REVIEW

RENEWABLE ENERGY VIEW

The authoritative annual report on the UK **Renewable Energy** and **Clean Technology** Sector

Achieving net zero: mapping the growth of the UK's energy transition

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Flexibility must be the new cornerstone of the grid

While the energy transition is inevitable as it is driven by economics, its cost is not.

According to Bloomberg New Energy Finance, the transition will be faster and less costly if flexible technologies and energy markets become the cornerstone of the grid. That is because both wind and solar power add to variability in supply, and mass EV charging will add greatly to variability in demand.

To avoid the need for costly grid upgrades and backup generation, the system must become more flexible to smooth resulting peaks and troughs in demand and supply.

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Foreword

Forward to Net Zero

I want to welcome you all to REview. Some of you may notice that it is being published at a different time than normal - and for some very good reasons! So much has been changing - UK politics itself, the climate emergency imperative and the UK political response, technologies and their costs, policy and regulatory impact on market models and jobs, and the REA itself.

As I sit here finishing this foreword, I am listening to the early pledges from our newly re-elected Prime Minister, Boris Johnson. He was restating the UK's commitment to achieve net zero greenhouse gas emissions by 2050 - reassuring us of his commitment after the extraordinary undertakings to bring this amendment to primary legislation this summer by the departing Theresa May. This is great to hear. However, the suggestions of imminent change not only of Ministerial responsibilities but of actual Government Departments (with rumours at time of going to press of a return for the Department of Energy and Climate Change (DECC)), sets us on a course of further uncertainty for many months to come.

Then on top of this is the BREXIT agenda, and the mandate this Government has to manage the relationship with the EU.
No one will deny that over the last three years Brexit has woven its tentacles through the legislative timetable strangling any oxygen out of the room which we have needed to address the climate emergency in detail. It takes no crystal ball to predict that this is only going to intensify.

Hot on the heels of the Prime Minister's high level assurances, I was also listening to the closing remarks and outcomes of the Conference of the Parties (COP) 25 in Madrid.

Dr Nina Skorupska CBE, CEO – REA

> **"** I want 2020 to be famous for more than the UK hosting COP 26. We must truly tap into the huge potential from renewables and clean technology at all levels.**"**

There were some extraordinary ideas and individual commitments made by business and some countries but sadly no agreement on the thorny areas of future renewable energy financing and carbon markets.

This places a huge responsibility and question on what the UK can achieve at COP26 this year in Glasgow.

The post-mortems of the UK General Election, Brexit and COP25 will go on for many months - well into 2020 before clear actions to address the climate emergency are likely to emerge.

So whilst this still does pose more questions than answers for the future there is no denying that over the past year, the pressure and appetite for action on climate change and the adoption of clean energy has grown exponentially. There is record public support and clear visible signs of businesses and communities taking action.

This is not going to change. So as we are at an incredibly important tipping point, it is a great time to take stock of what has been achieved to date in REview.

We are not only summarising the state of UK policies and regulations that have developed (or not) to support decarbonising our economy but also reporting on the areas where progress has been made: renewable energy and clean technology deployment across heat, transport and power, the important resource efficiency focus, the money invested, the jobs and where they are.

REview may also be the last year we compare the UK's deployment against the 2020 Renewable Energy Directive targets so clearly, quoting UK Government data to do so. We will be giving much thought to how we can show UK and EU working together to deliver the renewable energy and clean technologies we vitally need, as there is no denying that the achievement of broader European goals can only be done by working together to benefit all. This is notwithstanding the fact that the EU has also committed to Net Zero Greenhouse Gasses (GHGs) for 2050 legislation.

Importantly, we have included summaries of the work that the REA and its subsidiaries are also directly involved in on behalf of our members. A key goal for 2019 was to complete the very important, industry-led Bioenergy Strategy.

The final summary report was launched in September this year and it was pleasing to see all the relevant Government departments pay attention to it and see elements interwoven in the Committee on Climate Change (CCC) - the Government's own advisors - Net Zero recommendations report.

For many years the REA has been emphasising how connected the systems are across power, transport, the built environment and wider infrastructure. It has become more decentralised, digitised, decarbonised and democratised.

The Flexible Futures report published in September describes what is happening at the distributed power network level. One key message for me from that report is the "untapped potential" from the role our homes and businesses can play to accelerate the decarbonisation of our economy. Some of our members are leading the way in starting to make the markets and the opportunities but it is just the start.

The UK Government have invested a significant amount of money into programmes and demonstration projects sponsored from its Industrial Strategy and in particular, the Clean Growth Strategy but in the meantime we are still a long way from seeing consistently transparent and straightforward regulations and market models that anyone could have the choice to benefit from being "Eco-engaged".

So what is stopping this?

To help understand this and compare the UK to the performance of other leading European countries, the REA published a report sponsored by Eaton (our main REview sponsor) and Drax Group, covering the views of experts in the field to create a new assessment tool called the Energy Transition Readiness Index (ETRI).

We include the results from the first year's analysis in REview. It makes for interesting reading and has had the desired effect on all the key market players and stakeholders. They didn't just try and defend the UK, for being 8th out of 9, but acknowledged that there were still key areas of work to deliver. It has been acknowledged that even if some detailed "judgement" methodologies can be finessed, the "perception" is as as good as the truth when it comes to investing in UK's green economy, particularly around flexibility.

We will be repeating the exercise later in 2020.

Another area that we are repeating in this report is our work with Innovas looking at jobs and skills development in the UK in 2018. We wish to shine a light on the opportunities for people to enjoy a career in our sectors – as part of our work to ensure no one is left behind. There is an additional element this year. Many 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 Women in Science and Engineering (WISE) and Ambassador for POWERful Women. We have included some high level analysis of the proportion of women in renewable energy here in the UK and Internationally.

I mentioned at the start that the REA has also changed. I hope you agree it is a welcome change. We are STILL the REA but we have made it clearer as The Association for Renewable Energy and Clean Technology, that we represent not only renewable energy (power, heat and transport) here in the UK but also the supportive clean technologies.

The growth and activity in our organics, energy storage and electric vehicle (EV) infrastructure Forums demonstrate that our members recognise that we need a "joined up" approach to delivering our future decarbonised landscape. This change has also been reflected in the tone of the REA Manifesto that we published before the General Election. We have taken the opportunity throughout REview to weave in our "asks" for the future - as part of REA commentary.

I hope that we will see many of our asks come to pass - we will certainly be working hard for these to happen.

Decarbonising our energy system and efficient use of resources is one of the quickest and most cost-effective ways we can start to deliver greater progress on what so many of us are now demanding.

The REA will champion the work of people and businesses in our industry who are forging ahead sometimes despite the best intentions of Government and regulators.

I urge the Government and other key stakeholders to accelerate the changes necessary to create the market structures and regulation so that we can report that the UK is the leading destination for energy investment. Without clarity of regulatory structure, confidence will wane.

There is 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 perceive they should.

Dr Nina M Skorupska CBE
Chief Executive, REA

REA Key Asks of the Government

The REA wants the Government to unleash the full potential of the clean energy transition and we have outlined a series of key asks, which are vital to decarbonising the economy and meeting our legally binding Net Zero targets, listed below. We have outlined more detailed policy recommendations throughout this report, at the end of each section.

1. Implement 'quick win' policies in 2020 which would help decarbonise heat, power, and transport and preserve our natural capital, and to report on progress at COP 26
2. Ensure that the new Office for Environmental Protection has strong enforcement capabilities to ensure the Government produces policy that supports decarbonisation in line with the Carbon Budgets and advice of the Committee on Climate Change
3. Ensure that the Net Zero Strategy includes a detailed, funded and measurable roadmap that delivers the wholesale systems-change required to decarbonise heat, power and transport, while protecting natural capital and creating jobs – getting the transition right can create jobs and investment in all parts of the UK and aid the levelling up agenda
4. Implement a more effective taxation system that protects natural capital, and incentivises renewable energy and clean technology beyond fossil fuels to be announced at COP 26

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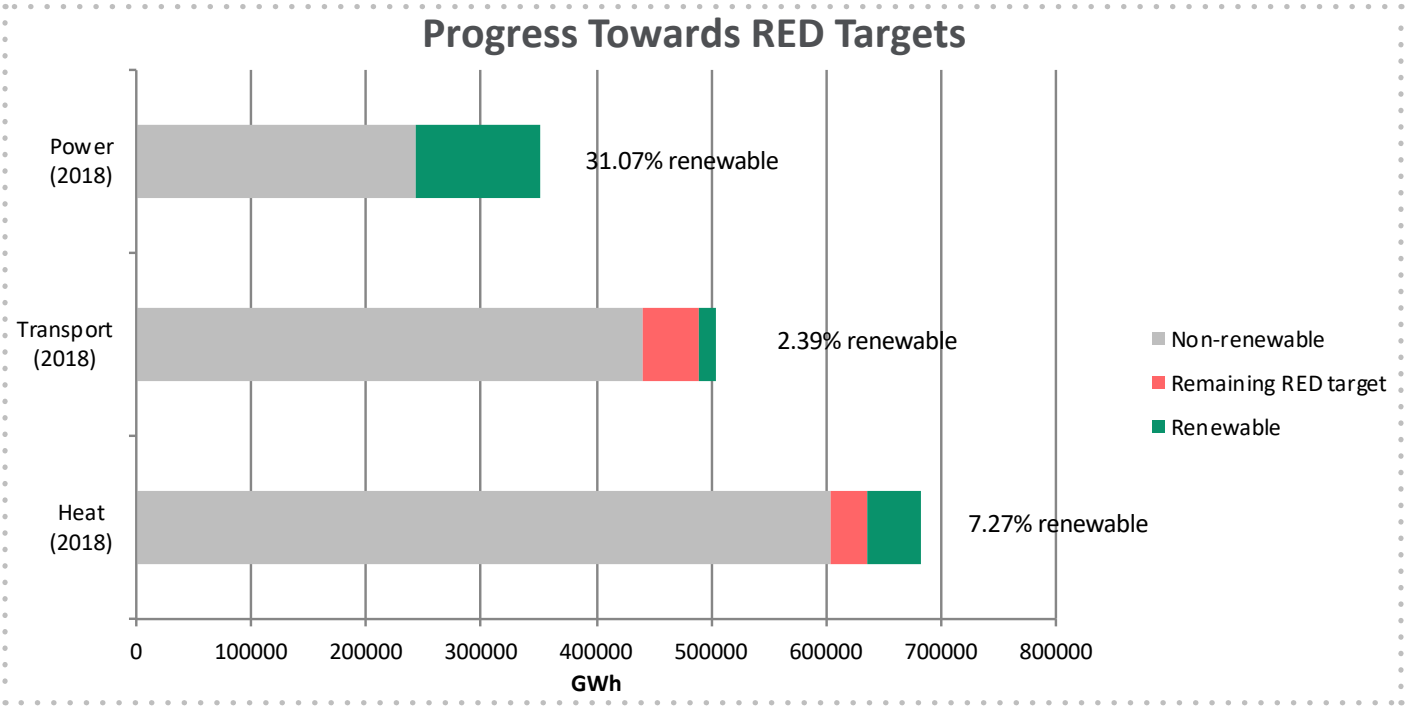
Deployment Data & Context Summary: Records broken in 2018, although growth slows and policy gaps leave little stability



This report covers generation data for 2018, the most recent full year for which data is available.

The period held a number of "firsts" when it comes to total UK CO_2 emissions, the contribution from renewable energy to total energy output and a number of policy developments. Renewable power generation capacity has tripled in the past five years, even faster growth than the rapid transition to gas fired power stations following privatisation in the 1990s – with 2018 being the first year that renewable energy power generation surpassed that of fossil fuels (between July and September).

In addition, the various elements: renewable electricity, heat and transport, that contribute to the UK's objective of 15% renewable energy by 2020 as part of the 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.

The interim RED target for renewables by 2020 has been surpassed, although this is due heavily to success in the power sector, whilst heat is still lagging behind, and the transport sector is now the largest emitter of carbon emissions. 2018's REview reported that renewable energy generation actually exceeded expectations in 2017 against the RED target. The UK had met its fourth interim target; averaged across 2017 and 2018, achieving 10.4 per cent renewable energy compared to the 10.2 per cent interim target.

> " We have indeed surpassed the fourth interim target of **10.2%** renewable energy, with renewables making up **11%** of the total energy consumed in 2018 overall "

We can confirm that for 2018 we have indeed surpassed the fourth interim target of 10.2% renewable energy, with renewables making up 11% of the total energy consumed in 2018 overall. 2018 has seen new records broken for renewable energy power generation, with an increase to 33% on the contribution of renewables to total UK electricity consumption.

Electricity generation from renewable sources increased by 11% between 2017 and 2018, to a record 110TWh. This was driven by increased capacity, resulting in record annual generation for wind, solar and bioenergy.

Renewable heat also saw modest successes, with generation increasing by 11% in 2018. Biomass and anaerobic digestion (AD) continue to be the largest contributors to heat decarbonisation, with AD generation increasing by 30% as a result of Renewable Heat Incentive (RHI) support.

Greater overall heat consumption is partly explained by the 'Beast from the East' driving down temperatures in the first quarter of 2018. Every year REView also publishes a set of jobs and investment figures that summarise the latest position regarding the numbers employed in the sector and the investment that has been received in the year, alongside the total number of companies active in the sector.

The figures show that for the financial year 2017/18, there were **128,954** people employed in the sector and over **6,600** companies, making the renewable energy sector worth **£18.8 billion** during this period. This was an increase of **1,844** jobs and **£867 million** in market value overall since 2016/17, but this masks significant falls in the solar PV sector.

We also make projections for future employment and market value growth showing the potential for the sector – showing that 140,000 jobs in solar, wind, storage and electric vehicle (EV) charging and 100,000 'bioenergy' technologies jobs could be possible under favourable scenarios.

Power

The cost for developing offshore wind projects and other technologies continues to decline thus cementing its growing role in power generation. For example offshore wind and advanced energy from waste saw the lowest ever strike price achieved in the most recent Contracts for Difference (CfD) auction. At £39/MWh this is a 30% reduction since the last auction in 2017.

Despite the continually declining costs for solar PV modules, growth in capacity in 2018 was extremely slow due to further cuts to the government support mechanism for small scale generation (the Feed-in-Tariff (FiT)), and a lack of route to market with no CfD funds allocated to the technology (which falls in pot 1) for grid-scale projects.

Despite this, the growth of the energy storage market offers solutions for solar PV – with the Capacity Market reinstated, and a range of flexibility tenders & frequency response markets on the horizon which offer co-located commercial solar & storage projects, and aggregated residential solar & storage, a route to market.

This is in addition to the new Smart Export Guarantee (SEG), which replaces the Government's "FiT Export Tariff" from 1st January this year. Bioenergy continues to play a crucial role in power sector decarbonisation, providing a sustainable solution to switching away from coal power plants.

Drax completed its 4th coal power unit conversion to biomass in August 2018, adding over 600MW to the UK's renewable electricity capacity, in addition to launching research streams into bioenergy with carbon capture and storage (BECCS).

Overall, 2018 saw records of 2017 being built on, which has demonstrated that decarbonisation is well underway.

Heat

A less clear-cut route can be seen in heat decarbonisation than power, although bioenergy certainly demonstrated its strength playing the core role in heat decarbonisation – and a varied approach will be required looking forwards.

Pioneering geothermal saw its growth as a serious contender among the emerging technologies in heat in 2018, as the Cornish "hot rocks" project secured funding – the first of its kind across the UK.

Developments in research and pilot projects on district heating also took place, although with the more established solutions for heat included heat pumps (ground and air source) for residential property, and biomass for rural and commercial sites. 2020 should see the first deep geothermal project since the 1970's to be connected to district heating get underway.

Transport

The transport sector despite being relatively early in its decarbonisation progress, has seen some positive developments in the deployment of zero-carbon passenger and light goods vehicles (cars and vans).

With strong growth in the deployment of EV charging infrastructure, government cemented its support of electric vehicle deployment through the publication of the Road to Zero strategy in 2018.

Regional support was also seen through the introduction of the first Ultra Low Emission Vehicle Zone (ULEZ) in London in April 2019, with other cities to follow suit in 2020.

While electric vehicle deployment is speeding up, it is doing so from a fairly low base and much of the transport-sector decarbonisation is being delivered by low carbon fuels. Progress on decarbonisation petrol can't be made until the UK shifts from E5 (a 5% bioethanol blend) to E10 (Bioethanol proportion at 10%).
The Government is poised to consult on this.

Biodiesel is also bumping up against its blend wall (B7 –7% Biodiesel proportion) and so higher blends (e.g. B20 or B30) need to play a role. Electrification is far more challenging in freight, and biofuels are expected to play a long-term role in the marine and aviation sectors.

There is a strong drive from Department for Transport (DfT) for the development of novel renewable fuels of non-biological origin (RFNBOs) and fuels made from non-food crop wastes, together known as "development fuels".

Natural Resources & Circular Economy

The composting and anaerobic digestion sectors contribute to a circular economy by turning food and garden wastes into composts and digestates which positively contribute to the carbon, nutrient and microbial contents of soils.

In addition, the AD sector generates valuable renewable energy and there was some growth in this sector in 2019 due to the Renewable Heat Incentive (RHI) support mechanism.

Multiple organisations have made efforts this year to eliminate single-use plastics in applications deemed unnecessary, to develop plastics with more recycled content and make them only from recyclable plastics, and the future role for compostable plastics is being considered. The 5 pence charge on plastic carrier bags (introduced in Northern Ireland in 2013, Scotland in 2014, England in 2015 and Wales in 2016) and packaging-procurers' efforts so far to reduce single-use plastics are steps in the right directions but the AD and composting sector needs more solutions that reduce plastics contamination in food and garden wastes.

In 2019, the Department for Environment, Food and Rural Affairs (DEFRA)'s first stage consultation on the Resources and Waste Strategy included questions about support for separate collection of food and garden wastes and the supply of food caddie/bin liners to householders. Local authorities need more resource to build on their recycling efforts so far and deliver improved communications to householders so more of them put the right wastes in the right bins.

Looking Forward

In the wider climate change space, the UK has seen a number of events over the past year including widespread protests from various climate groups across the country, witnessed international wildfires, and flooding, and a blackout of our own demonstrating the need for fast paced reform to support flexibility in our energy system. An increase in public support for renewables (at 82%), in addition to completing our first full week without coal generation, amongst other pressures in 2018, has culminated in the UK government adopting a new target – net-zero emissions by 2050, which has been written into UK legislation.

Key areas to unlock potential in the energy system include the creation and growth of markets to support flexibility. With generation exporting to the distribution networks doubling between 2012 and 2018 (REA, 2019), our recent Flexible Futures report highlighted the importance of distribution network flexibility, although the regulator, Ofgem continue to push ahead with damaging reforms such as those seen in the Targeted Charging Review.

On heat decarbonisation, what has become apparent is the urgent requirement for a detailed and coherent forward-looking heat policy, which accounts for the fact that a "one-size-fits-all" solution is not an option for heat. The REA's "Bioenergy Strategy" released in three phases, outlines a detailed plan for heat decarbonisation.

This highlights that we should not only look to replace the Renewable Heat Incentive once its budget comes to an end in 2021, but should offer detailed short-, mid- and long-term pathways for the decarbonisation of the sector, with the Future Homes Standard to be introduced in 2025 (mandating that all new homes are off-gas grid) offering the first glimpses of Government thinking on heat.

The built environment must also be tackled, as one of the largest emitting sectors, where we are beginning to see solutions based around "smart homes" integrating solar, energy storage, EV charging and other "smart" technologies to optimise self-generation, storage, and demand shifting to support the wider energy system in a connected manner.

On transport, E10 must be immediately introduced, key areas for electric vehicle rollout include ensuring a smooth consumer experience through robust integration of EV charging infrastructure across the country. This includes aspects such as ensuring the interoperability of public charge-point networks and the data management and utilisation behind this (as outlined in our Interoperability report last year).

The EV charging sector also heavily engaged with Government's proposed 'Smart Charging' consultation, which would mandate that all 'private' charge points are smart.

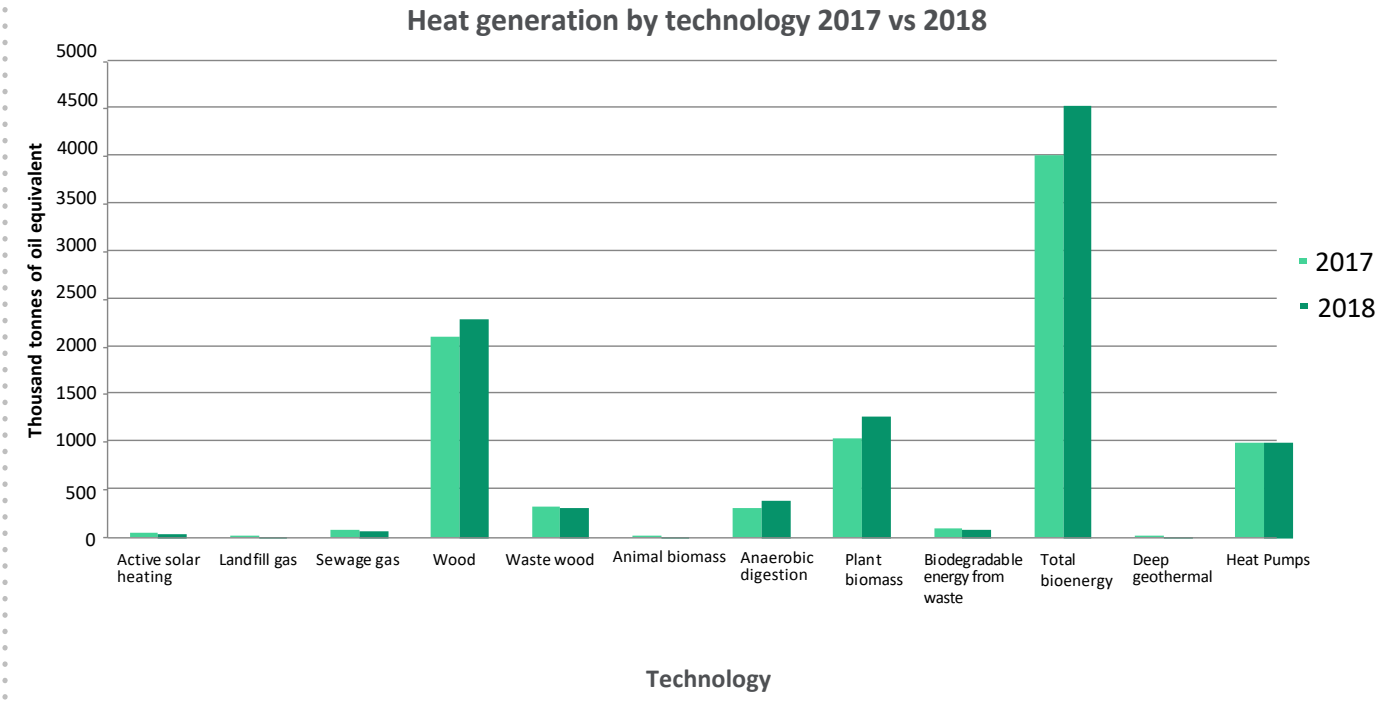
Simultaneously, Government consulted on amending Building Regulations to ensure charging infrastructure is incorporated into new homes and commercial premises.

There is also an overarching requirement as we leave the European Union (EU), for a continued harmonised carbon pricing scheme – to offer long term stability and price reflectivity to new projects competing with carbon intensive energy generation.

REA Cross–Sector Policy recommendations

1. Commit the UK Government's own procurement department, the Crown Commercial Service (CCS), to sourcing an increasing proportion of renewable energy. As the largest purchaser of power in the UK this could have a significant impact on the industry and carbon targets, and would not necessarily need to come at extra cost.
2. Introduce an ambitious carbon pricing scheme which can align with that of the EU post Brexit, with a target floor price of £70-80/t CO2 by 2026, and over £120 by 2032. Common carbon prices must be adopted across Europe to be effective.
3. Government or other funding for best practice documentation and the development of industry standards, is necessary to develop the market.

Deployment Data: Renewable Heat



The decarbonisation of heat is currently led by bioenergy technologies, with strong but slowed growth in 2018. With such reliance on the Renewable Heat Incentive (RHI) mechanism, biomass heat saw slowing deployment, especially with small and medium scale projects following the 2018 RHI reforms and regression of these tariffs. Slight growth in large scale non-domestic biomass installations was seen due to tariffs viewed as only just viable, but stable.

RHI tariff guarantees also came into effect mid-2018. RHI tariff guarantees allow for larger scale, non-domestic projects to lock in a tariff price up to a year prior to commissioning, meaning it is likely we will see a small increase in these types of projects, especially biomethane, into 2020 and 2021. Anaerobic Digestion saw steady growth in capacity in 2018, although slower than previous years' growth.

2018 reforms to the RHI introduced an uplifted tariff for biomethane, meaning a surge in new applications following a period where degression in the tariff caused a tough market for deployment.

The market also saw a very slight growth in heat pump capacity and generation, with little uptake of the RHI support mechanism as it faces similar issues to domestic biomass boilers and other small scale heat technologies. Despite this we may see a growth in ground and air source heat pump uptake in the 2020s should the electrification of heat prove to be a preferred route for the Future Homes Standard – to be introduced in 2025.

Heat generation from Waste to Energy (WtE) plants also stalled in 2018, with challenges for the route to market and limited sites left for projects in landfill gas and sewage gas capacity.

WtE may see an upturn in the coming years with renewed focus on the development of heat networks. Gasification is also receiving increasing attention, offering a solution to both hydrogen pathways and further biomethane. There are currently Government funded research and pilot projects under way to explore various uses of Hydrogen for heating.

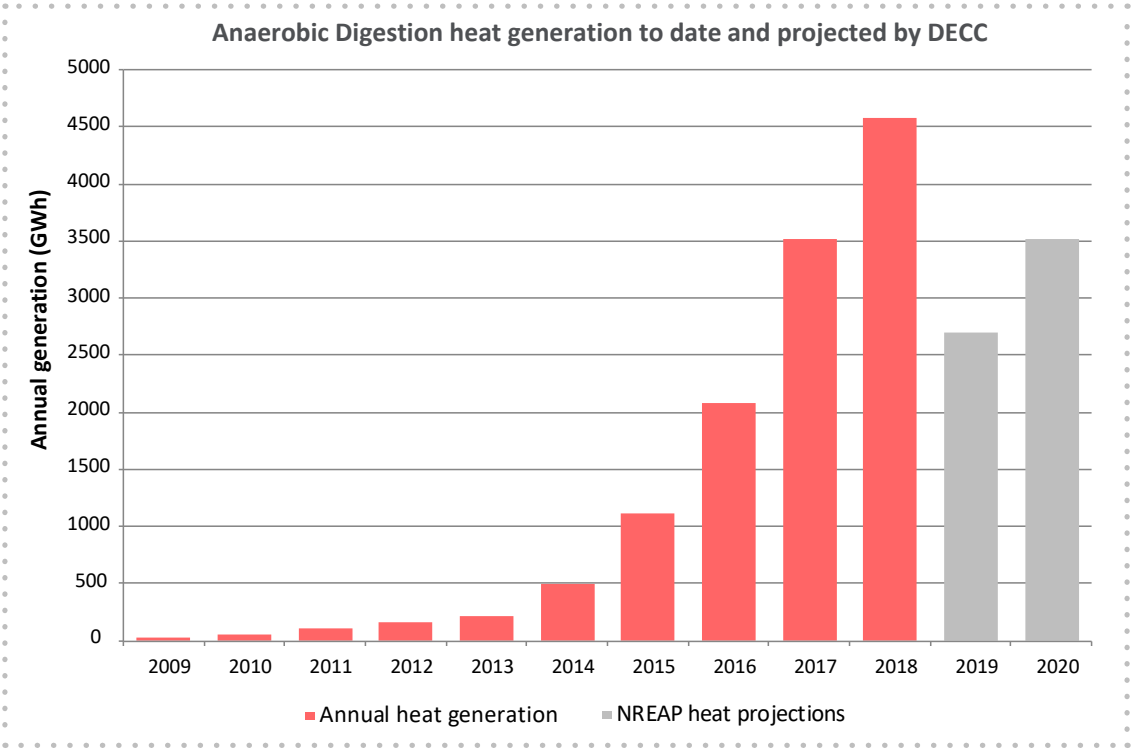
Overall, significant investment must be made into heat decarbonisation, accompanied by a renewed long term heat decarbonisation policy to replace the RHI. The REA's Bioenergy Strategy (REA, 2019) outlines industry's recommendations to inform government's heat policy following the closure of the RHI in 2021.

Deeper Insight

Anaerobic Digestion (AD)

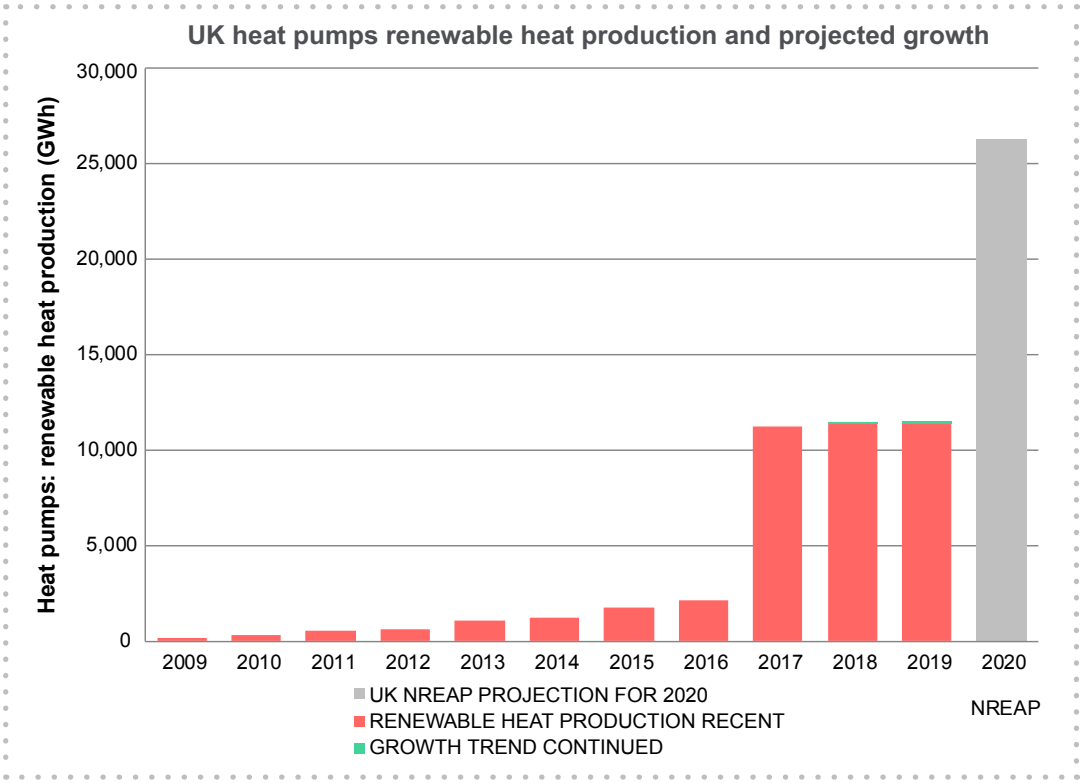
2018 saw steady growth in AD capacity, although slower than growth in previous years (2012-2016). Reforms to the RHI in 2018 introduced an uplifted tariff for bio-methane (a form of Green Gas), creating a new surge of applications. Previous degression was too strong and created a tough economic environment for AD project development.

AD in 2018 met the 2020 Government 'Electricity Market Reform (EMR)' projection and surpassed the Updated Energy Projections 'UEP' 2020 projection in 2016 (for both heat and power). AD for heat has far surpassed UEP and 2018 saw an additional 1000GWh of heat generated from AD, making it a strong player, especially in regards to helping to decarbonise our existing gas network.



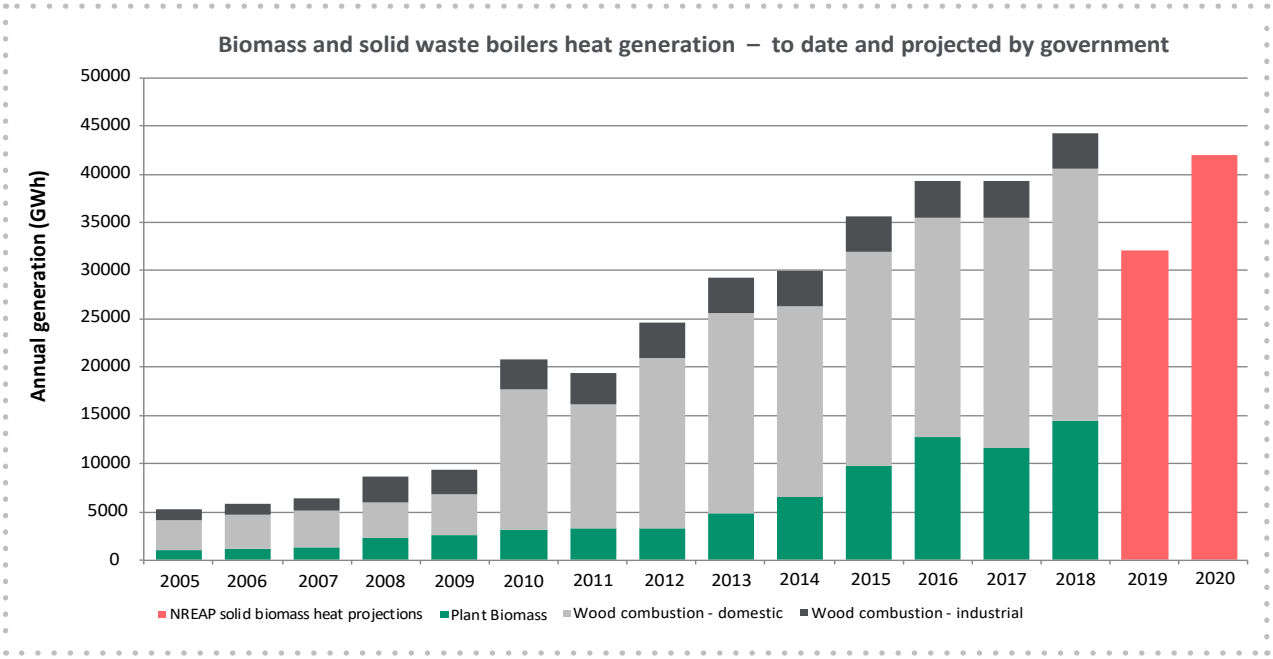
Heat Pumps (air and ground source)

Heat pumps saw a jump in installations between 2016-2017, but since 2017 have delivered very little growth in production and installations. Heat pumps have delivered below half of our 2020 National Renewable Energy Action Plan (NREAP) target for renewable heat production. We may see further growth in installs with the implementation of the Future Homes Standard, which states that all new homes will be "off the gas grid" by 2025. A review of the Building Regulations Part L (which covers the conservation of fuel and power) is already underway to complement the Future Homes Standard. (**Deployment graph on next page**)



Biomass Heat

Overall, heat generated from biomass and solid waste saw modest growth in 2018, exceeding the NREAP projections, after a slight stall between 2016-17. This is likely due to a number of factors including the latest set of RHI reforms. These reforms in 2018 affected biomass boiler deployment with a shift in support to incentivise the deployment of larger systems. However, overall deployment levels have been significantly lower than they were when the RHI was first introduced. In addition, as the RHI has shifted to support primarily non-domestic projects, these systems (which require longer lead times) are starting to come online, and are therefore now being captured in the statistics. A small number of further large scale biomass systems may come forward as a result of the introduction of RHI tariff guarantees. Overall though, the market is expected to contract due to policy uncertainty as we get closer to the end of the RHI budget in 2021 and there remains no clear policy for further heat decarbonisation beyond this time. A future focus on off-gas grid heat decarbonisation, as well as the need for situations that require high heat loads to power heat networks or large public buildings (like schools or hospitals) will mean biomass heat continues to have an important role to play in heat decarbonisation.



Geothermal

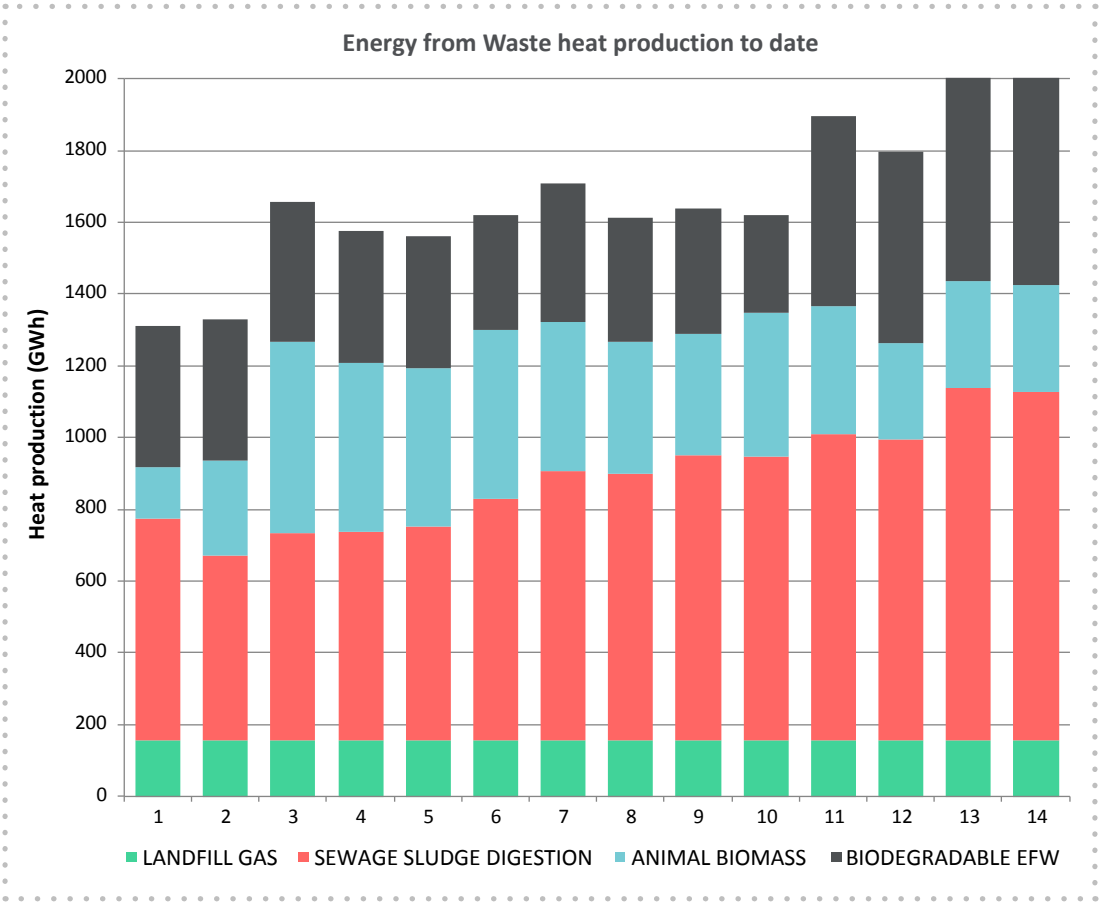
There are currently two proposed geothermal projects in the UK, one of which will provide heat and the other power. A new project to bring geothermal heat to the city of Stoke-on-Trent is under way with pipes being laid and drilling of the wells commencing in 2020.

Biofuels for Heating

Looking forward, there is also expected to be increasing use of biobased liquid fuels in heating, such as Bio-liquified Petroleum Gas (Bio-LPG). Production pathways for such fuels are increasing, utilising a range of biobased feedstocks and providing a 'drop-in' fuel alternative to conventional oil heating, particularly in off gas grid areas.

Waste to energy

Heat generation from waste to energy projects remains relatively steady since 2017. A significant barrier continues to be the difficulty of securing a suitably long term heat "offtaker", restricting the ability to create more Combined Heat and Power (CHP) projects. As such, dedicated projects that focus on biomethane production or process heating remain the main waste to energy heat contributions. With both an increasing focus on delivering heat networks and tapping into the potential of waste gasification for hydrogen, these are seen as routes to future growth. The emphasis on developing heat networks could provide sufficient levels of heat demand to make further CHP projects viable, while the potential for hydrogen to contribute to both heat and transport decarbonisation is being increasingly recognised.



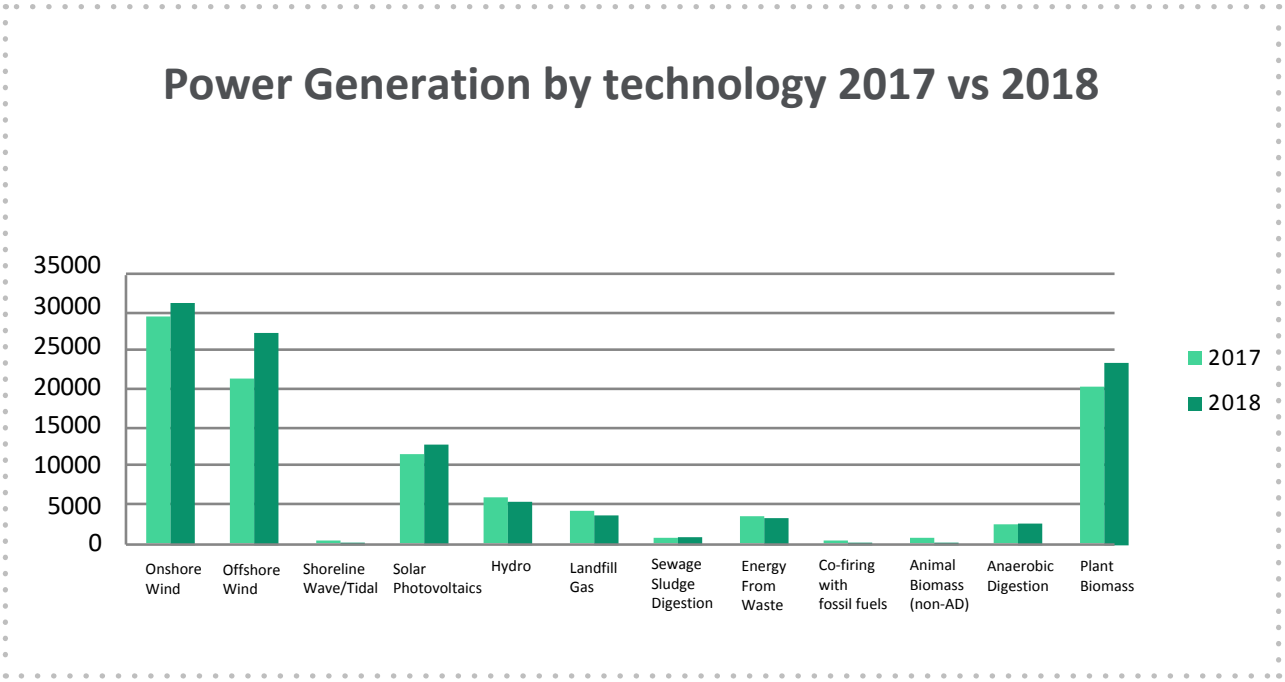
Policy Recommendations – Decarbonising Heat

1. The Renewable Heat Incentive (RHI) is the primary heat decarbonisation mechanism in Great Britain and is due to expire in 2021. The majority of the renewable heat industry relies on this mechanism to encourage decarbonisation and no plan is in place for its replacement. The REA calls for an immediate, time-limited extension to the RHI to keep the industry going as the lack of certainty is already stemming new investment in the sector
2. Implement a more effective taxation system that incentivises the use of renewable heating systems and fuels, while penalising the dirtiest fuels by gradual increases in fuel duties
3. In the medium term, a new mechanism is needed that supports heat decarbonisation past 2021, such as introducing a heat premium feed-in scheme that rewards low carbon heat users
4. Provide variable tax benefits to those who live or own properties with high energy efficiency standards and renewable heating installed. This should include rebates on income tax or council tax or discounting stamp duties at the point of sale. This would strengthen the link between energy efficiency and house prices
5. Amend the Energy Savings Opportunity Scheme (ESOS) to focus on carbon emission reductions, rather than just Energy Savings. This will drive commercial installation of renewable heating systems
6. Provide government backed low interest loans for commercial heating schemes
7. Address barriers to the deployment of district heating, prioritise those to be powered by renewable energy systems
8. Support biobased heating, such as biomass boilers and biofuels, as a key technology for use in the Future Homes Standard

Green Gas

9. Introduce a Green Gas Obligation on gas suppliers to meet a gradually increasing Green House Gas (GHG) reduction target. In order to meet this target they would have to source the gases that deliver the greatest and cheapest carbon savings. Similar approaches already exist for renewable transport fuels in the UK and elsewhere in the world
10. Take the opportunity from the reform of the Agricultural support schemes to promote on-farm AD, circular economy principles and good soil management

Deployment Data: Renewable Power



The renewable share of power generation has increased to 33%. The largest decarbonisation of any energy sector to date. Whilst capacity in 2018 grew only slightly - mainly in biomass, wind and solar - overall generation saw larger growth due to higher wind speeds than the previous year and the fifth sunniest summer on record in 2018.

Offshore wind saw the largest growth in capacity, mainly due to government support and its competitiveness in the CfD 'Pot 2' auction (for less established technologies) such as the lowest ever strike price, at below forecast wholesale rates, though this occurred in 2019 and will not be built out for several years. The sector is also expected to grow into the 2020s, with the offshore wind Sector Deal announced in March 2019.

The technology with the second largest growth in capacity was biomass power, mainly due to development of plants from the 2015/2016 CfD auctions. A key player in biomass power, Drax power station, also converted an additional coal power unit to biomass, which came online in 2018.

The Capacity Market was also still open during 2018, which supports biomass power as a dispatchable power generation source. Important to note that the Capacity Market was periodically halted during 2019 due to challenges on state aid rules, and reinstated in late 2019 following a European Courts of Justice ruling on the issue.

Solar PV saw the third most significant growth in capacity; in part due to continuously falling technology costs but also due to the continued use of energy storage – especially on grid scale and commercial & industrial sites – with 2018 bringing to play two new "subsidy free" solar farms utilising storage. The small scale sector also saw a surge in applications in 2018 due to nearing the end of the FiT subsidy, which closed to new projects at the end of March 2019.

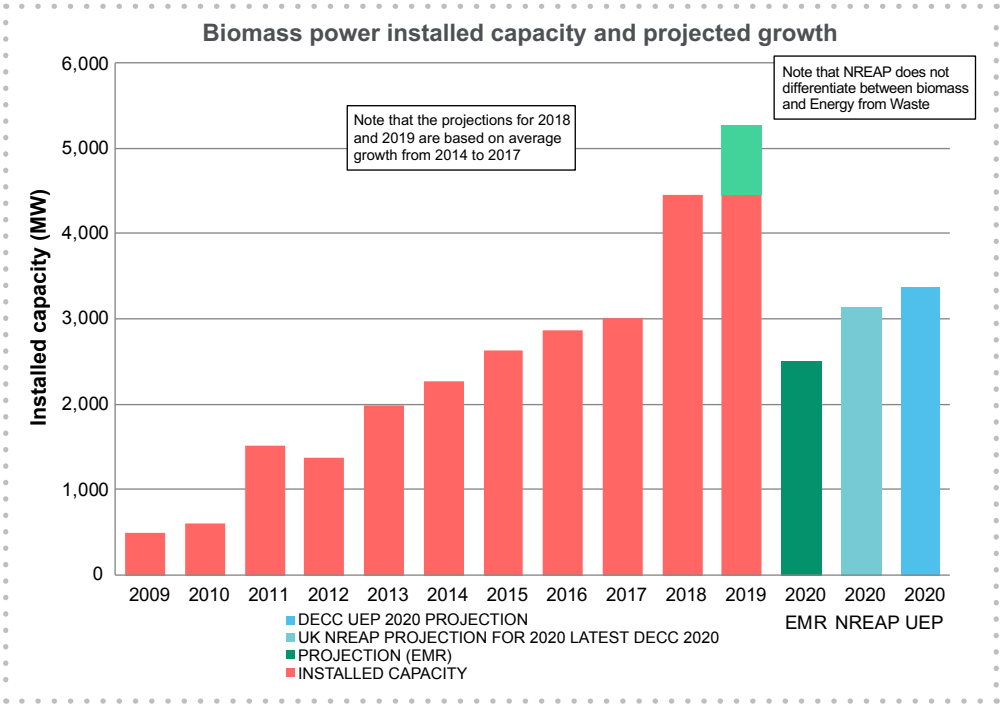
Other renewable power technologies remained relatively unchanged in capacity growth rates compared to 2017, although onshore wind saw slower growth again due to heavy policy and planning constraints.

Wave and tidal power also saw little change due to the lack of support in delivering projects from innovation to commercialisation stage.

Deeper Insight

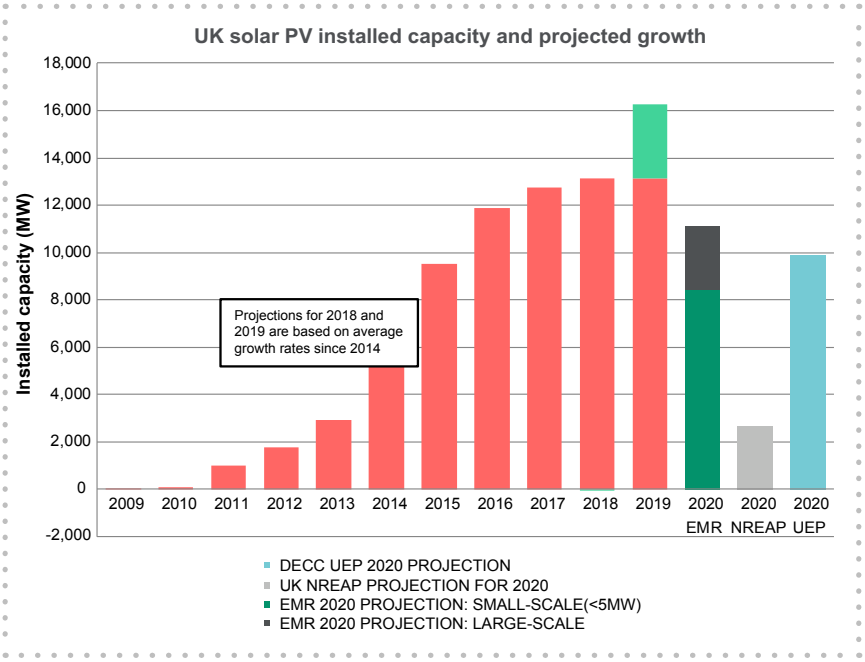
Biomass Power

In 2018 biomass power beat the NREAP projections for 2020, due to new projects being delivered from the 2015/2016 FID-e/CfD contracts, in addition to Drax completing their fourth coal-to-biomass unit conversion.



Solar PV

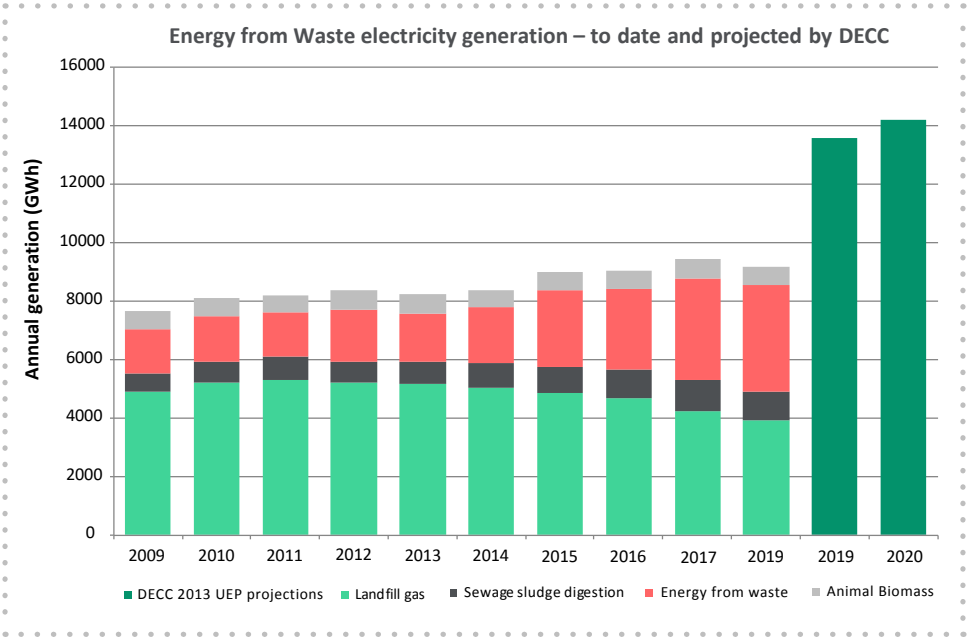
Solar PV deployment has far surpassed the 2020 NREAP targets, EMR targets, and UEP targets. 2018 saw a year of slowed growth due to subsidy cuts leading towards the closure of the FiT in March 2019. Deployment in 2019/2020 is also likely to be slow, especially on domestic and small-scale commercial projects. The introduction of the Smart Export Guarantee on the 1st January 2020 may see a pickup in deployment, as energy suppliers are mandated to offer an export tariff, although it should be noted that there is no minimum price or contract length, meaning that the route to market for projects, especially those requiring external finance, is as yet unclear. Large scale projects' viabilities are closely linked to energy storage cost reductions, in addition to grid charging and access changes e.g. the Targeted Charging Review, or the ability for energy storage to skip grid connection queues. The deployment of energy storage should be supported by the opening up and growth of flexibility markets, but is likely to primarily be used alongside co-located solar PV assets initially.



Mixed Waste-to-Energy

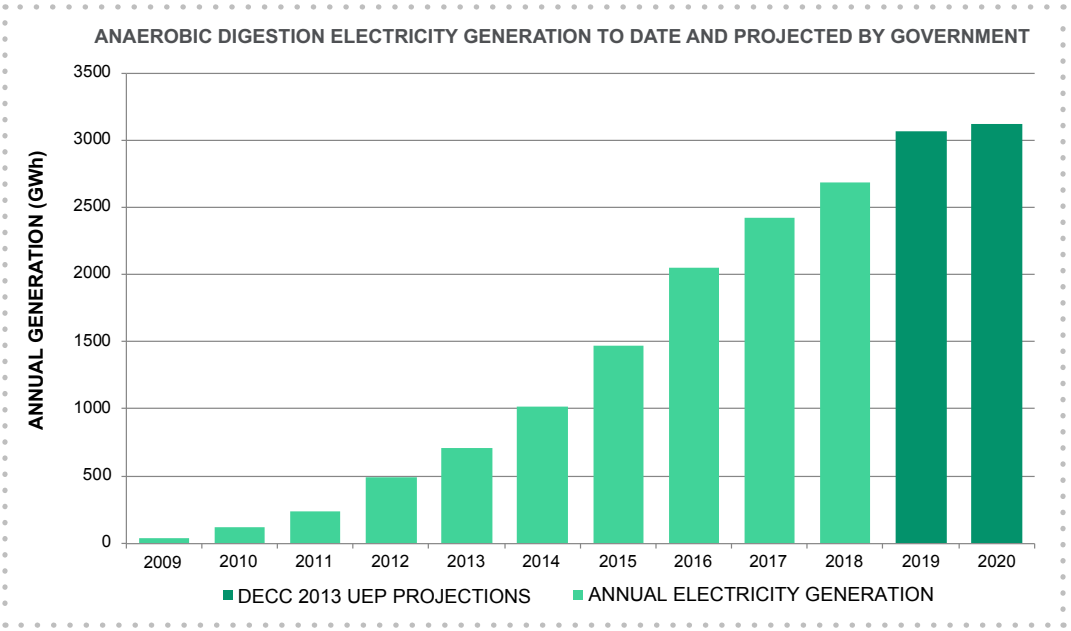
Total installed capacity has been growing steadily, with a modest pipeline of projects thanks to proven established technologies and the ability to combine power revenue streams with waste gate fees. However, overall power generation reduced slightly in 2018 from 2017 levels, with the general trend showing slow growth in this sector. Small decreases were seen in use of animal biomass and sewage sludge digestion, which are increasingly focused on biomethane production, rather than power. The landfill gas sector also saw natural decreases as rates of biomethane production at existing sites decays.

At the end of 2018 the Government released their 'Resource and Waste Strategy' which recognised an ongoing capacity gap for waste management solutions. Reducing tonnages of exported waste are also expected due to changing international markets and export processes that could see waste re-shored. Therefore, the future growth of waste to energy projects will likely be viewed as the technology providing a waste management solution, with power production a valuable secondary output. This growth will need to be considered in the context of wider waste management decisions, such as increasing recycling rates and waste policies that could change the nature and volume of waste arising.



Anaerobic Digestion

Meanwhile anaerobic digestion for power has seen slower growth in the past year than previous years, and UEP targets. This is due to the closure of the FiT, which has meant the sector is now focused on gas-to-grid projects supported by the RHI, rather than power generation. The introduction of the Smart Energy Guarantee (SEG) tariffs this year may see some small-scale AD projects being developed, however it remains to be seen exactly how the SEG market will develop.



Policy Recommendations – Decarbonising Power

1. Ensure the Smart Export Guarantee is fair to all generators and kept under regular review with Ofgem empowered to compel suppliers to offer better terms if those on offer are found to be insufficient
2. Commit to 'Pot 1' Contract for Difference (CfD) auctions for consented onshore wind and solar PV projects. Due to the low-cost nature of these technologies this could become a revenue stream for Treasury as developers effectively 'pay' for the certainty the CfDs provide
3. Set out a timetable for the next five years of regular CfD auctions
4. Consider reintroducing the 10MW minimum reserved capacity for wave and tidal energy, and including BECCS (Bioenergy Carbon Capture and Storage, providing negative-emissions, as supported by the Intergovernmental Panel on Climate Change (IPCC) & Committee on Climate Change (CCC)) projects, in order to unlock the Industrial Strategy benefits of these industries
5. Ensure the Building Regulations Part L review incorporates provision for the requirement of on-site renewables and flexible energy technologies (e.g. smart EV charging, storage) at new developments
6. Establish a single asset registry for the post Feed-in Tariff/post electricity 'subsidy' world, in order to track installations and net generation in one central location

Deployment Data: Renewable Transport

Transport is now the greatest source of emissions in the UK, accounting for 33% of all carbon dioxide emissions. There is now more focus on decarbonising the sector, with the launch of the Road to Zero Strategy in 2018. Most transport-sector decarbonisation policy is via the Renewable Transport Fuel Obligation (RTFO) or coordinated by the Office for Low Emissions Vehicles (OLEV), a joint office between the Department for Transport (DfT) and Department for Business, Energy, and Industrial Strategy (BEIS).

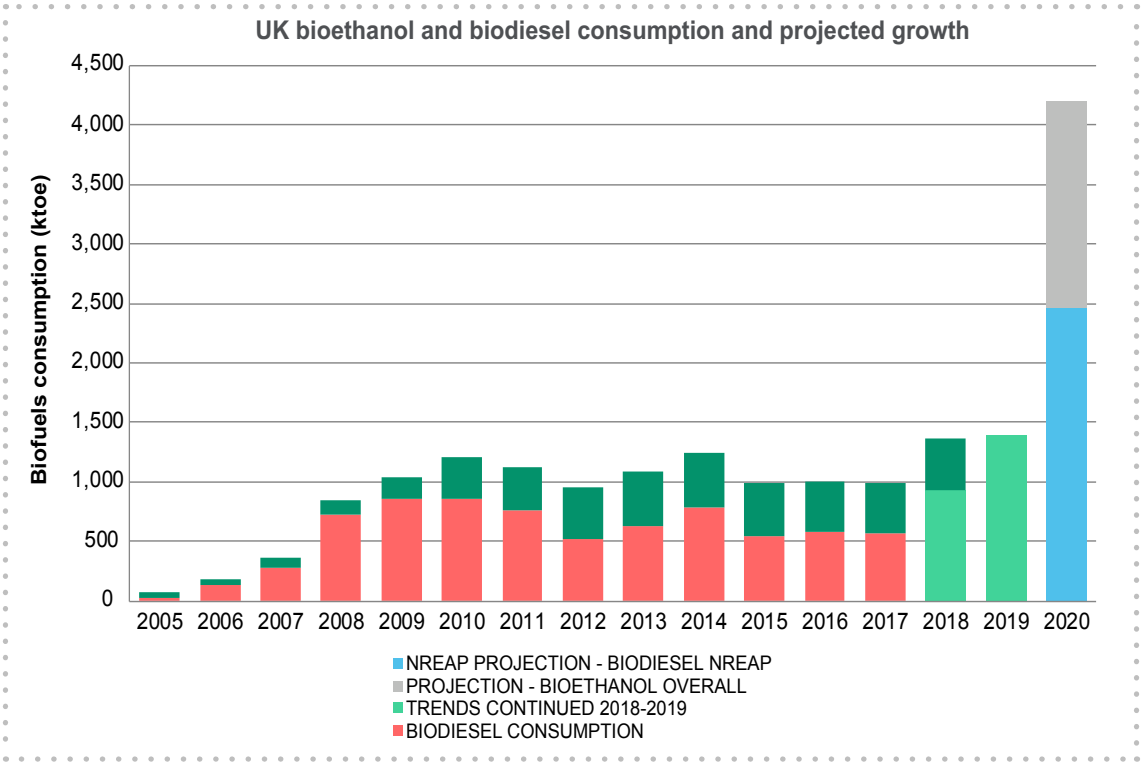
Strides have been made in the electrification of passenger and light goods vehicles, with the UK setting a target to become a world leader in electric vehicle (EV) charging. Further to this, numerous auto manufacturers (Auto OEMs) have stepped up to commit to ceasing research and deployment of new internal combustion engine (ICE) petrol and diesel vehicles in the 2020s. This aligns with Government's plan to end the sale of new 'conventional' cars and vans by 2040.

Sales for new battery electric vehicles (BEVs) hovers around 2% of total, and whilst deployment is increasing, the rapid introduction of E10 biofuel is also essential for the transport sector.

Deeper Insight

Liquid Biofuels

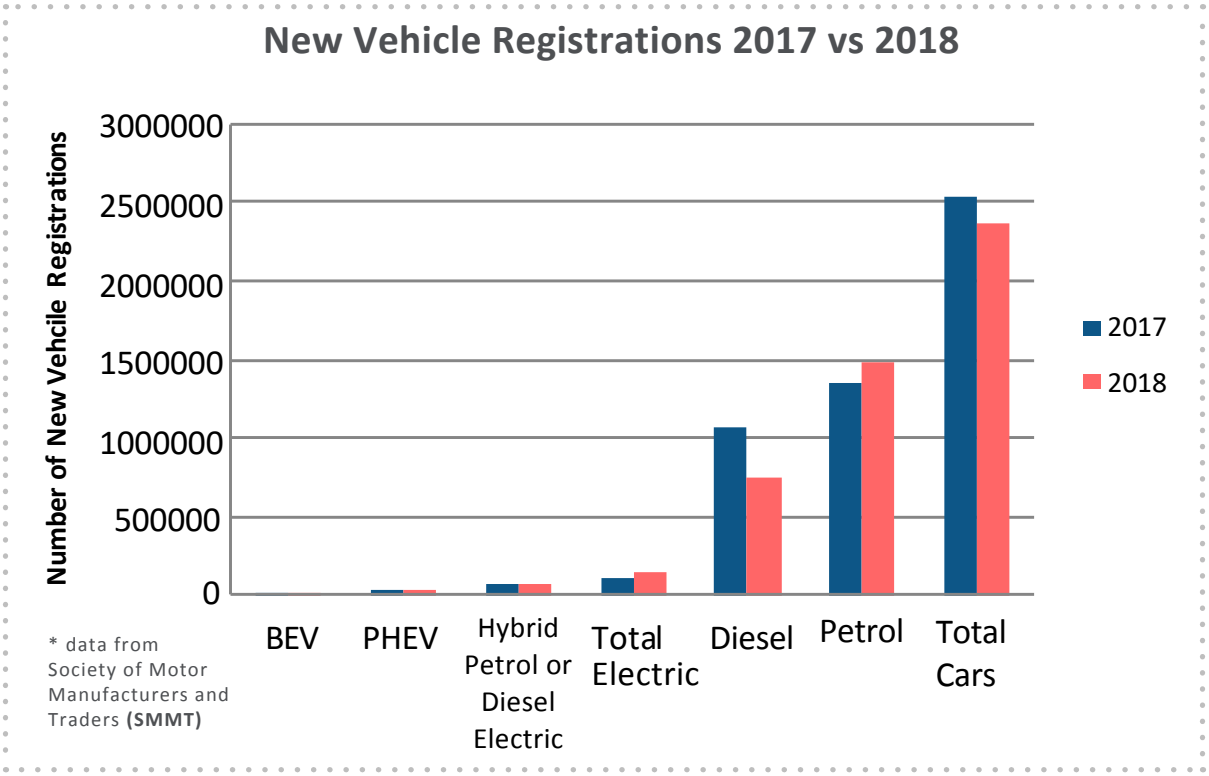
The use of liquid biofuels remains well below the Government projections for 2020, and indeed our mandatory 2020 RED targets. This can be attributed to low Government ambition and target levels. At present the only growth in the RTFO is in 'development fuels', none of which are yet available. There is every risk of going backwards, when it comes to blending biodiesel. With growth in electrification, more biomethane use in HGVs, general improvements in vehicle efficiency, and the long-delayed introduction of E10, biodiesel consumption could halve by 2032, unless the basic RTFO target is increased. An increase to 15% would merely keep the status quo. With transport CO_2 emissions rising relentlessly, and fossil fuels around for decades to come, even with electrification there is clearly a case for a far stronger drive for biofuels.

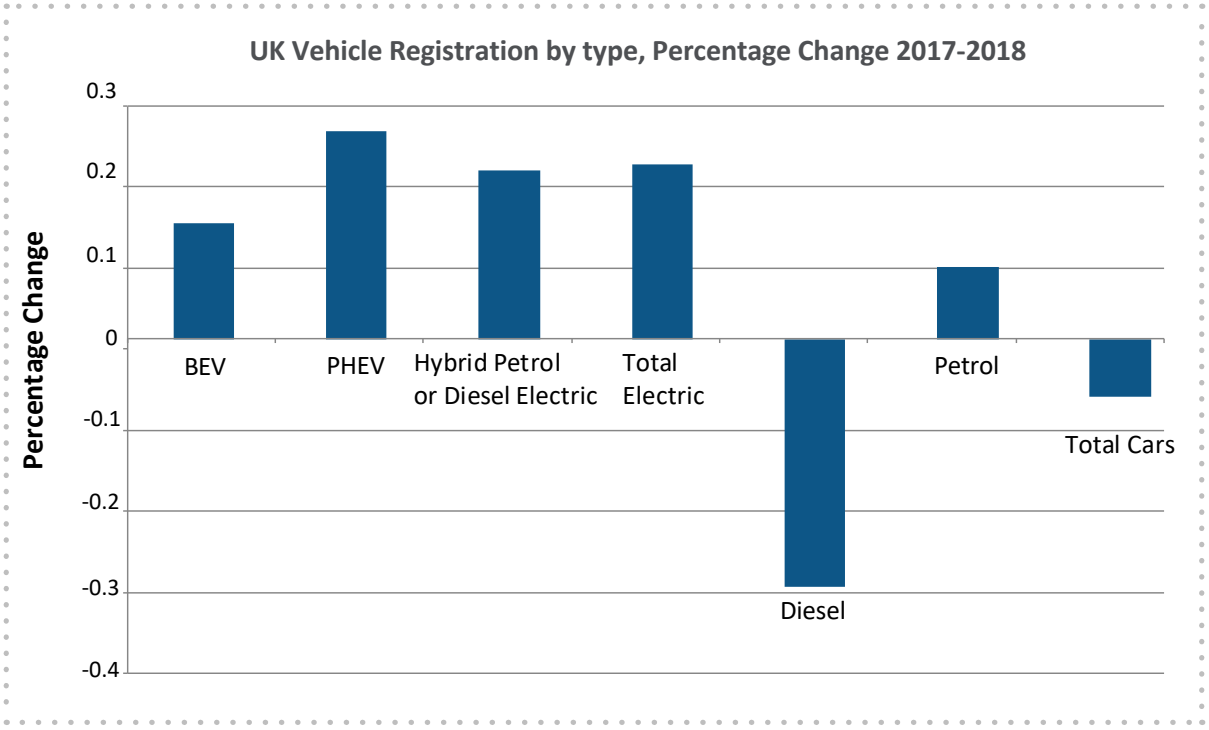


Electric Vehicles and EV Charging

Considering the market share of Electric Vehicles (EV) today, the UK has a good national public charging infrastructure network in place. This is rapidly growing, with numerous charge point operators raising funds for expansion in 2019 and 2020. A focus on the development of rapid 'charging hubs' demonstrated in the 2019 Transport for London EV Infrastructure Delivery Plan, is emerging in the sector.

A major barrier to further EV deployment is the supply of vehicles and batteries. An expanded range of models and manufacturing capacity is expected in early 2020. The development of the European Commission's EU Battery Alliance and the Faraday Institution's research on battery manufacturing in 2019 both highlight how the conversation around how different countries will secure battery 'gigafactories' is likely to intensify.





Policy Recommendations – Decarbonising Transport

Transport Fuels

1. Introduce E10 (a blend of 10% bioethanol in petrol) as a matter of urgency
2. Increase the basic target levels within the Renewable Transport Fuel Obligation (RTFO)
3. Retain the Greenhouse Gas Reporting Regulations, so that producers of renewable transport fuels have an incentive to strive for GHG saving levels above the minimum threshold required for the RTFO
4. Boost incentives for higher blend biofuel uptake in buses and heavier vehicles
5. Introduce more pragmatic rules to encourage the production of hydrogen from renewable electricity, for use directly as a transport fuel or for use in the production of renewable drop in biofuels and aviation fuel

EV Charging Infrastructure

6. Extend existing infrastructure grants, including the EV Homecharge Scheme (to 2023), Workplace Charging Scheme (to 2023) and the Onstreet Residential Chargepoint Scheme until a suitable taxation system can be introduced to support infrastructure deployment
7. Provide a grant for apartment block owners to install charging infrastructure
8. Support the strategic roll-out of rapid charging infrastructure along the motorway network, forecourts, train station, ports and airports
9. Support the existing proposals from OLEV on introducing charging infrastructure (or at least the enabling cabling) in new homes, mandating that all private chargers are 'smart,' and moving towards the interoperability of private charging infrastructure
10. Support industry efforts to introduce e-roaming / interoperability across public charging networks, and take regulatory action from 2021 if actors are not taking action from that stage

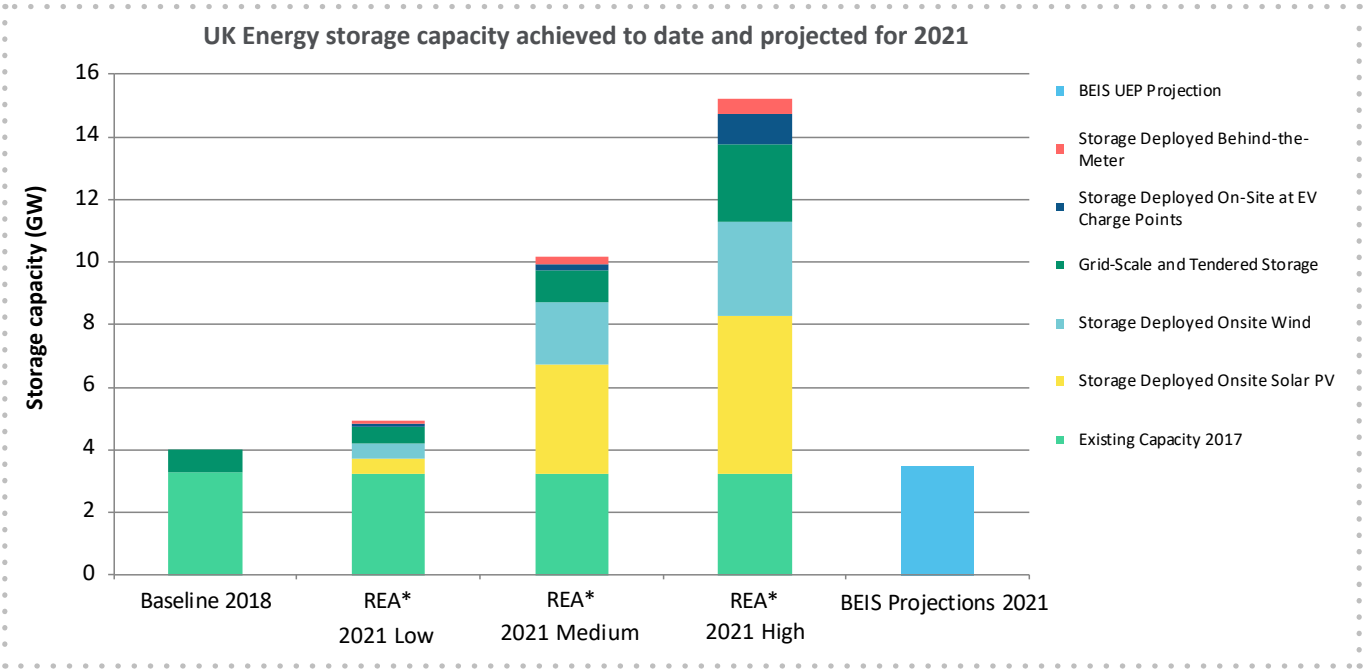
Flexibility and Energy Storage

2018 was another year of very modest deployment for 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 Enhanced Frequency Response (EFR) projects awarded contracts in 2016 (although the market now no longer exists), and some Capacity Market projects, but the build out is still a fraction of the interest in the market and projects applying for grid capacity.

Indeed, the amount of storage projects pre-qualifying for the Capacity Market auction in 2019 (at 1.5 GW), shows the level of shovel-ready projects currently unable to be built.

Investment, jobs and companies in the sector all remain similar to the previous 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.



Note: The BEIS deployment estimates in the Updated Emissions Projections (UEP) reference scenario are based on outputs from BEIS's Dynamic Dispatch model (DDM). The BEIS and REA outputs are not directly comparable. *REA figures are deduced from our annual energy storage report with in-house surveying.

For BEIS estimates see: **https://www.gov.uk/government/publications/updated-energy-and-emissions-projections-2018**

Policy Recommendations – Energy Storage

1. Extend the proposed Regulated Asset Base ('RAB') funding model being considered for nuclear developments, to large scale flexible technologies such as new Pumped Hydro Energy Storage projects, and Wave and Tidal projects with significant Industrial Strategy benefits for the UK
2. Make practical changes to the VAT increase on small-scale renewables implemented from 1 October 2019, and commit to a review of UK VAT and tax policy soon after EU Exit
3. Introduce a dedicated definition for energy storage in primary UK Legislation, to smooth out a number of issues regarding grid charges, planning, and regulatory treatment of storage devices
4. Ensure a level playing field with diesel generator and gas peaker plants and continue to implement progressive emissions intensity thresholds in future Capacity Market auctions and other future power markets
5. Ofgem should revisit the damaging proposed grid charging changes, specifically the Targeted Charging Review (TCR) which would act as a considerable disincentive to flexibility, while ensuring that the Access and Forward-looking charges review introduces adequate flexibility incentives
6. Ensure the roll out of regional Distributed System Operator (DSO) flexibility markets nationwide, following the pathfinder Power Potential project
7. Continue progress on simplified planning regimes for energy storage, EV charging and other flexibility assets - again this could be aided by a definition for energy storage in primary legislation
8. Distribution Network Operators (DNOs) should adopt proposals to allow energy storage projects to move 'up the grid connections queue' and therefore free up capacity for other generation projects while avoiding or delaying network overhead line upgrades
9. Continue to legislate to ensure EV chargers are all smart and genuinely interoperable in their nature, allowing them to participate in dynamic pricing markets best able to shift consumer behaviour to benefit the system
10. Standardise flexibility products and reduce barriers to product entry (akin to the 'Nordic' market model in Norway)
11. Government could offer interest-free loans for domestic solar and storage installations, akin to those introduced in Scotland

Natural Resources & the Circular Economy

This sector, in which we include organics recycling, composting and soils, and other circular economy activities, saw growth in 2018 in part due to the support of the government's Resources and Waste Strategy.

With significant focus on the reduction of single-use plastics and the previous introduction of the 5-pence plastic bag charge at supermarkets, development is now required in seeking solutions to reduce plastics contamination of inputs to composting and anaerobic digestion facilities, and providing support for local authorities to build on recycling efforts and deliver improved communications to householders.

The composting and anerobic digestion sectors contribute to a circular economy by turning food and garden waste into composts and digestates which positively contribute to the carbon, nutrient and microbial contents of soils. In 2019, the Department for Environment, Food and Rural Affairs (DEFRA)'s first stage consultation on the Resources and Waste Strategy included questions about support for the separate collection of food and garden wastes and the supply of food caddie/bin liners to householders.

Jobs, Investment and Companies active in the Composting sector, 2018

Composting	*Market side £m*	*Number of Companies*	*Number of FTE Employees*
Fabrication and Construction of Composting Plants	**120.59**	**64**	**783**
Operation and Maintenance of Composting Plants	**235.95**	**98**	**1520**
Research and Development into Enhanced Composting Technologies	**4.49**	**2**	**50**
Composting and Biomass Consultancy	**38.27**	**15**	**180**
Total	**399.30**	**178**	**2533**

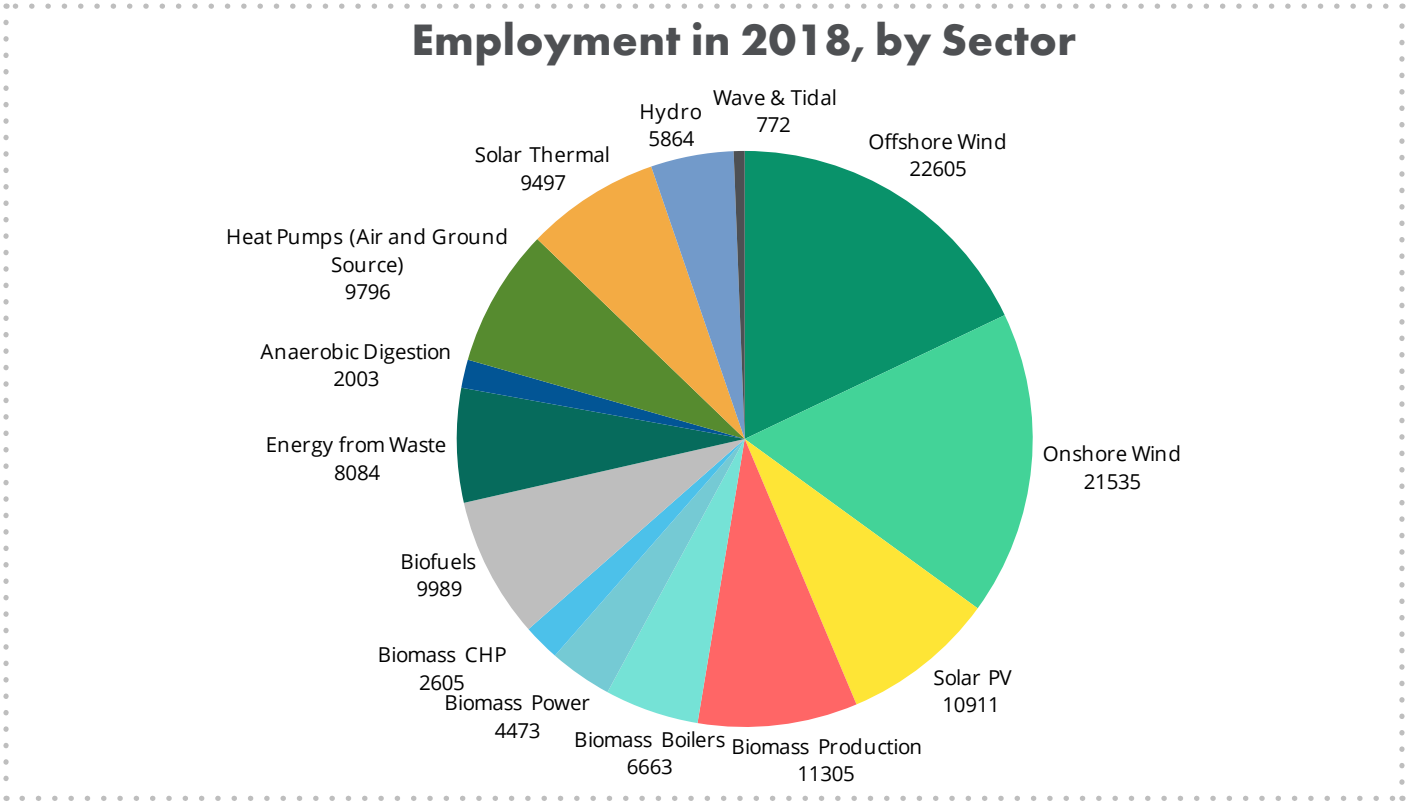
Policy Recommendations – Organics Recycling

1. Back up the Resource and Waste Strategy with effective funding for Local Authorities to really drive change in the plastics problem, resource use and recycling
2. Mandate food waste collections across England
3. Fund a national consumer-facing campaign to reduce plastic and other contaminants in food and garden waste collections.
4. Implement a widespread soil carbon sequestration programme, to incentivise soil management and the Circular Economy
5. Adequately fund the Environment Agency to enable it to tackle the backlog in permitting times and decisions and better regulate the sector
6. Support deployment of advanced conversion technologies in order to realise the potential of chemical recycling and producing renewable transport fuels from waste
7. Fund industry to strengthen bioenergy sustainability regulations and governance, and support the REA's forthcoming Bioenergy Sustainability Taskforce

Employment Data

Every year REView publishes a set of jobs and investment figures that summarise the latest position regarding the numbers of people employed in the sector and the investment that has been received in the past year, alongside the total number of companies active in the sector. Working alongside Innovas, using their technical modelling to understand the spread of FTE jobs, number of companies and market value, we have been able to deduct that ***for the financial year 2017/18, there were 128,954 people employed in the sector*** and over 6,600 companies, who had invested £18.8 Billion over the period.

This was an increase of 6,000 jobs and £1.7 Bn overall since 2014/15, but this masks significant falls in the Solar PV sector. If the policy cuts of 2016 had not occurred there could have been an additional 14,700 jobs and £3.44 Bn worth of investment our figures suggest.



This year's figures show that for the financial year 2017/18, there were 128,954 people employed in the sector and over 6,600 companies, who had invested £18.8 Billion over the period.

In this version of REview, we decided to take both a look back, and forecast forwards, to understand how far our industry has come, and learn from this journey to understand the opportunities to the market, if the right policy support is in place to reach our net zero targets. Using our own data from the REA Bioenergy Strategy, in addition to data from the Bloomberg NEF "Flexibility Solutions in High Renewable Energy Systems" report which we supported, and Innovas' employment modelling, we have deduced that there could be over 238,000 jobs in renewable energy and clean technologies by 2030 (almost doubling current employment rates), should a positive policy environment which takes into account REA policy asks be created. This means over 46,000 jobs in the North.

We also offer a new key feature, on Women in Energy, exploring how the renewable energy sector has surpassed oil and gas in global gender employment balance, although highlighting that the UK still has a long way to go on female representation in both STEM and wider renewable energy roles.

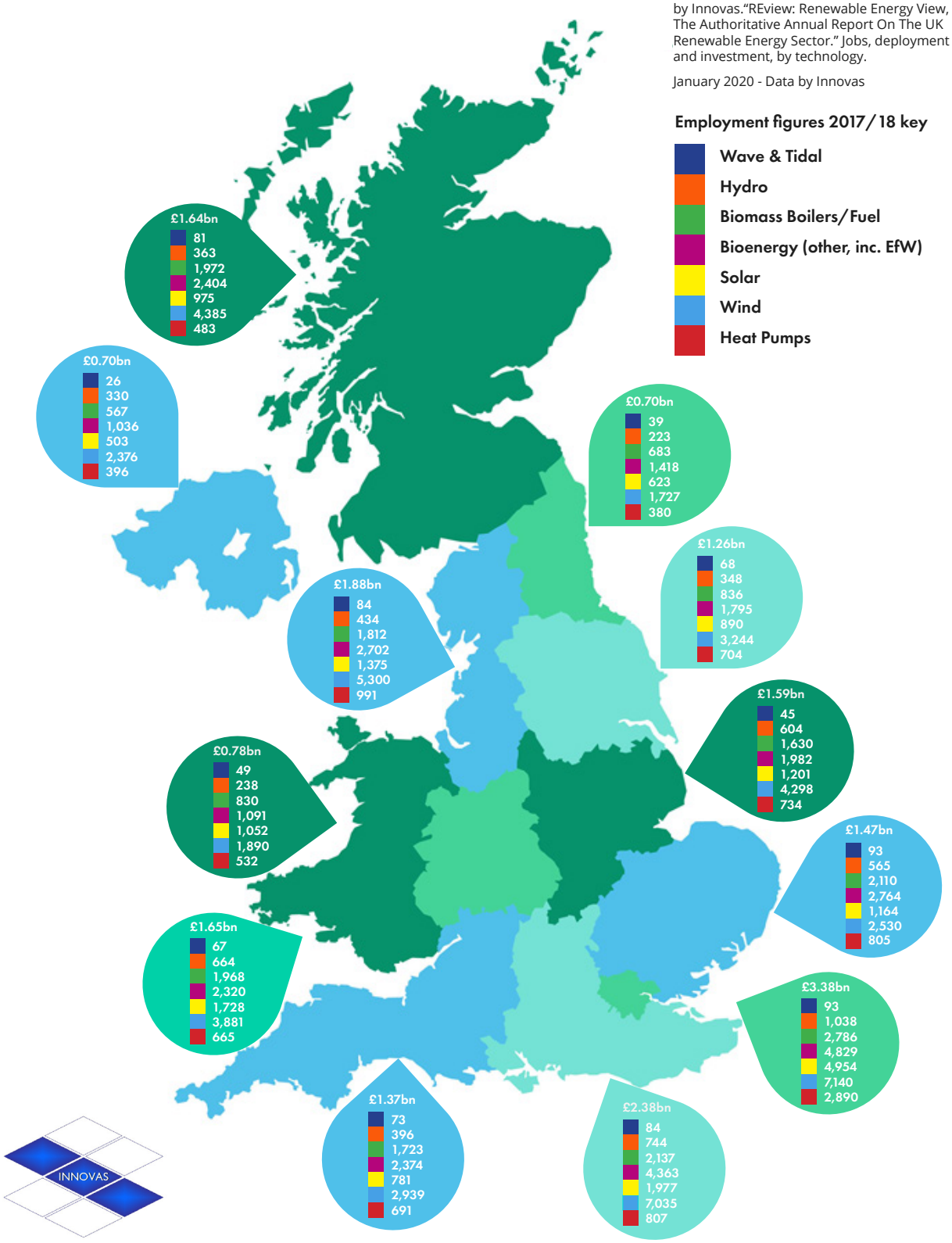
This section draws on reports and data from organisations such as WISE (Women in Science and Engineering), EWIRE (Entrepreneurial Women in Renewable Energy), and IRENA (the International Renewable Energy Agency), to explore the barriers for women in entering our industry. Jobs are a crucial metric to measuring the reach of the renewable energy and clean technologies industries, and ensuring a fair energy transition where workers are reskilled, trained, and offered fair and sustainable employment conditions, is central to the sustainability and decarbonisation agenda.

RENEWABLE ENERGY MADE IN BRITAIN

Employment and turnover by region and technology 2017/18

Made in Britain Map - employment and turnover by region 2017/18 as published in REA's REview 2019-2020. Report by the REA, data by Innovas."REview: Renewable Energy View, The Authoritative Annual Report On The UK Renewable Energy Sector." Jobs, deployment and investment, by technology.

January 2020 - Data by Innovas



Looking back

Employment

The largest sector in terms of market value is the wind sector with offshore wind established as the larger in terms of value at £4,055 million, employing around 24,400 people in 2017/18. Onshore wind was the second largest with a value of £3,336 million, employing about 22,350 people. The current support for the offshore wind energy sector through Contracts for Difference indicate that growth levels of over 10% are likely for the next few years.

Biofuels is a substantial sub-sector with market value of £1,770 million employing just over 10,000 people. The production of biomass also continued to show growth in the period, of 9.5%, with a market value of £1,687 million employing about 12,000 people.

Solar PV sector has seen a rapid decrease in market value and employment levels with about £1,670 million and 8,700 jobs lost since 2014/15. It is still a substantial market at £818 million and employing 8,118 people but the following years are likely to be flat. Solar thermal has also seen a decline and has not benefited as much from the Renewable Heat Incentive as anticipated.

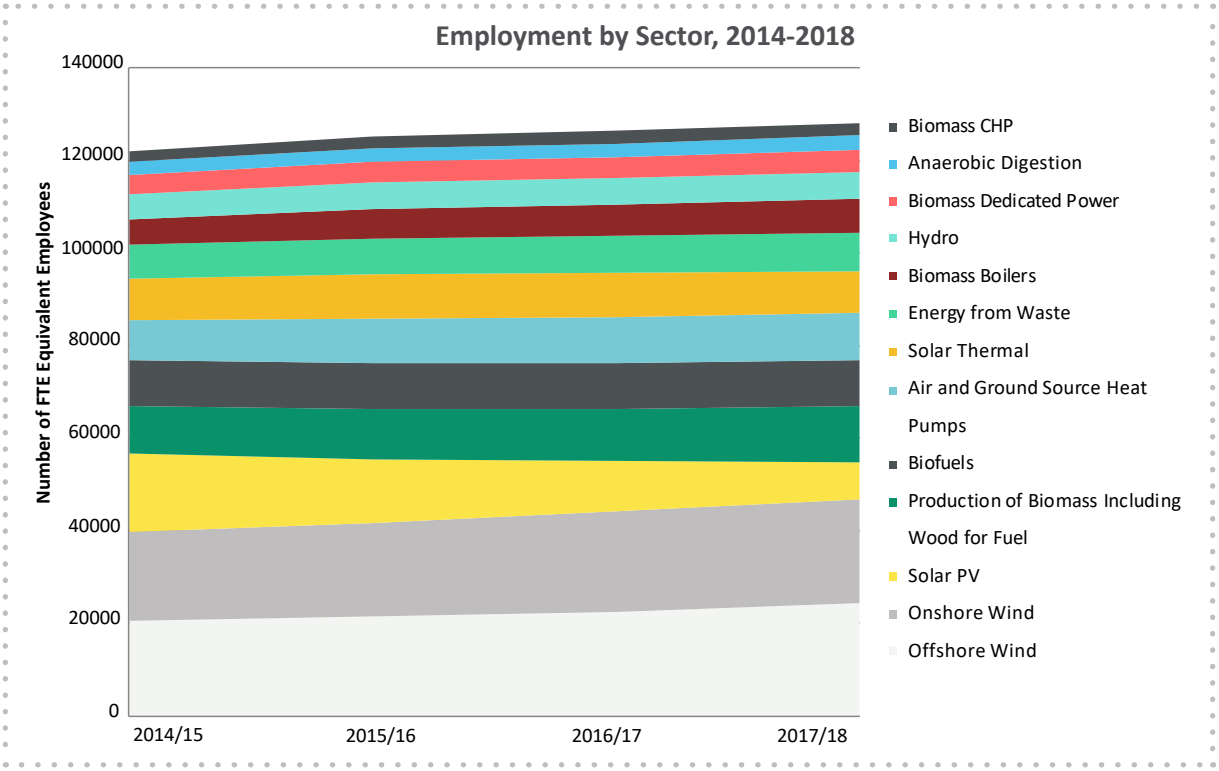
The Biomass boilers sector saw growth of 9.4% for 2017/18, to reach a market value of £973 million, employing about 7,085 people. The current RHI is anticipated to support continued growth though at a lower level than previous years, before closure of the scheme in 2021.

Headline changes from 2016/17 to 2017/18:

- The highest percentage levels of employment growth are seen in offshore wind at 8%, biomass power at 7.6%, biomass boilers at 6.3%
- The overall increase in employment across the sector was around 1,844 people (factoring in heavy job losses in Solar PV), and despite employment growing by only 1.5%, the market value of the renewable energy industry grew by 5%
- The offshore wind sector employs the largest number of people with a total of about 22,300
- The solar PV sector has seen a heavy decrease in jobs with a -25.6% percentage change and job losses of around 2,800 jobs in one year

There were around 129,000 people employed in the sector in 2017/2018.

Renewables Growth Summary from 2014/15 to 2017/18 – Employment



Percentage Change in Employment, by sector from 2014 to 2018

Sectors	*14/15 to 15/16*	*15/16 to 16/17*	*16/17 to 17/18*
Air and Ground Source Heat Pumps	9.60%	3.80%	2.90%
Anaerobic Digestion	3%	1.70%	4.30%
Biofuels	0.80%	-0.50%	0.90%
Biomass Boilers	12.40%	4.90%	6.30%
Biomass CHP	4.80%	1.80%	1.30%
Biomass Dedicated Power	9.50%	2.20%	7.60%
Energy from Waste	5.20%	5.10%	4.20%
Hydro	4.90%	1.50%	1.40%
Offshore Wind	4.80%	4.90%	8%
Onshore Wind	5.20%	6.60%	3.70%
Solar PV	-18.90%	-20.30%	-25.60%
Solar Thermal	8%	-1.50%	-4.10%
Wave & Tidal	9.50%	6.80%	4.10%
Production of Biomass Including Wood for Fuel	6.80%	3.40%	5.90%
Totals	2.50%	0.90%	1.50%

Companies and Turnover

The overall number of companies in the renewable energy sector decreased minimally (by just 6 companies) but this is being driven entirely by the decrease in companies in the Solar PV and solar thermal sub-sectors. But the impact of the closure of the FiT will not be reflected in these figures yet.

Most other sub sectors saw 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 heat pumps to diversify their business.

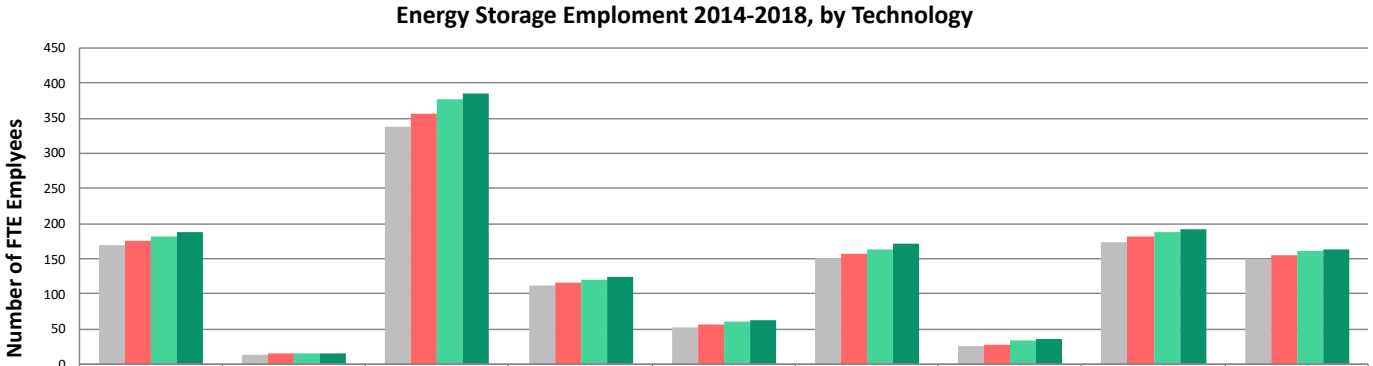
> **There were around 6,645 companies in the sector in 2017/18.**

Despite a contraction in number of companies, overall growth from 2016/17 to 2017/18 in market value is 4.8%, which is double last year when only a growth of 2.1% had been achieved.

> **Total sector market value 2017/18, was £18,807 million.**

Energy Storage

Employment remains largely flat compared to the previous year, but has increased from 2014/15. The graph below shows employment from 2014-2018 in large scale energy storage, excluding battery storage as battery storage employment is accounted for in our forward looking data from Bloomberg New Energy Finance (BNEF).

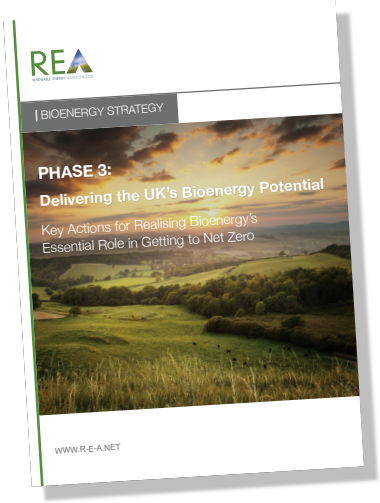


	Pumped Hydroelectric Storage	Flywheel Energy Storage	Hydrogen Produced by Electrolysis	Hydraulic Accumulators	Superconducting Magnetic Energy Storage	Compressed Air Storage (Cylinders and Caverns)	Energy Storage Research	Molten Salt Storage	Thermal Mass Storage
2014/15	170	14	338	112	53	151	27	174	149
2015/16	176	15	356	116	57	157	28	181	155
2016/17	183	16	376	121	61	164	34	188	161
2017/18	189	16	385	124	63	171	37	192	163

Looking forwards

This year we have attempted to project forwards somewhat in terms of future jobs numbers for the Renewable Energy Sector. We are doing this based on two major studies conducted in 2019 by the REA or in collaboration with the REA. We have referenced the REA Bioenergy Strategy for 'Bioenergy' jobs (ie those associated with biomass, AD, transport fuels, waste to energy, organics recycling and related technologies) and the Bloomberg New Energy Finance 'Flexibility Solutions' report for what we term 'Connected- non-fuelled' technologies , such as solar, wind, energy storage and 'smart' EV charging.

Bioenergy Jobs Projections – REA Bioenergy Strategy

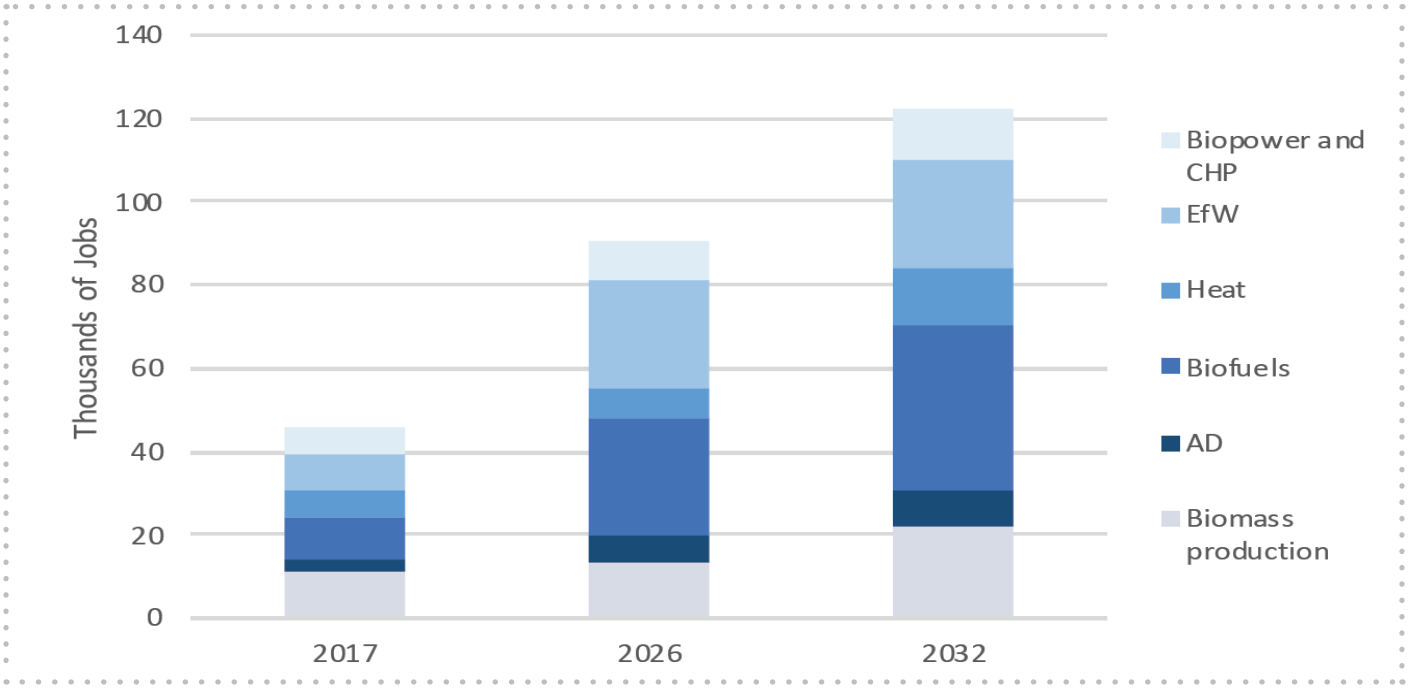


In 2017 our jobs survey indicated that there were over 46,000 jobs associated with bioenergy activities in the UK, and provided a sectoral breakdown, and we have used this as the basis for projections for these sectors.

Our 2019 Bioenergy Strategy set goals for Bioenergy generation and estimated the number of jobs that would be created if the vision in the REA Bioenergy Strategy was delivered, by scalling up the number of jobs in each sector according to the increases in energy delivered. The results are shown in the figure below, which indicates that the total might rise to 90,000 by 2026 and to 120,000 jobs by 2032.

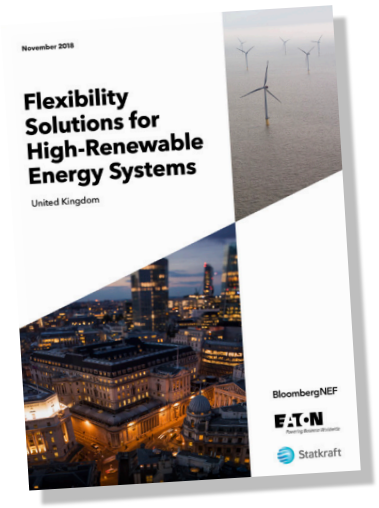
This estimate may overstate the level of employment as some economies of scale should be possible. Further work would be needed to identify more precisely the number of jobs and other socio-economic benefits associated with such growth in the sector. Nonetheless the estimate suggests the total is likely to rise to over 80,000 bioenergy related jobs by 2026 and over 100,000 by 2032.

Bioenergy Jobs Forecast



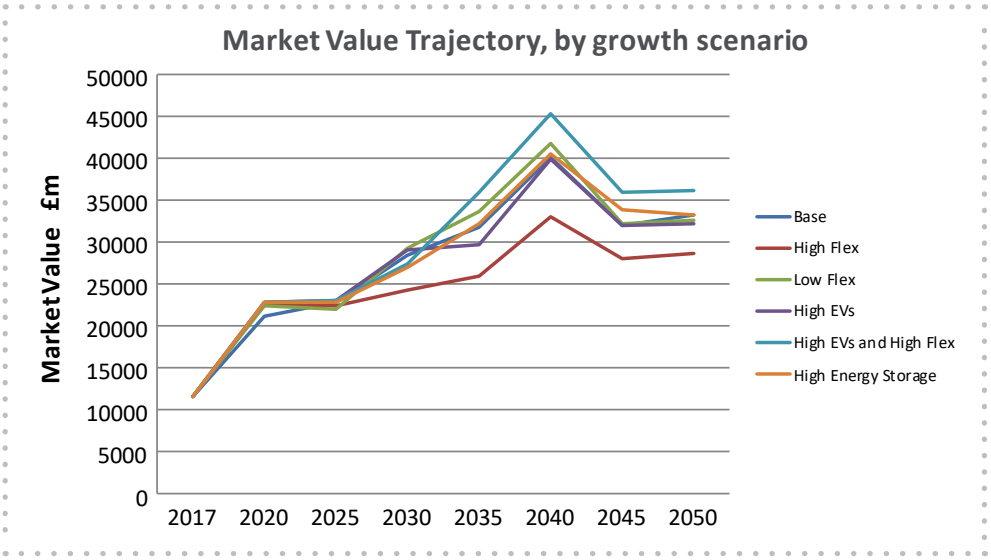
REA Bioenergy Strategy, 2019

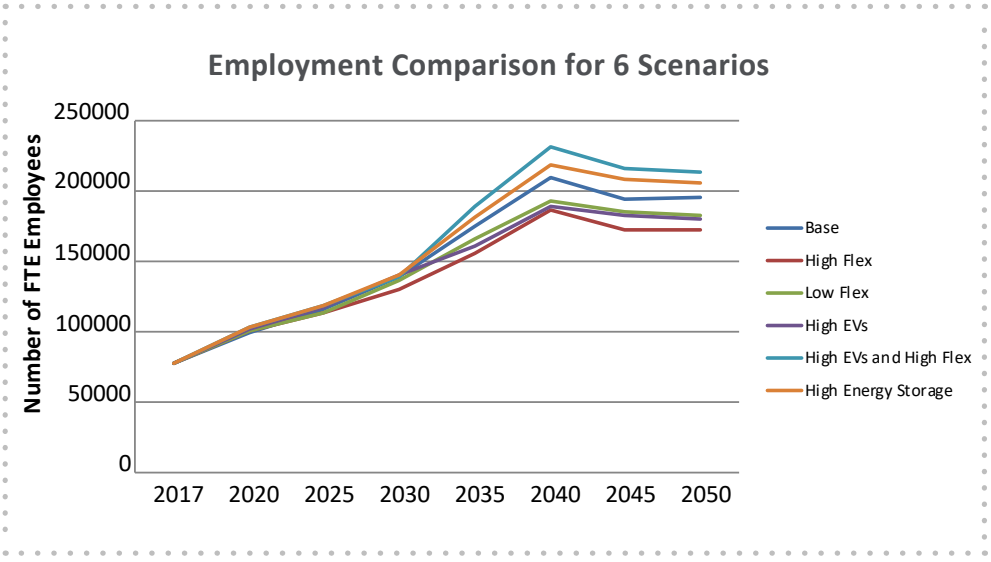
‘Connected, non-fuelled’ Technologies Jobs – Bloomberg Flexibility Solutions for High Renewable Energy Systems



The six scenarios that are used for this analysis are based on the Bloomberg report which uses a base scenario showing a large increase in wind both offshore and onshore and solar PV at utility scale for a total additional capacity of about 120GW supported by energy storage capacity of 33GW. It assumes that fossil fuels will be gradually phased out with a baseline of nuclear and gas power generation retained. This is primarily focused on power generation and does not include heating requirements or broader technologies.

Our analysis is focused on the potential impacts on market value (turnover) and employment. It does not include any commentary on the likelihood of this happening from a legislation or technical viewpoint, grid connection and smart grids being a case point, or the challenges faced from such large scale deployment particularly of solar PV and offshore wind. It takes into account only the technologies stated in the scenario and does not include any added potential for export jobs gained by development home markets. Market value and employment forecasts include service and maintenance of the cumulative deployed technologies and replacement of installations every 25 years, maintaining technology deployment levels at 2040 levels onwards.





Market values are stated in yearly figures as are the employment figures.

What is clear that in 2040 there is forecast to be a minimum increase of £21,455 million market value and around 108,900 jobs across these specific sectors. The maximum increase would be £30,191 million and around 153,500 jobs. The highest market value is generated in 2040 by the High Uptake of Electric Vehicles and Flexibility scenario with the lowest by some way being the High Flexibility scenario.

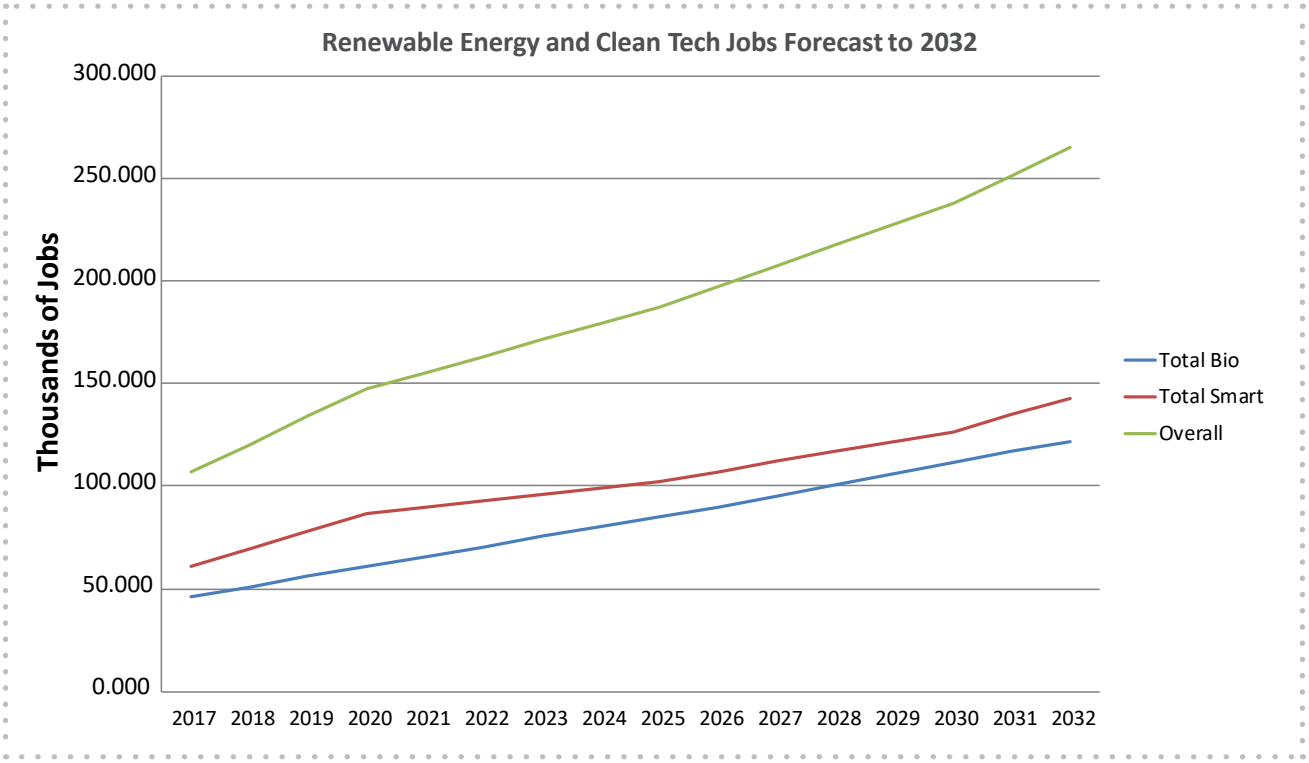
The high EV and flexibility scenario provides the highest employment followed by high energy storage with high flexibility and high EVs provides the lowest levels. The high flexibility scenarios require a lower level of power generating capacity and a higher level of energy storage capacity. There is a trade off in terms of market value and employment as a result, with lower levels for a pure high flexibility scenario without high uptake of electric vehicles.

The Base scenario sees an increase of £28,450 million in market value and 132,375 jobs by 2040. This is a substantial increase without developing a high flexibility network and high uptake of electric vehicles. The high energy storage scenario sees an increase of £28,796 million and 140,773 jobs by 2040. The market value increase is similar to the BASE scenario but employment is a further 8,000 jobs above.

These scenarios have all shown that there will be a substantial increase in market value and employment levels should they be adopted and delivered. The main issue regarding them is that they do not include any reference to heating, which could potentially change the power generating capacity requirements substantially, should there be a mass move to heat pump and electric heating options.

Renewable Energy and Clean Tech Jobs forecast to 2032

Combining the jobs forecast scenarios from the REA Bioenergy Strategy, and Bloomberg NEF Flexibility Report (using Innovas' employment modelling), we have deduced that there could be 238,180 jobs in renewable energy and clean technologies by 2030. This means an additional 109,000 people employed in this sector by 2030, on 2018 figures.



By 2025, a positive policy environment could mean that the sector employs 187,738 people, although rapid adoption of REA policy recommendations would be required to reach this figure in the short – mid-term timeframe suggested.

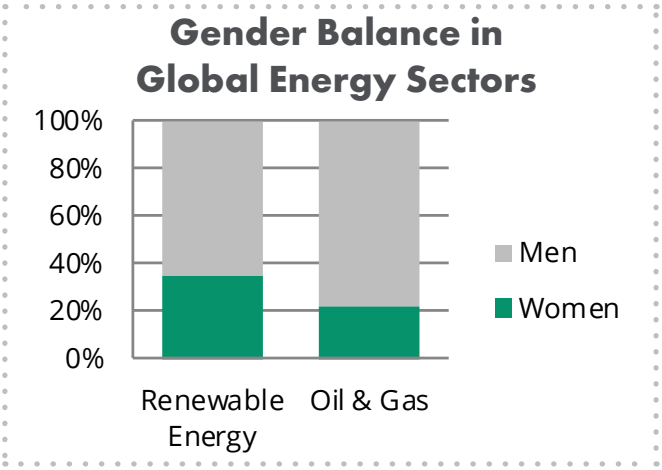
The regional spread of these jobs is also crucial, and we forecast that there could be over 46,000 jobs concentrated in the North of England in total by 2030, assisting to even out regional inequality and support a truly just transition.

Women in Renewables

There are a growing number of reports specifically regarding women in the energy sector. The majority are focused on the global situation, though comments and statistics examining the UK situation are included. The sector overall demands a high level of technical positions with engineers of the different disciplines such as electrical, physical, construction, civil and Heating, Ventilation and Air Conditioning (HVAC). There is also a considerable need for a mobile workforce for installation and servicing purposes. There are of course the important support services such as legal, finance and policy/regulatory specialisms.

Key figures for renenwable energy include:

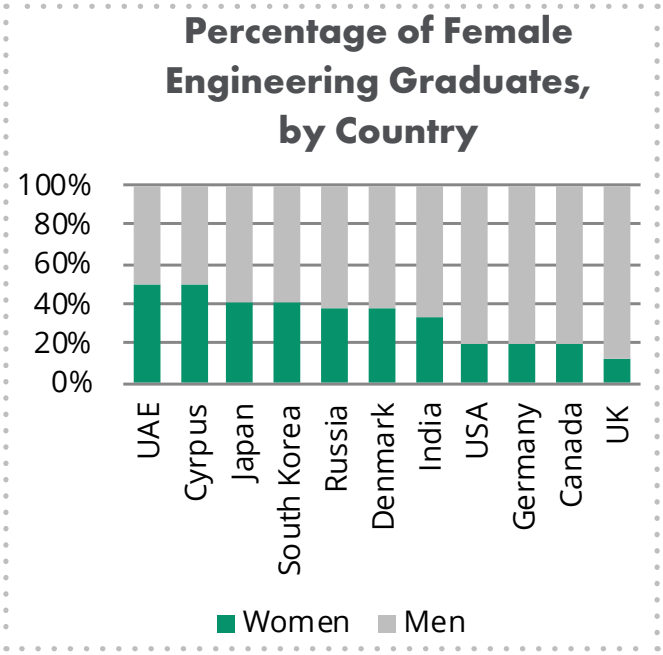
- 32-35% of jobs in the renewable energy industry globally are carried out by women
- This compares to 22% in the oil and gas sector
- In the UK the proportion of women working in energy is estimated to be 14% for the sector in total
- Notably, in the USA 32% of the renewable energy workforce are women, up from 20% in 2013



- Globally a breakdown of the roles of women in the renewable energy sector account for 32% of senior managers, 28% of technical Science, Technology, Engineering and Mathematics (STEM) staff, 35% of non-STEM technical staff and 46% of general administration staff

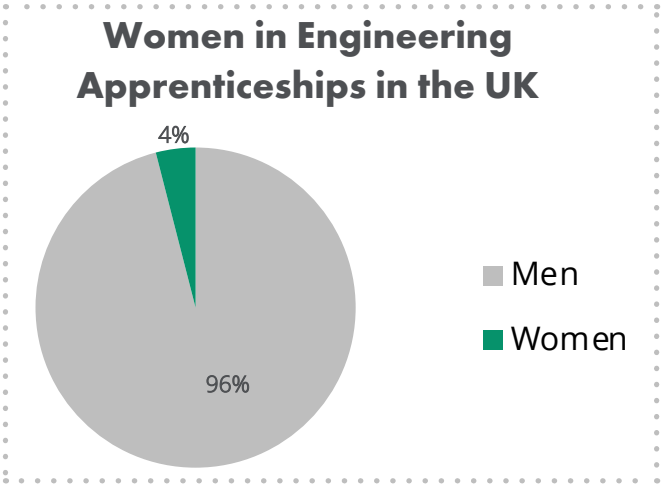
Looking at the important pipeline of technical/ engineering roles also needed for renewable energy:

- In the UK only 12% of engineering graduates are women
- In the UAE and Cyrpus 50% engineering graduates are women, in Japan and South Korea this is 40%, in Russia and Denmark 38%, in India 30% and 20% in the USA, Germany and Canada
- Only 4% of engineering apprentices are and 9% of STEM related ones
- Only 5% of executive board members in the renewable energy sector are women, with 19% of non-executive board members



- About 60% of companies in the energy sector have no women at board level
- 14% of senior managers are women
- Looking at the important technical skills needed for installation of many of the smaller scaled systems we will need in the future, a very telling statistic is the less than 1% of plumbers and gas engineers are women

Using the global average it can be estimated that about 41,000 women are employed in the UK renewable energy sector. However, the various reports, reviews and articles seem to suggest that in the UK there is a lower level of women employed than the global average with a figure between 14 and 20%. Therefore, this would lead to estimates of between 18 and 26,000 for 2017/18. Numbers have not increased dramatically since it was reported at a level of 17% in 2016.



Different "Women in" network groups in Energy or support of the Renewable Energy and Clean technology sectors include POWERful Women, Entrepreneurial Women in Renewable Energy (EWIRE).

She is Sustainable, Royal Academy of Engineering, and Women In Science and Engineering (WISE) campaign work in the UK to look how to improve the number of women engaged in exciting careers in the renewable energy and clean technology sectors. Various factors are acknowledged for the reason for the number is so limited and some of these apply to the companies looking to recruit and grow their female talent.

These include:

- Perception of lack of mobility – many of the jobs require travel to installation sites which is considered more challenging for women
- Appropiate skills and qualifications – in a number of the design, manufacturing and construction roles – a form ofn engineering degree are required – 12% of engineering graduates in the UK are women and only 25% of women aged 16-19 year olds consider engineering – less than 4% of engineering apprentices are women
- Real or perceived lack of STEM background – there are now over a million women working in STEM in the UK
- Lack of training opportunities
- Lack of childcare facilities
- Discouraging workplace policies
- Lack of awareness of opportunities
- Self-perception of capability to work in relevant and leading roles
- In built conscious and unconscious bias in hiring and promotion practices
- Cultural and social norms

There are many best practices schemes to support increasing the percentage of women in the sector.

They cover:

- Workplaces adopting a better work-life balance policy
- Workplace policies and regulations encouraging supportive policies
- Gender targets and quotas for companies
- Mainstreaming gender perspectives
- Creating networks and supporting mentorships
- Better access to education and training for female employees

One of the world leading schemes for companies to adopt is the WISE Campaign's "Ten steps".

The general view from the analysis is that the renewable energy sector has a higher percentage of women working in it than the rest of the energy sector in the UK, and that it provides better opportunities for progression.

The nature of the work naturally does require a high level of engineering and technical expertise and broad awareness in areas which traditionally in the UK have had far lower levels of women training and qualifying in. Great strides have been made in the USA and with the initiatives being brought to bear in the UK these numbers could increase significantly, particularly with the increased awareness of the population in general concerning the climate emergency. Further programmes for girls in schools such as "My Skills, My Life – Our Planet" can build on the Greta Thunberg "effect" and attract more girls to study relevant STEM and related topics to consider a career in renewable energy and clean technologies.

The women who are working in the sector tend to have good working conditions and wages, with 55% being the prime wage earner.

POWERful Women are working hard to tackle the very low numbers of women at board level and in senior management. Reports by McKinsey indicate that unless improvement is seen here, this may hinder the change in company policies to improve the recruitment and retention of women.

UK Investment Landscape

In previous editions of REview, we have invited key contributors to consider the UK Investment Landscape. 2018 and into 2019 has seen a plethora of reports regarding the opportunity for extraordinary growth for renewable energy and clean technology: Bloomberg New Energy Finance in their report "Flexibility Solutions for High renewable Energy Systems" have reiterated again (building on the 2017 "Tipping Points" report) that from a pure economic consideration, investment in renewable energy and clean technology systems including energy storage and tech-enabled demand side management should be the preferred choice of delivering the lowest cost energy transition.

Investment in large scale off-shore wind is progressing and for some "subsidy–free" solar plus storage connected sites. However for the technologies that are in the main connected to the distributed network or on-site systems – on homes or commercial buildings, these largely have stalled. The question for investors is why invest in the UK compared with other leading European countries?

For all the lauded commitment of the UK Government to make the low carbon energy transition and support the 2050 net zero Green House Gas emissions target, what is really happening on the ground in this area?

Energy Transition Readiness Index

The Energy Transition Readiness Index (ETRI), a report published by the REA and commissioned by Eaton and Drax, reviewed regulation and market access, social and political support for the energy transition, and deployment of enabling technologies such as energy storage, smart meters etc. in nine northern European countries.

The full report can be found on the REA website.

" We welcome Britain's ambition and its strong policy commitment to decarbonisation, encouraging new flexibility technologies and business models. However, we urgently need more clarity and an end to the flux to provide the certainty needed to spur private investment in the new technologies that will be required to ease the transition to a high-renewable energy future. "

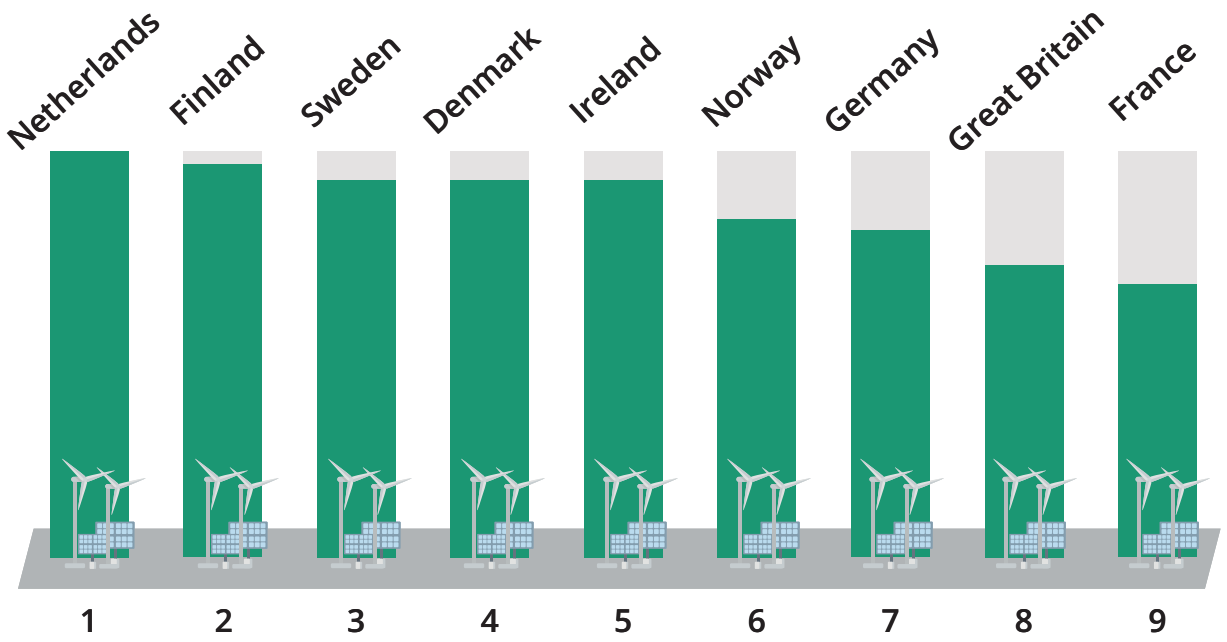
Fabrice Roudet

Head of Energy Storage Business, Eaton

They were assessed across three key principal areas:

Flexibility is becoming increasingly important as more variable renewables such as wind and solar replace Britain's large fossil-fuelled power stations to meet targets to cut carbon emissions. Large generators typically provided flexibility by supplying power during peak demand and ensuring that the system's voltage and frequency remained within operational limits.

Britain, which ranked eighth out of the nine countries in the index, scored poorly on market factors such as a clear and stable regulatory and market framework which should be giving clearer signals to create the burgeoning Flexibility market that needs to be in place fast.



Key findings for Britain:

- Despite strong progress in the enabling frameworks development, Britain ranks eighth out of nine northern European countries in attracting and facilitating investment in electricity system flexibility
- Delivering flexibility is crucial to power sector decarbonisation and achieving Net Zero targets
- Regulatory uncertainty, lack of visibility on returns, and technical challengesconnecting to the power network are delaying investment in flexibility and could hamper renewables deployment in the 2020s

Regulatory uncertainty, lack of visibility on returns, and technical challenges are impeding investment in flexibility services to support Britain's electricity network as more renewables come online, risking delays in the transition to a greener future.

REA Policy Recommendations – Financing the UK green economy

1. Address the concerns linked to the findings of the ETRI
2. Implement the recommendations of the Green Finance Taskforce and Patient Capital Review, for financing and supporting the energy transition
3. Reopen Enhanced Capital Allowances (ECAs) and Enterprise Investment Scheme support to renewable energy and clean tech systems, providing an attractive headline for investors and developers to install new renewable power and heating systems. Additionally, extend the ECA scheme to vehicle rental and leasing companies so that they are able to write down 100% of the cost of the first year of buying a Battery Electric Vehicle (BEV). Companies buying BEVs presently do this and extending the policy would stimulate the electric fleet market.
4. Provide Business Rate relief to companies with renewable energy and clean tech systems installed.

Methodology

REA (DEPLOYMENT DATA & GROWTH PROJECTIONS)

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

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

The Renewable Power Sector

Renewable power deployment statistics are published by BEIS quarterly in Energy Trends and annually in its Digest of UK Energy Statistics (DUKES) . The first full data sets for 2018 were published in Energy Trends on 25th July 2019 and were used to produce the graphs for historical capacity and generation. For capacity deployment in 2019 and 2020 we have shown the 2018 deployment plus the additional capacity that would be deployed if the average annual growth rate over the period 2014 to 2018 was maintained. In order to compare past performance with projections for 2020, we have drawn on three BEIS sources, the first of which we consider to be the most authoritative:

1. As part of its Electricity Market Reform Delivery Plan, the then DECC published National Grid's EMR Analytical Report in December 2013 . The report provides modelled capacity and generation projections for 2020 for a number of scenarios – we have used the reference scenario (described as 'Scenario 1').

2. Under the RED, each Member State was required to publish a National Renewable Energy Action Plan and the UK's was published by DECC in 2010 . Although somewhat dated now, it provides the Government's official statement of how it plans to fulfil the UK's obligations under the Directive. In particular Tables 10 - 12 provide year-by-year indicative projections of deployment, broken down by technology, from 2010 to 2020 for electricity, heat and transport

3. Finally, every year DECC published Updated Energy Projections (UEPs) , analysing and projecting future energy use and greenhouse gas emissions in the UK, based on assumptions of future economic growth, fossil fuel prices, electricity generation costs, UK population and other key variables. Renewables are only one part of the UEP, indeed the technology breakdown for renewables was only published in November 2013 following a special request, two months after the initial publication. We have included the UEP projections for comparative purposes.

   As for the EMR projections, a significant share of deployment is classified as 'Other renewables' and this has been broken down by technology using the same split as used for the EMR data. DECC was keen to emphasise that none of its projections constitute targets and they should not be viewed as such. Nevertheless, particularly the most recent ones provide a useful view of how BEIS envisages each technology contributing to deployment in 2020 and a benchmark against which to judge progress to date. It must be remembered that the 2020 renewables target is expressed as a percentage share of energy consumption, so the amount of renewable energy required in 2020 will vary according to changes in energy demand.

The Renewable Heat Sector

Renewable heat generation figures were published in BEIS's Energy Trends . For completeness we have included the headline figures in the introductory sections. However it is a different data set (Energy Trends) to that used in the detailed charts (DUKES) therefore to ensure consistency we have not changed the sector-specific heat charts, as Renewable heat consumption statistics are only published annually in DUKES (on 25th July 2019) so the latest year for which data exist is 2018. With the advent of the Renewable Heat Incentive (RHI) BEIS has started to publish monthly data on the capacity of accredited installations, however this still forms a small share of the UK's total renewable heat capacity.

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

The Renewable Transport Sector

Statistics on the UK consumption of liquid biofuels for transport are published quarterly by BEIS as part of Energy Trends, drawing on HMRC's Hydrocarbon Oils Bulletin . The data in Table 6.2 of Energy Trends includes annual consumption data for bioethanol and biodiesel from 2005 to 2018. The Department for Transport in turn publishes quarterly reports under the Renewable Transport Fuel Obligation, including the national origin of the biofuels supplied under the Obligation.

Projections for 2020 again rely on the National Renewable Energy Action Plan published in 2010 (Table 12). Projected growth is based on achieving the RED's sub-target of a 10% renewable contribution to transport by 2020 and includes a small but growing contribution from renewable electricity. New electric car registrations utilises extracts data from The Society of Motor Manufacturers and Traders (SMMT). Please note: Additionally, please note: this data includes only new car registrations and not commercial vehicles.

Flexibility and Energy Storage

Deployment figures are from the REA's forthcoming Energy Storage: Market Overview report, 2017 edition (updated with 2018 baseline statistics). There is no central Government source of data for UK energy storage projects. Baseline 2016 figures comprise projects identified from the REA's research and verified projects on the US Department of Energy's global project database.

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

The BEIS future deployment projection for 2021 is taken from the 'BEIS Updated Energy & Emissions Projections', published 15 March 201710.

Natural Resources and Circular Economy

Deployment figures were not included although jobs and market size data is collated by Innovas (see below for further information).

INNOVAS (JOBS DATA)

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

For the first time this year we have also included data on the composting sector.

The REA produces an annual update of this analysis and data, although ideally the Office for National Statistics (ONS) would be providing this information.

Definition of sector

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

Innovas's final data levels go beyond SIC code definitions.

Data sources

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

Model

The full sector analysis model is a bottom up, multi-staged model that uses econometric techniques, sources and methods (such as data triangulation) to verify and enrich source data drawn from multiple sources.

The approach uses data from actual, live and accumulated business cases and computes confidence levels for final reported numbers, based upon a rigorous assessment of the source data. The model also measures activity in the supply chain for each sub-sector, totals are aggregated from 2,300 discrete individual product group lines for the whole low carbon and environmental goods and services sector.

Each of these lines uses specific data sources and can be analysed individually, unlike traditional studies which often group together data sources.

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

Modelling for the Forward Looking data on Energy Storage, Electric Vehicle Charging, and Interconnectors to the Nordics, was derived from the Bloomberg New Energy Finance report, "Flexibility Solutions in High Renewable Energy Systems" – UK Edition , which mapped out expected capacity in four scenarios, to 2050.

Modelling for the Forward Looking data on bioenergy, was derived from the REA Bioenergy Strategy Report – Phase 3 , which maps out expected employment to 2032 in the scenario that REA Bioenergy Strategy policy recommendations are implemented.

These two forward looking forecasts were merged to create the overall renewable energy to 2030 employment forecast. As the bloomfield flexibility scenarios data originally modeled bioenergy deployment, these figures were removed from the Bloomberg NEF data when collating with the REA Bioenergy Strategy data, as not to cause bioenergy jobs to be double countered.

Key facts

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

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

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

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

Regional data methodology: Having identified the total company stock in the region, product and service outputs have been identified and verified by accessing further databases that include: institutional data sets, Yellow Pages, proprietary databases, Euromonitor, Dun and Bradstreet and Thompson. The methodology measures where the economic activity actually occurs and is reported, rather than just at the headquarters or main facilities.

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

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

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

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

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UK renewable energy capacity surpasses fossil fuels for first time, The Guardian, 2018, bit.ly/2RzGiMs

Abbreviations and Key Words

ASHP – Air Source Heat Pump

BECCS – Bioenergy Carbon Capture, Usage and Storage

BEIS – Department for Business, Energy and Industrial Strategy

CHP – Combined Heat and Power

DECC – Department for Energy and Climate Change (now Department for Business, Energy and Industrial Strategy)

DNOs – Distribution Network Operators, who own the local grid networks in the UK

E5 – 5% Bioethanol blend in standard petrol supplies

EFR – Enhanced Frequency Response, a grid services tender for flexibility services

EMR – Electricity Market Reform programme from 2013 which included projections of renewable power technologies' deployment by 2020

EfW – Energy from Waste, such plants generate energy using waste as a feedstock

ESOS – Energy from Waste, such plants generate energy using waste as a feedtsock

EV – Electric Vehicle, being an electric rather than Internal Combustion Engine, powered vehicle

FTE – Full Time Equivalent (numbers of people employed)

GSHP – Ground Source Heat Pump

GW – Gigawatt

GWh – Gigawatt Hour

KW – Kilowatt

KWh – Kilowatt Hour

LPG – Liquefield Petroleum Gases. Can be created from bioenergy sources as well

MW – Megawatt

MWh – Megawatt Hour

NREAP – National Renewable Energy Action Plan: a series of projections from the mid 2010s

Off Gas grid – homes and buildings not connected to the national gas network

RED – Renewable Energy Directive, forming the UK's 2020 renewable energy targets

SEG – Smart Export Gurantee

STEM – Science, Technology, Engineering and Mathematics

TCR – Targeted Charging Review, changed grid usage charges and overseen by Ofgem

UEP – Updated Energy Projections (published by the then Department for Energy and Climate Change)

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For further information please contact:

Frank Gordon

Head of Policy

fgordon@r-e-a.net

Nina Skorupska

Chief Executive

nskorupska@r-e-a.net

Lindsay Barnett

Head of Membership, Marketing & Events

lbarnett@r-e-a.net

A FUTURE BUILT ON RENEWABLE ENERGY AND CLEAN TECHNOLOGY

While the world around us has changed dramatically since we started out, our goal has always been the same: championing our members and promoting a future built on renewable energy and clean technology.

We do this by developing informed policy and advocating on behalf of our members to Government.

We are a coalition built to be the voice for renewable energy and clean technology in the UK. We are the largest renewable energy and associated clean technology body in the UK representing every type of renewable energy.

We empower our member companies to build commercially and environmentally sustainable businesses, by providing the latest information on policy updates, sector-specific insights, topical briefings and industry-leading training and events.

Together, we are working towards the Government's goal of achieving net-zero carbon emissions.

Why not join us? Visit www.r-e-a.net

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