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Repower to the people

How upgrading the UK's old onshore wind fleet can cut carbon, reduce bills and support local communities

March 2018

EXECUTIVE SUMMARY

As one of the first nations to invest heavily in wind power, the UK is increasingly reaping the rewards of supporting a rapidly growing industry. We are seeing records broken in renewable generation nearly every year, dramatic falls in the cost of contracts for electricity from wind, and a growing manufacturing and service sector to support an industry that is on the up both at home and around the world.

A number of the first wave of UK onshore wind farms are now approaching the end of their terms. At this stage in the life of a wind farm, the owner is presented with three options:

- dismantle the site
- extend the land lease and planning consent, and sweat the assets for as long as financially viable
- 'repower' the site – upgrading to the latest and most efficient equipment.

This report finds that, across England, Scotland and Wales, owners of more than 750 turbines across nearly 60 sites will face this decision within the next five years. These wind farms were installed around the turn of the millennium, when turbine technology was less developed and costs higher. Repowering these sites and taking advantage of the ever-lower prices of onshore wind (as seen in auctions across Europe) would yield a net increase in capacity of more than 1.3 gigawatts (GW), and an electricity output of more than 3 terawatt hours (TWh) per year – enough to power nearly 800,000 homes, based on conservative estimates. It would also accelerate progress towards meeting carbon targets – acceleration that the government acknowledges is needed. This could all be achieved without the need to develop new sites, and via subsidy-free contracts.

Onshore wind is the cheapest source of new electricity generation capacity. And electricity from repowering projects is likely to be even cheaper than that from virgin sites. Even with an additional 'flexibility' cost to account for output variability, power from these repowered wind farms would save more than £77 million per year compared with obtaining it from gas-fired power stations, lowering energy bills as well as reducing carbon emissions and dependence on imports fossil fuels.

A repowering boom would benefit a supply chain based increasingly in the UK, including by boosting demand for high-quality steel. It could also benefit local communities through payments from the developer. These community funds are already the most popular way for wind farm owners to give back to the local area, with a potential pay-out of more than £100 million from this first wave of repowering projects. As many of the oldest wind farms are based in Scotland and Wales – which also benefit from both community and political support – more than 80% of these community payments would flow to regions in these countries.

Surveys show that onshore wind is highly popular in all parts of the UK, and that support continues to grow. It has also been shown that people would prefer to live near a wind farm than other energy infrastructure. Which suggests that Government policy of effectively banning new onshore capacity is out of line with not only the general population but also with Conservative Party membership.

Giving developers freedom to repower these soon-to-retire wind farms would help put the country back on track to meeting climate change targets, would reduce energy bills and reliance on gas imports, reinvigorate a "made in Britain" industrial supply chain. And it is an opportunity that ministers can grasp now, given the substantial stock of eligible projects becoming available in the coming few years.

INTRODUCTION

British wind power is a modern-day success story. Since the first wind farms were erected in the early 1990s, the UK has gone on to be the world leader in offshore capacity and the premier provider of legal and financial services for a growing global industry.[1] The most recent ONS statistics show that the green economy grew three times faster than the rest of UK plc during 2016, with the wind sector a significant contributor.[2]

The growth in wind as a contributor to the UK's energy mix is also clear. During 2016, the proportion of UK electricity needs met by wind exceeded that from coal for the first time, and during 2017 wind generated more than twice as much of our electricity as coal.[3] As the contribution from wind has grown, so has grid reliability, with the UK system one of the most reliable in Europe.[4]

The UK installed its first wind farms during the early 1990s, when the technology was in its infancy. As a result, electricity generated was significantly more expensive than that produced from then-dominant fossil fuels, but without associated carbon emissions and air pollution issues.[5]

However, developments in the industry since then mean that this no longer holds true. Modern turbines generate much more power than their ancestors at a cost that is now competitive with, and often cheaper than, coal- and gas-fired generation, especially when located onshore.

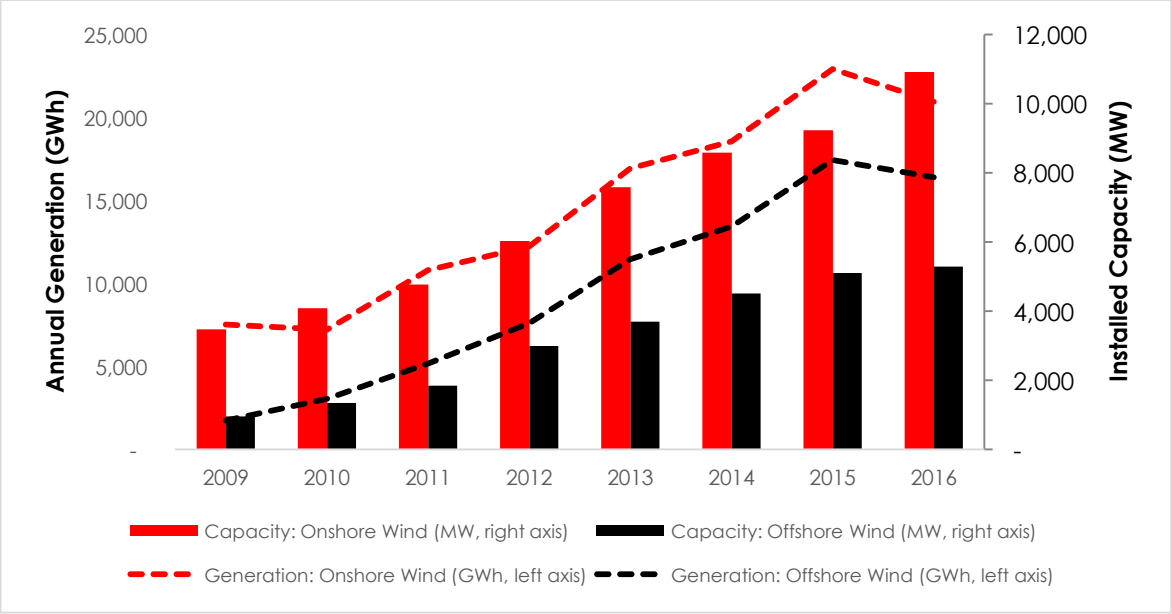

Figure 1: Capacity and output of UK onshore and offshore wind. **Source:** BEIS.[6] Note, 2016 generation fell despite increased y-o-y capacity due to low wind speeds during the year.

Similar to other electricity-generating assets, wind turbines have a finite operational lifetime; they do not last forever. This is largely dictated by wear-and-tear and the length of contract agreed when built – which in turn affects the duration for which planning permission is granted (and thus

1 http://www.renewableuk.com/page/WindEnergy
2 https://www.ons.gov.uk/economy/environmentalaccounts/bulletins/finalestimates/2016
3 https://www.carbonbrief.org/uk-low-carbon-generated-more-than-fossil-fuels-in-2017
4 https://www.gov.uk/government/speeches/greg-clark-speech-at-energy-uk
5 https://www.gov.uk/government/publications/updated-energy-and-emissions-projections-2016
6 https://www.gov.uk/government/statistics/energy-trends-section-6-renewables

the duration of any lease on land). Once end of life has been reached, a wind farm owner is faced with three options:

- dismantle the site, pulling down the turbines and restoring the land to its original state
- apply for a lifetime extension, a longer lease and planning permission, to keep existing turbines running for as long as is economically feasible
- repower the site, upgrading old turbines to a smaller number of larger, more technologically advanced and more efficient units.

As well as offering simplicities and potentially lower costs compared with developing a new site, repowering is also logical given that many of the earliest wind farms are in locations that have the best wind resource.

When a site is repowered, new turbines are installed in place of those reaching retirement. As turbines have increased in size and efficiency, new bases are generally needed to support the heavier structures and to fulfill planning extension requirements. However, the use of some existing supporting infrastructure can be continued, with network connections and other on-site facilities often re-used or upgraded at a cost lower than for installation on a virgin site.

Almost all UK turbines reaching their 20th birthday by the end of this decade are smaller than one megawatt (MW), while the most up-to-date turbines are three to four times this size. In addition to increasing power output, the capacity factor of larger turbines (the ratio of actual output to theoretical maximum output) is higher than for smaller ones. For example, a 3MW turbine typically generates around 39% of its maximum possible output, compared with 25% for 500kW turbines.[7]

Larger turbines are also able to operate in a wider range of wind speeds than older, smaller ones, showing greater resilience to high winds in which older units were unable to operate safely, and also showing better performance at lower speeds. Additionally, the greater height of new units allows them to access stronger winds away from the ground.

Putting this all together, a state-of-the-art 4MW wind turbine can generate up to 50% more electricity over the course of a year than a typical 3MW unit, which were introduced just seven years ago; and many times more than older turbines.

If larger turbines cannot be installed, an alternative is to install turbines comparable to those already in place at the existing locations. While this can lead to lower construction costs, the use of existing infrastructure will limit turbine size, restricting output and curbing benefits from repowering. This is an option in areas where use of taller turbines is not possible or where grid constraints limit an increase in capacity,[8] and allows re-use of existing tracks, crane pads and cable trenches to keep costs down.[9] Upgrading to the latest equipment can see an increase in performance, but to a much smaller degree than from increasing turbine size.

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[7] Installing fewer large units to generate the same amount (or more) electricity can lead to a dramatic reduction in wake losses, inefficiency caused by turbulence as blades interact with wind flows. Wake losses for an 18 MW farm made up of 500 kW turbines can be as high as 10%, which falls to 1.66% if 3 MW units are installed instead. Lower wake losses allow greater turbine efficiency, and therefore greater generation output and lower costs

[8] https://www.ssen-transmission.co.uk/media/2411/north-of-scotland-onshore-wind-repowering.pdf

[9] https://www.sepa.org.uk/media/219689/sepa-guidance-regarding-life-extension-and-decommissioning-of-onshore-windfarms.pdf

Some of the UK's earliest onshore wind farms have already been presented with this decision. Delabole in Cornwall was one of the first wind farms to be built in the UK, coming into service in 1991. It was repowered between 2009 and 2011, during which time capacity was increased from 4 MW to 9.2 MW, the number of turbines was cut from 10 to four, and annual output increased to cover more than 6,000 homes.[10]

An increase in capacity of this magnitude is not uncommon. The capacity of Carland Cross increased from 6 MW to 20 MW when it was repowered in 2013 (up 233%),[11] while plans to repower Scottish Power Renewables' Llandinam farm would see capacity upgraded from 31 MW to 117 MW (a 280% increase). In both cases the number of turbines falls as newer, cheaper and more efficient equipment replaces outdated technology.

Increasing size is one of the major drivers behind higher turbine efficiency and lower costs. The power output of a wind turbine increases by the square of the rotor radius and by the cube of the wind speed.[13] Therefore, installing larger turbines in the windiest areas can result in a near-exponential increase in generation output.

However, UK turbine size often is limited by planning restrictions, and also hindered by aviation regulations that require structures above a certain height to be extensively lit to avoid collision with aircraft, a policy that increases the visual impact of a wind farm and generally reduces local willingness to host one.[14] However, even within these limits repowering can deliver significant increases in output and efficiency, as the majority of the UK's oldest turbines are well below the current maximum allowed height.

HOW MUCH CAPACITY IS REACHING RETIREMENT AGE?

Following the closure of the Renewables Obligation scheme to new entrants in March 2017,[15] and with current Government policy explicitly ruling out new large-scale onshore wind,[16,17] the UK's ability to refresh its ageing wind fleet is compromised. Therefore, without a change in policy, capacity that reaches the end of its lifetime is likely to face disassembly, with direct consequences on domestic electricity generating capacity and the ability to produce the necessary zero-carbon power to meet legally-binding climate targets.

Analysis of a database of onshore wind farms across England, Scotland and Wales show that there are close to 60 projects that will reach their 20th birthday within the next five years.[18] As with Delabole and other early projects, many of these wind farms sit in optimum sites for wind generation. With a combined capacity of more than 440MW and upwards of 750 individual wind turbines, these projects offer a clear potential to boost UK onshore wind supply, without developing new sites.

10 https://www.goodenergy.co.uk/our-energy/our-energy-farms/our-wind-farms/delabole-wind-farm/

11 https://www.scottishpowerrenewables.com/pages/carland_cross_repowering.aspx

13 http://cdn.intechopen.com/pdfs/16242/InTechWind_turbines_theory_the_betz_equation_and_optimal_rotor_tip_speed_ratio.pdf

14 http://eciu.net/assets/Reports/ECIU_Blown_Away_Final_1.pdf

15 https://www.ofgem.gov.uk/environmental-programmes/ro/about-ro/ro-closure

16 https://www.conservatives.com/manifesto

17 http://www.scottishconservatives.com/wordpress/wp-content/uploads/2017/05/GE2017_Manifesto_A5_Scottish_DIGITAL.pdf

18 http://www.renewableuk.com/page/UKWEDSearch Data for capacity constructed in 2002 or earlier extracted. Units that have already repowered were removed.

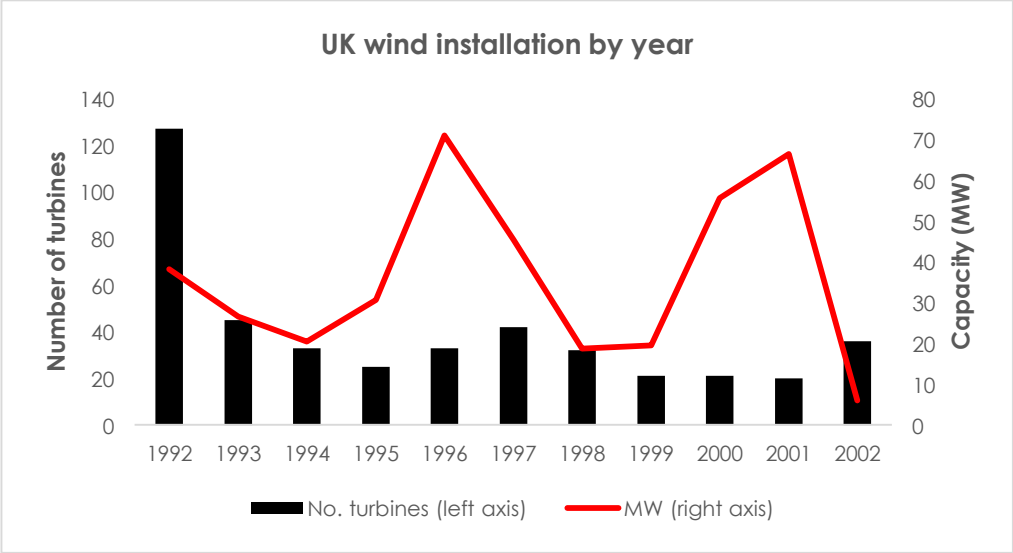

Figure 2: UK onshore wind installations by year. **Source:** RenewableUK

The average turbine size across these sites is just 720 kW, approximately one-fifth that of the latest technology, and around one-third of the average turbine size used in the most recent UK onshore wind installations (which is already much smaller than in other countries).[19] As such, the UK is in a prime position to increase the amount of zero-carbon electricity generated from wind farms without the complications linked to new developments.

Based on previously repowered projects, it would not be unreasonable to see capacity increase by a factor of 2-3 upon repowering (depending on grid capacity restraints and some other factors, such as access and local acceptance). The upper end of this range would see more than 1.7 GW of generating capacity installed, compared with the counterfactual where the 60 sites are dismantled – the bottom end, 1.32 GW. Compared with the capacity operating at present, the upper end brings a net increase of 1.3 GW, the bottom end 0.9 GW.[20]

This is a not an inconsiderable amount of capacity, even taking the lower figures. If the latest turbines are installed, an annual output in excess of 3 (TWh) would be expected.[21] For context, the Committee on Climate Change has identified that Government need to enact policies that will deliver an additional 80-100 TWh of clean power per year by 2030 to meet the fifth carbon budget.[22] Although much smaller than the anticipated annual output of EDF's Hinkley Point C nuclear power station (25 TWh),[23] repowered onshore wind farms would deliver units of electricity at less than half of Hinkley's price.[24]

Current Government policy that prohibits new onshore wind developments due to perceived unpopularity raises the potential of not all of this capacity being delivered, especially in England. However, 80% of the capacity set to reach retirement age in the next five years is located in Wales and Scotland, where there is strong local and government support for new onshore wind projects.

19 http://eciu.net/assets/Reports/ECIU_Blown_Away_Final_1.pdf

20 This lower value is used in future calculations to account for potential grid limitations and hub height restrictions.

21 Assuming 40% capacity factor. Doubling of output used to account for the potential of grid restraints curbing overall capacity. Calculation based on repowered capacity only, rather than net difference to counterfactual.

22 https://www.theccc.org.uk/publication/independent-assessment-uks-clean-growth-strategy-ambition-action/

23 https://www.edfenergy.com/energy/nuclear-new-build-projects/hinkley-point-c

24 https://www.gov.uk/government/publications/clean-growth-strategy

This, coupled with plans to allow new onshore wind projects on remote Scottish islands, could re-open the route-to-market for onshore wind that is currently called for by industry.

Repowering Welsh and Scottish sites alone would allow around 1 GW of net onshore wind to be brought online, enough to meet the annual power demand of 600,000 homes. This could be achieved without the need to locate and develop new sites, and at lower cost than farms currently operating in these locations.

Passing up the opportunity to repower these sites would not only impede the development of new capacity, but would lead to a loss of capacity as units are dismantled. This would represent a backwards step, putting the Government even further off the trajectory needed to meet the 2030 carbon targets (5th Carbon Budget).

The decentralised nature of wind power means that it is essential to consider the discrete nature of each wind farm, which need individual analyses during planning. Each site will have different grid restrictions, differing interactions with other nearby wind farms, and will be subject to different levels of accessibility (essential to install larger units) and relationships with local populations. The proposed increase in capacity in this report is a conservative estimate based on previous projects, but is subject to variability with each individual site.

REDUCING ENERGY BILLS

New onshore wind farms are already the cheapest form of new electricity generation,[26] beating gas, offshore wind, biomass, nuclear and everything else. A recent UCL study found that allowing mature renewable technologies – of which onshore wind is the lowest cost – to compete in future auctions would help close the gap between industrial electricity prices in the UK and those on mainland Europe.[27] Modelling of an auction in which onshore wind was allowed to participate showed that a capacity comparable to the UK's repowering potential would impose no additional cost to the wholesale market during a 15-year contracted period.[28]

The dominance of turbine costs as a proportion of overall project costs (Figure 3), together with the high likelihood that turbine bases will need to be strengthened and grid connections reinforced, means that savings from repowering are likely to be small, but still significant compared with building from scratch. Around 80% of onshore wind farm costs are fixed costs, which can be reduced for larger projects, especially those over 5MW, due to lower per-megawatt CAPEX costs.[29] The work involved in building a new site (and that in dismantling the pre-existing equipment) also means that repowering a wind farm has a lead time comparable to that for an existing project, at 3-5 years.[30]

26 https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/566567/BEIS_Electricity_Generation_Cost_Report.pdf

27 http://www.ucl.ac.uk/news/news-articles/0218/ucl-green-energy-blueprint-for-cutting-uk-electricity-prices

29 https://ac.els-cdn.com/S0960148117312685/1-s2.0-S0960148117312685-main.pdf?_tid=0ca92b44-ff74-11e7-b300-00000aab0f26&acdnat=1516626154_5da35440a2c5b7be34069da14e5ca9ce

29 https://ac.els-cdn.com/S0960148117312685/1-s2.0-S0960148117312685-main.pdf?_tid=0ca92b44-ff74-11e7-b300-00000aab0f26&acdnat=1516626154_5da35440a2c5b7be34069da14e5ca9ce

30 https://www.windpowermonthly.com/article/1425160/europes-repowering-drive-stuck-bottom-gear

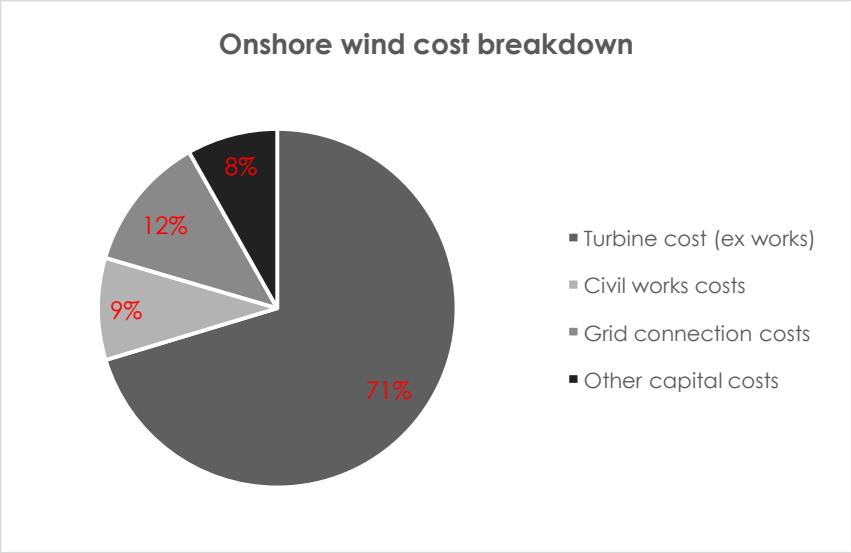

Figure 3: Breakdown of construction costs of a new onshore wind farm. **Source**: DECC (now BEIS).[31]

Despite not being expected to be vastly cheaper than new sites, repowering existing wind farms will bring savings compared with building virgin projects, most notably during the planning process. The accumulation of years of wind data will allow developers to forecast future earnings more accurately – although alterations will be needed to account for changing turbine height and interactions with other wind farms in the area.

This added certainty is likely to enable access to cheaper credit, which will reduce overall costs. For CAPEX-heavy investments such as wind turbines, capital costs are a major part of overall project costs; therefore cheaper credit can directly feed through to lower household and industrial energy bills. Anecdotal evidence suggests that falling returns on capital placed by investors and lenders are responsible for around one-third of the much-publicised fall in UK offshore wind prices, as risk fades from an increasingly mature industry.

The planning process is also likely to be easier than for a new site, as local communities may be more willing to host a repowered project that a new one, especially if the local area has been in receipt of community benefit funds. With a reduced 'fear of the unknown', grassroots opposition to projects is often lower, as has been seen in some projects that were able to repower under the now-withdrawn Renewables Obligation (RO) support regime.

In Germany and Denmark, for example, annual onshore wind auctions place repowered projects in competition with new onshore schemes, increasing competition between projects to drive down costs. In addition to being delivered with either no or very little subsidy, many of these repowered projects are community owned, with profits flowing directly into the local economy.

The latest government forecasts project that the cost of electricity from a combined cycle gas turbine (CCGT) power station built in 2025 will be £82/MWh.[32,33] The annual cost of generating 3TWh

31 https://www.sciencedirect.com/science/article/pii/S0960148117312685

32 https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/566567/BEIS_Electricity_Generation_Cost_Report.pdf

33 While care must be taken to avoid conflating LCOE and CfD strike prices, using the LCOE for the higher figure provides a conservative estimate for costs. Strike prices are higher than LCOEs as they include other costs, such as land costs and developer margin. These are included in the cost of onshore wind, but not in that for gas-fired electricity, therefore the savings from onshore wind are expected to be even greater. Central CCGT cost forecast taken from BEIS projections.

of low-carbon electricity from Britain's repowered onshore wind farms will be £168.3 million[34] compared with £246 million from a new CCGT, an annual saving of more than £77 million (more than 30%). This electricity would also be significantly cheaper than that generated from the current wind farms, which were supported more generously at a time when less-developed technology required higher subsidies.

Although they represent the cheapest form of new generation, most proposed new onshore wind farms (and repowered ones) do not have a viable route to market. On top of government policy standing in the way of new capacity in England and Scotland, uncertainties in both the economic and policy landscape increase the cost of debt for developers, a problem for a capital-intensive sector. Few investors are currently willing to put in the up-front CAPEX costs needed to bring onshore wind farms to market.

The low overall price indicates a clear rationale for these wind farms to be repowered. One possible approach would be for the Government to establish a mechanism similar to the existing Contracts for Difference (CfDs) scheme for offshore wind, nuclear and biomass. It would offer developers fixed-price contracts for a fixed period of time. Importantly this would not be a subsidy, as the total sums paid over the project's lifetime would be less than the cost of obtaining the same amount of electricity from the wholesale market.[35],[36] Therefore, this would not fall foul of the 2017 Budget pledge to control 'green' energy expenditure until overall costs begin to fall.

Offering contracts on this basis would not require rerouting any of the £557 million support for low-carbon power that was re-confirmed by the Government in the 2017 Clean Growth Strategy,[37] and would therefore not impede the roll-out of other low-carbon capacity such as offshore wind, which is needed to hit current (and avoid widening the gap to future) carbon budgets.

These figures represent only a small proportion of UK-wide repowering potential, as the number of turbines approaching repowering age is set to swell significantly beyond 2025 and into the 2030s.

COMMUNITY BENEFITS

Although increasingly common elsewhere, the UK does not have a history of community-owned energy projects, instead favouring 'community funds' through which site developers inject money into the local economy and into community projects. Across Scotland, more than £12 million was paid out to local communities in the year to November 2017,[38] with funds supported by the largest sites creating significant benefit to the local economy.

Vattenfall's Pen-y-cymoedd is the largest onshore project in England and Wales; a 76-turbine wind farm in South Wales, constructed on hills surrounding former coal-mining communities. The project

34 Calculated from £46.10/MWh figure presented by Baringa Partners, plus a £10/MWh flexibility cost, to account for the additional cost on the system of a variable generator. £10/MWh is at the higher end of calculated ranges for flexibility costs.

35 https://www.baringa.com/getmedia/99d7aa0f-5333-47ef-b7a8-1ca3b3c10644/Baringa_Scottish-Renewables_UK-Pot-1-CfD-scenario_April-2017_Report_FINA/

36 A recent report by Aurora Energy Research showed that, were it allowed to participate in different markets, wholesale revenue streams for offshore wind farms could be topped up by around 10%. Opening ancillary services, balancing and capacity markets to onshore wind (supported through a zero-subsidy CfD) is likely to add comparable benefits to that seen in offshore alternatives, making projects even more competitive and further bringing down costs for consumers.

37 https://www.gov.uk/government/publications/clean-growth-strategy

38 http://www.gov.scot/Resource/0052/00529536.pdf

supports a community fund that funnels £1.8 million per year into the local area, funding 80 projects including museums, youth groups, sports and music clubs, and local radio, among many others.[39] This is on top of providing more than 1000 jobs during construction, routing more than half of the £350+ million construction costs into the Welsh economy, and funding a £3 million habitat restoration scheme.

If repowered projects across England, Wales and Scotland opted for the same per-megawatt payments into a community fund as Pen-y-cymoedd, those identified in this report would pay out more than £104 million during the length of a 15-year zero-subsidy contract (Table 1). Of this, more than £83 million would be in Scotland and Wales.

	Repower capacity (MW)	**Total community pay-out (£million)**
England (total)	**177.4**	**21**
East Midlands	2.4	0.3
East of England	6	0.7
North East	13	1.5
North West	83	9.8
South West	42	5
Yorkshire and Humber	31	3.7
Wales (total)	**319.8**	**37.9**
Mid Wales	230.8	27.3
North Wales	71	8.4
South Wales	18	2.1
Scotland (total)	**386**	**45.7**
TOTAL	**883**	**104.6**

Table 1: Breakdown of potential repower capacity and community benefits by region. Total pay-outs over lifetime of 15-year fixed-price contract.

Two of the five largest projects up for repowering in the next five years – Carno (A and B), and Llandinam (P and L) – are located in Mid Wales, an area that has suffered economic decline as industrial output has fallen in recent decades. In addition to construction and maintenance jobs in the local area, these proposed community funds would inject more than £15 million into the local area over the duration of a zero-subsidy, fixed-price contract, more than £1 million per year.

In Scotland, the largest repowering sites are not located in one single area, suggesting that repowered community funds would be spread around the country. The three largest sites are in Midlothian, Argyll and Bute, and Dumfries and Galloway, and would deliver just under £10 million in community payments over 15 years.

39 https://corporate.vattenfall.co.uk/projects/operational-wind-farms/pen-y-cymoedd/

These payments would only be the start of a reliable source of revenue for local communities. As more and more projects come to repowering stage in the late 2020s and into the 2030s, these benefits will grow significantly.

A UK wind repowering programme could lead to benefits spread across the economy, as seen in the growing number of industries that support the UK offshore wind programme.[40] The decline of UK steel production has been a common story over the past decade as competition from low-priced imports and falling global demand has damaged balance sheets, yet the industry is beginning to see shoots of rebirth to supply material for British offshore wind projects.

CS Wind is Scotland's only turbine manufacturer, employing more than 150 people in Kintyre with an annual wage bill of more than £5 million,[41] while Liberty House has restarted production at two Scottish steel mills to make material for turbine towers.[42] Overall, two-thirds of total lifetime spend on UK onshore wind projects remains in the UK,[43] showing that a re-booted onshore wind programme would have distributed economic benefits. On average, a megawatt of new wind capacity requires just over 100 tonnes of steel,[44] therefore a gigawatt of new capacity would require more than 100,000 tonnes of material. This in on top of the forecast demand of 1.89 million tonnes of steel required for UK offshore projects through to 2020.[45]

A stream of repowering projects, arising as each reaches the end of its scheduled lifespan, would result in a continuous market for industry, supporting UK jobs over more years than building single projects. Germany, for example, has been repowering onshore wind farms for several years, with more than 2.3 GW repowered 2014-2016 – producing a 2.5-fold increase in capacity despite cutting the number of turbines by more than 300.[46] These figures represent a fraction of the growing demand in Europe, in which 28% of total wind capacity will be older than 15 years by 2020.[47] Further afield, the US repowering market could reach $25 billion by 2030,[48] amid a world market that will grow dramatically in the next decade or two. Despite opting into the wind market early, UK PLC has largely missed out on the turbine industry. Repowering affords an opportunity to move into a nascent global market that is set to grow rapidly.

LOCAL SUPPORT

Public opposition is often cited as the main hurdle to new onshore wind capacity in the UK, despite BEIS' regular public polling constantly showing it to be one of the most popular forms of electricity generation (Figure 4). This sentiment is also reflected on a local level, with a recent survey showing that more people would be happy to live near an onshore wind project than either a fracking site or small modular nuclear reactor.[49]

40 http://c.ymcdn.com/sites/www.renewableuk.com/resource/resmgr/publications/Offshore_Wind_Investment_V4.pdf

41 http://www.cswinduk.com/newsfeed/2

42 http://www.renewableuk.com/blogpost/1334524/252153/The-steel-and-renewable-energy-industries-are-natural-partners

43 http://sse.com/newsandviews/allarticles/2017/07/whats-the-future-for-onshore-wind-in-scotland/

44 http://www.theenergycollective.com/robertwilson190/344771/can-you-make-wind-turbine-without-fossil-fuels

45 http://www.renewableuk.com/blogpost/1334524/252153/The-steel-and-renewable-energy-industries-are-natural-partners

46 https://www.windpowermonthly.com/article/1425160/europes-repowering-drive-stuck-bottom-gear

47 https://ac.els-cdn.com/S1364032117313503/1-s2.0-S1364032117313503-main.pdf?_tid=34d4fe1c-ff89-11e7-89c3-00000aacb362&acdnat=1516635222_e82e670af2234bb86c25b1cab9be5274

48 https://www.evwind.es/2017/05/23/ge-adds-value-to-the-us-wind-turbine-industry-with-its-repower-offering/59916

49 https://1010uk.org/press-releases/fracking-and-small-scale-nuclear-struggle-as-onshore-wind-finds-favour-with-the-public

Academic research has shown the disparity between the realities of public opinion on onshore wind, and that which is perceived by the Government.[50] It is true that levels of objection are higher among members of the Conservative Party than the overall public, yet around half of party members were in favour of onshore wind when the ban was first mooted in 2010. Support has risen since, with 59% of Conservative voters in 2017 backing onshore wind, on the provisos that local communities have the final say over any projects and that there is no subsidy involved.[51]

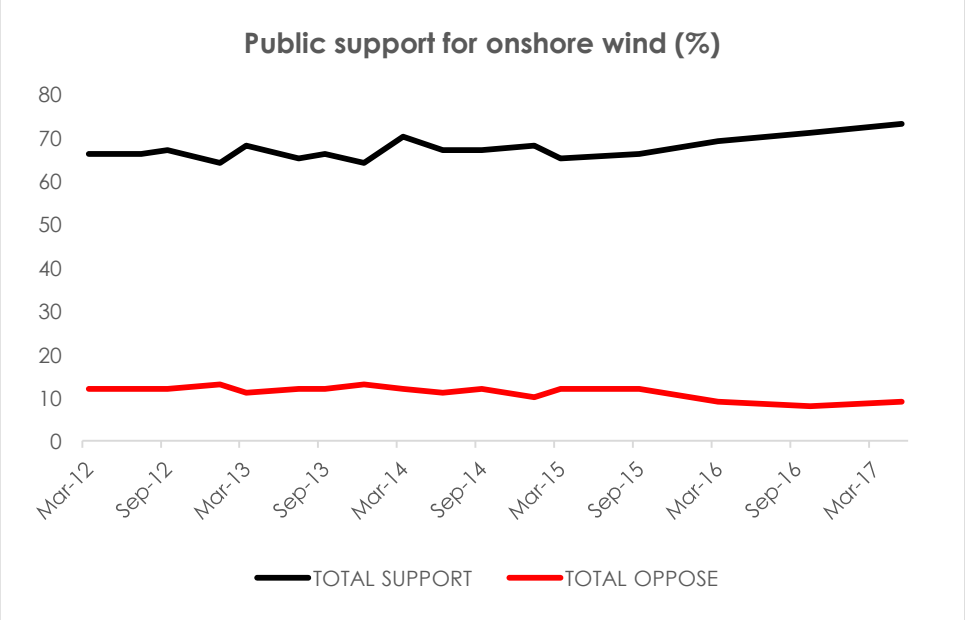

Figure 4: Levels of public support for onshore wind. **Source**: BEIS.[52]

The current UK and Scottish governments stress that local communities should have the final say on renewable energy projects. As shown earlier, the development of community funds to provide a boost to local areas can help to assuage resistance where it exists, in addition to the jobs and other local economic benefits that result from new onshore wind capacity.

Since 2015 support for onshore wind has gradually increased. This could be due to multiple factors, one of which is greater public acceptance of an increasingly ubiquitous technology.[53] This bodes well for a planned repowering programme, as regions with existing wind farms are more likely to have warmed to the technology, especially if the community has been in receipt of financial benefits.

Conclusions

The impending retirement of hundreds of British wind turbines presents an important decision for ministers, developers and local communities. Should these wind farms be dismantled, further increasing the shortfall of low-carbon electricity needed to meet our legally binding carbon targets, or should they be repowered, locking in low-cost and low-emission electricity for years to come?

50 https://www.sheffield.ac.uk/polopoly_fs/1.88117!/file/Understanding-wind-farm-opposition---Dr-Chris-Jones-PDF-674K-.pdf

51 http://green.brightblue.org.uk/blog/2017/5/4/a-manifesto-for-green-conservatism

52 https://www.gov.uk/government/statistics/energy-and-climate-change-public-attitudes-tracker-wave-24

53 http://eciu.net/assets/Reports/ECIU_Blown_Away_Final_1.pdf

With the fate of more than 750 turbines across the country up for discussion in the next five years – and multiple times this figure during the 2030s – the decision on whether to repower some of the oldest sites is becoming increasingly important, for both Government and for the growing industries that deliver low-carbon and low-cost power into British homes and businesses.

Based on conservative estimates, this report shows that – compared to the counterfactual scenario in which the sites are dismantled – there is a net 1.3 GW gain in onshore wind capacity. This will not only result in more than 3 TWh of clean electricity generation per year, but will do so at a cost that cannot be matched by other new forms of technology. On top of this, the use of larger and more efficient equipment will mean that the overall number of turbines will be decreased. A repowering scheme would not only benefit an increasingly UK-based supply chain, but also local communities through payments from the developer. These community funds are already the most popular way for wind farm owners to give back to the local area, with a potential payout of more than £100 million from this first wave of repowering projects. As many of the oldest wind farms are based in Scotland and Wales – which also benefit from both community and political support – more than 80% of these community payments would flow to these rural regions.

These figures only represent potential for projects facing the decision to repower or close in the next five years, beyond this the potential for new capacity, low carbon power and community support increases several-fold.

As with other proposed onshore developments, local support is essential. Surveys repeatedly show that onshore wind is highly popular in all regions of the UK, and that support is growing. People would also prefer to live near a wind farm than other energy infrastructure. This means that Government policy of effectively banning new onshore capacity is out of line with not only the general population, but also out of line with its aim to achieve the lowest energy costs in Europe.

Repowering existing wind farms as they reach the end of their intended working lives is the cheapest way to accelerate build-out of the nation's low-carbon electricity generation. It would reduce energy bills, reinvigorate the onshore wind supply chain, and is likely to prove popular.

The Government says in its Clean Growth Strategy[54] that additional measures are needed to put the country back on track to meeting carbon targets, specifically the 5th Carbon Budget, without needing to resort to "flexibilities"; and the statutory advisor, the Committee on Climate Change, says new measures are needed this year.[55] Repowering retiring wind farms is one opportunity that can be grasped right now, with no apparent downsides.

54 https://www.gov.uk/government/publications/clean-growth-strategy

55 https://www.theccc.org.uk/publication/independent-assessment-uks-clean-growth-strategy-ambition-action/