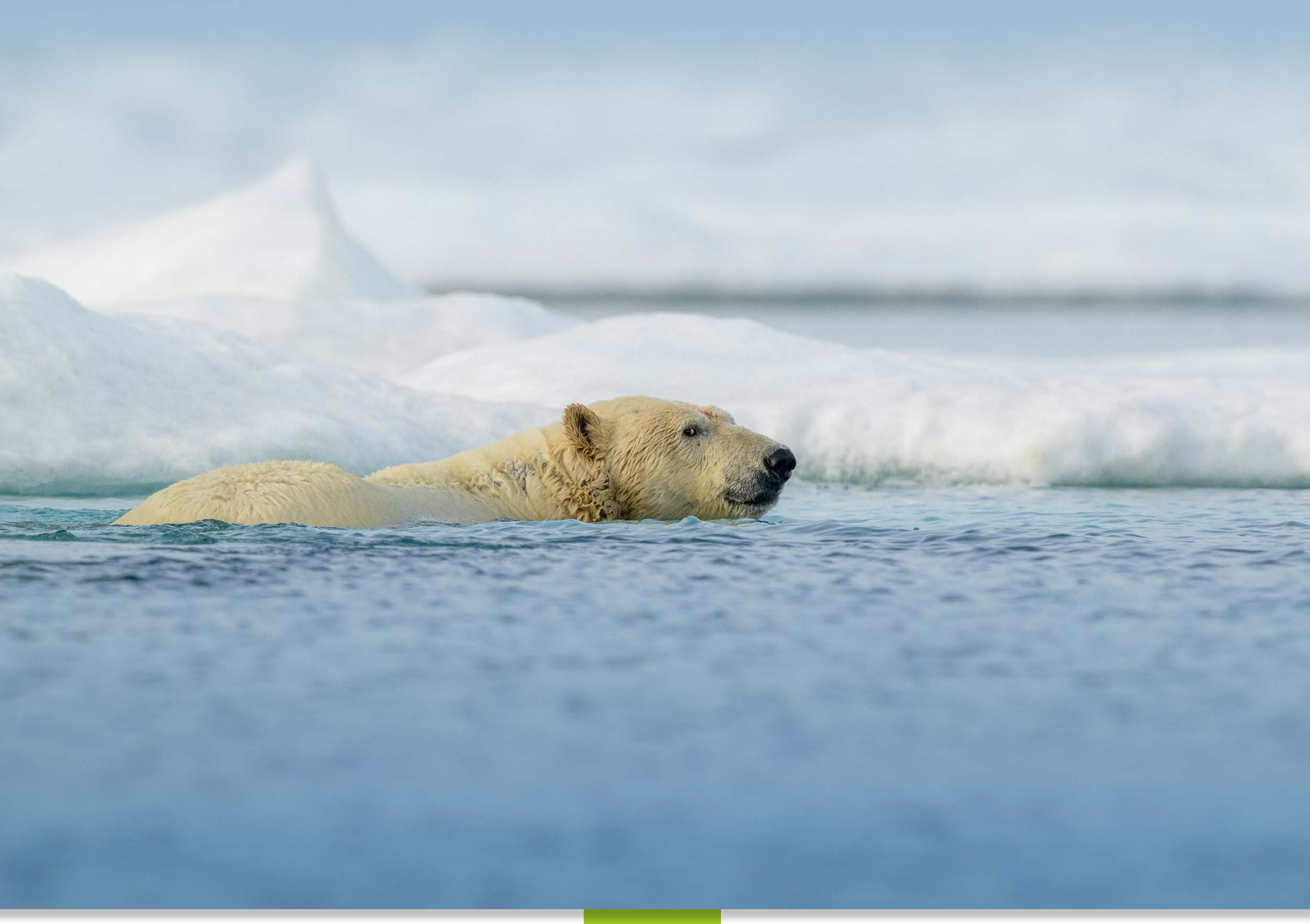
A GREEN BRITAIN FOUNDATION REPORT

THE CASE FOR GREEN ENERGY

AUGUST 2024

Polar Bears and Ice Caps or Jobs and GDP?



Foreword - The real economics of green energy

Green is the colour of the environment and of money. And traditionally the two have been quite separate - we have typically needed to pay for one with the other.

This may at least partly explain why it's commonplace to hear arguments about green energy and the related transition to net zero, that characterise it as something expensive that we have to slow down to make more affordable.

It is quite normal to expect that we have to pay for the environment with the economy. Green energy has been a good example of that. It simply cost more and needed support.

But things change. In the last few years we've seen a rapid price reduction in the technologies we use to harness the power of the wind and sun.

In this report we take a close look at the economics of green energy compared to those of fossil fuels. We've crunched the numbers and expressed the potential in terms of two key economic measures - jobs and economic growth created.

This should enable an update to the narrative on this most vital of all issues - green energy is after all fundamental to the transition to net zero which itself is fundamental to avoiding the worst of the climate crisis.

Our research shows that investing in green energy creates more than twice as many jobs in the UK than the equivalent investment in fossil fuels.

And that it contributes almost twice (1.7 times) as much to our GDP.

Twice the jobs and twice the GDP growth in broad terms

The business case for green energy is underscored dramatically by this example - One billion pounds invested in solar energy will return almost two billion pounds to the economy (£1.9b).

That same billion pounds invested in fossil fuels will return only marginally more than the original investment at just £1.1 billion.

These numbers show the current narrative as counter factual - we don't need to slow the transition down to save money - we need to speed it up.

We get more jobs and greater GDP growth with green energy investment — but also we get enduring versions of both, because the wind and sun are forever fuels — while fossil fuels are single use.

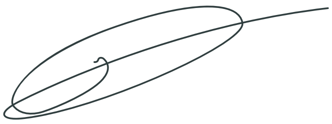
Britian's fossil fuels are running out, the North Sea is 90% depleted now. Our wind and sun will never run out. It's as simple and dramatic as that. Green energy jobs are forever jobs.

The transition to green energy is the biggest economic opportunity we've had, probably since the first Industrial Revolution.

This report shows that investment in green energy is not an environment policy, it's first and foremost an economic one.

It's not about ice caps and polar bears any more. It's about jobs and GDP.

It's the Green Economy stupid, as Bill Clinton nearly said.



Dale Vince OBE
Founder of Ecotricity

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Context

This research summary contains a rapid, systematic review of evidence for the employment and growth outcomes of investment in renewable energy technologies such as wind and solar, in line with the UK government's legally binding net zero commitment. Building on a previous analysis conducted by 3Keel in partnership with Greenpeace, on *Jobs and the Green Recovery*, this project aims to answer the following three questions:

1) What is the gross contribution of investment in wind and solar to employment in the UK?
2) What is the gross contribution of investment in wind and solar to the GDP of the UK?
3) What level of investment is needed to build sufficient renewable capacity to meet the UK government's net zero commitment?

To answer these questions, we focus on two indicators and three levels of impacts:

Indicators:

- **Employment** – the sum of paid employment generated as a result of investment
- **Gross value added (GVA)** – the sum of value generated in the production of goods and services as a result of investment; we use the GVA estimates to approximate our GDP estimates.

Levels of impacts:

- **Direct** – increased GVA and employment generated directly by investment
- **Indirect** – increased GVA and employment generated in the supply chain
- **Induced** – increased GVA and employment generated from greater demand and spending by those who are employed as a result of the direct and indirect impacts

This study includes a review of macro-level data for each of the key technologies investigated, as well as a selection of case studies to provide real life context. The following slides outline the methodology, key findings, and conclusions of our research.

Key Findings

- **Investing in clean energy creates up to 2.5 times more jobs in the UK than the equivalent investment in fossil fuels.** Per billion pounds invested, the UK government could create approximately 16,400 UK jobs by investing in solar, or 6,200 in onshore wind, while investment in fossil fuels creates only 5,700 UK jobs.

- **Investing in clean energy contributes up to 1.7 times more to the UK's Gross Domestic Product (GDP) than the equivalent investment in fossil fuels.** One billion pounds invested can contribute £1.9bn to UK GDP if invested in solar, £1.2bn if invested in wind, and only £1.1bn if invested in fossil fuels.

- **Investing in a mixed renewable energy portfolio can create jobs across multiple sectors and all four nations of the UK.** Investment in wind and solar can create jobs in manufacturing, construction, professional, scientific and technical activities, as well as boosting the UK's energy security and decarbonising the grid.

- **The UK can create 200,000 jobs every year by investing in sufficient clean energy generation to meet its legally binding net zero commitments.** According to the Climate Change Committee's *Balanced Net Zero Pathway*, the UK will need to generate 514 TWh of electricity every year from offshore wind, onshore wind and solar photovoltaics by 2050 in order to achieve a net zero grid – in addition to storage, flexibility and other clean energy sources. Achieving the wind and solar components of this alone would add £29bn to annual UK GDP and create 200,000 jobs, every year.

Technology	GDP contribution per £1 billion invested	Employment contribution (FTE) per £1 billion invested
Solar PV	£1.88 bn	16,400
Onshore wind	£1.16 bn	6,186
Offshore wind	£0.86 bn	4,859
Coal, Oil & Gas	£1.11 bn	5,678

Table 1: GDP and employment contributions per billion pounds invested, by technology

Economic Impacts

We estimate that every £1 billion invested in each of these industries will generate:

Solar PV	Onshore Wind	Offshore Wind	Fossil Fuels
£1.88 bn	£1.16 bn	£0.86 bn	£1.10 bn

Figure 1: GDP impacts of investment in different renewable electricity generation technologies

Broken down by direct, indirect and induced GDP, this means:

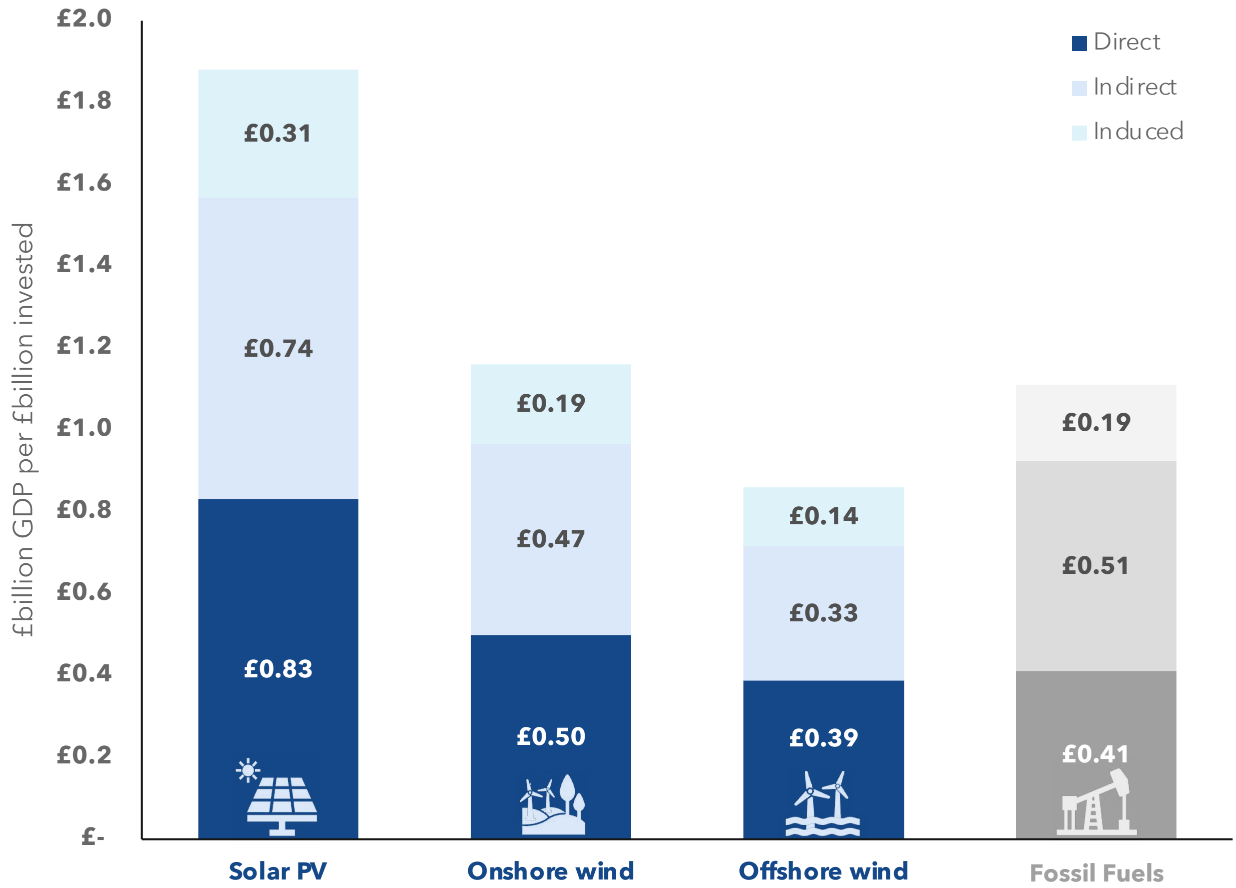

Figure 2: Direct, indirect and induced GDP impacts of investment in different renewable electricity generation technologies

Economic Impacts

Distributional impacts on GDP: by regions

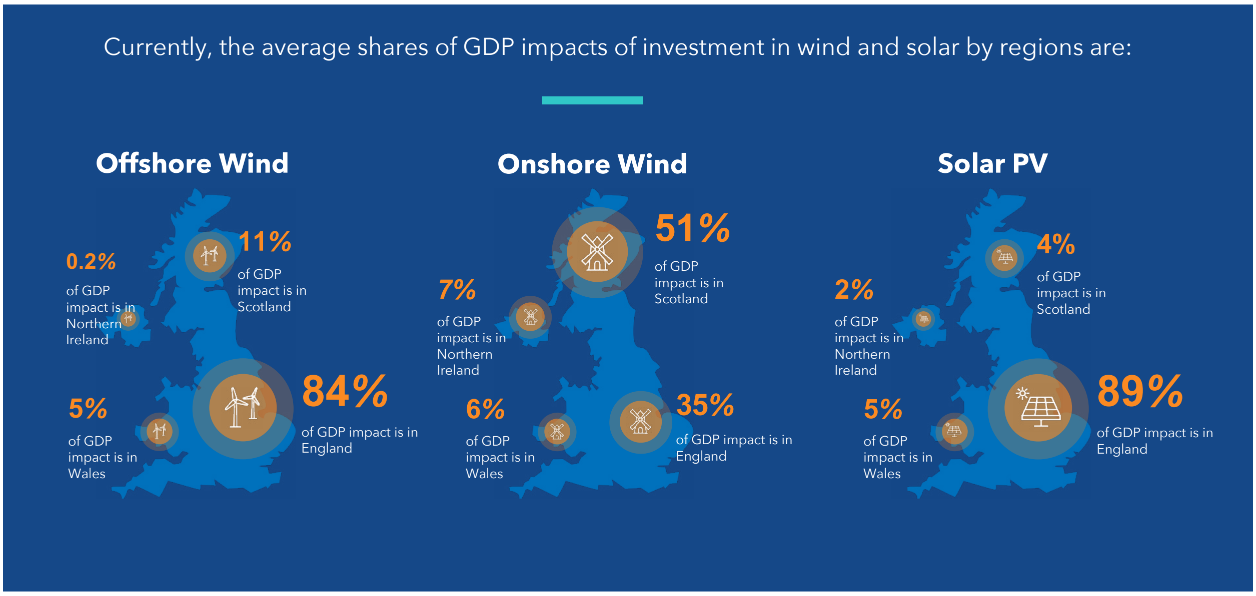

Figure 3: GDP distributional impacts of investment in different renewable electricity generation technologies, by region

Distributional impacts on GDP: by industries

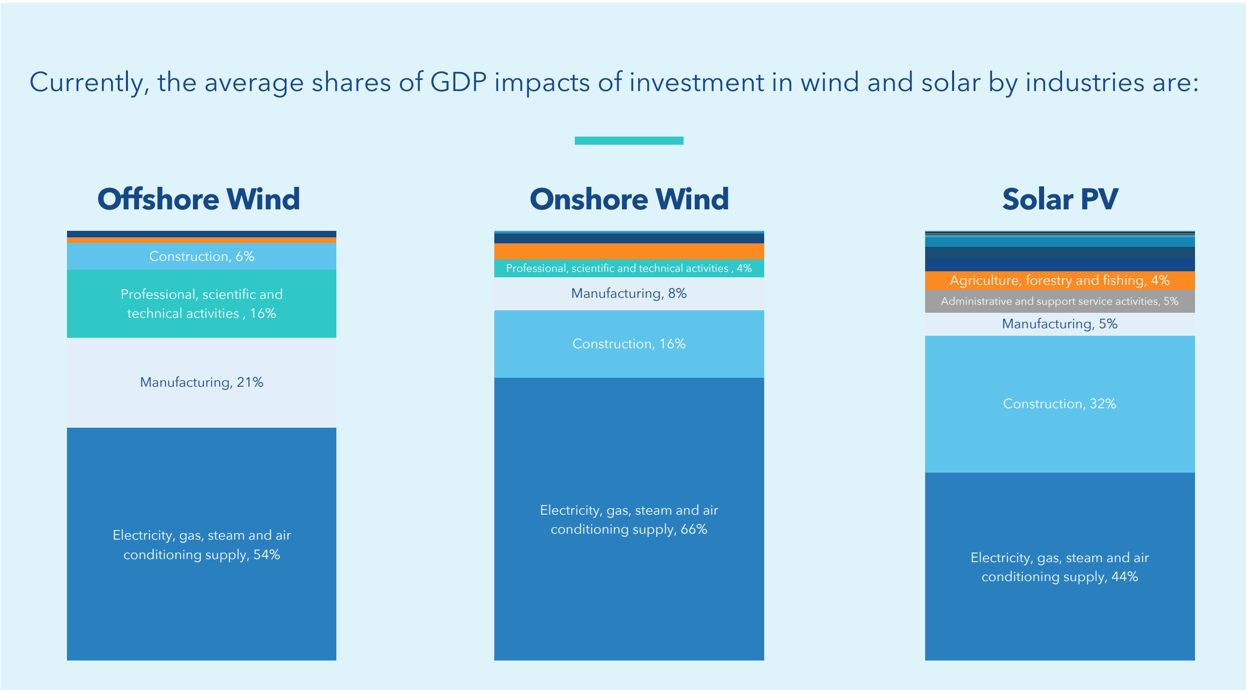

Figure 4: GDP distributional impacts of investment in different renewable electricity generation technologies, by industry

Employment Impacts

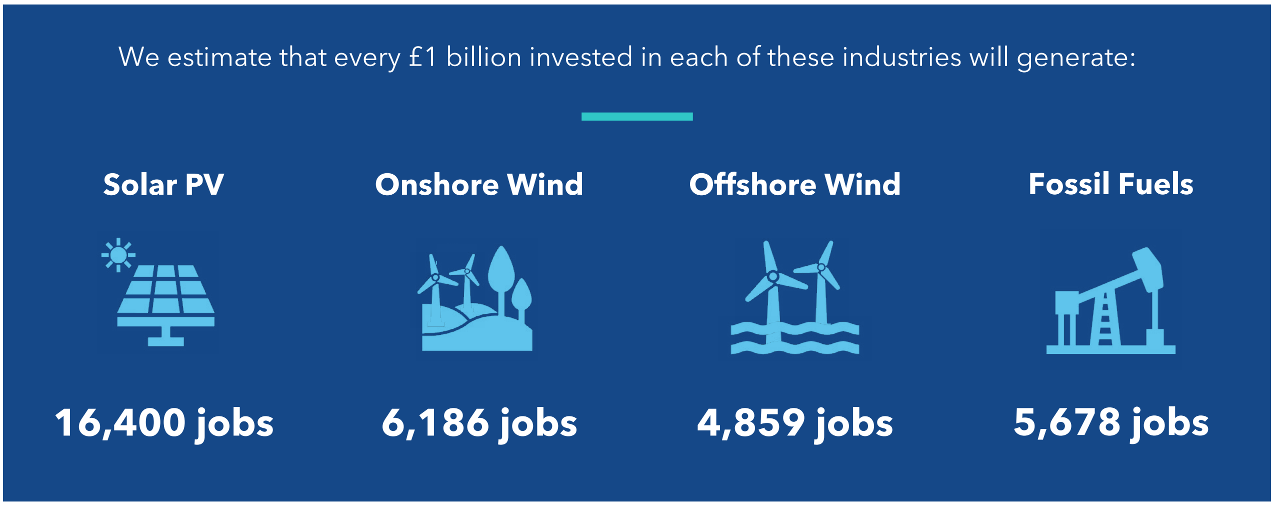

Figure 5: Employment impacts of investment in different renewable electricity generation technologies

Broken down by direct, indirect and induced jobs, this means:

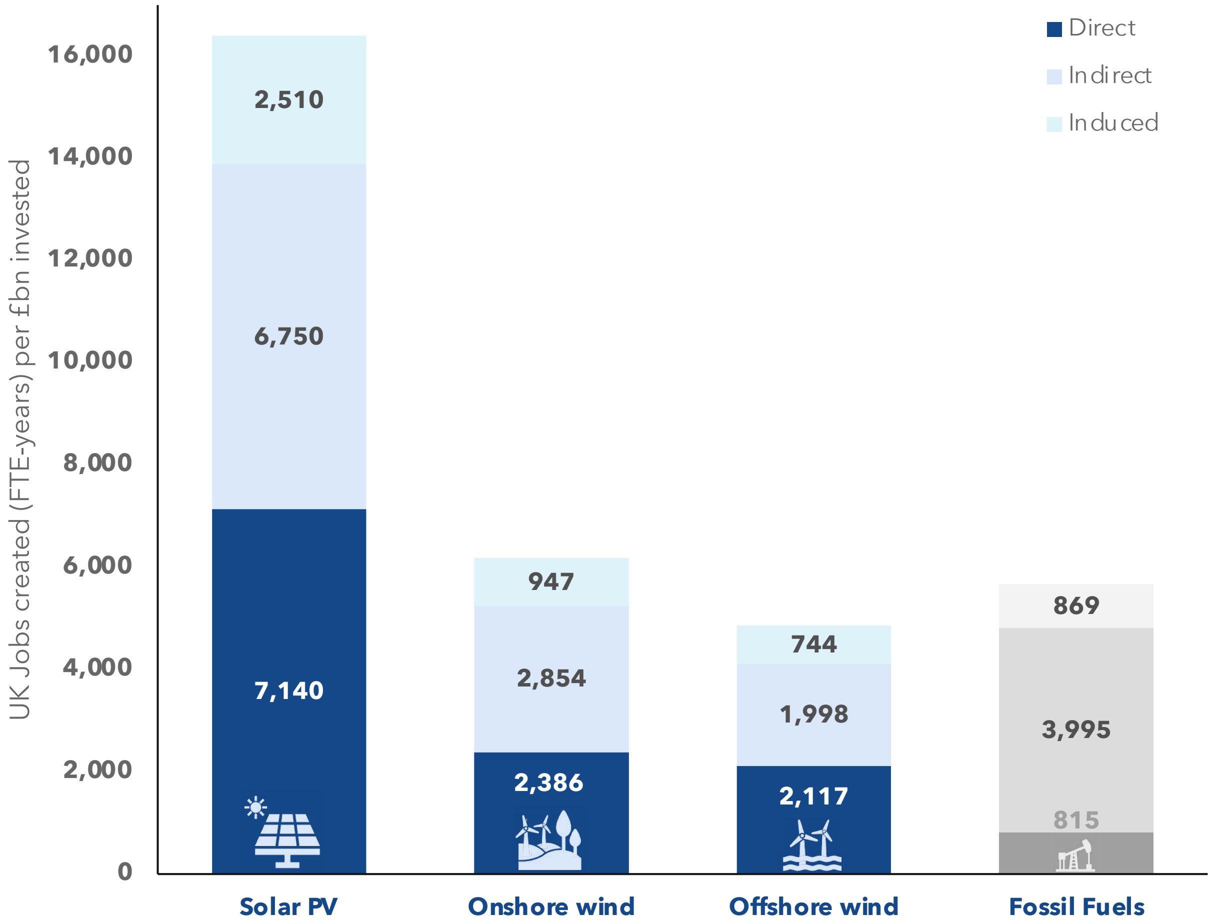

Figure 6: Direct, indirect and induced employment impacts of investment in different renewable electricity generation technologies

Employment Impacts

Distributional impacts on jobs: by regions

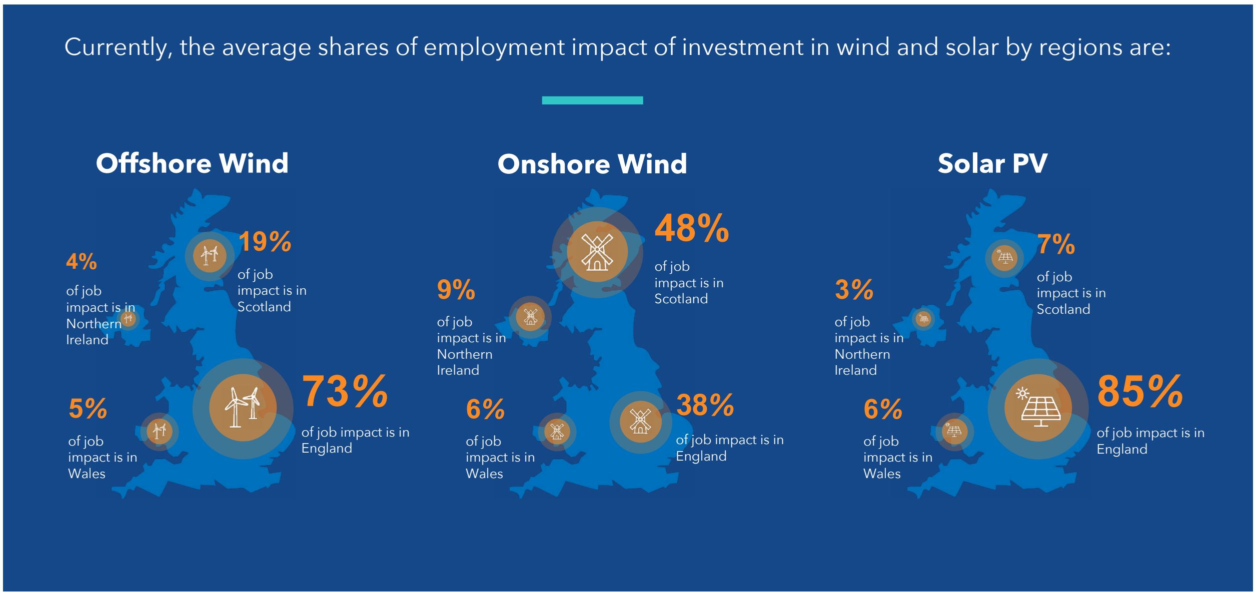

Figure 7: Employment distributional impacts of investment in different renewable electricity generation technologies, by region

Distributional impacts on jobs: by industries

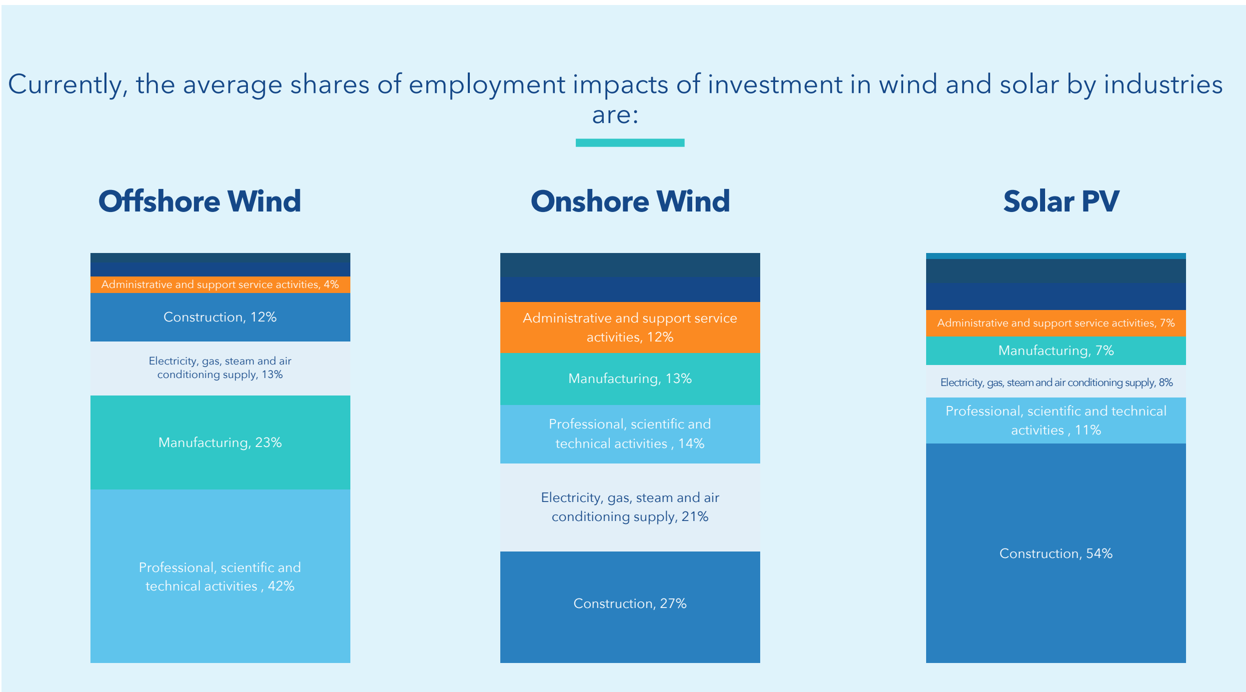

Figure 8: Employment distributional impacts of investment in different renewable electricity generation technologies, by industry

Net Zero Requirements

According to the UK's Climate Change Committee, meeting the UK's Net Zero Balanced Pathway will require a significant increase in electricity generation:

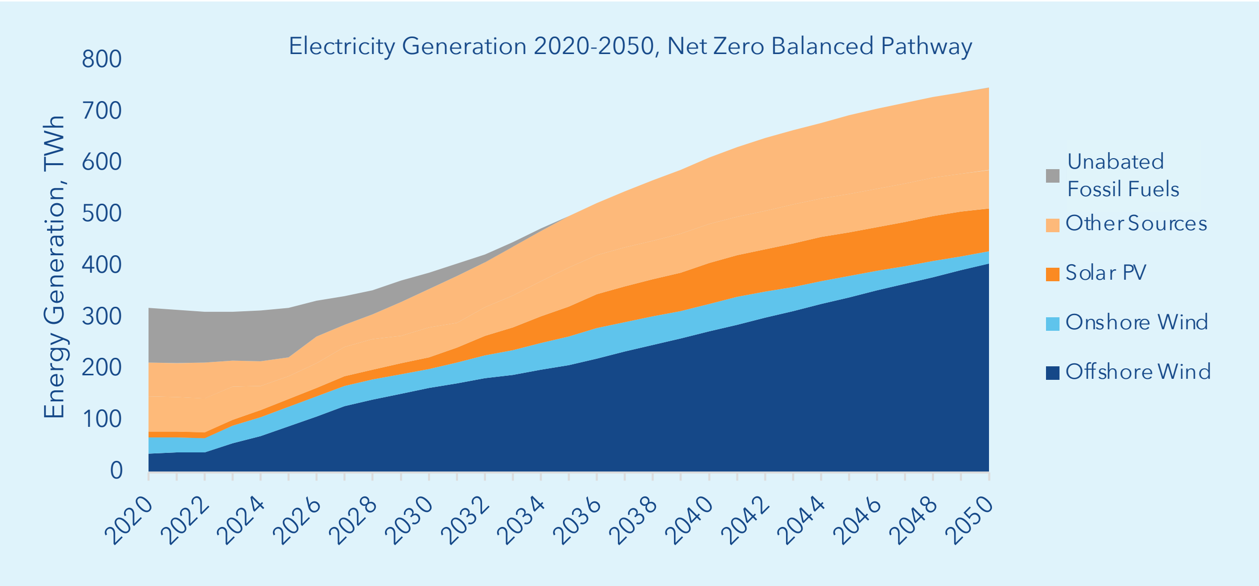

Figure 9: Electricity generation required to meet the CCC's Net Zero Balanced Pathway. Other sources include nuclear, other renewables (e.g. hydro), interconnection, storage, biomass and/or CCS approaches.

To meet this increase, the UK will need to invest significantly in new renewable energy development. Investing in the solar PV, offshore wind and onshore wind components of this alone would require £23bn annual investment from 2022-2050. This would generate 2.4 times more UK jobs and contribute 1.7 times more to the UK's GDP than the equivalent fossil fuel investment that would be required to meet growing electricity demands, as shown in figure 10 below:

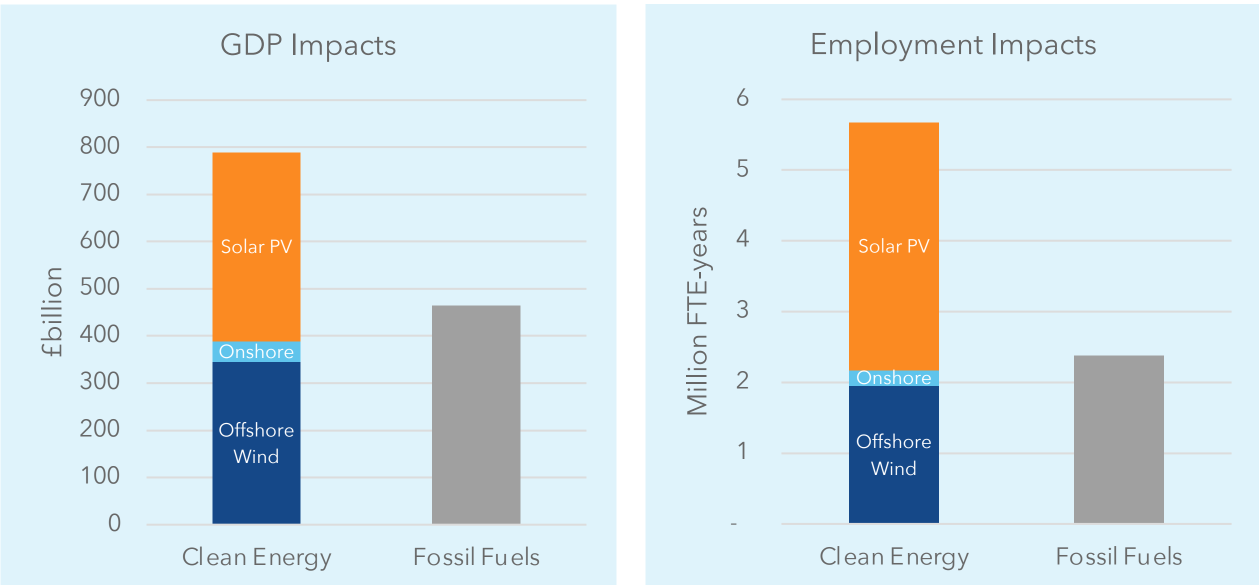

Figure 10: GDP (left) and Employment (right) created by investing £23bn a year to meet the UK's electricity generation requirements by 2050. Figures include recognition of the variability of renewable sources, accounting for individual technologies and their load factors.

Appendix 1: Methodology

Top-line estimates

To generate our top-line estimates, we performed a simplified input-output analysis, by calculating the GVA and employment contribution of investment in wind and solar.

To calculate the total GVA and employment generated, for example, we applied the following:

- Total GVA impacts: $Total\ GVA = Direct\ GVA \times Type\ II\ multiplier$
- Total employment impacts: $Total\ employment = Direct\ employment \times Type\ II\ multiplier$

In both calculations, Type II multipliers sum together the direct, indirect, and induced impacts. Our methodology for finding the GVA and employment estimates comprised two key steps:

- **Step 1:** Find estimates for direct GVA and employment created from investment in wind and solar
- **Step 2:** Find estimates for Type II multipliers for GVA and employment.

Data sources for top-line estimates

To ensure the validity and robustness of our results, we relied on two types of data sources, macro-level and micro-level data:

Macro-level data: The key data source was economy-wide and sector-wide data provided by the Office for National Statistics and the Scottish Government Input-Output team. We utilised the annual estimates of low carbon and renewable energy economy activity in the UK and constituent countries to identify the total turnover, employment, and acquisitions for offshore wind, onshore wind, and solar PV, produced by the Office for National Statistics. To find total GVA, we applied a GVA-turnover ratio of 42%, derived from the UK Annual Business Survey, produced by the Office for National Statistics. To find the multipliers, we used sector-specific Type 1 multipliers, produced by the Office for National Statistics, and Scotland's economy-wide Type 2 multipliers, produced by the Scottish Government Input-Output team. As the Type 2 multipliers were not available for the UK, we used Scotland's Type 2 multipliers for our estimates. We used the GVA estimates to approximate our GDP estimates using a GVA-GDP ratio of 88%, derived from the UKEA data on taxes on production and imports less subsidies as percentage of GDP.

Micro-level data: The second type of data source was project-specific data produced by companies. This data included the estimates for direct, indirect, and induced impacts from the investments in solar and wind. For this data, we focused only on UK-based projects.

Distributional impacts

To investigate the distributional impacts of the investment in wind and solar, we relied solely on macro-level data provided by the Office for National Statistics. The annual estimates of low carbon and renewable energy economy activity in the UK and constituent countries include the breakdown of turnover and employment by regions and industries.

Investment needs for net zero

To investigate investment needs for net zero, we used data from the Climate Change Committee (CCC)'s 6th Carbon Budget – which provides estimates for the total electricity generation requirements needed to meet the 'Balanced Net Zero Pathway', a scenario which models decarbonisation pf the UK as part of a just transition to net zero. We used this data, combined with BEIS load factors (to account for the intermittency of renewable electricity generation), to estimate the total new renewable electricity capacity required to deliver a net zero grid by 2050. We combined this with our Macro-level data for the investment cost required per MWh of new electricity capacity, to estimate the total investment required to produce sufficient renewable electricity to decarbonise the grid. Note that this only includes the investment required to develop, construct, operate and decommission clean energy infrastructure, and does not include investment required for energy storage or other grid modernisations related to grid updates.

Appendix 2: Case Studies

Technology	Site/Location	Source	Data Type	£billion GVA per £billion invested				£billion GDP per £billion invested				Employment (FTE-Years) per £billion Investment			
				Direct	Indirect	Induced	Total	Direct	Indirect	Induced	Total	Direct	Indirect	Induced	Total
Offshore wind	**UK Average**	**LCREE**	**Macro**	**0.34**	**0.29**	**0.13**	**0.76**	**0.39**	**0.33**	**0.14**	**0.86**	**2,117**	**1,998**	**744**	**4,859**
Offshore wind	Beatrice	SSE	Micro	0.37	0.37	0.22	0.96	0.42	0.42	0.25	1.09	4,254	4,346	3,464	12,064
Offshore wind	UK Average	Allan et al.	Macro	0.34	0.33	0.53	1.20	0.38	0.38	0.60	1.36	5,282	4,916	9,613	19,811
Onshore wind	**UK Average**	**LCREE**	**Macro**	**0.44**	**0.41**	**0.17**	**1.02**	**0.50**	**0.47**	**0.19**	**1.16**	**2,386**	**2,854**	**947**	**6,186**
Onshore wind	Strathy North	SSE	Micro	0.47	0.35	0.32	1.14	0.54	0.39	0.37	1.30	6,411	5,344	4,663	16,417
Onshore wind	Great Glen	SSE	Micro	0.48	0.32	0.30	1.10	0.54	0.36	0.34	1.25	5,690	4,287	4,047	14,023
Onshore wind	Keadby	SSE	Micro	0.42	0.37	0.24	1.03	0.48	0.42	0.27	1.17	6,339	6,510	4,455	17,304
Onshore wind	Sutherland	SSE	Micro	0.53	0.31	0.34	1.19	0.61	0.36	0.39	1.35	7,199	4,537	5,255	16,991
Onshore wind	Clyde	SSE	Micro	0.20	0.20	0.13	0.54	0.23	0.23	0.15	0.61	2,985	3,781	2,338	9,104
Onshore wind	Scottish Power (8 Farms)	Scottish Power	Micro	0.59	0.39	0.22	1.21	0.67	0.45	0.25	1.37	13,906	11,179	4,383	29,468
Solar PV	**UK Average**	**LCREE**	**Macro**	**0.73**	**0.65**	**0.28**	**1.65**	**0.83**	**0.74**	**0.31**	**1.88**	**7,140**	**6,750**	**2,510**	**16,400**
Solar PV	UK Average	CEBR	Macro	0.73	0.54	0.48	1.75	0.83	0.61	0.54	1.99	7,140	5,569	3,927	16,636
Solar PV - Rooftop	UK Average	LCREE	Macro	0.77	0.69	0.29	1.75	0.88	0.78	0.33	1.99	7,327	6,928	2,576	16,831
Solar PV – Utility scale	UK Average	LCREE	Macro	0.64	0.60	0.22	1.46	0.72	0.68	0.25	1.66	6,718	6,352	2,362	15,432
Fossil Fuels	**UK Average**	**ONS**	**Macro**	**0.36**	**0.45**	**0.16**	**0.98**	**0.41**	**0.51**	**0.19**	**1.11**	**815**	**3,995**	**869**	**5,678**
Fossil Fuels	UK Average	OGUK	Macro	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	815	3,611	3,591	8,017
Fossil Fuels	UK Average	Neptune	Macro	0.36	0.22	0.13	0.71	0.41	0.25	0.15	0.81	815	13,745	8,983	23,543
Fossil Fuels	UK Average	Oxford Economics	Macro	0.36	0.32	0.21	0.90	0.41	0.36	0.24	1.02	815	624	532	1,971

Table 2: GVA, GDP and employment contributions per billion pounds invested, by example. Rows in **blue** are UK average macro-level figures, rows in **grey** are macro-level studies, micro-level case studies or literature studies

Appendix 2: Case Studies

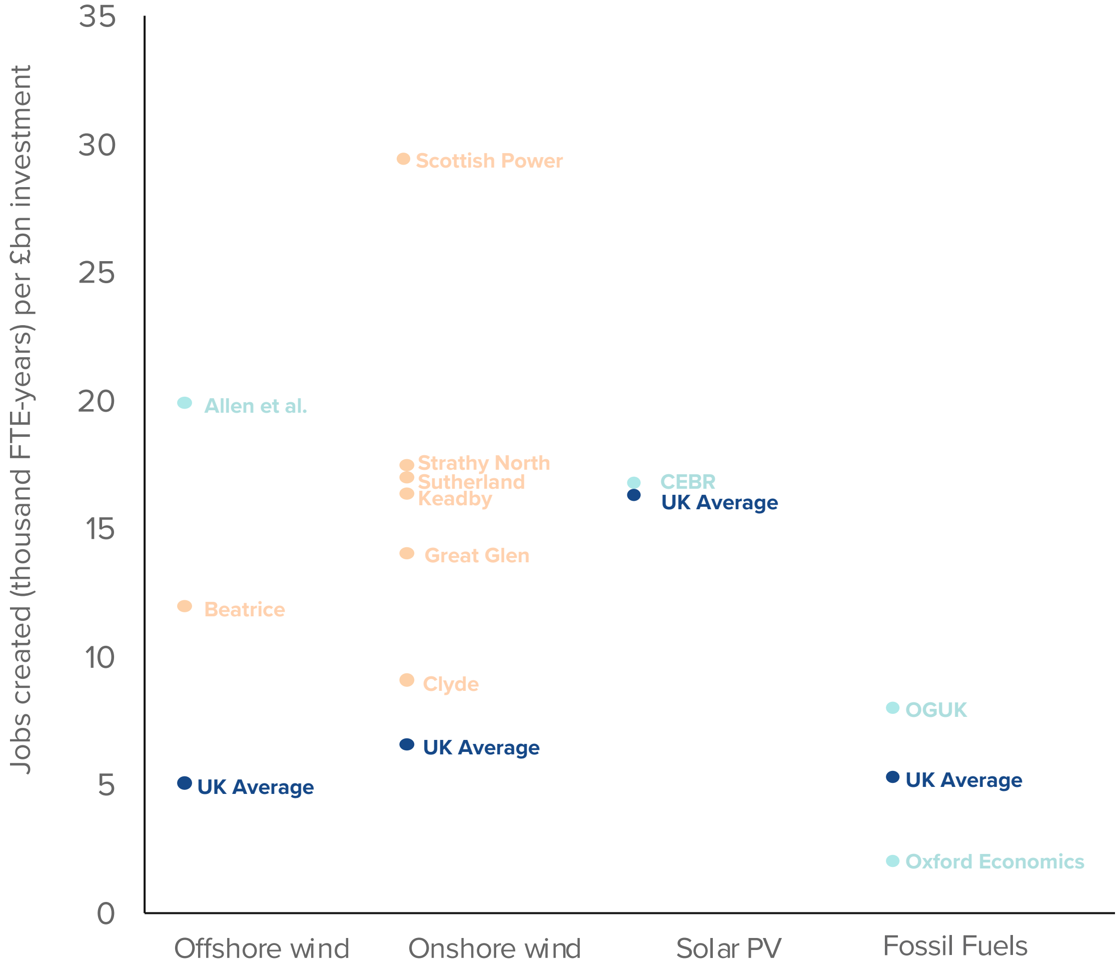

Figure 11: Real life (orange) and literature (green) case studies compared to UK average macro-level figures on employment figures per £bn investment

Appendix 3: Biomass & Energy Efficiency

In addition to analyses of wind, solar and renewables, data has also been collected exploring the economic and employment impacts of investment in biomass and waste, as well as energy efficiency programmes. These analyses have been performed using the same data and methodology as described in Appendix 1.

Table 3, below, shows the results of this analysis:

				Direct	Indirect	Induced	Total	Direct	Indirect	Induced	Total	Direct	Indirect	Induced	Total
Technology	Site/Location	Source	Data Type	£billion GVA per £billion invested				£billion GDP per £billion invested				Employment (FTE-Years) per £billion Investment			
Biomass & Waste	**UK Average**	**LCREE**	**Macro**	**1.33**	**1.13**	**0.49**	**2.96**	**1.52**	**1.28**	**0.56**	**3.37**	**8,590**	**8,612**	**3,108**	**20,310**
Energy Efficiency	**UK Average**	**LCREE**	**Macro**	**8.35**	**5.91**	**2.85**	**17.1**	**9.49**	**6.71**	**3.24**	**19.4**	**177,636**	**125,361**	**56,561**	**369,558**

Table 3: GVA, GDP and employment contributions per billion pounds invested, by technology.

The figures for energy generation from biomass & waste have been compared to a case study provided by Ecotricity, detailing the economic and employment impacts of building one green gas mill. Results are shown in Table 4 below:

				Direct	Indirect	Induced	Total	Direct	Indirect	Induced	Total	Direct	Indirect	Induced	Total
Technology	Site/Location	Source	Data Type	£billion GVA per £billion invested				£billion GDP per £billion invested				Employment (FTE-Years) per £billion Investment			
Biomass & Waste	**UK Average**	**LCREE**	**Macro**	**1.33**	**1.13**	**0.49**	**2.96**	**1.52**	**1.28**	**0.56**	**3.37**	**8,590**	**8,612**	**3,108**	**20,310**
Biomass & Waste - Green Gas Mill Only	**Ecotricity**	**Ecotricity**	**Micro**	**0.83**	**0.70**	**0.31**	**1.84**	**0.94**	**0.80**	**0.35**	**2.09**	**2,727**	**2,734**	**987**	**6,448**

Table 4: GVA, GDP and employment contributions per billion pounds invested, for UK Average biomass & waste data, compared to Ecotricity case study (green gas mill only).

The research was compiled by 3Keel who are an Oxford-based firm of sustainability advisors specialised in working with food systems, supply chains and landscapes. They use their knowledge and skills to accelerate systems change and business transformation towards a world in which nature, people and enterprises thrive.