Quantifying benefits of onshore wind to the UK

Report prepared for RenewableUK

Final report

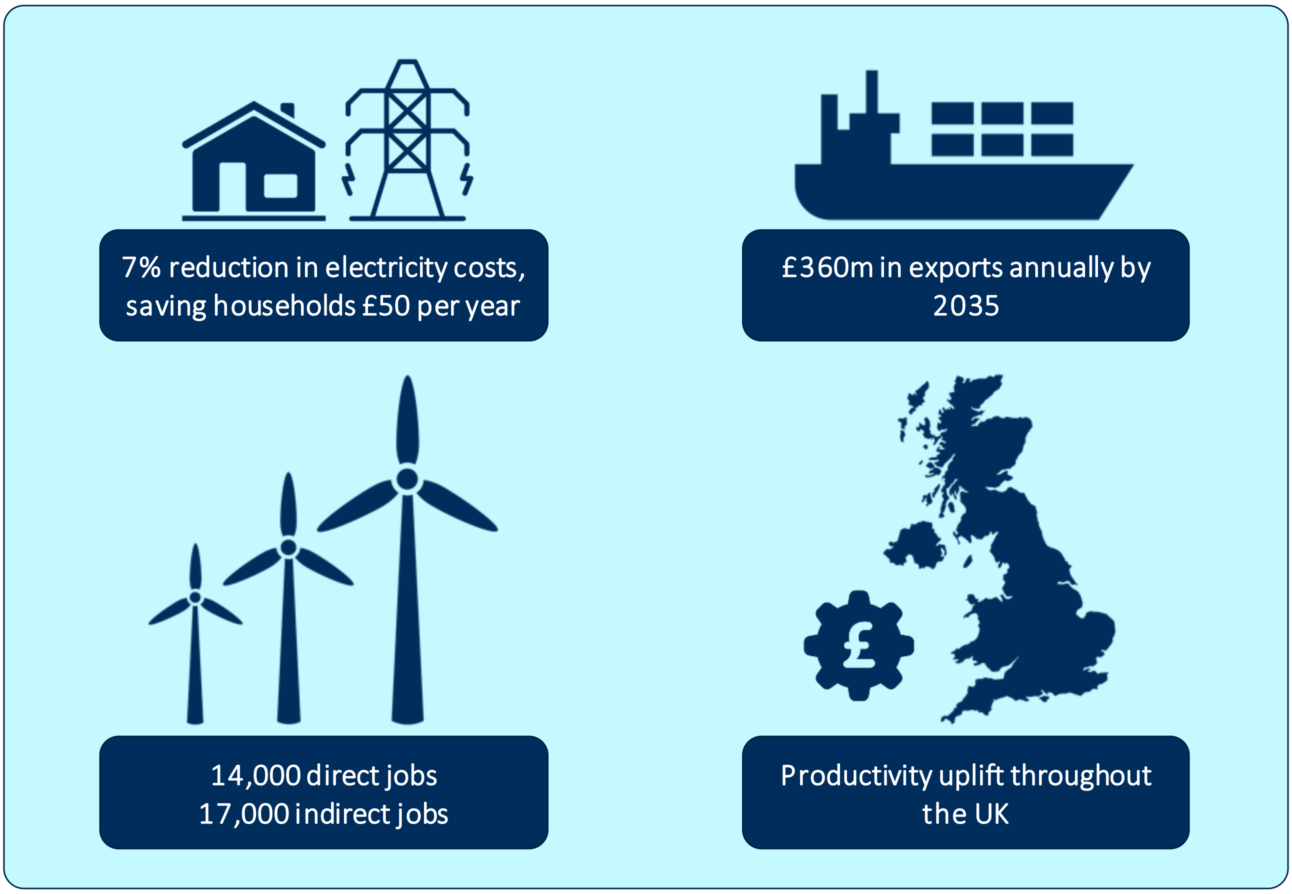
June 2019

putting economics to good use

Executive Summary

Deploying 35 GW of onshore wind by 2035 could reduce UK electricity costs by 7%, support 31,000 jobs, lift productivity throughout the UK and enable a £360m export industry. The Committee on Climate Change (CCC) recently recommended that the UK government adopt a net zero emissions target by 2050, which would require a significant acceleration of onshore wind deployment. This recommendation was accepted by the UK Government and Parliament has now legislated to set the 2050 net zero target. Onshore wind is the cheapest low-carbon generation technology available. In order to reach net zero greenhouse gas emissions at least-cost by 2050, the UK could need up to 35 GW of onshore wind capacity by 2035 (Vivid Economics and Imperial College London, 2019). This would require the deployment of 1.4 GW of onshore wind annually, a significant increase on the modest 0.6 GW deployed in 2018. Beyond reducing emissions, accelerating deployment in line with CCC net zero recommendations would result in a series of socioeconomic benefits to the UK, as set out in Figure 1.

Figure 1 Summary of economic benefits in 2035



Note: Reduction in electricity price is calculated relative to the Gas-led scenario.
Source: Vivid Economics

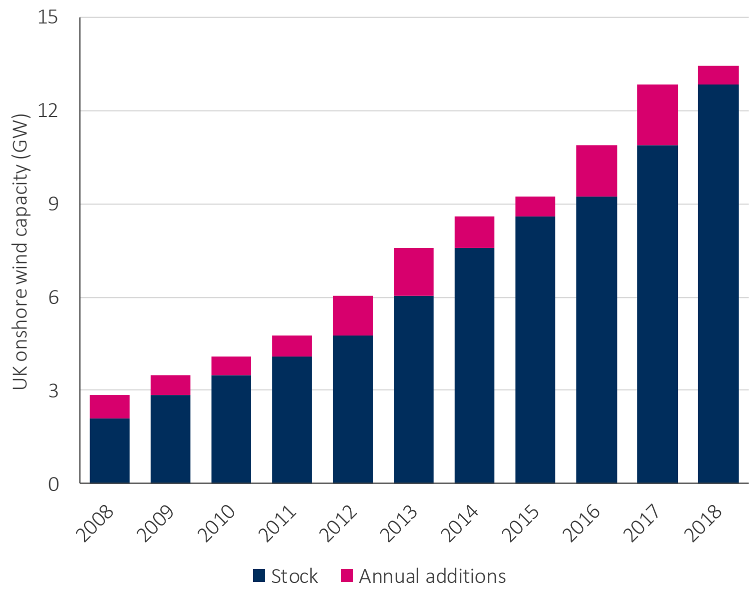
Contents

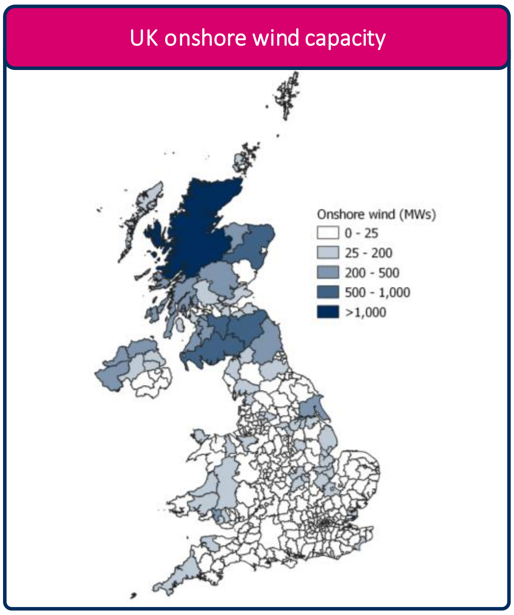
List of figures

1 Introduction

The onshore wind industry generated 29 TWh of electricity and supported 5,300 direct jobs in 2017.[1] Figure 2 depicts the rapid growth of UK onshore wind capacity over the last decade and shows its locations throughout the UK at the local authority level. The end of 2017 marked a decade of strong growth, in which capacity increased fourfold from 2008. Onshore wind generated £2.8bn in turnover across 4,000 UK businesses and exported £53m worth of goods and services (ONS, 2019a).

Figure 2 Onshore wind capacity additions and location today





Source: Vivid Economics based on BEIS (2018), BEIS (2019b), and Wind Europe (2019)

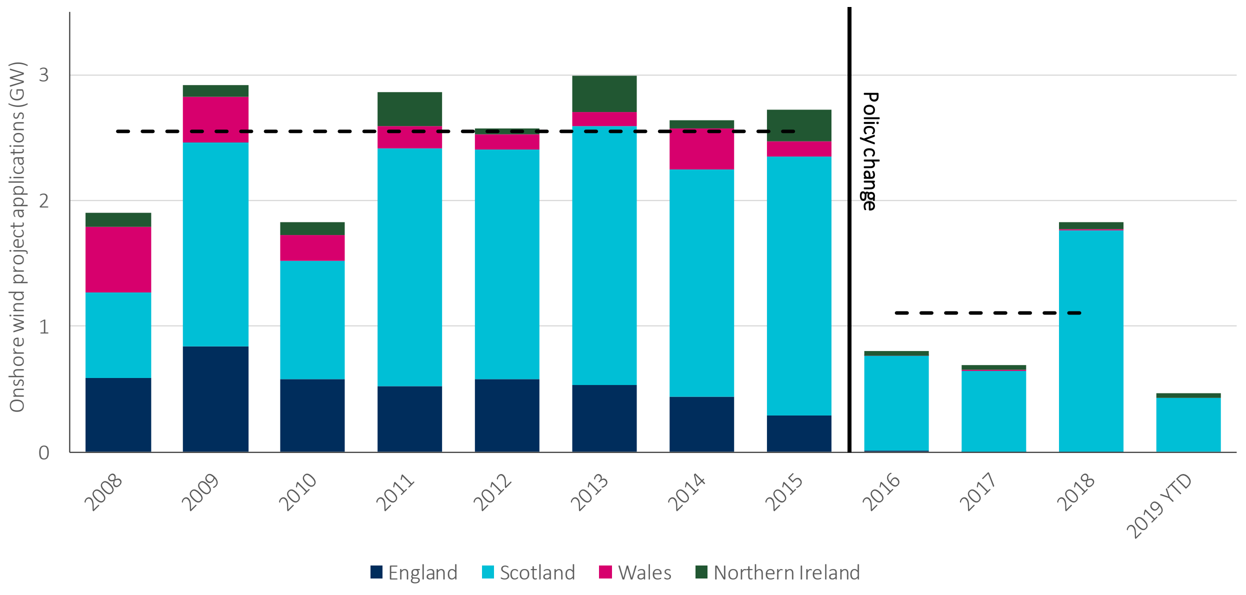
Up to 35 GW of onshore wind could be needed by 2035 to reach net zero emissions by 2050. In May 2019, the CCC recommended that the UK adopt an ambitious new target to reduce greenhouse gas emissions to zero by 2050. This 'net zero emissions target' requires the phase-out of unabated fossil fuels in the power sector and widespread electrification of transport and heat (Committee on Climate Change, 2019a). The deployment of additional onshore wind could help achieve these objectives at least-cost by decarbonising existing electricity generation and by meeting increasing demand from the electrification of heat and transport. Up to 35 GW of onshore wind could be needed by 2035 to accommodate the rapid uptake of electric vehicles and hybrid heat pumps (Vivid Economics and Imperial College London, 2019). However, in 2018, annual additions slowed to 0.6 GW in response to barriers to additional onshore wind deployment (Wind Europe, 2019).

Continued expansion is challenged by multiple barriers, including lack of access to CfD auctions and a strict planning regime. As of 2015, onshore wind projects are not eligible for support in the UK's contract-for-difference (CfD) auctions. 2015 also saw the introduction of strict rules governing the planning phase of onshore wind farms, which have impacted the deployment of new onshore wind. Figure 3 depicts the decline in onshore wind applications by region following these policy changes. According to industry, lack of progress in aviation radar mitigation and grid infrastructure development further restricts the quantity of

[1] For generation, see BEIS (2018); for jobs, see ONS (2019a).

viable onshore wind sites. Combined, these restrictions stifle deployment, reducing investment in the UK-based supply chain and increasing consumer bills.

Figure 3 Onshore wind applications: 2008 to 2019 YTD



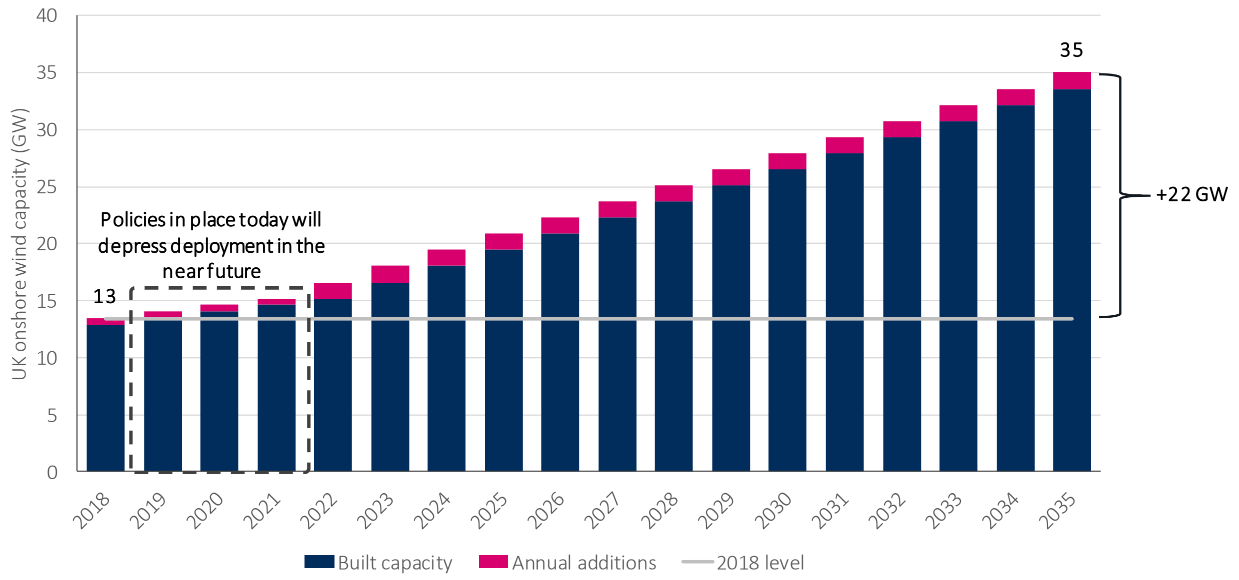
Note: Project applications on the Renewable Energy Planning Database without a planning application submission date are not included.

Source: BEIS (2019b)

The lack of access to CfD auctions is the key barrier to increasing deployment. The CfD scheme is the main mechanism for supporting low-carbon generation in the UK (BEIS, 2019a). CfDs incentivise renewable energy by stabilising the market price renewable generators receive for selling electricity into the wholesale market, which guarantees a minimum level of revenue for generators. According to industry, revenue stability is the primary barrier to investment for developers and, without a guarantee, onshore wind projects are subject to uncertain and volatile wholesale electricity prices, which can discourage investment. The revenue stability from CfDs can lower the cost of capital for developers, which in turn can lower the levelised cost of electricity (LCOE) of an onshore wind project by £6–£12/MWh compared with merchant (Arup, 2018). Committing to regular CfD auctions also acts as a coordination mechanism for the sector as regular auctions anchor expectations around the amount of capacity that is needed in the future (Vivid Economics and Imperial College London, 2019). This reduces investor uncertainty and can unlock investment in the onshore wind supply chain as investors are able to anticipate the level of future demand for onshore wind goods and services. In the 2018 Progress Report to Parliament, the CCC recommended that the government extend its current CfD approach and to offer CfDs with no net subsidy to support low-cost, low-carbon generation, including onshore wind (Committee on Climate Change, 2018).

Existing barriers to onshore wind are out of line with the CCC's net zero recommendation. Reaching net zero by 2050 could require the UK to deploy an additional 22 GW of onshore wind and repower nearly 5 GW by 2035. The policies in place today make achieving this target difficult and are likely to have already impacted deployment in the near future (2019–21) given the time it takes to develop and deploy new onshore wind. In order to reach 35 GW by 2035, annual deployment rates would have to average 1.4 GW after 2021, nearly 1 GW more than 2018 net capacity additions. Figure 4 sets out the deployment pathway consistent with achieving a net zero emissions target.

Figure 4 Onshore wind deployment to 2035 consistent with net zero emissions in 2050



Note: Repowering of existing capacity is assumed to take place after 24 years of operation in line with BEIS (2016). Deployment from 2019–21 reflects the impact of existing policy inertia.

Source: Vivid Economics

This report quantifies the economic benefits to the UK generated by deploying an additional 22 GW of onshore wind by 2035. Three types of economic benefits are considered: consumer, employment and productivity benefits.

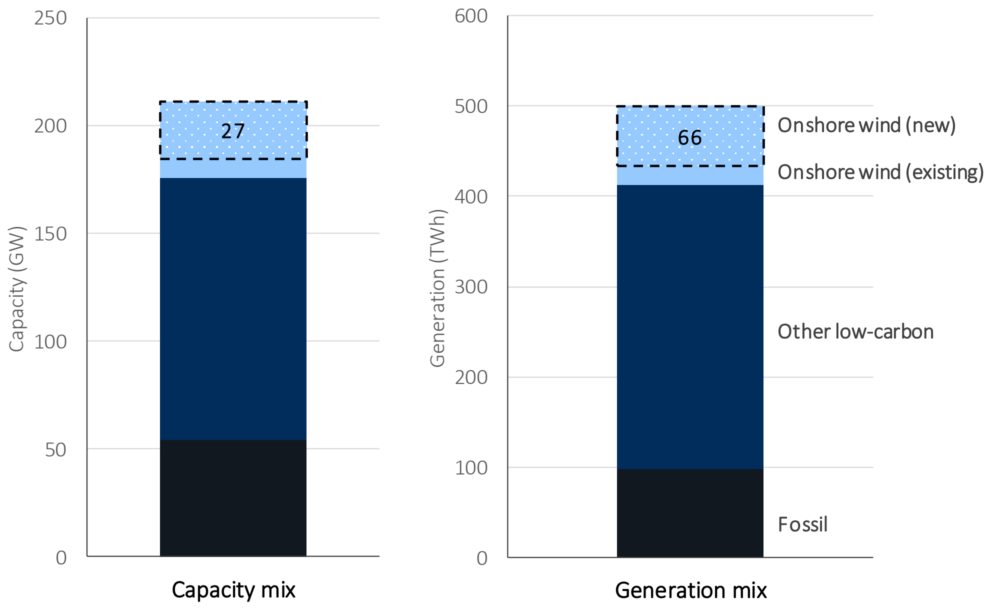
- Consumer benefits quantify the household savings from deploying onshore wind compared with a gas-led scenario in 2035.
- Employment benefits quantify the number of direct and indirect jobs supported by the domestic and export markets for onshore wind goods and services. Employment benefits are assessed by type of economic activity and the likely location of onshore wind jobs at the national, regional and local authority level.
- Productivity benefits quantify the productivity uplift from onshore wind supported at the national, regional and local authority level.

2 Consumer savings

Large-scale deployment of onshore wind is an important contributor to meeting a net zero emissions target. As described in the introduction, up to 35 GW of onshore wind generating 87 TWh of electricity could be needed by 2035 to meet electricity demand under a net zero emissions target for 2050.

A 66 TWh generation gap could arise if insufficient onshore wind is deployed. Figure 5 shows the capacity and generation mix in 2035 that could be needed to meet electricity demand under a net zero emissions target. Of the 35 GW of onshore wind that could be needed by 2035, around 9 GW is existing capacity and 27 GW is new capacity (including repowering of existing sites). If this new capacity does not come forward, 66 TWh of generation would need to be met by alternative sources.

Figure 5 Capacity and generation mix in 2035

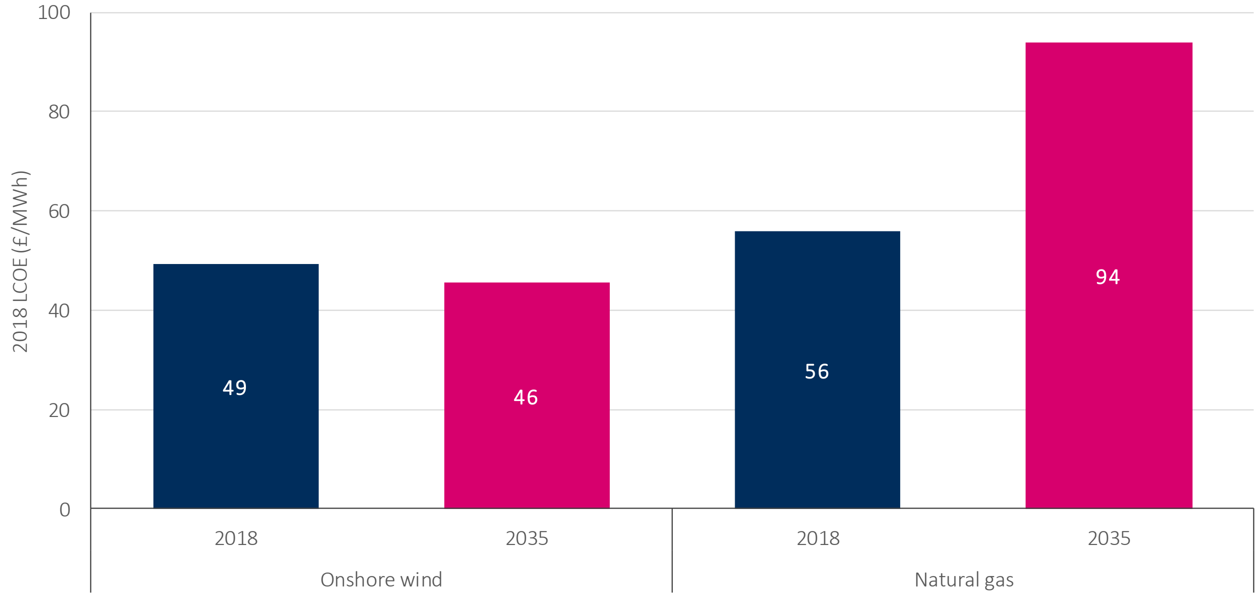


Source: Vivid Economics

Gas generation is expected to be significantly more costly than onshore wind generation by 2035. Figure 6 shows current and projected 2035 costs of onshore wind and gas generation. Onshore wind generation costs are around £49/MWh today, and could fall to £46/MWh by 2035. Gas generation costs are higher than onshore wind costs due to the carbon price associated with CO_2 emissions from gas generation. Gas generation costs are around £56/MWh today, and are projected to rise to over £90/MWh by 2035, as the carbon price rises over time.[2]

[2] The carbon price is assumed to be £118/tCO_2 in 2035, in line with BEIS (2019c).

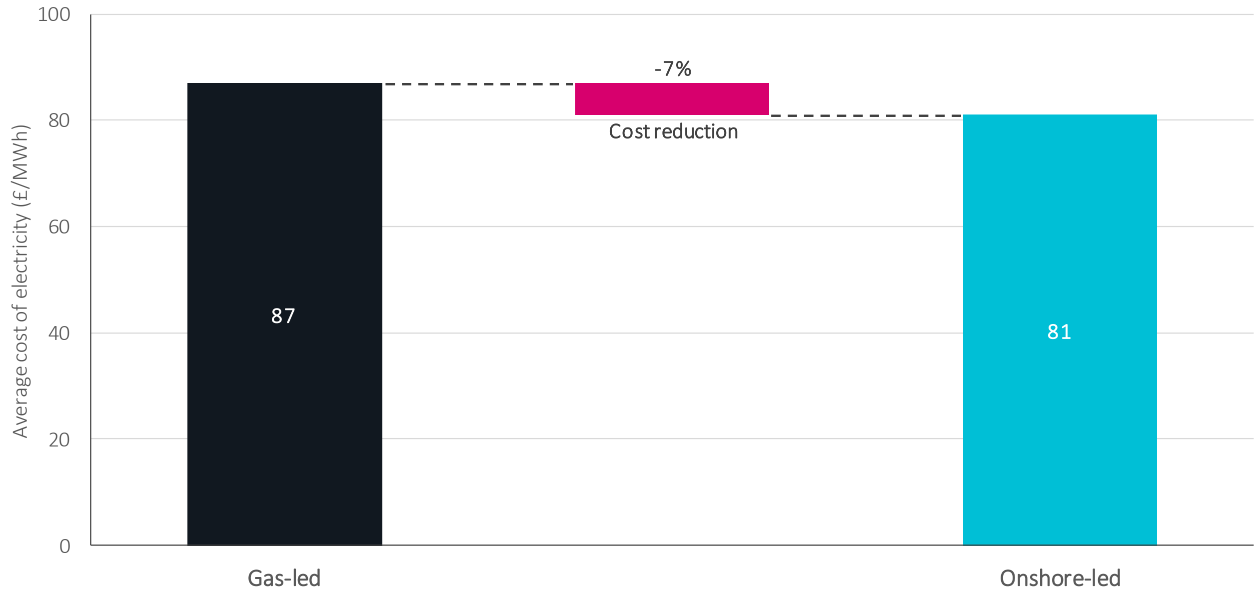
Figure 6 Gas generation is expected to be significantly more costly than onshore wind by 2035



Source: Vivid Economics

Deploying new onshore wind instead of gas could reduce electricity costs by 7% by 2035. Figure 7 shows the average cost of electricity in 2035 under the Gas-led and Onshore-led scenarios. The average cost of electricity under the Gas-led scenario is £87/MWh, while the cost under the Onshore-led scenario is £81/MWh, delivering a 7% cost saving.

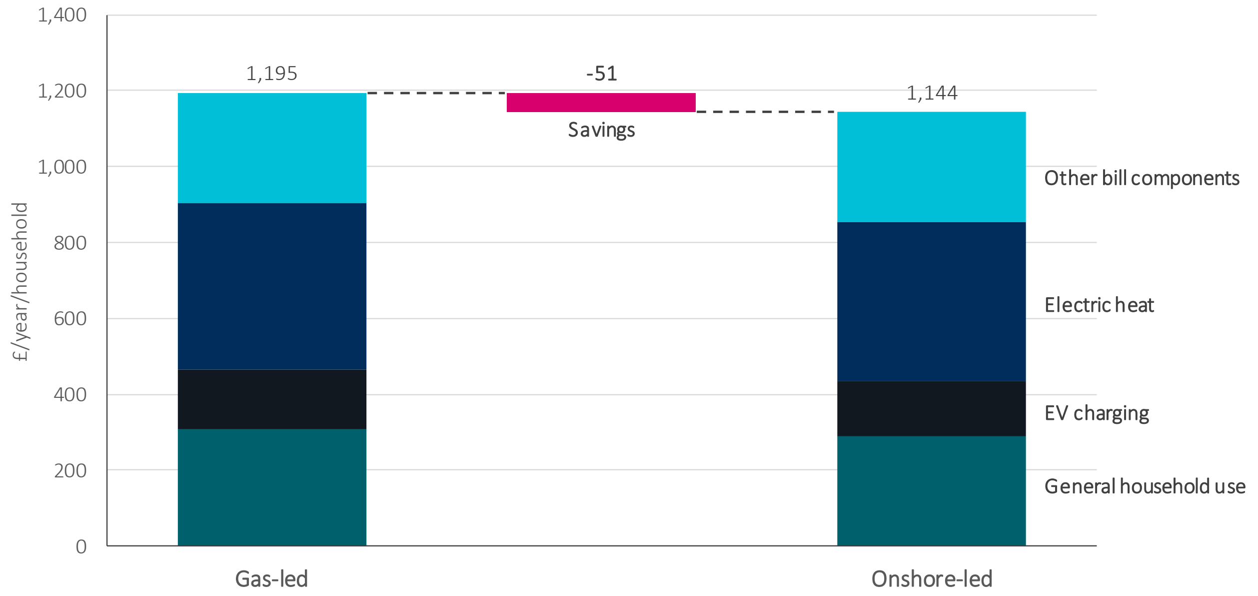
Figure 7 Deploying new onshore wind instead of gas could reduce electricity costs by 7% by 2035



Note: Average cost of electricity is expressed in 2018 prices.
Source: Vivid Economics

This reduction could save a typical household around £50 per year in 2035. Figure 8 shows the electricity bill of a typical household in 2035 under the Gas-led and Onshore-led scenarios. We assume that by 2035 a typical household operates an electric rather than petrol car, and a heat pump rather than a gas boiler. As a result, a typical household could consume around 10,500 kWh of electricity per year, comprising 3,500 kWh for general household use, and a further 7,000 kWh to operate an electric vehicle and heat pump. Under the Gas-led scenario, a typical household bill could be just under £1,200 per year. Under the Onshore-led scenario, with a 7% reduction in the cost of electricity, a typical household bill could be just under £1,150, delivering savings of around £50 per year.[3]

Figure 8 Deploying new onshore wind could save a typical household around £50 per year by 2035



Note: General household use of 3,500 kWh per year is in line with current levels. Other bill components comprise electricity supplier revenues, transmission and distribution network charges, non-generation consumer levies, and VAT. EV, electric vehicle.

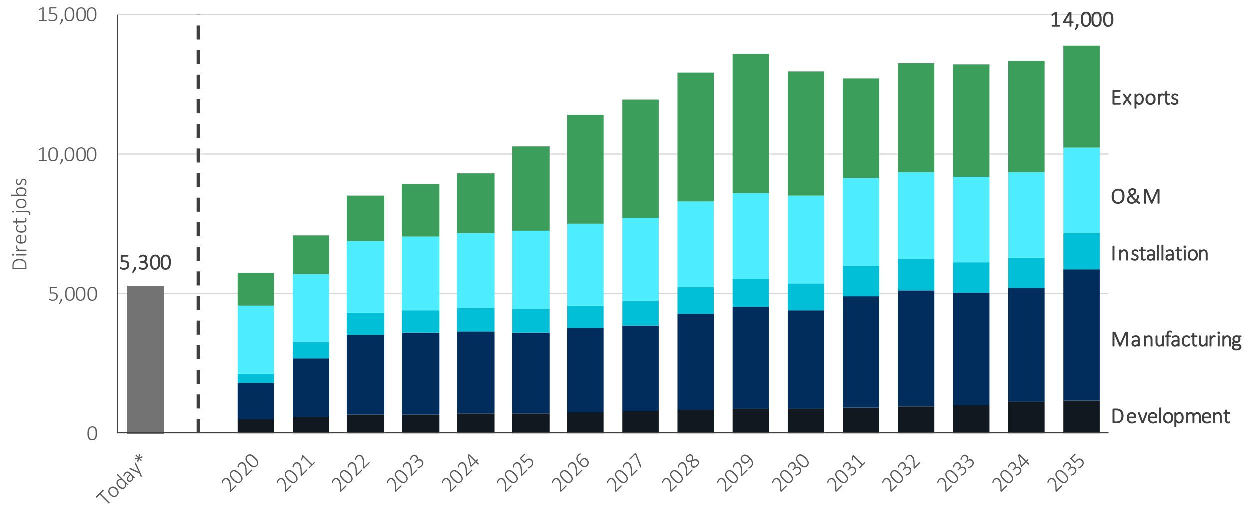
Source: Vivid Economics, Committee on Climate Change (2017)

[3] Electricity cost represents all generator, storage and interconnection costs. It accounts for wholesale price, carbon price, low-carbon support costs, and capacity market payments, and reflects system integration costs of onshore wind and other renewables. No repowering is assumed in the Gas-led scenario.

3 Employment benefits

Deploying 35 GW of onshore wind by 2035 could support 14,000 jobs, which would be a threefold increase on current levels. The ONS estimates that there are 5,300 direct onshore wind jobs across the UK today (ONS, 2019a). This number could nearly triple under a CCC-consistent deployment scenario, driven by an increase in development, manufacturing and installation jobs to around 7,200 in 2035.[4] Operations and maintenance jobs are expected to increase steadily to around 3,000 in 2035 as the expenditure needed to operate and maintain onshore wind farms increases with deployment levels. To a lesser degree, these increases are driven by an increase in UK wind farm content from 66% today to a target of 70% by 2030.[5] Jobs from exports could reach 3,700 by 2035 as the UK lifts exports from £53m today to £360m in 2035. Figure 9 depicts the profile of direct jobs from today to 2035.

Figure 9 Direct jobs to 2035



Note: Includes jobs from repowering existing onshore wind farms. O&M, operations and maintenance. The most recent ONS estimate of direct jobs today is for 2017.

Source: Vivid Economics, ONS (2019a)

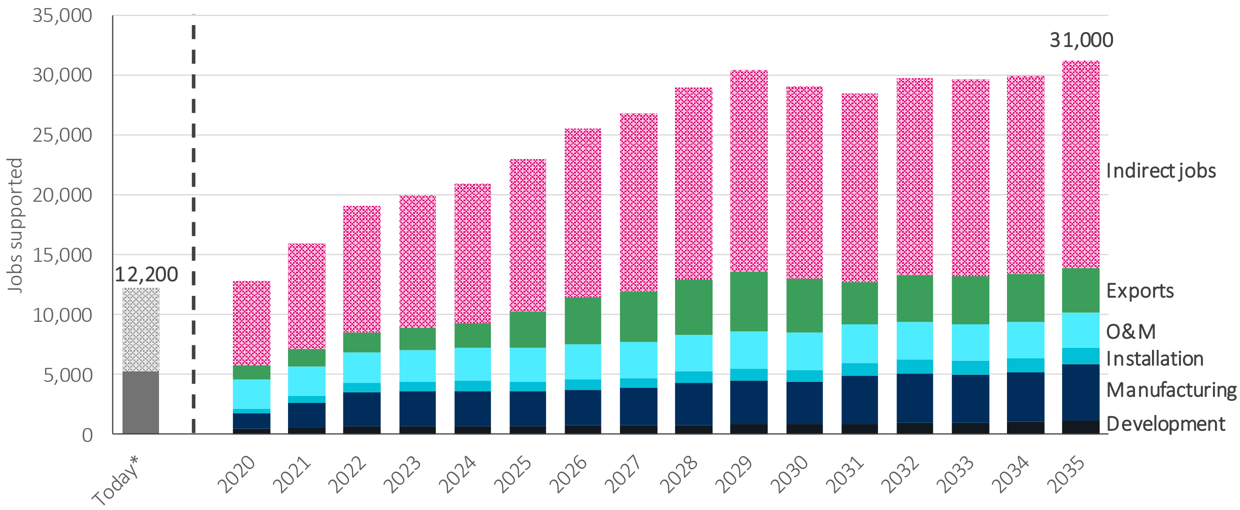
There is a sizeable opportunity for the UK to increase content in domestic wind farms from 66% today to 70% by 2030. It is estimated that UK firms supply high shares of content for development and the operation and maintenance of UK wind farms today, capturing 94% and 85% of expenditure, respectively. However, the UK onshore wind supply chain is estimated to capture only 34% of capital expenditure (CAPEX). Within CAPEX, UK firms are estimated to supply 3.5% of turbine content, 79% of civil works content, and 43% of electrical works content (BVG, 2017). The low level of turbine content is driven by the lack of a large UK-based onshore wind turbine manufacturer. By 2030, the UK could increase overall content to 70% (BVG, 2018) by supplying moderately higher shares of development expenditure (DEVEX) and operating expenditure (OPEX), and by ambitiously aiming to supply around 10% of turbine content. Higher turbine content can be delivered by manufacturing and supplying turbine components, such as towers, blades or bearings, to large oversees turbine manufacturers for use in UK projects.

[4] Estimate of jobs includes jobs from powering existing wind farms that reach the end of their lifetime. Repowering from existing wind farms is assumed in order to reach 35 GW of capacity by 2035.

[5] For an estimate of UK content today, see BVG (2017). For an estimate of future UK content levels, see BVG (2018).

The onshore wind industry could support up to 31,000 direct and indirect jobs by 2035. The ONS estimates that each direct onshore wind job supports 1.24 indirect jobs (ONS, 2019a). Indirect jobs are a result of employment from the indirect economic activity generated by the onshore wind sector. Indirect economic activity results from the indirect effects of direct spending or investment, such as increased demand for inputs or the demand for products of other firms generated by the wages paid to workers employed by the onshore wind sector (ONS, 2019a). Today, the ONS estimates that the onshore wind industry supports 12,200 direct and indirect jobs. Deploying 35 GW by 2035 could increase direct and indirect jobs steadily to 2030, followed by more modest job growth between 2030 and 2035. Figure 10 shows the direct and indirect jobs profile from today to 2035. The modest job growth between 2030 and 2035 is driven by a deceleration in onshore wind capacity additions in the EU27, a key export market.

Figure 10 Direct and indirect jobs to 2035



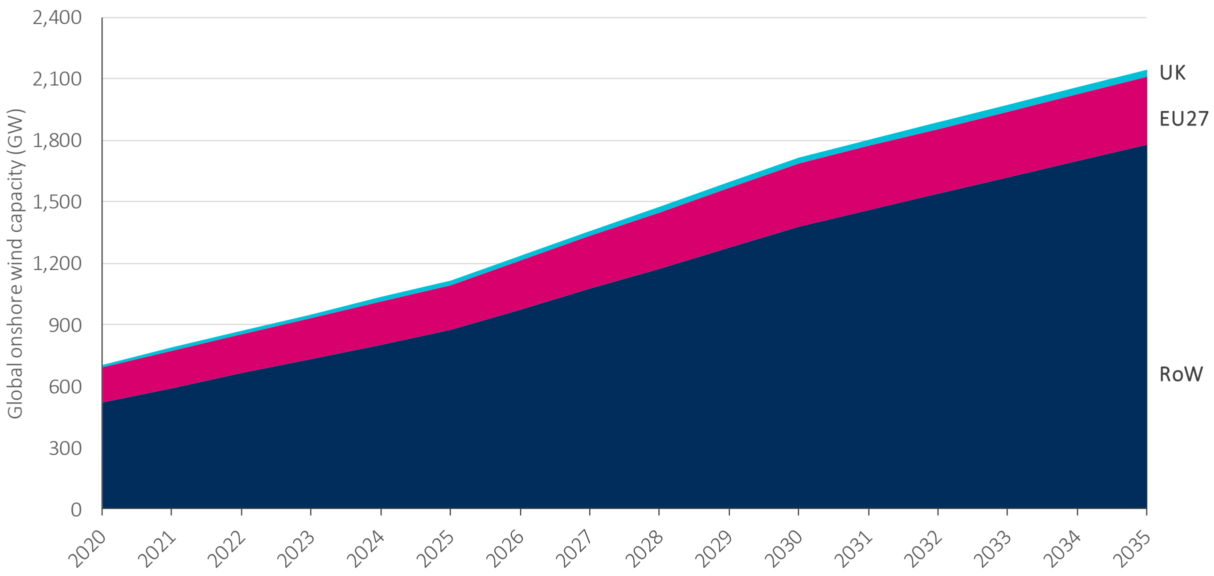
Note: Includes jobs from repowering existing onshore wind farms. O&M, operations and maintenance. The most recent ONS estimate of direct jobs today is for 2017.

Source: Vivid Economics, ONS (2019a)

Exports of manufactured goods and installation services are a significant opportunity for the UK supply chain. In 2017, the UK exported £53m worth of onshore wind goods and services (ONS, 2019a), capturing around 0.2% of the global market. The IEA estimates that the global deployment of onshore wind will increase fourfold from today to nearly 2,150 GW (IEA, 2017). Figure 11 depicts the IEA's 2 Degree Scenario (2DS) for the EU27 and rest of the world (RoW) markets. An assessment of UK trade in goods similar to onshore wind suggests that a 1.6% share of the EU27 market (EU28 – UK) and 0.4% of the RoW (world – EU28) is feasible.[6] If the UK onshore wind supply chain can achieve these modest market shares, the turnover from exports could reach £360m and support 3,700 jobs in 2035.

[6] See the technical appendix for a discussion of the UK market share of the EU27 and RoW.

Figure 11 Global onshore wind capacity to 2035 consistent with the IEA 2DS



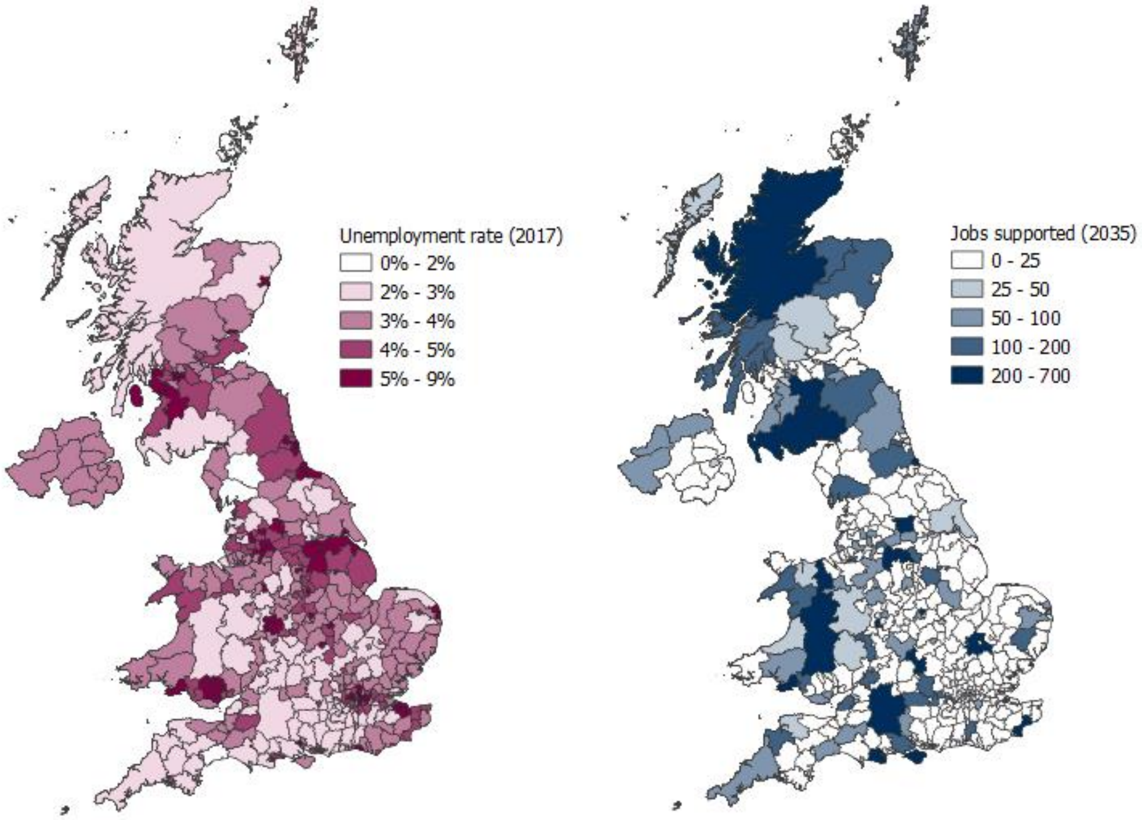
Note: For UK deployment path see Figure 4.
Source: Vivid Economics, based on IEA (2017)

Deploying 35 GW of onshore wind by 2035 could support around 9,500 direct jobs in England, 2,300 direct jobs in Scotland, 1,600 direct jobs in Wales, and nearly 500 direct jobs in Northern Ireland. However, the future location of employment is uncertain, and the location of employment benefits presented here should be treated as an indicative projection. Projecting the future location of jobs supported by development, manufacturing, installation and export activity is estimated based on the location of existing supply chain facilities today. Projecting the future location of operations and maintenance jobs is estimated using the location of existing onshore wind farms today, the location of onshore wind farm applications in the Renewable Energy Planning Database (BEIS, 2019b), and by estimating the location of future onshore wind farms, which is determined by wind quality and technical constraints.[7]

Onshore wind employment is likely to be located in local authorities most in need of high-paying jobs. Local authorities in Scotland and Wales are likely to see sizeable employment benefits by 2035. Figure 12 shows unemployment rates today (left panel) and the employment benefits from onshore wind in 2035 at the local authority level (right panel). Areas of relatively high unemployment in Scotland and Wales are likely to benefit from future onshore wind supported jobs.

[7] See the technical appendix for a discussion of locating employment benefits.

Figure 12 Current unemployment rate (left) and jobs supported by onshore wind in 2035 (right)



Note: Unemployment data is unavailable for the City of London and the Isles of Scilly. Unemployment data for Northern Ireland is available only at the regional level.

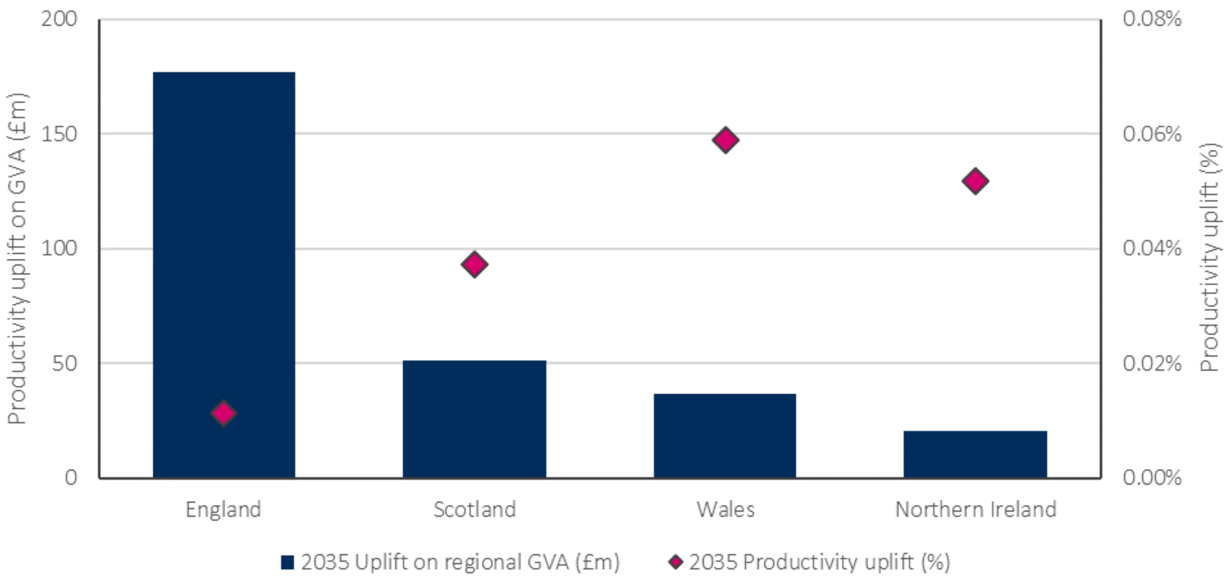
Source: Vivid Economics, ONS (2019b)

4 Productivity benefits

Onshore wind employment can lift productivity throughout the UK, supporting an additional £290m of GVA per annum by 2035. Productivity gains are generated by the uplift from direct onshore wind jobs, which have a higher productivity than the UK average. Measured by gross value added (GVA) per worker, the national average currently stands at £54,000 per worker (ONS, 2019c). In Wales and Northern Ireland, productivity is only around £45,000 per worker (ONS, 2018). By contrast, productivity in the development, manufacturing and installation of onshore wind is approximately £60,000 GVA per worker. Jobs associated with the operation and maintenance of onshore wind sites are highly productive, at £180,000 per worker.[8] As with employment opportunities, this productivity uplift is expected to be distributed throughout the UK, allowing most areas to share in the benefits.

By 2035, productivity increases are estimated to be particularly strong in Wales and Northern Ireland, at 0.06% and 0.05% of their respective GVA per worker levels today. When measured as a percentage of current productivity, the uplift is strongest for Wales and Northern Ireland, where existing productivity levels are only 82% and 87% of the UK average. Productivity growth in both regions has been tepid, at an annualised growth rate of only 0.3% per year over the last ten years (ONS, 2019c). However, in absolute terms, productivity gains result in the largest GVA uplift in England, at £180m per year by 2035. This is followed by Scotland (£50m), Wales (£40m) and Northern Ireland (£20m). Hence the uplift brought by onshore wind represents a sizeable boost to regional productivity and could help these regions narrow the gap with the national average. Figure 13 presents the GVA uplift in each UK region in absolute and relative terms.

Figure 13 Productivity uplift by region



Note: Uplift refers to the change in average productivity in the area as a result of extra onshore wind jobs, and the resulting increase in regional GVA.

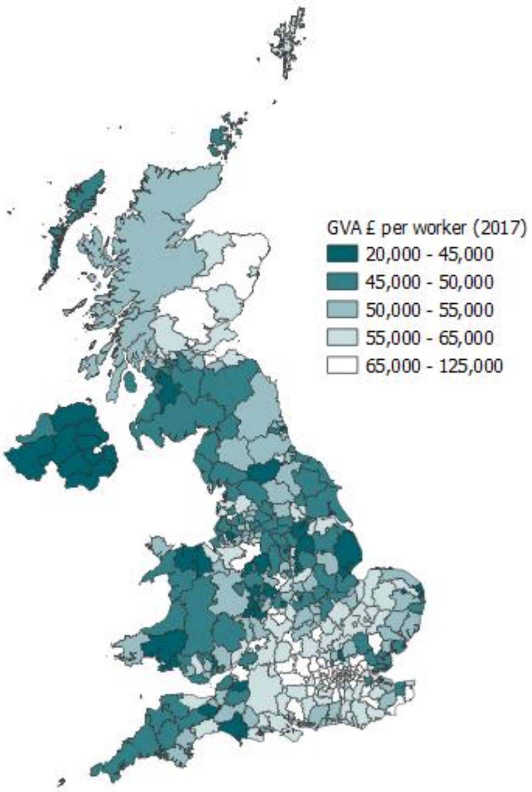
Source: Vivid Economics

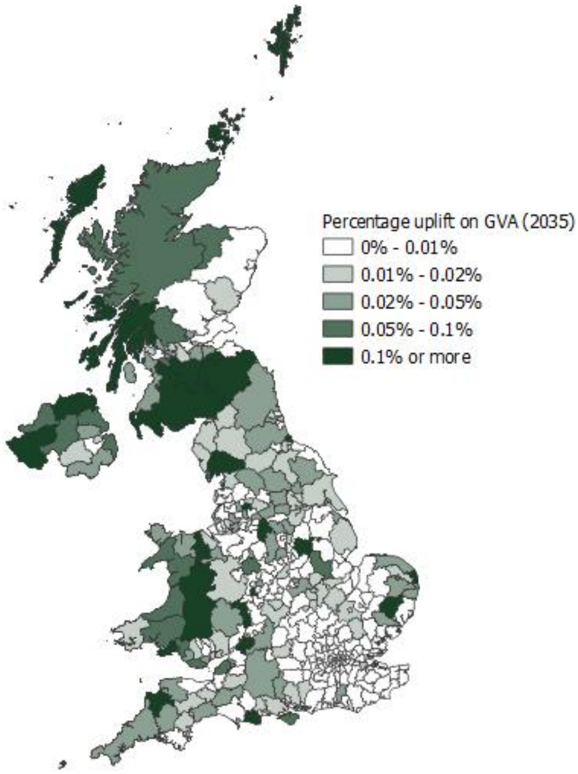
Productivity gains could be larger in local authorities that are currently below the national average. Figure 14 shows the productivity of local authorities (left panel), and the percentage uplift on GVA that can be brought by onshore wind (right panel). As shown, local authorities that receive the greatest productivity uplift from

[8] See the technical appendix for the data source and estimation procedure for onshore wind job productivity.

onshore wind jobs coincide with some of the least productive local authorities, distributed across Northern Ireland, Scotland, Wales and Cornwall. As with the location of future employment opportunities, the location of productivity benefits presented here should be treated as an indicative projection.

Figure 14 Distribution of existing productivity levels (left) and percentage uplift on GVA (right)





Source: Vivid Economics, ONS (2019c)

5 Concluding remarks

An affordable low-carbon future in line with the CCC's net zero recommendation requires the use of low-cost, low-carbon technologies including onshore wind. If it fails to recognise this, the UK risks an unnecessarily expensive transition and missing out on significant socioeconomic benefits. This report outlines how deploying 35 GW of onshore wind by 2035 could reduce UK electricity costs by 7%, support 31,000 jobs, lift productivity throughout the country, and enable a £360m export industry. These benefits are, however, contingent on removing existing barriers that have depressed deployment in 2018 and undermined the economic viability of future projects. The lack of access to CfD auctions and strict planning constraints remain the greatest challenges.

References

Arup (2018) Cost of Capital Benefits or Revenue Stabilisation via a Contract for Difference: https://www.arup.com/perspectives/publications/research/section/onshore-wind-financing

Baringa (2017) An analysis of the potential outcome of a further 'Pot 1' CfD auction in GB: https://www.scottishrenewables.com/publications/baringa-sr-analysis-potential-outcome-pot-1-cfd-/

BEIS (2016) Electricity Generation Costs: https://www.gov.uk/government/publications/beis-electricity-generation-costs-november-2016

BEIS (2018) Digest of UK Energy Statistics (DUKES) 2018: https://www.gov.uk/government/statistics/digest-of-uk-energy-statistics-dukes-2018-main-report

BEIS (2019a) Contracts for Difference: https://www.gov.uk/government/publications/contracts-for-difference/contract-for-difference

BEIS (2019b) Renewable Energy Planning Database: https://www.gov.uk/government/publications/renewable-energy-planning-database-monthly-extract

BEIS (2019c) Valuation of Energy Use and Greenhouse Gas: https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/794737/valuation-of-energy-use-and-greenhouse-gas-emissions-for-appraisal-2018.pdf

BVG (2017) Economic benefits from onshore wind farms: https://bvgassociates.com/economic-benefits-onshore-wind-farms/

BVG (2018) The Power of Onshore Wind: https://bvgassociates.com/the-power-of-onshore-wind/

Committee on Climate Change (2017) Energy Prices and Bills Report 2017: https://www.theccc.org.uk/publication/energy-prices-and-bills-report-2017/

Committee on Climate Change (2018) Reducing UK emissions: 2018 Progress Report to Parliament: https://www.theccc.org.uk/wp-content/uploads/2018/06/CCC-2018-Progress-Report-to-Parliament.pdf

Committee on Climate Change (2019a) Net Zero – The UK's contribution to stopping global warming: https://www.theccc.org.uk/publication/net-zero-the-uks-contribution-to-stopping-global-warming/

Committee on Climate Change (2019b) Net Zero Technical Report: https://www.theccc.org.uk/wp-content/uploads/2019/05/Net-Zero-Technical-report-CCC.pdf

EWEA (2009) The Economics of Wind Energy: http://www.ewea.org/fileadmin/files/library/publications/reports/Economics_of_Wind_Energy.pdf

Genecon (2014) Dogger Bank Offshore Wind Farm Economic Benefits Study, Technical Paper: https://infrastructure.planninginspectorate.gov.uk/wp-content/ipc/uploads/projects/EN010021/EN010021-001157-Forewind%20Response%20to%20Second%20Written%20Questions%20Question%2068%20Appendix%201.pdf

IEA (2017) Energy Technology Perspectives 2017: https://www.iea.org/etp2017/

IRENA (2019) Renewable Electricity Capacity and Generation Statistics, April 2019: https://www.irena.org/Statistics/View-Data-by-Topic/Capacity-and-Generation/Statistics-Time-Series

ONS (2018) Annual Business Survey (ABS): https://www.ons.gov.uk/businessindustryandtrade/business/businessservices/methodologies/annualbusinesssurveyabs

ONS (2019a) Low carbon and renewable energy economy, UK: 2017: https://www.ons.gov.uk/economy/environmentalaccounts/bulletins/finalestimates/2017

ONS (2019b) LI01 Regional labour market: Local indicators for counties, local and unitary authorities: https://www.ons.gov.uk/employmentandlabourmarket/peopleinwork/employmentandemployeetypes/datasets/locallabourmarketindicatorsforcountieslocalandunitaryauthoritiesli01

ONS (2019c) Subregional productivity: labour productivity indices by city region: https://www.ons.gov.uk/economy/economicoutputandproductivity/productivitymeasures/datasets/subregionalproductivitylabourproductivitygvaperhourworkedandgvaperfilledjobindicesbycityregion

Vivid Economics and Imperial College London (2019) Accelerated electrification and the GB electricity system: https://www.theccc.org.uk/publication/accelerated-electrification-and-the-gb-electricity-system/

Wind Europe (2019) Wind energy in Europe in 2018: https://windeurope.org/wp-content/uploads/files/about-wind/statistics/WindEurope-Annual-Statistics-2018.pdf

Company profile

Vivid Economics is a leading strategic economics consultancy with global reach. We strive to create lasting value for our clients, both in government and the private sector, and for society at large.

We are a premier consultant in the policy-commerce interface and resource- and environment-intensive sectors, where we advise on the most critical and complex policy and commercial questions facing clients around the world. The success we bring to our clients reflects a strong partnership culture, solid foundation of skills and analytical assets, and close cooperation with a large network of contacts across key organisations.

Contact us

Vivid Economics Limited
163 Eversholt Street
London NW1 1BU
United Kingdom

T: +44 (0)844 8000 254
enquiries@vivideconomics.com