are massive cost reductions that can happen with strong government support and through learning with more deployment. Marine could provide 20% of the UK's electricity, and do so in a predictable manner. There is no one technology that can fix the decarbonisation of heat, yet geothermal could provide over 100GW of heat, as well as 9.5GW of baseload electricity.

It is too early to give up on such promising technologies, and we cannot afford to do so if we are to meet our climate targets.

Organics Recycling and Anaerobic Digestion

Greening your Bin

Biodegradable waste continues to be an area of waste management that attracts significant attention at this time.

Biodegradable waste continues to be an area of waste management that attracts significant attention at this time. Within this terminology we include green waste and food waste both from commercial and domestic sources. In the UK there is still only 50% of households that receive some kind of food waste collection, with England languishing behind at a collection rate of 45% and Wales at over 95%. More importantly both Scotland and Wales have mandatory food waste collections which have driven collection regimes and volumes upwards encouraging inward investment in treatment infrastructure and employment.

> In the UK there is still only 50% of households that receive some kind of food waste collection

The REA has been pushing on Ministers doors for some time for the mandatory collection of food waste, but Government are not keen to implement any forced or mandatory scheme but want to allow the market to effect any change. As part of the Circular Economy Package (CEP), the revised Waste Framework Directive recognises the potential of the bioeconomy and provides vital incentives that will boost the circularity of bio-waste across Europe. For the first time, the way is paved, that annually around 100 million tonnes of valuable organic resources within Europe will be separately collected and recycled.

Green waste collections are available for the majority of households, however the most recent intervention has been to introduce charges to households for the provision of a kerbside collection scheme which has reduced the volume of material available for treatment.

Additional challenges for the sector are in respect to feedstock quality. Too much cost and effort has to be expended by the biowaste site operators to clean up the feedstock received both from the commercial and local authority providers. It is an imperative that feedstock quality is improved, before we reduce the available land bank which the sector relies on so heavily for this material to be spread.

On a more positive note, there has been much mention of protecting the UKs 'Natural Capital' within the recent 25 year Environment Plan and there are few products as well placed to provide a sustainable input to our soils as compost and digestate. It is important that we continue to encourage the use of these products as their use becomes more widespread and accepted as the norm by farmers and the growing media manufacturers nationwide.

Hydropower

(Energy Storage, Power)

As we noted in the last edition, hydro deployment rates in recent years has been low, with the limited deployment taking place on the smaller scale.

When looking further ahead, due to technology-specific and policy reasons this is likely to remain the case, although regional pipelines of projects (for example in the Highlands) are planned.

HYDROPOWER CONTEXT

- Support available via the Contracts for Difference and Feed-in Tariff schemes.
- UK expertise in supply chain and services markets.
- Currently deployment limited to smaller scale, though some future projects planned.

REA CONTACT

Frank Gordon, Policy Manager

James Court, Head of Policy & External Affairs

Heat Pumps

(Air, Water and Ground-Source Heat)

There are three types of heat pump; air source which absorbs heat from outside air, water, which absorbs heat from a water source and ground-source which extracts heat from the ground using pipes buried in the ground. Air and ground-source heat pumps are commonly used in the UK. They can be used in homes businesses as well as schools, hospitals and other large buildings.

A much-favoured technology by policymakers with huge potential to contribute to decarbonising the heat sector especially where buildings are very well insulated.

Despite increasing the direct financial support for heat pumps, deployment levels have not increased. They make up 60% of all domestic RHI accreditations, although still behind that originally envisaged for 2020, which were overly ambitious. It has been suggested that upfront payments would be more effective in incentivising deployment, than quarterly payments over seven years.

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).

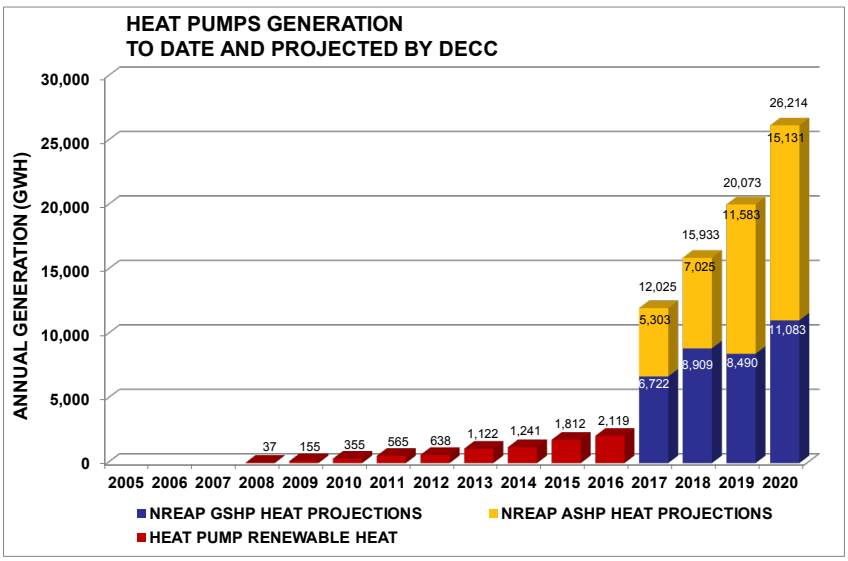
HEAT PUMPS CONTEXT

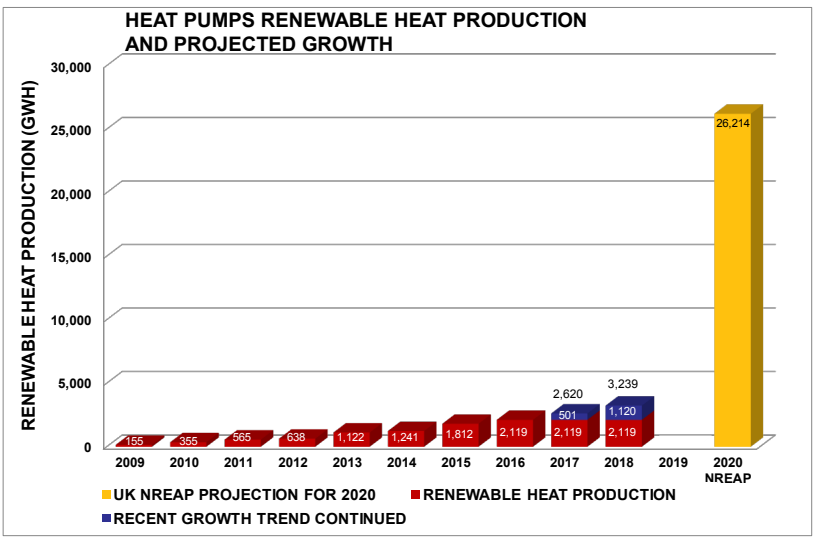
- Stable deployment in the Renewable Heat Incentive, with third-party finance potentially further incentivising deployment.
- Installation requires sophisticated understanding of heat demands of building and existing heating systems. Without this, consumer electricity bills and GHG emissions will be far higher than expected.

REA CONTACT

Frank Aaskov, Policy Analyst

James Court, Head of Policy & External Affairs





JOBS IN HEAT PUMPS

MANUFACTURE AND DESIGN

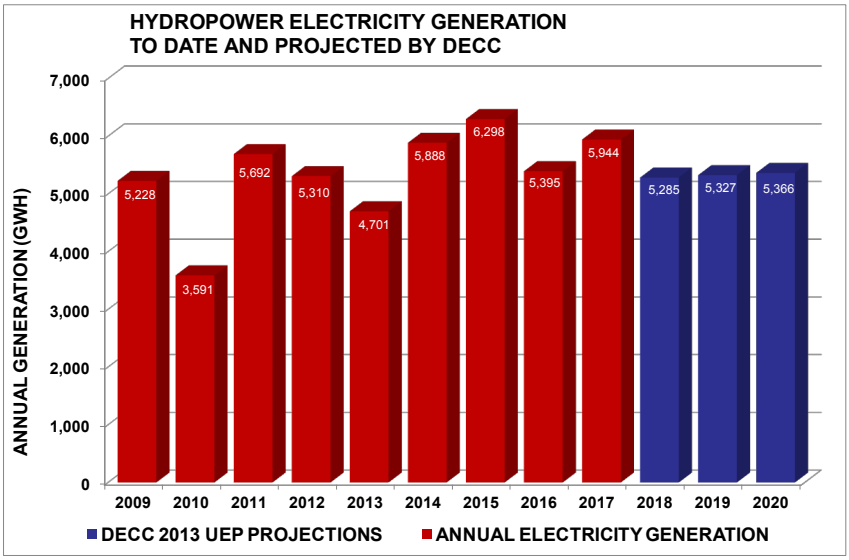
Structural design engineer; Surveyor; Heat pump engineer; Electrical engineer; Skilled and semi-skilled assembler; Welder; Machinist; Metal worker; Hydro geologist; Geologist; Mechanical engineer.

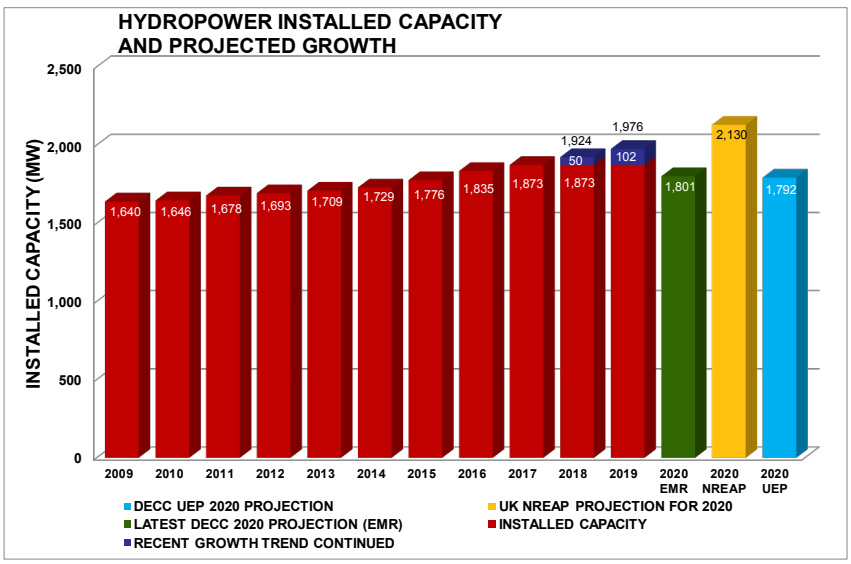
INSTALLATION AND MAINTENANCE

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	2016-2017
Sector Turnover (£'millions)	935	1,058	1,097	1,158	1,249	1,353
No. of people employed across UK supply chain	7,320	7,345	8,315	8,611	9,441	9,796
No. of UK companies across supply chain	380	381	417	421	473	489





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	2016-2017
Sector Turnover (£'millions)	560	577	595	615	639	666
No. of people employed across UK supply chain	4,970	4,955	5,390	5,508	5,778	5,864
No. of UK companies across supply chain	260	261	276	278	296	301

Energy from Waste

"Waste not, Want Not"

Government interest in future waste infrastructure requirements has grown substantially in the last year.

Multiple Government bodies are currently examining future waste infrastructure needs and the potential for innovation in the sector, with new policies expected to be announced by the end of 2018. Does this mean the Government is finally getting fully behind the circular economy?

From the ambitions stated within the Clean Growth Plan, Industrial Strategy and 25 Year Environment Plan, it would seem that the Government has sincere, if high level, ambitions in regards to realising both the waste hierarchy and seeing better resource stewardship. Commitments to investing £99 million out to 2021 on innovation in natural resources and maximising resource productivity are to be welcomed, as is the ambition to reach a 'zero avoidable waste' economy by 2050.

In addition, it seems fairly likely the Government will adopt the EU Circular Economy targets, which include 55% of business and household waste being recycled by 2025, going up to 65% by 2035. The Package is on course to be ratified by the end of 2018 and be replicated in the UK law through the EU Withdrawal Bill. Brexit seems unlikely to stop its implementation in the UK, if for no other reason than a lack of alternative policy and regulations to immediately replace it following our departure.

However, realising these ambitions is, of course, a very different question and we are yet to see if Government has understood all the options and potential for innovation present in each stage of the waste hierarchy. So far, we have seen fairly knee-jerk policy making on the important issues like plastics. New policies to tax single-use plastics and ban straws are very welcome, but addressing our wider waste problems, and realising the opportunities, will require a far more comprehensive analysis of the waste stream looking across production, consumption and waste management.

Commitments to investing £99 million out to 2021 on innovation in natural resources and maximising resource productivity are to be welcomed

Thankfully this is exactly what the Department for Environment, Farming and Rural Affairs (DEFRA) has stated as their ambition as they develop a new Waste and Resource Strategy. This work is also expected to be heavily informed by National Infrastructure Commission, the independent body that has spent the last two years attempting to model both waste arising and capacity infrastructure requirements out to 2050. The NIC recommendations are due to be published imminently and the strategy due by the end of the year. The REA has been regularly feeding into these discussions, especially in regards to organic recycling, anaerobic digestion (AD), landfill gas, and energy from waste.

On organics, the question of biodegradable waste segregation at source is paramount. The REA has long called for separate food waste collections, which will improve national recycling rates while driving demand for AD capacity. The importance of AD should not be understated, as it provides the ability to utilise organic waste in the decarbonisation of heat and transport

sector through the utilisation of biogas for transport and injected into the grid, as well as curbing GHG emissions from the agricultural sector and improving soil health.

Landfill gas sites also remain frequently overlooked within the broader waste and resource discussion. The welcome diversion of waste from landfill is leading to a rapid decline in landfill gas production, however, the headroom provided by the availability of existing electricity export connections is an opportunity for diversification e.g. into solar PV and energy storage. Ensuring planning policy is suitably favourable, by instigating a 'presumption in favour of development' should be encouraged so that these sites are again fully utilised within the clean economy.

Finally, energy from waste must also not be resigned to simply being at the bottom of the waste hierarchy. After economically recyclable materials have been removed it is correct that this valuable residual waste is put to further use for production of renewable power and heat. Equally, Government must get to grips with what they want to be delivered from Advanced Conversion Technologies (ACTs), such as gasification and pyrolysis. Aside from DEFRA's work, both the Department for Business, Energy and Industrial Strategy (BEIS) and the Department of Transport (DfT) want to see the delivery of highly efficient ACT plants capable of delivering waste to renewable transport fuels and BioSNG for gas-to-grid. The Waste and Resource Strategy is an opportunity to set clear ambitions for ACTs, stipulating precisely what Government wants to be delivered, and for dedicated cross-departmental policies to be put in place to support these innovative technologies which can add great value to the UK circular economy.

Energy from waste must also not be resigned to simply being at the bottom of the waste hierarchy

Overall, after a decade of little attention being paid to waste policy, Government have evidently turned a corner. There is huge potential to be realised across the circular economy which, if done correctly, could reform how the UK uses and manages its waste for decades to come. It is positive that Government is now engaging with these issues through multiple work streams and industry must not miss this opportunity to play its part in highlighting the diversity of potential solutions that can be realised across the waste hierarchy. As the old adage goes 'waste not, want not' - especially when it comes to opportunities for strong waste policy reform which should lead to building a sustainable UK circular economy fit for the future.

Mixed Energy from Waste

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

Waste to Energy covers a large number of different technologies and feedstocks, ranging from thermal combustion for Energy recovery and landfill sewage gas to Advanced Conversion Technologies (ACTs), like gasification. Government interest in understanding the UK waste infrastructure needs has substantially increased in the last year. Delivery of the circular economy and better resource management is included within the Industrial Strategy and a key component of the 25-Year Environment Plan. New policies are now expected within DEFRA's Waste and Resource Strategy, due to be published by the end of 2018.

For ACTs, the market remains relatively nascent in the UK. However, Government policies are becoming increasingly focused on systems that will deliver renewable transport fuels, Gas to Grid and green chemicals, rather than straight power production.

Landfill Gas technologies offer a range of benefits beyond electricity generation, including enhanced greenhouse gas savings from avoided methane emissions from landfill. Future growth is based on the CfD scheme and subsidy free projects, while generation from existing sites will slowly reduce over time.

MIXED ENERGY FROM WASTE CONTEXT

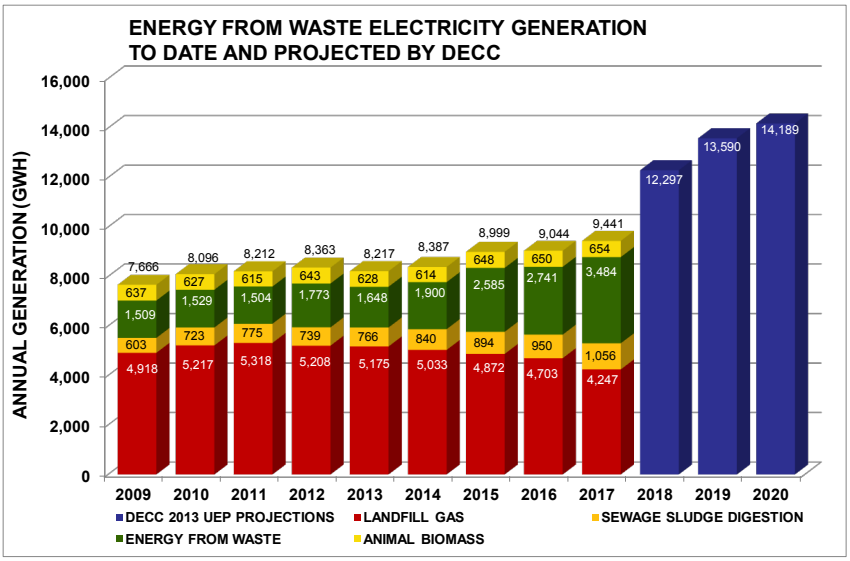
- Includes landfill sewage gas, conventional energy recovery and advanced treatments like gasification.
- There remains industry debate about the level of future waste management capacity that shall be required as policy intervention will determine amounts of residual waste arising.
- Planning issues remain a significant barrier.
- The size of the capacity gap will also be influenced by whether the UK continues to export significant volumes of waste to Europe or chooses to utilise it domestically.
- Government fiscal incentives are becoming focused on delivery of efficient ACTs that will lead to the delivery of alternative sustainable products beyond power production.

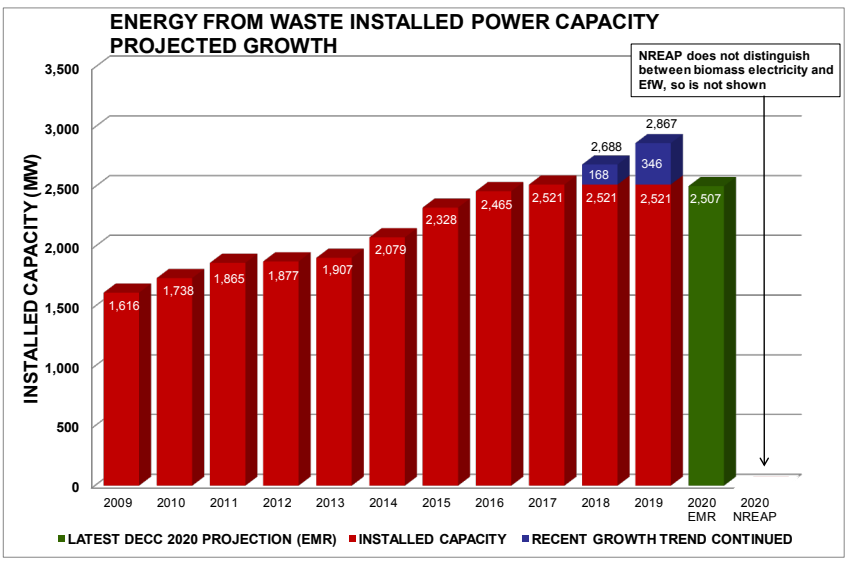
REA CONTACT

Mark Sommerfeld, Policy Analyst

Frank Gordon, Policy Manager

Gaynor Hartnell, Landfill Gas Lead, Head of Renewable Transport Fuels





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	2016-2017
Sector Turnover (£'millions)	809	832	866	895	939	1,027
No. of people employed across UK supply chain	6,020	6,545	7,109	7,316	7,694	8,084
No. of UK companies across supply chain	330	341	363	366	392	401

Solar PV

After Dawn - the Future of Solar

In the 1980's technology companies lobbied the EU about the fact that space technology, solar modules powering satellites, could potentially power buildings.

That lobbying led the EU to fund research centres, primarily universities, to see if solar really could generate useful quantities of electricity if deployed in EU countries such as the UK. This research finally focused on solar being an integrated part of a buildings fabric, providing power for that building's needs.

The UK was deeply involved in this research through a variety of universities along with major companies such as BP, Shell and Pilkington. Research focused on demonstrations of how solar could be made into a building's roof, facade or shading system. This research attracted top architects who assisted in developing the products. The UK led the development of what was then termed Building Integrated Photovoltaics (BIPV) with the largest BIPV facade in the world on Northumberland Building in Newcastle (40kWp) and the largest integrated solar system on a commercial building in the world at the Ford engine plant in Bridgend. Also, companies such as Redland and Solar Century developed innovative BIPV systems for the residential sector and made headway deploying systems, particularly in the social housing sector.

Even with the success of these projects, and many others, UK Government failed to see the potential solar had and dismissed it as a significant contributor to the UK's energy mix, while countries such as Germany and Japan continued to develop, support and deploy the technology. The need to develop new technologies to be deployed in East Germany as part of the reunification played a big part in what was at that time driving the German solar market.

The supply of solar modules was also changing, Shell and Pilkington withdrew from the market whilst BP Solar became the world leader in cell and module production. Also, electronics companies such as Sharp entered the market, with Sharp setting up a manufacturing facility in Wrexham.

During this time the future of solar was often discussed in relation to it only being viable in places where there were the highest levels of sunlight, an example often used was if a 200 square mile solar module array positioned in the Sahara was developed it could provide the world with all its energy. Whilst true it ignored the fact that transmitting electricity over such large distances would require super conductors or efficient batteries which in themselves were not viable at the time. Unfortunately, it also distracted many from the opportunities closer to home.

> At present around 1.3% of the world's energy comes from solar so the opportunity for the solar industry is huge

Whilst academics pondered solar's future and some Governments, such as the UK's, struggled with the economics and the potential for cost reduction, those within the sector knew that mass production would one day drive down the cost and make solar a viable energy provider, much closer to home than the Sahara Desert.

Thankfully forward-thinking Government's, such as Germany, had the vision to create the scale necessary to drive down the global price by creating demand and thus a solar market. At that time the biggest solar manufacturing plants were only producing tens of MW's a year and with demand growing, cells were becoming scarce. With a market created, it was the Chinese that realised the opportunity that industrial scale would bring and started to build factories capable of manufacturing GW's of solar. Consequently, cell and modules became more plentiful and the price of solar dropped rapidly, catching some subsidy systems out, namely Spain and the UK.

Indeed, in the UK our Government had expected that the Feed-in Tariff would only create a total installed capacity of around 1GW over a 5-year period. However, because of the frequent price reductions and the inability of Government policy to keep pace around 14GW have been deployed. Yet, with BIPV being more expensive, any market that did not have a top-up subsidy such as the one designed for the French market, would see BIPV systems struggle to compete against lower cost standard module solutions.

So, with solar continuing to fall in price subsidies have all but disappeared, and now because of high manufacturing volumes and associated cost reduction in the supply chain, solar is now creating its own non-subsidised markets. For instance, in Mediterranean countries solar is competitive with any other form of electricity generation. With demand for solar across the world increasing year on year by over 30%, costs will continue to reduce, which opens further markets and drives prices down still further.

Thinking has now moved on even further. It is now recognised that solar will, and indeed already is in some markets, the cheapest method of electricity generation in the world. The original scientists predicted this in the 1980's with the likelihood that 50% of the worlds energy would come from solar. Despite rapid growth and 74GW being installed worldwide in 2016, at present around 1.3% of the world's energy comes from solar so the opportunity for the solar industry is huge.

Of course, with solar costs still falling it is now time to shift back to developing BIPV products and companies are responding to the opportunity that was the EU's vision back in the 1980's.

The world of energy is changing from centralised electricity generating systems, to one based on local distributed energy which is ideal for solar.

The recent development of battery technology, lithium ion along with other emerging technologies, will assist the deployment of solar by being able to store the energy generated, is a technological game changer. The distributed generation transition that we are witnessing here in the UK, where buildings become generators but are also able to store the electricity for use later in the day, has only just begun. Excess generation can also be transferred to other users through the distribution

system which will, eventually make the power stations linked to a national grid, redundant in providing our energy needs.

This transition is happening fast with the world's move for clean sources of energy, avoiding the polluting impact from carbon intensive energy generation. With the increased electrification of our buildings and transport system, the market opportunities for solar linked with storage, the world over, are enormous. Once again it is the speed that technology is moving that means policy makers are still playing catch up and few can envisage where we will be in this transition as we enter the next decade.

As an example of the opportunities one should think around the generation benefits to buildings and from adjacent land that solar, with storage, can provide while also linking with the transport market opportunities and its charging network, let alone the opportunity to develop and manufacture BIPV products here in the UK.

Are you up for the challenge and the global opportunities solar will provide?

Solar Photovoltaics

(Power)

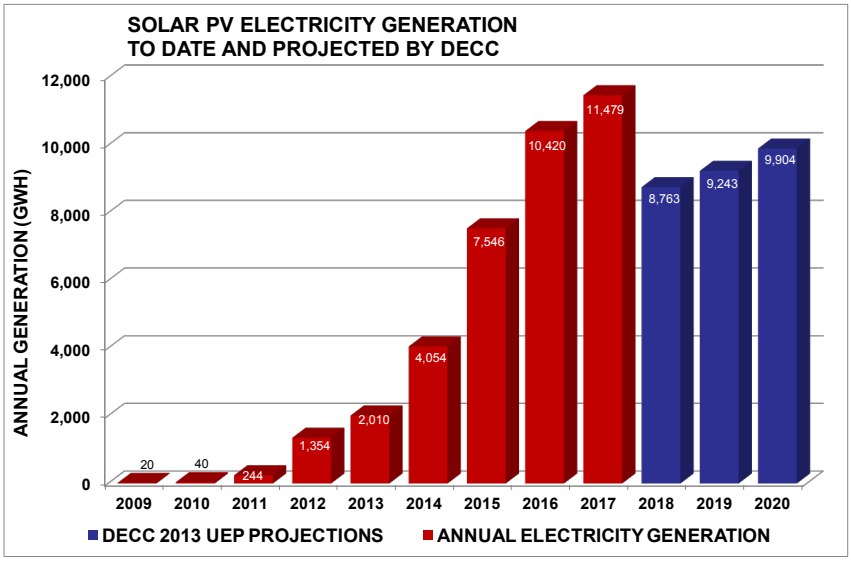
As the deployment statistics reflect, solar PV remains one of the most appropriate renewable technologies for deploying in the built environment and on brownfield or low grade agricultural land.

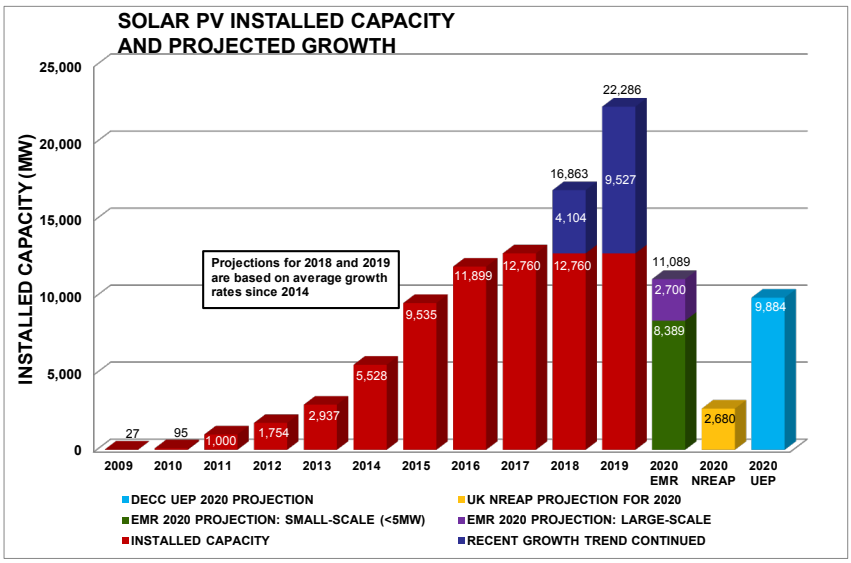
However, the closure of the RO and forthcoming ending of the Feed-in Tariff slated for March 2019 mean there are challenges ahead. Although with the world price of solar continuing to fall, and energy storage being able to store electricity so it can be released at times that maximise its value, it shouldn't be too long before deployment once again rises.

In the shorter term solar's cause will be aided by the rising oil price. As we enter the post subsidy world we should also see the use of building integrated solar systems (BIPV) increase as the cost of these systems moves closer to traditional roof coverings.

SOLAR PV CONTEXT

- Deployment slowing as subsidies end.
- Cost of solar continues to fall meaning not too long before solar is competitive subsidy free.
- Energy storage will be a gamechanger for solar, tipping economics further in solar's favour.
- Meaningful change in building regulations to deliver zero carbon homes would further help solar in a post subsidy world.





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

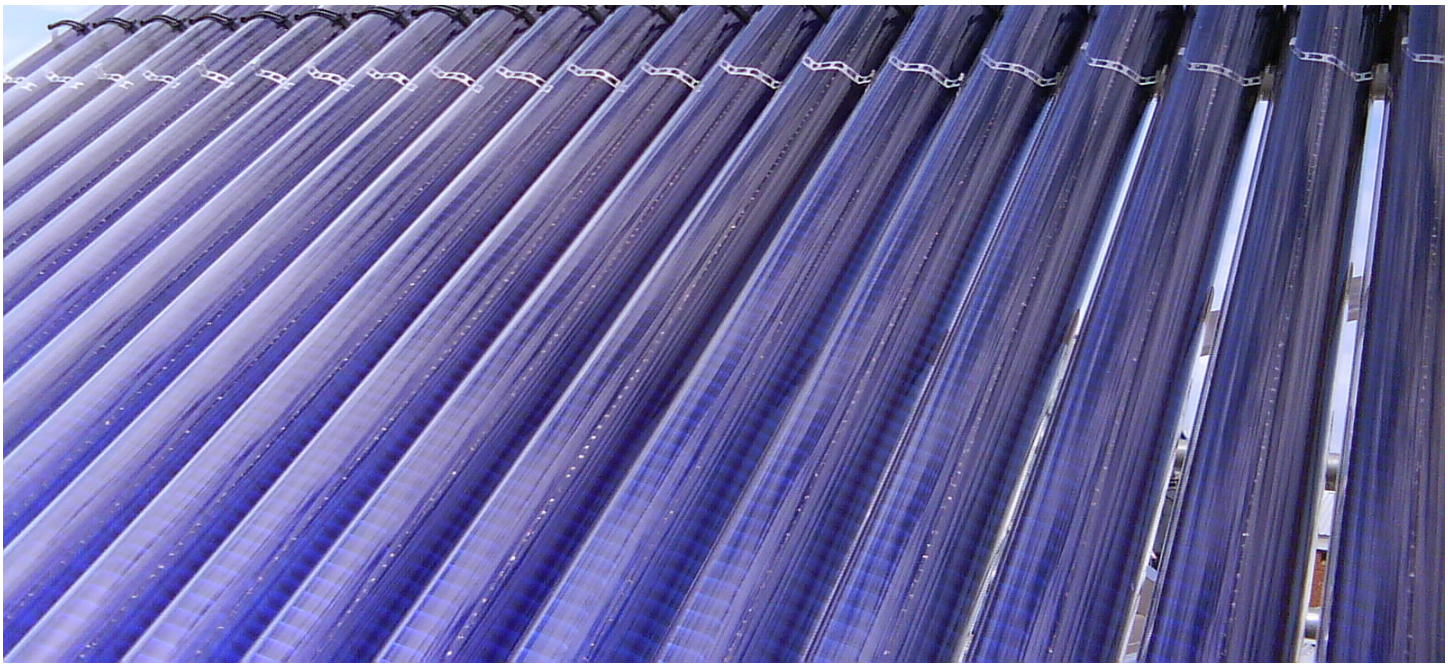
Stuart Pocock, Chief Operating Officer

SIZE OF THE UK SOLAR PV SECTOR

	2011-2012	2012-2013	2013-2014	2014-2015	2015-2016	2016-2017
Sector Turnover (£'millions)	2,027	2,166	2,307	2,477	2,037	1,286
No. of people employed across UK supply chain	15,650	15,620	16,103	16,880	13,687	10,911
No. of UK companies across supply chain	2,200	2,178	2,088	2,005	1,241	936

Solar Thermal

(Heat)



Whilst there are estimated to be over 250,000 historic solar thermal installations in the UK, more recent deployment under the RHI has been disappointingly low.

However, this is not quite the full story as in some cases installations on new-build properties will not be ineligible for the RHI and thus not counted in official figures. However, it is very difficult to estimate how many systems are installed in that manner.

Looking forward there may be grounds for optimism as the technologies biggest competitor, solar PV, will not be subsidised after March 2019.

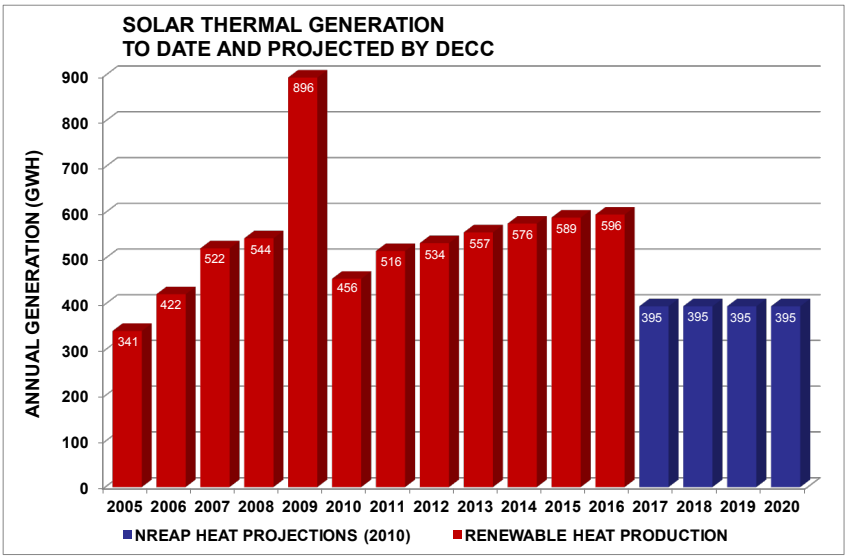
SOLAR THERMAL CONTEXT

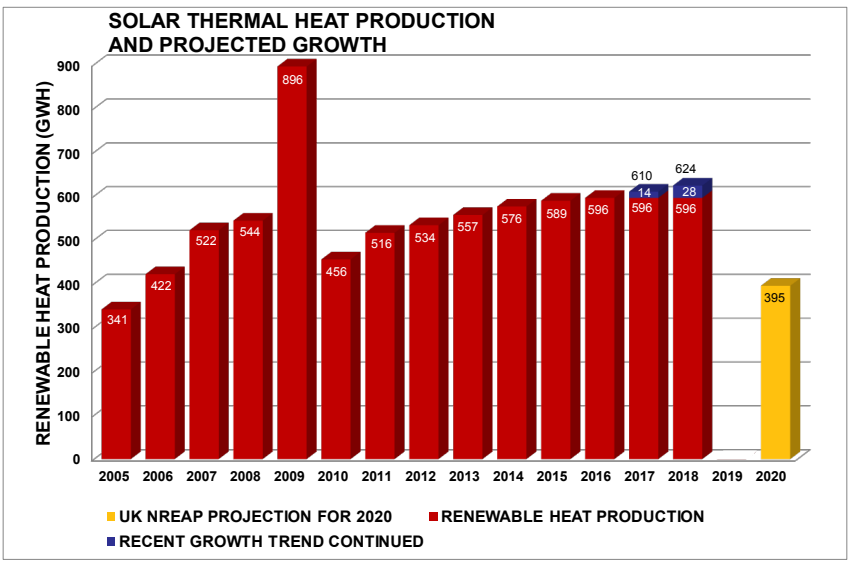
- Systems have been successfully operating in the UK for many years.
- Largely a residential market, but works equally well on commercial buildings, especially hospitals and schools where there can be high demand for hot water.
- Has the potential to significantly reduce gas consumption and thus reduce CO_2 emissions.

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	2016-2017
Sector Turnover (£'millions)	885	941	1,008	1,058	1,126	1,114
No. of people employed across UK supply chain	7,550	7,533	8,639	8,926	9,637	9,497
No. of UK companies across supply chain	340	337	372	375	414	399

Decentralised Energy

DECENTRAL
RENEWABLE ENERGY ASSOCIATION

New NORMAL?

Do we need to rip up the old lexicon for energy as words that were deemed novel for describing the possible energy landscape, just two years ago, are now considered the new normal?

Do we need to rip up the old lexicon for energy? Words that were deemed novel for describing the possible energy landscape, just two years ago, are now considered the new normal. Who knew what an "aggregator" was, or what demand side response is, smart grids are now being taken for granted and new buzzwords such as blockchain and energy vectors (such an awful word) are being thrown around regularly. And whilst people do not go around declaring loudly that they are prosumers, that is actually what they are when over a million households and businesses invest in on-site renewable energy.

There is no question that the deployment of renewables on the distributed network system, and the evolution of technologies from "cost plus" to being amongst the cheapest options for homes and businesses alike, has tipped us towards this new energy world. Would you say that we are there yet? Well, not quite, but we would argue at the REA that it is unstoppable.

The cost reductions have been supported greatly by the important and still-centralised deployment of renewables, such as large scale solar and wind, both in the UK and internationally[1]. The acceleration of the transition to include decentralised smart solutions is being super charged by the dash for EVs, as environmental concerns for air quality in cities sit alongside the drive to reduce CO_2 and tackle climate change.

At the REA we have taken our members on this journey of the Energy Transition over the last four years of publishing REview, our annual report[2],[3],[4]. Our job of working with Government and other important bodies such as the UK's Energy Regulator, Ofgem, infrastructure champions (and REA members), National Grid, and certain Distributed Network Operators (DNO) appears to be paying off after frustrating "pauses" in policy development caused by sequential elections.

> In last year's REview we reported that there were a remarkable 48 retail supply businesses, many of whom are making low carbon or completely renewable offerings to our domestic market already. This number has now risen to 69

More recently, the REA has been invited to attend an important Government Forum, held jointly by the Department for Business, Energy and Industrial Strategy (BEIS) and Ofgem, to advise on how to progress a plan to deliver the smart systems and flexibility[5] technologies that are key to upgrading our energy system. The work behind the plan focuses on four key areas and there has been some important progress against 29 specific actions identified:

- **Removing barriers to smart technologies;** very importantly for Energy Storage, Ofgem launched consultations on a modified generation licence for the technology, and the important question around ownership of storage by both transmission and distributed network operators themselves. Simply clarifying the type of licence storage was a subject to, greatly influenced the charges and Use of System aspects it faces in the complicated world of network rules and costs. BEIS has been considering defining storage in legislation when Parliamentary time allows (a key REA priority), and considering how the planning regime might be improved for storage.

- **Smart homes and businesses;** critical to connecting the systems together are developing standards for smart appliances and consumer protection. BEIS have recently launched (March 2018) a consultation with the key aim to develop this market. In addition, BEIS has proposed new powers in the Smart Meters Bill that allows the regulator to deliver market-wide half-hourly settlement. The push here is to enable this to move more swiftly and smoothly than we have seen under existing processes. Supporting this Ofgem has launched a "Significant (Network) Code Review" in July 2017 and published a working paper on key functions of players under market-wide half-hourly settlement. They expect to publish an outline business case in Autumn 2018. All of this is linked to the growing electric vehicles (EVs) drive, and the Automated & Electric Vehicle Bill is being progressed through Parliament in these early months of 2018. This will provide powers to ensure all new EV charge points are smart-enabled.

- **Markets for flexibility;** the Energy Networks Association (ENA), the trade association for the network companies, published their "Opening Markets for Network Flexibility"[6] report in December 2017. This included commitments to

and reinforcements to market competition and improved processes for coordinating between transmission and distribution networks. In addition, progress is being made to enable access to the Balancing Mechanism (BM) for independent aggregators and other non- traditional BM parties (planned for summer 2018). On the UK's Capacity Market (CM), BEIS and Ofgem have simplified requirements to enable "stacking" of value opportunities across the CM and more traditional ancillary services.

- **Innovation;** six innovation competitions have been launched to deliver new solutions across all of the key activity areas above and more, covering reducing costs of larger scale energy storage technologies, DSR domestic and commercial business aggregation models through to (electric) Vehicle to Grid (V2G) innovation and the important market models to both value and trade "flexibility" from these and renewable energy smart technologies at local levels.

This is in addition to the Faraday Challenge, a £246 million investment to ensure the UK leads the world in the design, development and manufacture of electric vehicle batteries, all framed within the UK Government's Industrial Strategy[7] launched last November. Clear opportunities to demonstrate the exciting innovative steps will be supported by a new Industrial Strategy Challenge Fund programme - 'Prospering from the energy revolution' (supported by InnovateUK) to be rolled out in 2018.

It is clear that the UK needs to boost our universities with consistent support to enable us to catch up with countries such as China, Japan and South Korea that are leading and deploying these life changing technologies. It will also be important that the Industrial Strategy just doesn't become an industry talking to itself and that we see the diverse range of consumers and our proven "smart" communities and businesses benefit directly too. A truly smart tactic that the UK Government can take is to ensure that the decision makers will be made up of new expert-thinking representing our diverse society and energy leaders that can see both the risks to change and incredible opportunities.

In last year's REview we reported that there were a remarkable 48 retail supply businesses, many of whom are making low carbon or completely renewable offerings to our domestic market already. This number has now risen to 69[8], the offerings of some (large and small) are not waiting for the energy landscape transformations of the Smart Flexible Systems Plan to come to full fruition,

A consumer-driven strategy means we need to talk to people using energy in their every day lives

but are evolving their business models in parallel. The next critical step to enable homes and businesses to take up these opportunities falls almost equally on communicating these opportunities and what it means for them, as much as the technology and regulatory developments themselves. A consumer-driven strategy means we need to talk to people using energy in their every day lives rather than a theoretical, purely technical change project that some whole system studies focus on. Communities, Local Authorities and industry leaders must agree that this is a societal priority as well as an opportunity for businesses to sustainably make money. For the tipping point to happen all walks of society must benefit from the energy revolution and see that smart clean technology will become an everyday expectation. We have seen this happen in less than 5 years for smart mobile telephony. At the REA, we believe this can happen in as-short-a-time for clean smart energy too and our members are working to make this happen. You will have to read the next exciting installment of the DECENTRALised energy story in REview 2019 to see how this progresses.

[1] "Beyond the tipping point: flexibility gaps in future high-renewable energy systems in the UK, Germany and the Nordics", A study prepared by Bloomberg New Energy Finance for Eaton and Renewable Energy Association. Downloadable from www.eaton.com/tippingpoints

[2] REview 2015: "Is the UK energy market ready to break with tradition?", Renewable Energy Association, May 2015

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

[4] REview 2017: "Take back control", Renewable Energy Association, June 2017

[5] OFGEM/BEIS "Upgrading our energy system: Smart Systems and Flexibility Plan July 2017", https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/633442/upgrading-our-energy-system-july-2017.pdf

[6] "Opening Markets for Network Flexibility", a report from Energy Networks Association's Open Networks Project, including 2017 Achievements and Future Direction, Dec 2017 http://www.energynetworks.org/assets/files/electricity/futures/Open_Networks/14574_ENA_Open%20Networks%20Report_AW_v9_Web.pdf

[7] BEIS "Industrial Strategy: building a Britain fit for the future", November 2017, https://www.gov.uk/government/publications/industrial-strategy-building-a-britain-fit-for-the-future

[8] OFGEM "Facts and figures on how Britain's energy market is structured, larger supplier prices and profits, energy bills and customer switching", https://www.ofgem.gov.uk/publications-and-updates/infographic-bills-prices-and-profits?utm_medium=email&utm_source=dotMailer&utm_campaign=Daily-Alert_30-04-2018&utm_content=Infographic%3a+Bills%2c+prices+and+profits&dm_i=1QCB,5M3HU,GDUOI6,LTEC5,1

Energy Storage

(Heat, Power, Transport)

It has been another year of very modest deployment for the energy storage technologies in the UK, in the face of continued policy and cost challenges. Most activity continues to focus on lithium-ion battery technology due to the more established supply chains and modular deployment format.

There has been continued build out of EFR projects awarded contracts in 2016 (although the product now no longer exists in the same form), and some Capacity Market projects, but the build out is still a fraction of the interest in the market and projects holding applying for grid capacity. Indeed, the amount of storage projects pre-qualifying for the 'T-1' Capacity Market auction this year (at 1.5 GW), which would have required build out in only a few months, shows the level of shovel-ready projects currently unable to be built.

Investment, jobs and companies in the sector all remain similar to last year and growth will be dependent on the faster implementation of the Smart Systems and Flexibility Plan published in summer 2017, of new markets currently under development for balancing services, and on more favourable financing structures.

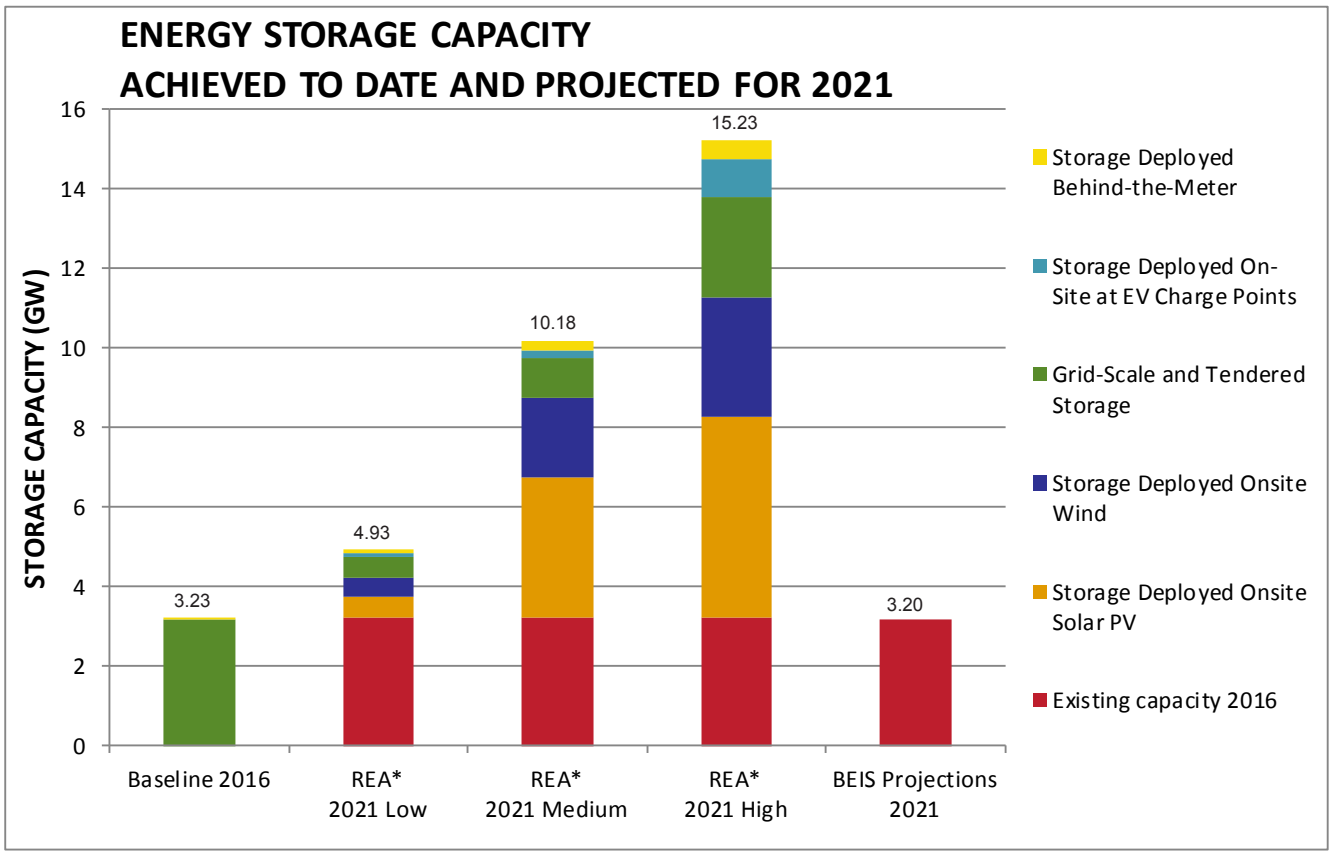
ENERGY STORAGE CONTEXT

- Energy storage comprises a series of technologies, including thermal storage, compressed air, liquid air, pumped hydro, batteries and flywheels.
- The development of batteries in particular, and battery energy storage capabilities, is also a key feature of the Industrial Strategy, with over £250 million assigned to various initiatives.
- The Smart Systems and Flexibility Plan, released by Government and Ofgem in summer 2017, is one of the main frameworks for delivering growth in the sector, featuring 29 principle action points.

REA CONTACT

Frank Gordon, Policy Manager

Daniel Brown, EV Lead



SIZE OF THE UK ENERGY STORAGE SECTOR

	2010	2011	2012	2013	2014	2015	2015-2016	2016-2017
Sector Sales (£'millions)							1,231	1,302
No. of people employed across UK supply chain							10,061	10,006
No. of UK companies across supply chain							507	510

Electric Vehicles

(Energy Storage, Power, Transport)

The EV market continued to grow in 2018 and avoid trends impacting the petrol and diesel segments. Department for Transport data outlines that in 2017 "over 53,000 new Ultra Low Emission Vehicles (ULEVs) were registered in the United Kingdom, an increase of 27% on 2016[1]." This is in the face of a 6% overall decline in vehicle sales.

While around 90% of EV sales relied on the Plug in Car and Van grants, costs are falling and technology is improving. The launch of the new Nissan LEAF, the UK's best-selling Battery Electric Vehicle (BEV), included a 40kWh battery which equates to an increased range of 111 miles compared to the previous entry-level LEAF. A range of manufacturers in the past year have committed to part or full electrification of their vehicle offerings in the coming decade, with Volvo setting a target for 50% of their sales by 2025 to be all-electric[2].

The Committee on Climate Change has also taken initiative in identifying national charging needs. It's new report Plugging the Gap takes the CCC's central scenario of 60% electric vehicle sales by 2030 (which is roughly in line with the REA's own forecasting) and has identified the need for 1,170 rapid or ultra-rapid chargers along major motorways and 27,000 public-access 'top-up' chargers strategically located across the country in places such as supermarkets and cafes. This is in addition to home and workplace charging which is expected to be the backbone of the fueling of EVs.

ELECTRIC VEHICLE CONTEXT

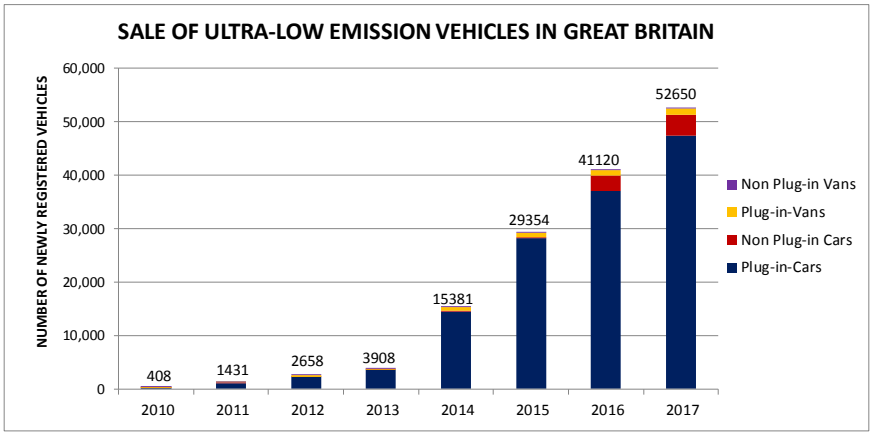
- Electric vehicles research and manufacturing is seen as a priority area in the UK's industrial strategy.
- ULEVs make up almost 2% of new vehicle registrations.
- Growth in the sale of Plug-in Hybrid Electric Vehicles (PHEVs) and Battery Electric Vehicles (BEVs) is expected to increase.

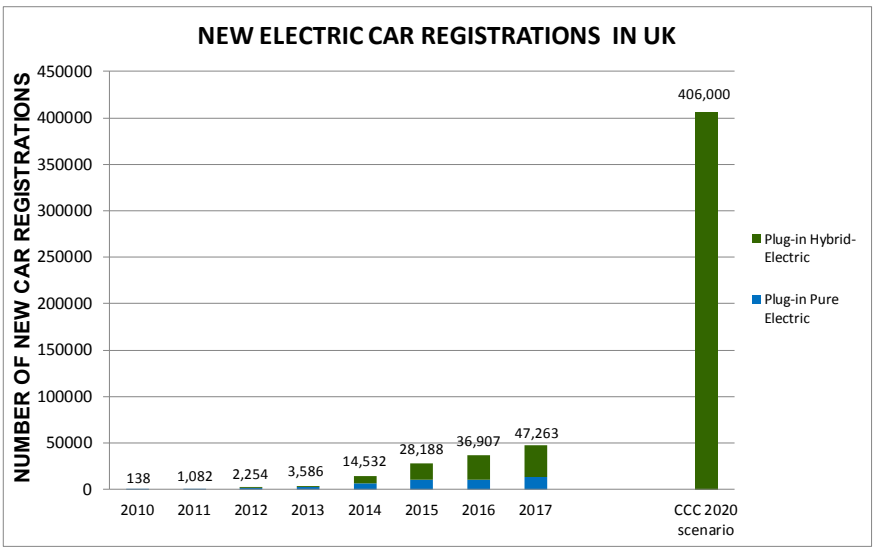
[1] https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/699229/vehicle-licensing-statistics-2017.pdf
[2] https://insideevs.com/volvo-cars-50-of-car-sales-to-be-all-electric-by-2025/

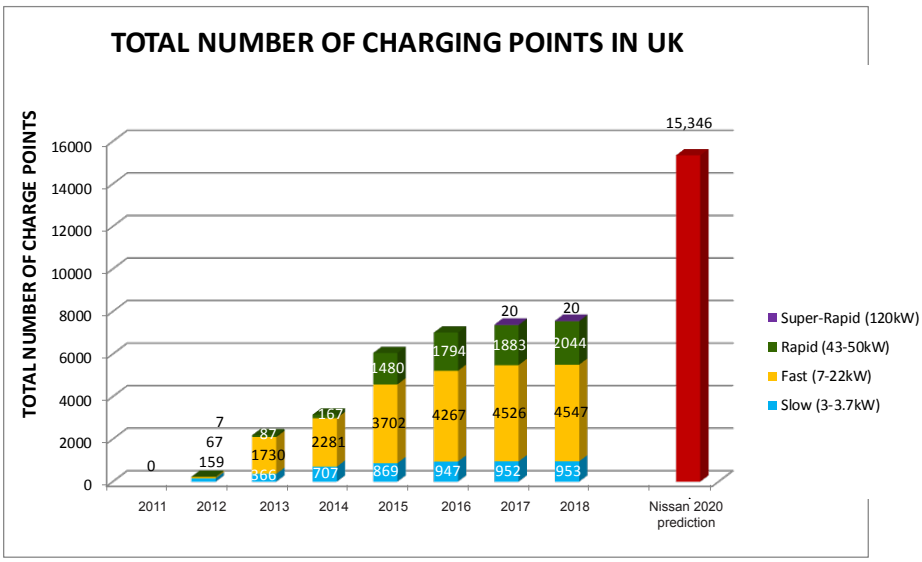
REA CONTACT

Matthew Trevaskis, Head of Electric Vehicles

Daniel Brown, EV Lead







REA national charging network vision

- Clusters of high power rapid chargers along major motorways for long-distance journeys
- Destination charging at key locations like supermarkets or shopping centers
- Slower overnight home chargers for those with driveways
- On-street chargers for those without driveways near to EV owners' homes
- Rapid chargers at railways stations and airports that will facilitate taxi charging
- High-capacity strategically located charging banks for heavier vehicles such as buses, vans, rubbish trucks and haulage vehicles
- Depot charging for fleets and trucks with a 300-500 mile range
- Ship to shore charging at ports to reduce diesel emissions near cities

SIZE OF THE UK ELECTRIC VEHICLE SECTOR

	2010	2011	2012	2013	2014	2015	2015-2016	2016-2017
Sector Sales (£'millions)							919	1,135
No. of people employed across UK supply chain							6,195	7,755
No. of UK companies across supply chain							374	402

Electric Vehicles & Biofuels

Renewable transport - finally out of neutral

At the REA, we see electric vehicles as representing a great opportunity for decarbonisation, for air quality improvement, and for reducing the total cost of car ownership.

With EV car sales growth rates at nearly 30% and around 2% of the UK's vehicle parc now with a battery element, we seem to be going in the right direction. Progress is crucial as emissions from the transport sector are rising; it is now the UK's largest source of carbon emissions (following a dramatic plunge in output from the power sector, which is now at Victorian-levels of CO_2 pollution).

EV car sales growth rates at nearly 30% and around 2% of the UK's vehicle parc now with a battery element

We believe that for the car and van market segments, change is coming quickly. Costs for EVs are falling and a reliable, affordable, and strategic national infrastructure is achievable with existing technology and supportive public policy. A plethora of companies and market actors, ranging from National Grid to Tesla, ABB, Flexi Solar, and numerous regional developers such as Alfa Power, are rising to the challenge to deliver the full range of charging solutions - ultra rapid hubs next to motorways, fast chargers at destinations such as supermarkets, home and on-street chargers for primary use overnight, and workplace chargers for the day.

While it's in the nature of our organisation to champion change, it's also in our nature to develop roadmaps on how to get there. It will take time to reach the UK's Committee on Climate Change's aspirations of 60% electric vehicle sales by 2030, and there is an urgency to reducing our emissions and improving air quality today.

Going forward, a portion of such EV sales will include Plug in Hybrid Electric Vehicles (PHEVs) - low-carbon fuel will be important in them as well. Heavy goods vehicles is also an area of growth for the fuels sector and biomethane has a role to play in long-distance haulage. This year's landmark agreement from the International Maritime Organisation (IMO) - to reduce greenhouse gas emissions by 50% by 2050 (compared to 2008 levels), in addition to the global agreement struck by the aviation industry in 2016 to reduce or offset its emissions by 2050, are also creating new markets for the UK's resilient and innovative fuels sector.

The passage of new legislation this April widens the scope, increases the size and

Every new petrol care sold since 1st January 2011 has been fully warranted to use E10

sets out targets to 2032 for the Renewable Transport Fuels Obligation (RTFO). There is considerable interest in supplying biomethane and other novel and waste-based fuels.

The increase in the obligation is expected to result in fuel suppliers making E10 (petrol with a 10% mix of bioethanol) available, but the question is when. This is vitally important to the UK's two bioethanol refineries which need the switch to happen soon. The fuel suppliers want to make the switch, but it's not without its challenges and none of them want to be the first to act.

Every new petrol car sold since 1st January 2011 has been fully warranted to use E10 and the majority of new cars since 2000 are also warranted to use it. Although the number is falling away with time, at present there are some 500k older (pre 1997) cars on the road for which E10 may not be suitable and which will continue to need E5 (petrol with a 5% mix of bioethanol).

The move from E5 to E10 would save an additional 0.76 million tonnes of carbon from road transport

Increasing the amount of ethanol in the UK's petrol is the cheapest means of meeting the Obligation, and the move from E5 petrol to E10 would save an additional 0.76 million tonnes of carbon from road transport.

Will we get to 60% EVs in the UK, and will it radically decarbonise the majority of transport emissions? That seems certain. Yey for now at any rate, and for those sectors where electrification may not be an option, we must employ all the low-carbon solutions at our disposal.

Offshore Wind

(Power)

A technology arguably favoured by Government in recent years, as the main beneficiary of the Contracts for Difference (CfD) auctions. Growth has continued in the past few years. This comes from the build out of Renewables Obligation, and FIDeR CfD projects, totalling many hundreds of MW.

The CfD auction results in autumn 2017 (so not included in this year's REView statistics) awarded contacts to offshore wind at half the expected price.

As the dominant technology in the 'Pot 2' ('less-established technologies') CfD auction process, and with a dedicated Sector Deal as part of the Industrial Strategy, deployment is expected to continue in the coming years.

OFFSHORE WIND CONTEXT

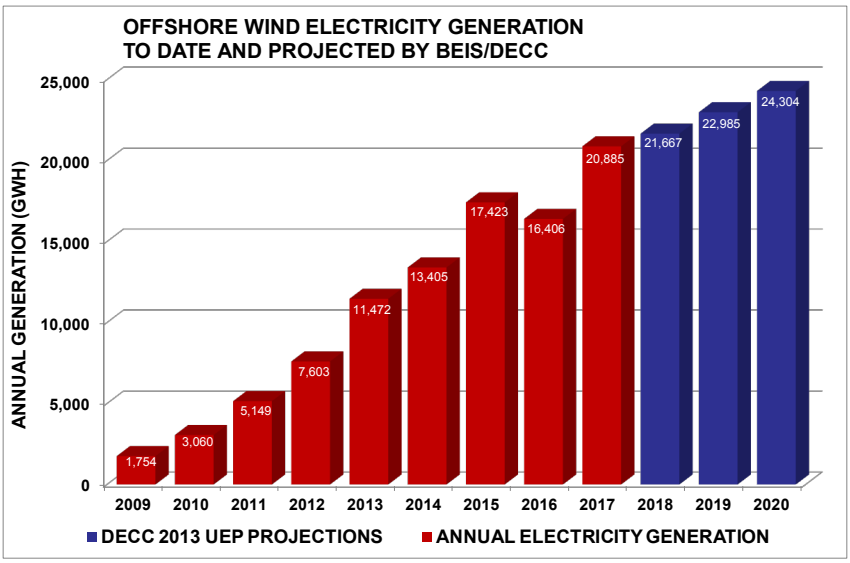
- Likely main beneficiary technology of next Government-funded CfD auction in spring 2019.
- Long-standing targets on cost-reduction between industry and Government.
- Supply chain industrial opportunities seen as priority by Government, with Industrial Strategy Sector Deal drafted.

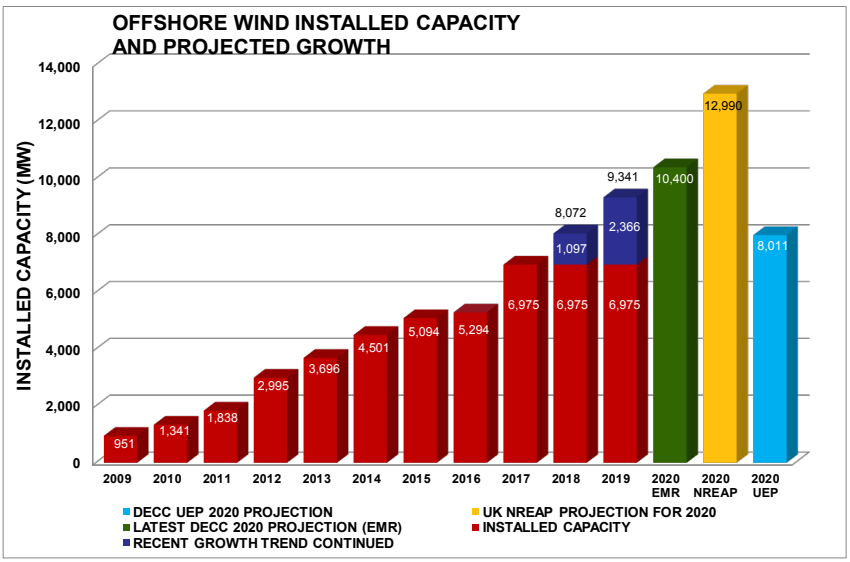
REA CONTACT

Frank Gordon, Policy Manager

James Court, Head of Policy & External Affairs

For full explanation of terms, methodology and growth projections see pages 71-73





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	2016-2017
Sector Turnover (£'millions)	2,100	2,469	2,693	2,929	3,185	3,495
No. of people employed across UK supply chain	16,200	18,280	19,478	20,570	21,557	22,605
No. of UK companies across supply chain	790	790	913	924	976	1,001

Onshore Wind

(Power)

The Renewables Obligation was closed to new onshore wind projects early in 2017, and this combined with a lack of other Government-backed routes to market, has led to a dramatic drop in deployment in the UK.

Deployment is currently limited to small-scale projects at a very limited number of Feed-in Tariff backed sites, plus activity in Scotland, where the political environment is more supportive.

Looking forward, future deployment chances will be heavily based on the planning regime in England and any re-inclusion in the Contracts for Difference scheme.

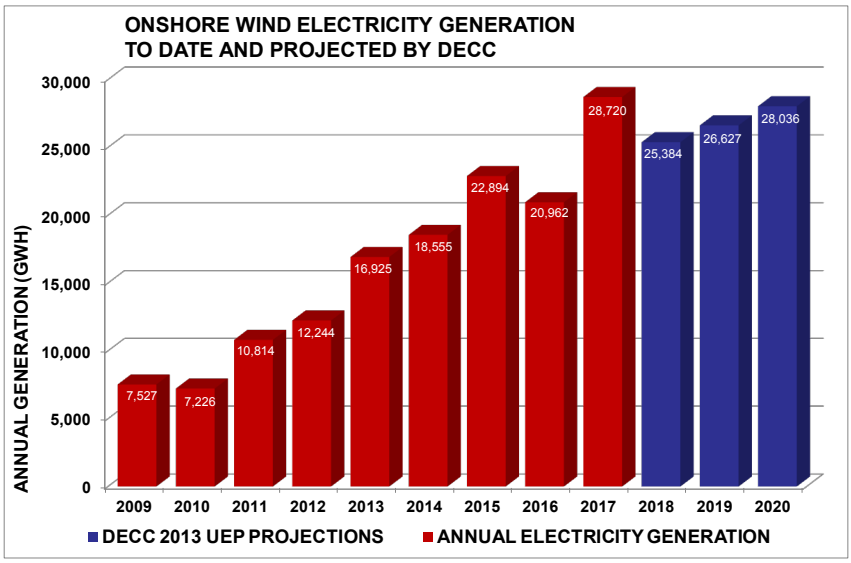
ONSHORE WIND CONTEXT

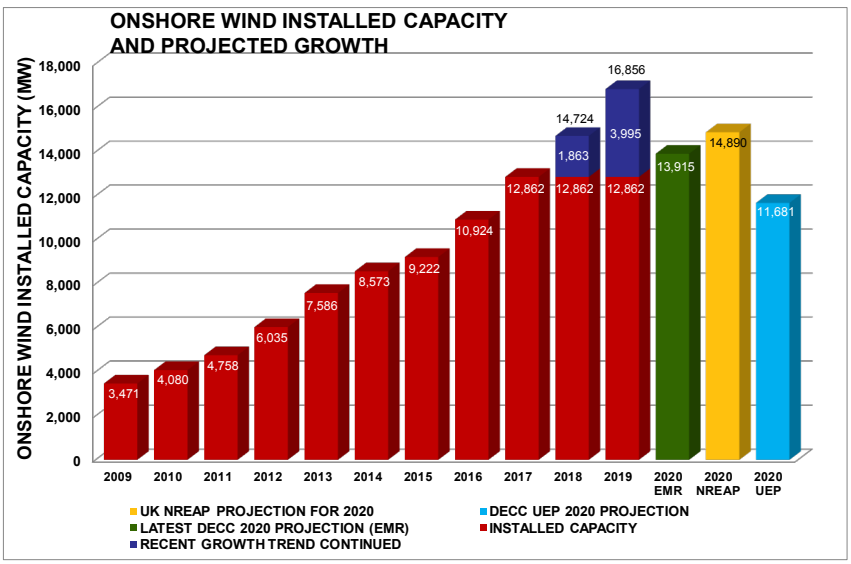
- One of the cheapest forms of power (of any source) in the UK yet effectively barred from the market.
- 'Remote Island' Wind projects likely to be included in future CfD auctions, the proposal having received State Aid clearance.
- Future deployment may lie in 'subsidy-free' projects and if the technology is re-allocated funding via 'Pot 1' of the Contracts for Difference (CfD) mechanism.
- Planning and policy support effectively with-drawn post-election, in line with Conservative manifesto pledges.

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.

SIZE OF THE UK ONSHORE WIND SECTOR

	2011-2012	2012-2013	2013-2014	2014-2015	2015-2016	2016-2017
Sector Turnover (£'millions)	2,110	2,278	2,493	2,712	2,967	3,305
No. of people employed across UK supply chain	15,20	17,071	18,191	19,210	20,209	21,535
No. of UK companies across supply chain	730	726	844	863	933	957

Wave and Tidal

(Power)

The Swansea Bay Tidal Barrage project has not yet received confirmation of whether it will be granted a CfD, although the Hendry Review recommended this. The prospect of a pipeline of such projects being built out is therefore also on hold, although other companies have now entered the space.

Meanwhile, wave and tidal stream projects continue to face widespread problems deploying, including the suitability of the current power support mechanisms.

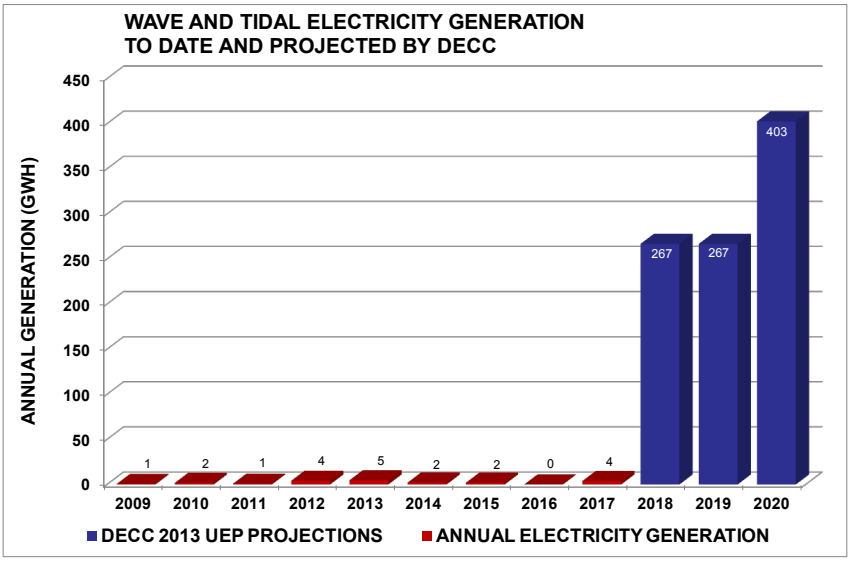
WAVE & TIDAL CONTEXT

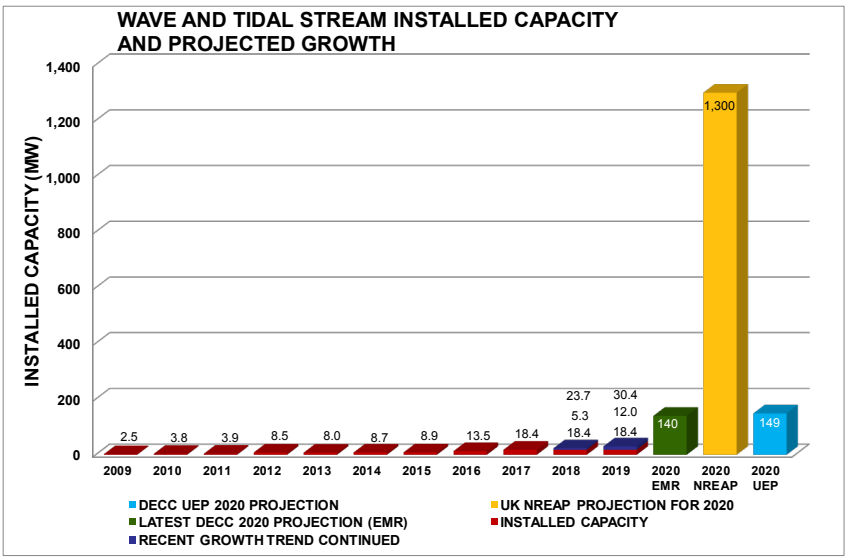
- Very limited UK deployment to date, but very innovative sector with huge promise for UK given geographical features.
- Early Intellectual Property, technological and manufacturing leads for UK, but rest of world catching up due to lack of deployment.
- Current CfD policy has not seen any deployment due to method used to allocate support and relative early stage of technology.

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	2016-2017
Sector Turnover (£'millions)	91	397	103	109	118	127
No. of people employed across UK supply chain	570	570	635	660	723	772
No. of UK companies across supply chain	33	30	36	40	41	47

Fernando Valda

Independent advisor to the REA Finance Forum

Evolution with a hint of Revolution

During the past twelve months, the UK saw continued growth in renewable energy, albeit at a far slower pace than in recent years. A very real tipping point was reached when the country's electricity demand, for the first time since the 1880s, was met for an entire day without coal-fired generation.

The National Grid appears to have coped well with this transition in the energy mix, although headwinds may be approaching as the complexity of balancing the system looks set to increase leading up to the mid-2020s[1]. A myriad of new technologies promise to continue rewriting the script within an increasingly decentralised energy system in which storage must also help fill the seasonal/weather induced shortfalls in renewable power generation.

It is an exciting time as cutting-edge innovations, which include artificial intelligence, big data and blockchain all have the potential to underpin a more pervasive energy revolution. However, it is certainly not an easy time for the incumbent market participants, investors or for the overstretched regulators. Government policy is tasked with change at an unprecedented pace in the energy sector and with only limited time available for policy implementation.

One certainty amongst all this uncertainty is that it brings a plethora of new investment opportunities. Statistics released by ONS on the broader environmental goods and services sector (EGSS), which goes beyond the renewables and cleantech industry, showed the entire sector contributed £62.5 billion of output to the UK economy in 2015 (growth of 27% since 2010) and responsible for 335,000 full-time equivalent jobs[2]. This sector is now a material constituent of the UK economy and the Government is committed to it being an important engine of growth.

That was so 2017…

… Renewable generation

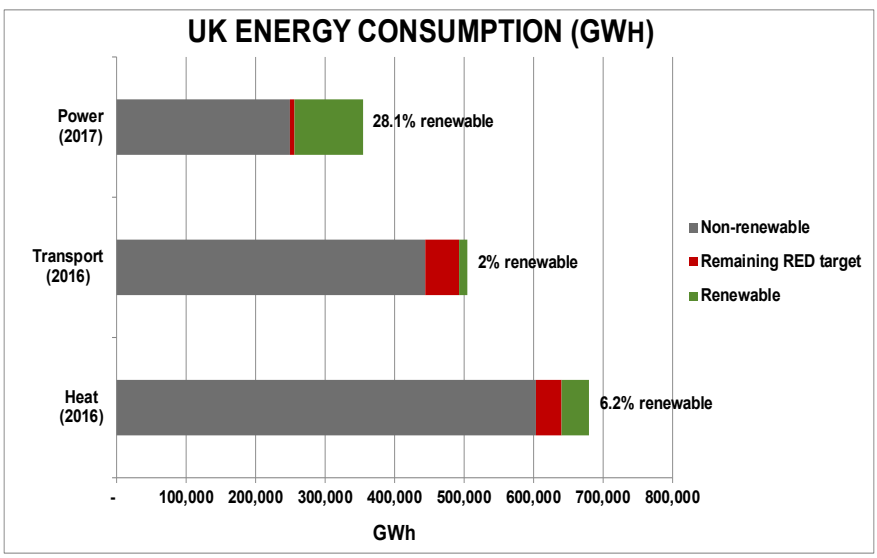
In generation terms, renewable electricity grew from 83TWh to almost 99TWh (+19%) buoyed by increased capacity and a good wind/solar resource year. This represented almost a 30% share of total UK generation, an impressive achievement. Installed capacity has increased by c.5GW p.a. over the past 5 years breaching 40GW by the end of 2017, again[3] underlining the maturity of the wind and solar sectors in particular.

The first 24 hour period of no coal-fired generation was eclipsed in April 2018 when a full 72 hour period was achieved. The death knell for coal generation is steadily getting louder, following the commitment to phase it out by 2025 and the cancellation of the Carbon Capture and Storage Government-backed project in 2017.

There are concerns more frequent periods of negative prices will arise due to the new generation mix, however, this market signal will surely encourage generation flexibility and more demand-side response which is to be encouraged on our journey to decarbonisation.

While Clean Energy investment in the UK is reported to have fallen, the last six years has seen a steady increase in renewable energy capacity and generation levels, in part, due to the good wind/solar year which elevated load factors[4]. Looking to the future it should be recognised that policy support has succeeded in establishing the renewable energy sector, but it is now time for market forces to prevail, especially as capital costs have fallen to provide more MW for each £ invested.

One revelation in 2017 was the reduction in offshore wind pricing heralded by the last CfD auction clearing price of £57.50/MWh. According to Clean Energy Trends 2018[5], the UK now has the largest installed capacity of offshore wind farms in the world. This capacity leadership position will be extended as offshore wind competes for a slice of the £557 million CfD pot in 'spring 2019'. The UK is after all endowed with Europe's best wind resources.



Source: BEIS March 2018 Renewable Energy Generation update

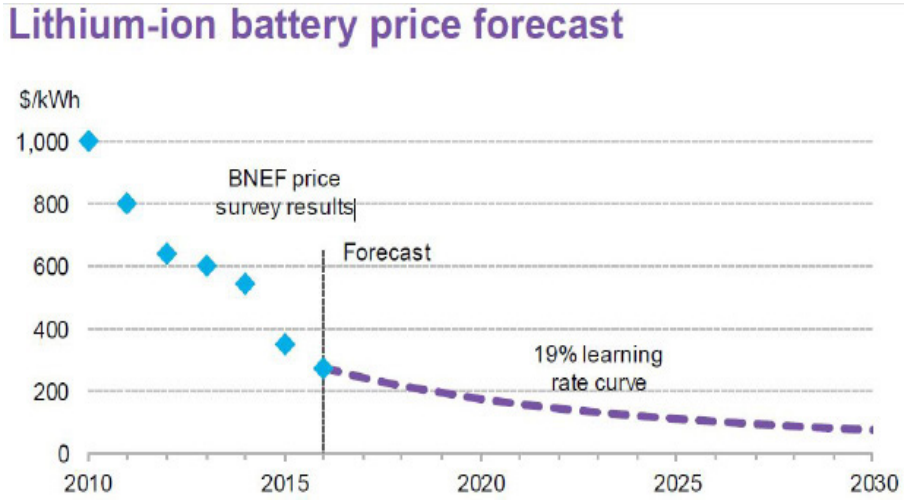
Further evidence of capital cost reduction is clear in the solar sector where despite the UK not having the highest levels of low solar irradiation, £1bn+ of private sector capital has been announced[6] for rooftop solar rollouts, notably in the social housing sector. The first proclaimed 10MW 'subsidy free' solar project commissioned by Anesco (with 6MWh battery) is also a positive development, although it should be recognised that this project benefitted from cost savings in the form of land and grid infrastructure.

It is clearly welcome news that the UK has advanced in EY's most recent Renewable Energy Country Attractiveness Index to a position of 7th globally (May 2018) noting there are now opportunities in repowering older wind farms with enhanced new technology, which do not require direct fiscal support.

The UK's £10bn investment last year is an impressive amount for new capacity but the finance sector is still not totally convinced that new conventional generation, in the form of gas-fired power, is not required. An REA straw poll conducted in May 2018 is divided on whether WWF's assertion, that it is possible to leapfrog 'gas' in the near term, is viable.

… Storage coming of age …

In contrast to renewables, there is no dedicated subsidy support mechanism for energy storage, so investors (some say quite brave ones) fight to capture multiple revenue streams to meet expected returns. It is heartening that its rapid cost reduction is elevating energy storage towards a tipping point of c£100/MWh where widespread adoption is considered economically feasible for multiple business applications.



Source: 23 Beyond the Tipping Point, BNEF Study, November 2017

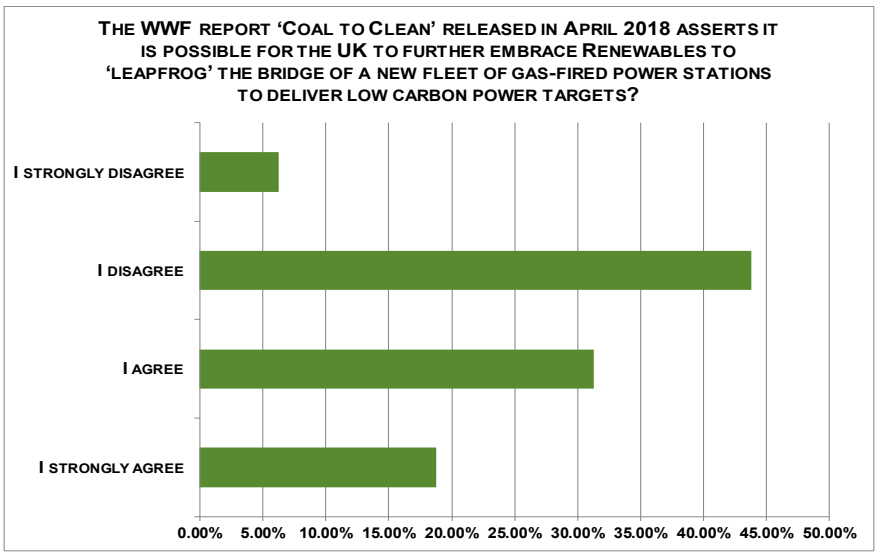
There is much focus on the incumbent technology 'Lithium-Ion' and its evolution to reach an economic tipping point in the period 2020-2025, as shown by the forecasted falling prices. Although limiting factors do need to be accounted for, such as its use primarily for "power" response of approximately one hour[7].

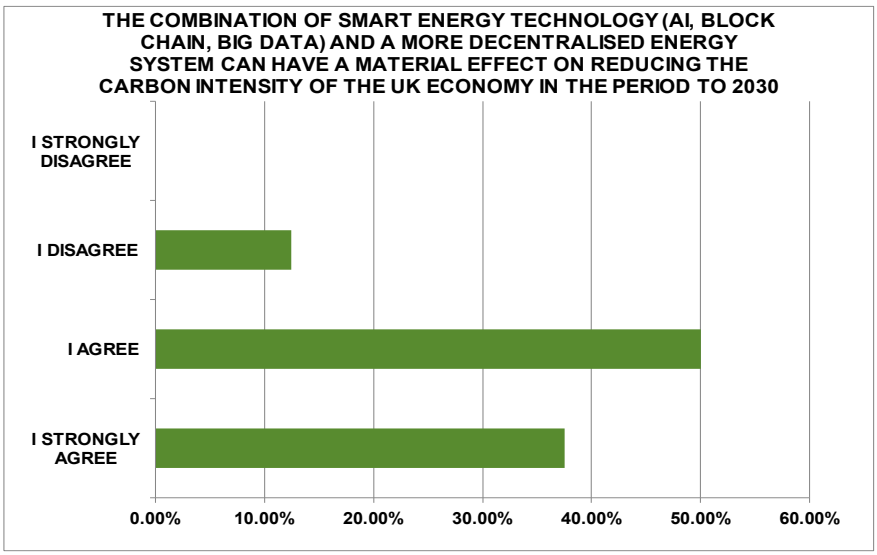
As anyone who owns an iPhone knows, there can be concerns over degradation of lithium-ion batteries after a couple of years. Other technologies including flow batteries, compressed air and chemical storage claim to offer the prospect of longer duration 'energy' delivery over 4 hours+ for wider grid-scale applications and longer battery lives, while some also assert the £100/MWh target may be met by them sooner than 2020[8].

The 'use cases' of storage can be very different and the ancillary costs can differ markedly between technologies. The wide technology set may seem reminiscent of the 'VHS vs Betamax' video standards battle, however, it appears likely there will be more than a single winner as there are clearly differing applications.

New technology, new players, new business models, …

The technology revolution that is enabling the creation of the decentralised energy system will keep the policymakers on their toes for some time. In 2017, we have observed new players, such as Limejump[9], aggregate distributed generation assets alongside demand-side response to capture income from the volatility in energy prices.





It is impressive how quickly firms have become adept at managing huge quantities of data and affecting 'second by second' changes leveraging the telecommunications network. Households with solar and storage may one day soon employ blockchain to support the sale of excess power to their neighbours down the street. Artificial intelligence applications that learn from energy consumption behaviour to inform better decision making also seem to hold great promise.

The REA straw poll shows there is strong agreement that these technologies can have a material impact over the next decade.

A number of UK SME tech companies may have the potential to become truly global leaders so desperately need the enabling policy and regulation to get there. During the last 18 months, we have seen encouraging signs for companies, such as Reactive Power and Origami, who have successfully raised tens of millions as investors become convinced of the value proposition of these new business models.

The Committee on Climate Change (CCC) estimated that Government investment in clean growth technologies from 2015-2021 will be £2.6bn with £841m (33%) for the transport sector (EV/batteries) and, in contrast, £265m for smart energy systems.

The Green Finance Taskforce report released in March 2018 included recommendations of a Green Investment Accelerator for early-stage technologies and a dedicated public-private green venture capital fund. It is hoped that this work can dovetail with the British Business Banks £2.5bn of capital to support Patient Capital deployment to grow UK SMEs that could become the next Dyson or ARM.

New players may potentially change the dynamics in the renewable energy sector including the 'dusted off' strategies of the Oil Majors BP and Shell re-entering the sector with plans of billions of pounds in investment. BP took a stake in Lightsource, the solar project developer, for $200m. Shell global CEO recently announced that its Board is now committed to pursue a sustainability-based strategy, investing $500m p.a. in low-carbon activities that will see it reduce its carbon footprint by 3.5 million tonnes out to 2025. Shell's acquisition of First Utility also provides further optimism.

Global warming ... heat decarbonisation

It was highlighted in last year's REview that heat is responsible for almost one-half of total greenhouse gas emissions in the UK. There is some optimism that decarbonisation through the transformation of the heat sector will shortly have the policy certainty to unlock investment in 2018.

The Renewable Heat Incentive (RHI) provides much of the stimulus for the expanding renewable heat production. With £444.9m spent in Great Britain on subsidies in 2017 it led to 7,688GWh of renewable heat being produced. Recent amendments to the RHI scheme, such as Tariff Guarantees for larger schemes, should improve the investment case by providing greater certainty for investors and developers alike.

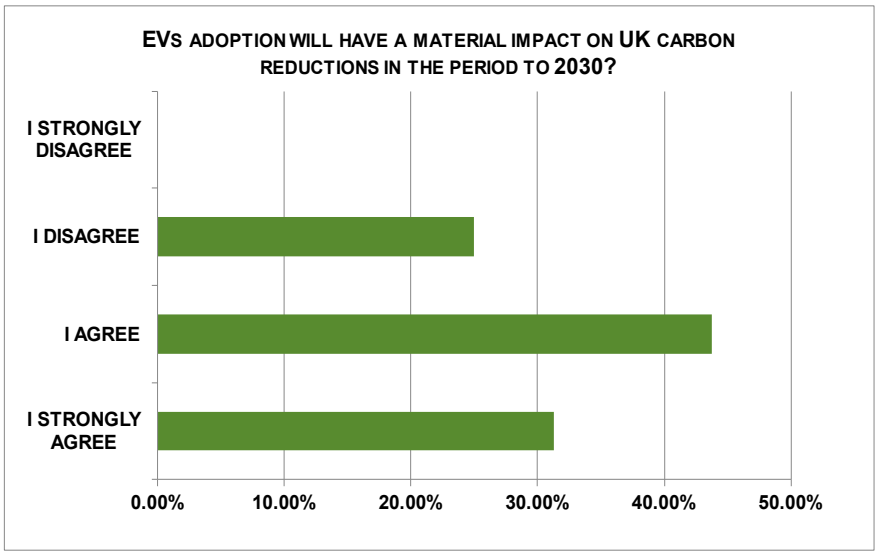
Further stimuli will be provided via the Heat Network Innovation Programme (HNIP) with the next phase of the programme due to be launched in early 2019. With a £320m budget, the aim is to kick-start the development of heat networks in the UK, which the CCC estimate under their central 2050 scenario could supply 18% of the UK's heat, saving 15m tonnes of carbon.

Transportation transition ...

Public awareness of the importance of greening our transport network has elevated due to concerns over the effect on public health; especially from Nitrogen Oxide on congested city roads. Electric Vehicles (EVs) have grown in prominence, especially since the Government announced that the UK will ban all new petrol and diesel cars by 2040. News of increased driving range of EVs between charges is positive, but this also must be matched by investment into EV charging station infrastructure.

There is strong agreement that EVs will have a material impact on UK carbon reductions, as shown by the straw poll results opposite.

The Faraday Initiative promises to 'power Britain's battery revolution' with £246m of public sector finance. This is no small task as China, USA, Japan, Korea and Germany are already accelerating to the 'billion-dollar' Gigafactory manufacturing scale. The UK undoubtedly has some promising new technology developments at an early stage, but patience will be required as there are notable cases of failures



occurring during the scaling phase overseas. The Faraday Initiative will hopefully help mitigate this risk.

Policy, Policy, Policy …

Government policy challenges abound as Ministers try to provide the right direction, support and control, to ensure the security of energy supply at least cost to consumers. The Clean Growth Strategy, Industrial Strategy and, most recently, the Green Finance Task Force report all seek to provide the right measure of investor certainty. Whilst there is great ambition, a growing chorus of voices is warning that the necessary conditions for capital deployment are not yet sufficient. CCC figures suggest an investment of up to 1% of GDP per year, - approximately £22 billion, will be required to meet our 2032 carbon targets.

The Patient Capital Review released in 2017 provided recommendations for 'scale up' capital for UK technology SMEs leveraging the Enterprise Investment Scheme (EIS)[10]. The British Business Bank (BBB) will also be endowed with a further £2.5bn, some of which will hopefully flow to scaling up green technology SMEs. BBB will hopefully recruit individuals who understand this sector, or there is the very real risk that funds simply flow to the more traditional sectors or to overhyped tech solutions.

Direct parliamentary criticism of UK Government policy came in May 2018. The Environmental Audit Committee associated the 56% fall in investment during 2017 to ill thought out policy. Committee chair, Mary Creagh, recently commented:

"Billions of pounds of investment is needed in clean energy, transport, heating and industry to meet our carbon targets. But a dramatic fall in investment is threatening the Government's ability to meet targets… The Government must urgently plug this policy gap and publish its plan to secure the investment required."

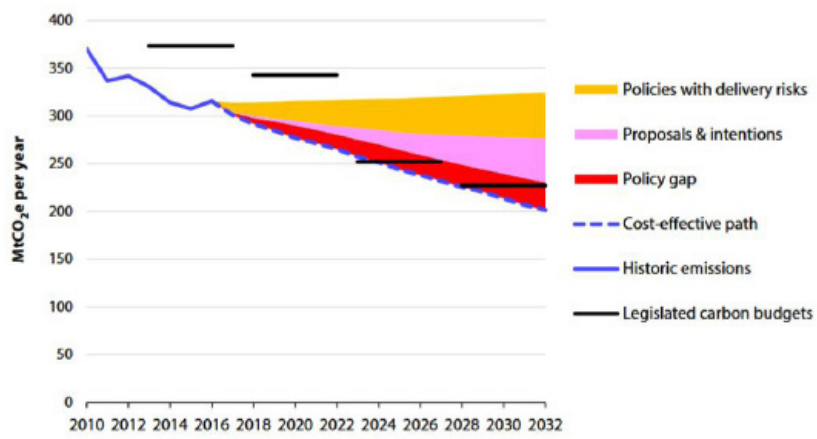
The REA straw poll echoes the concern expressed by the report with over 90% of respondents stating the required level of investor confidence is not currently sufficient.

The challenge of Government to find the 'goldilocks' nirvana of not causing private sector overheating or worse still capital retreating from low 'cold' returns is not an easy one. However, the Committee on Climate Change report released in January 2018 highlights a concerning 50-70TWh policy gap which needs to be addressed in order to meet our 2030 targets, meaning they must continue to grasp the nettle.

Policy makers are hopefully encouraged by the latest release of the Government's survey on the public's support for renewable energy, which confirmed an overwhelming 85% of people positively support renewables[11].

Government should also take note the cost of new (or refurbished) onshore wind energy is now said to be cheaper than the wholesale cost of power. A 'low risk/regret' policy option being touted is a zero cost PPA guarantee from Government to unlock favourable long term bank debt finance. Private investors

Figure 1. Remaining gaps to the fourth and fifth carbon budgets (non-traded sector)



Source: BEIS (2017) *Updated Energy and Emission Projections 2016*, BEIS (2017) *2016 UK Greenhouse Gas Emissions, provisional figures*, HMG & HMT (2009) *Building a low-carbon economy: implementing the Climate Change Act 2008*, CCC analysis.

simply need an assured route to market for their power to secure the funding and will take the full price risk.

The REA straw poll did see good support for 'subsidy free CfDs' and promotes policies such as a more effective carbon price as most impactful to hit the 2030 targets. Direct comments highlighted that the Grid's ability to accept more renewable power is also critical and a simplification of planning rules is key. As such, innovative policy options are required to maintain investors' confidence and interest in the energy transition.

… Energy efficiency

The UK Government is targeting improvements in energy efficiency of 20 per cent among UK business and industry by 2030 as set out in the Clean Growth Strategy, published in October 2017. The renamed and now private 'Green Investment Group' offers a 'pay-as-you-save' Energy Services Agreement (ESA) enabling businesses to benefit from investment in energy assets without directly funding the upfront cost. The broad technology set is said to include self-generation, heating and cooling, controls and systems, batteries, transport, and lighting[12]. It is positive to see other business models evolving to unlock the vast unfulfilled potential in this sector.

Closing thoughts …

It is right to question whether our political establishment can rise to the challenges of climate change due to the adverse incentives within its structure. The often quoted legally binding GHG emission commitments to 2050 and interim Carbon Budgets are all well and good and necessarily long term. Politicians, however, are typically short termist and focus on remaining in power, so tend to kick the hard issues down the road.

The REA straw poll shows that 80% of respondents currently have a less than 60% confidence level in the 2050 targets being met.

The complex challenge for the private

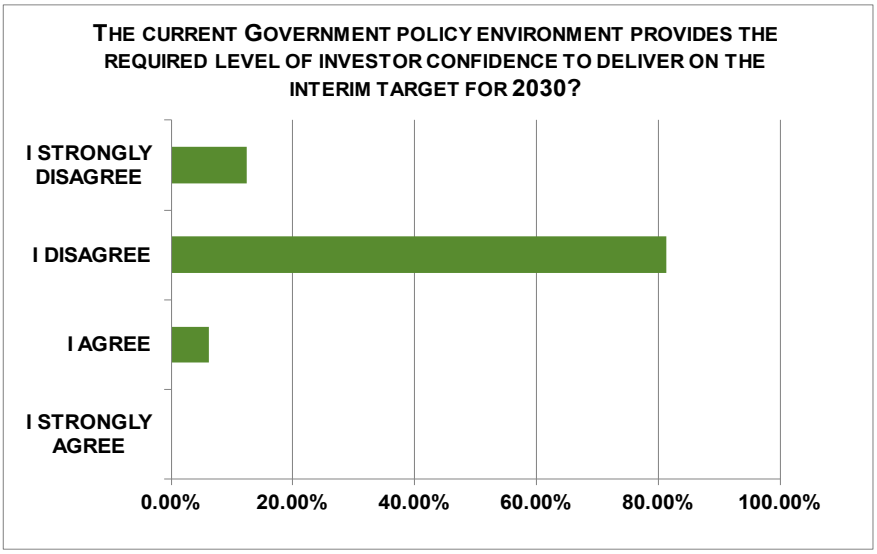
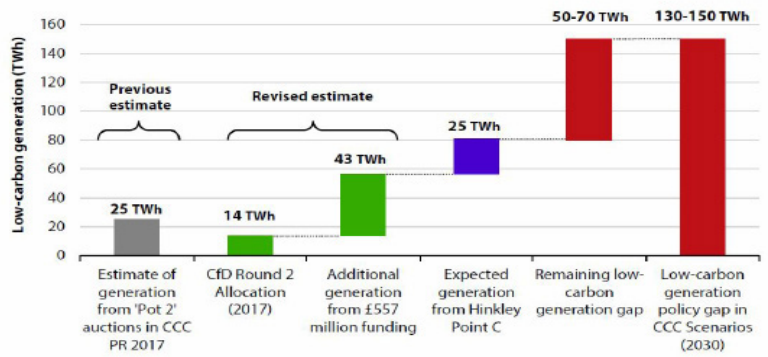
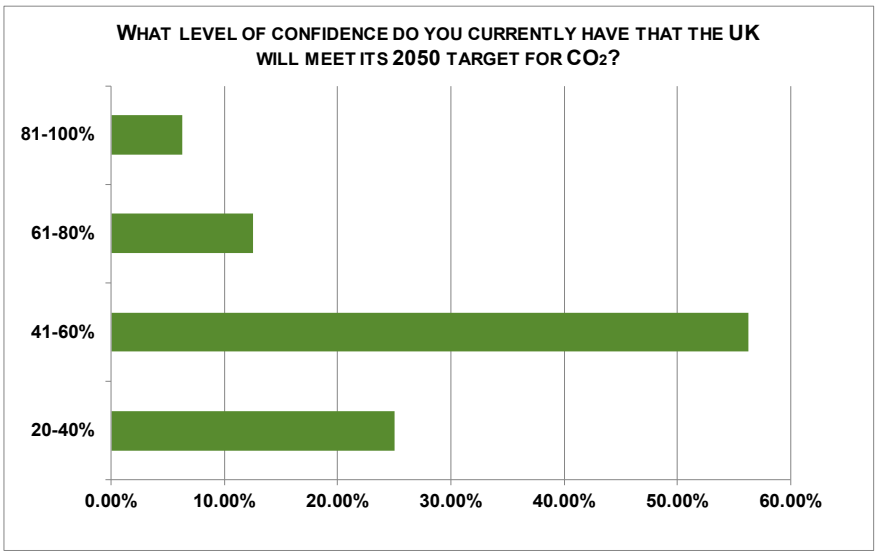


Figure B3.1. The power sector policy gap

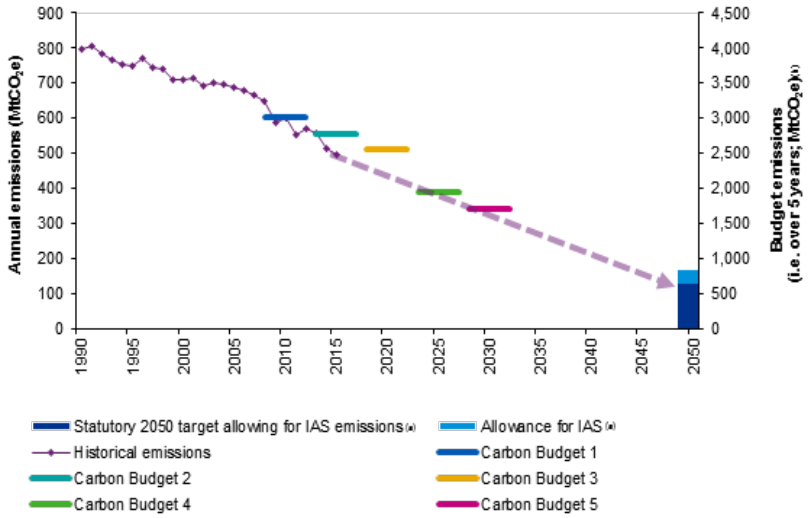


Source: CCC analysis.
Notes: Pot 2 auctions are for less-established technologies and include: offshore wind, tidal stream, wave, 'Advanced Conversion Technologies', and Biomass Combined Heat and Power (CHP).

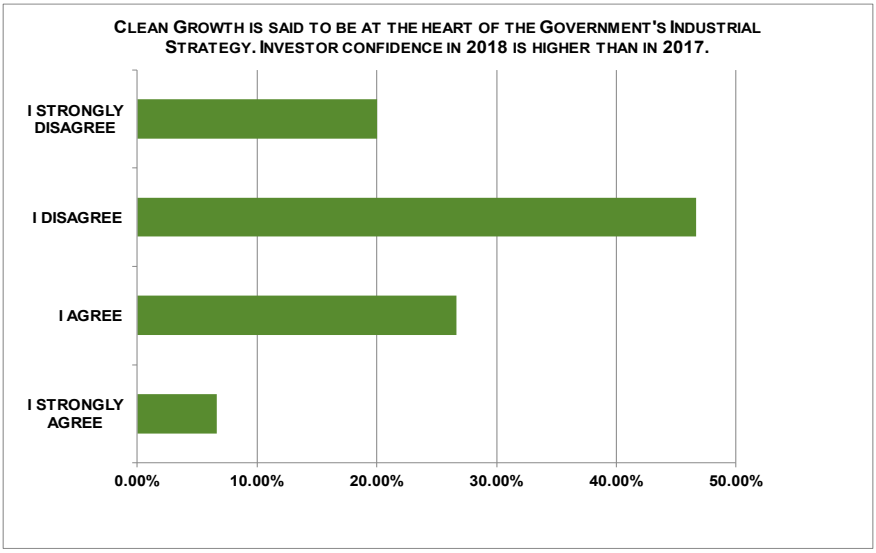


sector is to decide when, where and how to deploy capital at this time of unclear policy detail. The aspirations for UK clean growth are poised to provide waves of new investment, however a lack of clarity on how best to reap the benefits can cause widespread inaction. One investment approach is to create a number of options and be ready to rapidly deploy capital should the right conditions arise. Such 'real option' thinking was once the preserve of the oil majors, who also seem to be placing some bets again in this sector. With their capital firepower the transition to a decarbonised economy could be one step closer.

Finally, in the very near term, the BREXIT transition is not especially helpful in the UK's energy transition and the level of economic uncertainty may even exacerbate the renewables investment decline. The Government should step up to face this challenge with faster implementation of policies that give investment certainty. Whilst the majority of respondents to our straw poll below believe investor confidence is lower than last year, it is not overwhelmingly so. Some swift positive policy moves by Government have the potential to tip the balance and stimulate that esoteric 'confidence level' to unlock the vast investment sums available in favour of decarbonisation. Hopefully, that will be the positive reflection made in next year's REview.



UK Greenhouse Gas (GHG) emissions against legislated budgets and 2050 target[13]



[1] The tipping point – Flexibility gaps in future high-renewable energy systems in the UK, Germany and Nordics (BNEF, Eaton, REA) November 2017. By the mid 2020s renewable energy expected to be more than 50% of power supplied

[2] https://www.ons.gov.uk/economy/environmentalaccounts/bulletins/ukenvironmentalaccounts/2010to2015

[3] Department for Business, Energy & Industrial Strategy, RE capacity and Generation (March 2018). www.gov.uk/government/statistics/energy-trends-section-6-renewables

[4] The 1.2GW offshore Hornsea wind project significantly boost 2016 investment totals meaning 2017 was measured relative to a challenging yardstick (due to its scale, offshore wind can create lumpy investment years). Reduced investment by Green Investment Bank due to its prolonged privatisation process was another core factor

[5] TLT report May 2018

[6] //www.solarpowerportal.co.uk/news/solarplicity_unveils_details_of_1_billion_social_housing_solar_scheme (2017) and Eon/Google 'Sunroof' solar scheme (www.eon.com)

[7] In the USA a period of 4-6 hours is considered more useful for a broader scope of grid needs

[8] Li-ion battery prices fall from $273/kWh in 2017 to $73/kWh in 2030 (BNEF tipping point study)

[9] Limejump website states it now has 1200 organisations and 150 generators to create a virtual power plant capable of supplying over 200 MW of capacity to the National Grid. www.cleantech.com/announcing-our-2017-global-cleantech-100-ones-to-watch-companies/

[10] This tax based incentive for investors helped stimulate the £billion+ of investment that occurred in the solar sector

[11] BEIS Energy and Climate Change Public Attitude Tracker (PAT) survey. The REA's straw poll broadly agrees with this sentiment.

[12] Investment of >£100-200m by 2019 is targeted so real opportunities of scale do exist.

[13] 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.

Fernando Valda - Pachamama Ventures, Independent advisor to the REA Finance Forum. https://pachamama-ventures.com/

Policy and Campaigns

The REA in Parliament

The REA's presence in Parliament over the past year, as ever, continued to shift and adapt as required with renewable heat, energy storage, and electric vehicles capturing particular attention.

Powering energy storage growth

In 2017 energy storage was in the spotlight particularly following the launch of the joint BEIS and Ofgem Smart Systems and Flexibility Plan. This landmark plan is designed to create greater flexibility in power markets as the grid becomes increasingly decarbonised, decentralised, and the penetration of low-cost variable renewable generation sources continue to grow. The plan lays out 29 points for policy change and, most importantly, key timelines for adoption.

It may seem minor but significant industrial growth hinges on policy reforms such as the introduction of a definition of energy storage in primary legislation. Or upgrading now-esoteric grid codes to allow for faster, cheaper connections. Or that creating new tariff structures for homes will allow for clean tech to further reduce energy bills. Additionally, our existing structures designed to "keep the lights on," such as the Capacity Market, don't recognise the value and maturity of new technologies such as battery storage or demand-response, instead opting to rely on the use of traditional gas plants. The Plan touches on many of these issues.

appg THE ALL-PARTY PARLIAMENTARY GROUP energy storage

The REA and the All-Party Parliamentary Group (APPG) on Energy Storage, (which the REA serves as secretariat for) has been at the fore of these discussions. Indeed most of the recommendations put forward by the REA were included in the Smart Systems and Flexibility Plan, and now the goal is to lay out the benefits and ensure it all gets done.

Since the launch of the plan, the APPG has held events to highlight the opportunities that the proposed policy reform is creating - all 12GW of them! Following a meeting in September which was attended by a half dozen parliamentarians including former energy ministers and a former energy secretary, the REA and the APPG drafted a report which sought to quantify the market impact of the plethora of policy changes presently in play.

While this is a tricky area for analysis, three scenarios for battery storage deployment in the UK to the end of 2021 were drafted, including behind the meter, on-site at solar and wind farms, standalone, alongside EV charge hubs and transmission-connected.

The report concluded that there's significant potential for battery storage deployment in the coming years (assuming the availability of storage units and continued price declines), but policy remains the single largest barrier to success. The gap between the high, medium, and low deployment scenarios, which rests entirely on the pace of policy implementation, is significant - ranging from 12GW at the most optimistic, around 8GW as a medium and more likely outcome, and around 2GW if little changes in the coming years.

The REA was pleased that this APPG report, entitled 'Batteries, Exports, and Energy Security', was launched to senior industry and public sector leaders on the banks of the Thames at a major parliamentary reception in December.

The chair of the APPG has subsequently taken his campaign for the timely implementation of The Plan to the pages of Britain's papers, making the case in both Prospect Magazine and the New Statesman in the early months of 2018.

Since the launch of The Plan the industry has also rallied and created a platform, the Smart Power Industries Alliance (SPIA), which reaches across trade associations to rally behind the implementation of these reforms. Chaired by former energy minister Charles Hendry and backed by MPs from Labour, the Liberal Democrats, and Conservatives, the SPIA is a forum where the range of proposed policy reforms can be analysed from the perspective of large scale generation, wind, solar, bioenergy, and more. You can expect to hear more from it in the next twelve months.

appg The All-Party Parliamentary Group on Electric and Automated Vehicles

Electric vehicles in parliament

In the same month (July 2017) that the Business Secretary, Greg Clark, launched the Smart Systems and Flexibility Plan

that Environment Secretary, Michael Gove, launched an equally landmark policy - the ban on the sale of new conventional petrol and diesel vehicles by 2040.

While a move along these lines may have been expected within existing climate legislation, for the Government to so clearly champion it as an initiative, making headlines across the nation, signaled a very real changing of the tides.

Since then the EV sector has only increased in momentum. In the autumn a range of automotive manufacturers pledged to electrify their offerings and roll out brand new models in the early 2020s. New charging coalitions, such as the Ionity network in Europe, gathered steam and the sale of new EVs in the UK reached milestone highs as overall auto sales stalled and diesel sales and manufacturing declined. China has launched its landmark 'Zero Emission Vehicle' mandate and Europe it's 'Battery Alliance' in a bid to win a larger share of future EV manufacturing.

At home, the UK's Industrial Strategy has also begun to bite. The Autumn Budget made available £246 million in funding for battery research and development as part of the 'Faraday Challenge' to make the UK a world leader in batteries and EVs. The funds have made their way into a range of "Vehicle to Grid" trials, advanced materials research, and have funded a new scale-up facility in Coventry.

Within the context of this burst in activity in the sector the REA, in partnership with the Rt Hon Dame Cheryl Gillan MP (Con), launched the all-new All Party Parliamentary Group on Electric and Automated Vehicles.

We've attracted over 30 senior parliamentarians, including a former transport minister, a former energy secretary, and members of the international trade and business select committees in the Commons to be members.

The APPG's events to date include ones on industrial policy and the pace of market change, and on tackling grid-related barriers to electric vehicle deployment. The REA is working with this group of motivated parliamentarians on a range of future events, which will look at public perceptions of automation, the ownership of data, industrial policy, road safety, and the range and role for other low-carbon fuel sources.

First meeting of the Automated and Electric Vehicle APPG

The APPG is also involved in legislation in Parliament. The Automated and Electric Vehicles Bill, at the time of writing being debated in the House of Lords, is proposing clarifying an insurance framework for automated vehicles, and for electric vehicles it has proposed empowering the Government to mandate the 'smartness' of chargers and the ability to mandate that fuel retailers install charging points on their premises.

The REA has been involved with the Bill, briefing Lords and MPs on its passage. Our Autumn 2017 position paper EV Forward View and its recommendations, have been raised by parliamentarians from the Conservative and Labour benches in the Commons chamber. Our view is that it is a constructive start but more needs to be done in relation to expediting the installation of charging infrastructure, particularly on street, in housing developments, and at ultra-rapid hubs along major motorways.

This is an exciting time for the renewable energy and the clean tech industry in parliament - as costs fall, media interest grows, and the boundaries blur between what used to be clearly delineated transport, power, energy storage and heat sectors, we have an opportunity to tell new stories and make new cases for the suite of low-carbon solutions our members represent.

Creating clarity for the renewable heat sector

The renewable heat sector was a major parliamentary priority in 2018 as the legislation to enact reforms to the Renewable Heat Incentive, the Government's flagship policy for driving renewable heat deployment, met with delay. While the REA and Wood Heat Association (WHA) did not fully support all the reforms in the first place once decisions were taken it was critical that timelines for tariff guarantees and tariff increases were clearly laid out so developers could properly plan their projects.

Such timelines did not come about. The lack of clarity was significantly impacting business certainty and had an adverse impact on a range of industry players, ranging from biogas to biomass heat project developers. In particular, the short timeframe for tariff guarantees has caused the policy to be less effective in delivering large, more cost-effective projects, and less attractive to developers.

The WHA and the REA had called for changes to the eligible heat uses, as there was some concern over misuse within the scheme. These changes will be implemented together with the wider reforms. Finally, it is still a great concern that the tariff for biomass heat projects have been lowered so significantly, which will damage the supply chain and companies that have spent years building up experience and knowledge within the sector.

Following campaigning from the REA and after working closely with Government, the amendments have, at the time of writing, been tabled in parliament and are making their way through the House of Lords. The REA and WHA briefed several members of Parliament on the regulations' during their passage. The association is working closely with the department to track its way through Parliament, as it will have a great impact on industry members.

REA Achievements

The past year was yet another demanding but inspiring one at the Association. Larger and more confident than ever, the REA set the agenda for renewables and associated clean tech in 2017 - 2018.

Highlights included;

. . . Launched our EV Group

The REA's EV sector group is up and motoring . . The team has been out and about at events up and down the UK, talking to the industry and launching reports and driving EVs.

. . . Handed a copy of REview 2017 to SoS Greg Clark

After his announcement that the National Battery Manufacturing Development Facility (NMDF), with £80 million of funding from the Government's £246 million investment in battery technology - the Faraday Battery Challenge, will be based in West Midlands.

. . . Launched the Electric and Automated Vehicle APPG

We've held two group meetings at the House of Commons, both packed out to the rafters.

. . . Fired up the RHI

The REA's heat team championed RHI regulations to give some clarity to the biogas industry.

. . . Launched the APPG on Energy Storage position paper at the Winter Reception

Batteries, Exports and Energy Security: The depolyment of 12GW of battery storage by the end of 2021 is achievable and can support post-Brexit growth. The report was produced and researched by the REA.

. . . RTFO good, but more to do

Government confirmed that the UK market share for renewable transport fuels will now reach 9.75% by 2020 and 12.4% by 2032 which is helpful. Still further campaigning needed though to increase the amount of bioethanol and, to get biomethane, largely derived from food and organic farm waste, qualified as a Development Fuel.

Join us today and ensure your voice is heard

CHAMPIONING the role and benefits of renewable energy
INFORMING governments, industry and individuals
EMPOWERING renewable energy businesses to achieve sustainable growth

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