UK Energy Research Centre

UKERC Technology and Policy Assessment

Green Jobs II Project

UKERC project scoping note

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Introduction to UKERC

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Technology and Policy Assessment (TPA) within UKERC

The Technology and Policy Assessment (TPA) team was set up to inform decision-making processes and address key controversies in the energy field. It aims to provide authoritative and accessible reports that set very high standards for rigour and transparency. Subjects are chosen after extensive consultation with energy sector stakeholders.

The TPA has been part of UKERC since the centre was established in 2004 and is now in its fourth phase, which started in 2019. The primary objective of the TPA is to provide a thorough review of the current state of knowledge through systematic reviews of literature, supplemented by primary research and wider stakeholder engagement where required.

Contents

1. The subject of this TPA project

1.1 Introduction: the subject and its importance

In 2014 the UKERC TPA team completed a review on low carbon jobs, examining the evidence for net job creation from policy support for energy efficiency and renewable energy (Blyth et al., 2014). This report examined the economy-wide consequences of policies encouraging investment in energy efficiency and renewable energy. It examined whether, how, to what extent and under what conditions such policies lead to net job creation in the implementing regions. The assessment was confined to OECD economies and covers all relevant policy measures with the exception of carbon taxes and carbon emission trading schemes.

Given the UK net zero emissions target and the economic implications of the COVID-19 pandemic, there is a pressing need to update our previous analysis on net job creation potential and skills requirements in the renewable energy and energy efficiency sectors. A key question is whether investment in the low carbon transition can be combined with, and facilitate, post-COVID-19 economic growth (Figueres and Zycher, 2020; Gross, 2020b). There have been a plethora of calls for investment in green jobs, skills and infrastructure to help kickstart economic recovery from COVID-19, in a way that is compatible with achieving net zero emissions and a societally just transition (Allan et al., 2020; CCC, 2020; EEIG, 2020; Jung and Murphy, 2020; Webb et al., 2020). In their latest Progress Report to Parliament, the Committee on Climate Change (CCC, 2020) highlight several priority areas for post COVID-19 investment which include low-carbon and climate-resilient infrastructure, reskilling and retraining for a net zero and climate resilient economy, and low carbon retrofitting and future proofing of buildings.

This project will provide an update to the 2014 UKERC TPA report on green job creation (Blyth et al., 2014). Our updated analysis will consider the question of whether policy driven expansion of specific low carbon sectors actually creates jobs, particularly if the policies in question require subsidies that are paid for through bills or taxes. Employment and economic benefits are often cited as part of efforts to lobby for investment in clean energy projects such as renewables, low carbon heating and energy efficiency (e.g. EEIG, 2020; Hydrogen Strategy Now, 2020; McPhee, 2020). Such claims are often backed up by project or sector specific analyses. However historically, other literature has been more sceptical, claiming that any intervention that raises costs in the energy sector will have an adverse impact on the economy as a whole (Huntington, 2009; Michaels and Murphy, 2009; Morriss et al., 2009). One significant change since 2014 is the rapid reduction in costs of leading renewable energy technologies (IRENA, 2020; Jansen et al., 2020), and this changes the economic context that the project will explore.

This topic area has links to related topics including skills and supply chains, transitioning to a low carbon economy, industrial decarbonisation, just transitions, and local/community energy – all topics that were raised as priority areas during the most recent TPA topics consultation exercise. In respect of policy relevance it has

clear links to the latest UK Government Clean Growth Strategy (BEIS, 2017) aspiration and plans.

1.2 Context and earlier work

In some contexts, it is important to explicitly define what is meant by a 'green job'. Some categories of job will be obviously 'green'; installing and maintaining solar panels or wind turbines, for example. Others are less obvious – are the lorry drivers who deliver the solar panels to site carrying out a green job? The issue UKERC's 2014 report addresses is whether 'green' policies lead to the creation of additional jobs (Blyth et al., 2014). As long as the jobs contribute to fulfilling the aims of the policies, then they count as job creation, irrespective of whether they individually would be considered as being particularly 'green'. To further avoid controversies around definitional issues, the 2014 report focused on a relatively narrow subset of 'green' policies, namely support for renewable energy and energy efficiency. It aimed to address the following specific research question:

"What is the evidence that policy support for investment in renewable energy and energy efficiency leads to net job creation in the implementing regions?"

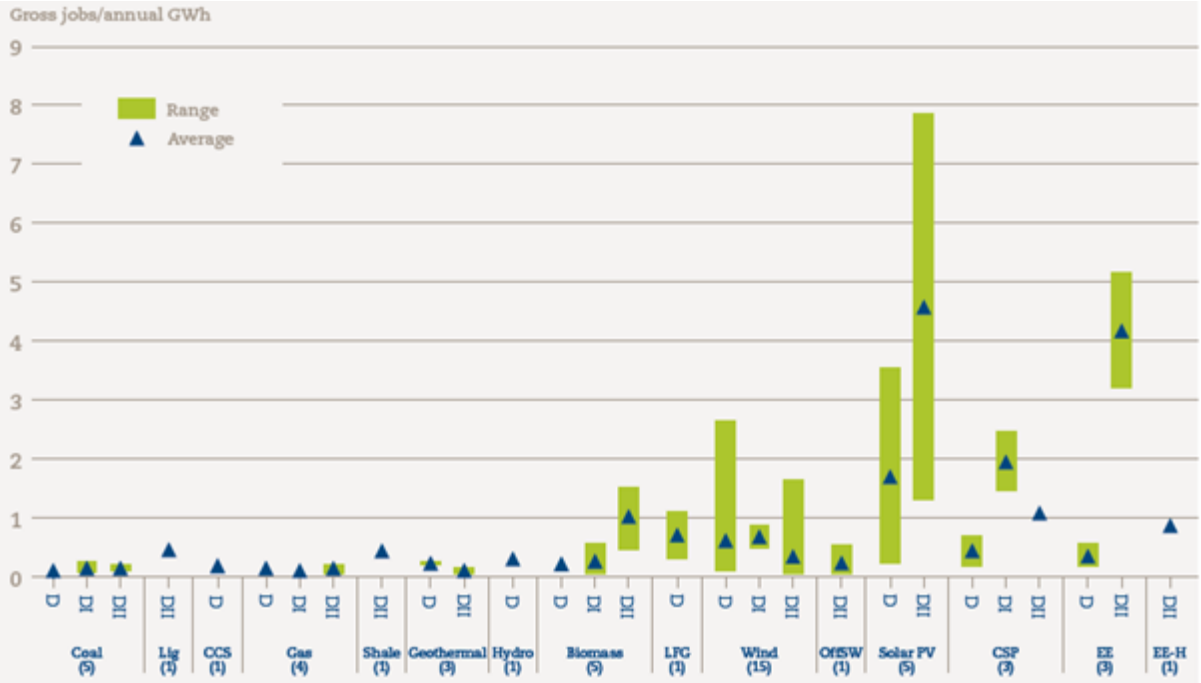
The question reached particular policy relevance at the onset of the 2008 financial crisis when governments were considering how to spend economic stimulus money. At this time, and similar to now with post-COVID-19 economic recovery, issues of how many jobs would be created by different investment pathways were paramount.

Blyth et al. (2014) reviewed the pros and cons of methodologies used in the literature to estimate job impacts. Primary data is often gathered through case studies, together with questionnaires and supply-chain surveys. Studies often include not just direct employment impacts, but also the wider ripple-through indirect effects of increased demand in the supply chain, as well as the induced effect of higher spending potential for those households that have benefitted from the higher employment rates. The most common analytical approach for these wider effects is input-output modelling. Studies also address wider macro-economic impacts through computable general equilibrium (CGE) modelling, or macro-econometric approaches.

The quantitative evidence base reviewed in UKERC's 2014 report comes from two main different types of literature. The first (comprising the majority of the literature surveyed) are studies where authors provide estimates of gross job impacts of individual projects for specific types of generation. To get an approximate estimate of net job impacts, Blyth et al. (2014) compared across different studies the gross job impacts of investing in renewable energy and energy efficiency with the gross job impacts of investing in fossil fuel plant. In the second type of literature, authors explicitly calculate the net job impacts of renewables and energy efficiency compared to fossil fuels, giving a direct indication of the net impacts. This was a smaller set of literature, but produced a roughly similar result to the first set of literature, giving some additional confidence in the overall conclusion. The review found there to be a reasonable degree of evidence that in general, renewable energy

and energy efficiency are more labour-intensive in terms of electricity produced than either coal- or gas-fired power plant, as illustrated in Figure 1 below.

Figure 1 Gross jobs per annual GWh generated (number of studies in brackets)



Key: D: direct jobs, DI: indirect jobs, DII: induced jobs, CCS: carbon capture and storage, LFG: land-fill gas, OffSW: offshore wind, CSP: concentrated solar power, EE: energy efficiency, EE-H: energy efficiency in households.

Source: Blyth et al. (2014)

The implication of this analysis is that at least in the short-term, building new renewable generation capacity or investing in greater energy efficiency to avoid the need for new generation would create more jobs than investing in an equivalent level of fossil fuel-fired generation. The magnitude of the difference is of the order of 1 job per annual GWh produced (Blyth et al., 2014).

Whilst the evidence reviewed by Blyth et al. (2014) seems reasonably robust that renewables and energy efficiency are in general more labour-intensive than fossil fuels, this does not automatically mean that preferential investment in these technologies will lead to higher employment in the economy as a whole. In the 2014 report wider economic factors are also explained, with reference to Keynesian economics. Keynesian economics provides one of the leading theoretical bases for understanding unemployment effects, and explicitly relies on the assumption that economies are out of equilibrium during periods of high unemployment. For example, in a depressed economy in which aggregate demand is low compared to potential supply of goods and services (creating a so-called ‘output gap’), then Keynesian measures of stimulating additional employment in particular sectors, such as through a fiscal or monetary stimulus, are very likely to lead to higher overall employment,

and it makes sense to focus such efforts on more labour-intensive options. On the other hand, in an economy which is closer to 'equilibrium' conditions and 'full employment', the room for such manoeuvres is more limited: if human and physical resources are fully deployed, then output cannot be increased. Government-led investments may crowd out private investment leading to lower-than-expected net employment results.

Policies that have impacts beyond the time horizon of the current business cycle lock-in the economy to a particular set of behaviours that go beyond their initial stimulus impacts. This is particularly true for decisions in the electricity sector which concern long-lived strategic infrastructure. In these cases, it is important to assess the balance of costs and benefits to the economy in terms of the impact on growth potential. When designing stimulus programmes, it makes sense to support technologies and projects that support technological progress in the long-term, because if they have a persistent impact on the economy beyond the timeframe of the direct stimulus effects, they should also help contribute to long-term growth. In this longer-term context, labour intensity is not in itself economically advantageous, as it implies lower levels of labour productivity (economic output per worker), which could adversely impact prospects for economic growth (Blyth et al., 2014).

Therefore, the 2014 report also cautions that the employment characteristics that matter in the long-run are not just how many jobs are created per unit of investment, but also whether or not the investment contributes to an economically efficient transition towards the country's strategic goals, taking account of externalities such as environmental impacts and energy security considerations.

1.3 Work plan

As a 1st task of this project and to provide some context for the scoping note, we have collated relevant international estimates on gross low carbon jobs (see section 1.4). The 2nd task of this project will be to carry out a scoping review of relevant academic and grey literature. The scoping review will inform and refine key words and search strategies to be used in the full systematic review, which is the 3rd and most substantive task. Section 2.5 sets out the planned approach for the full systematic review. For the scoping review, we plan to combine a small selection of key words or phrases shown in Table 1 below, and combine them in search strings applied to two databases: Science Direct and Google Scholar. These initial searches will be restricted to the years 2014 to 2020, as an update to, and in order to avoid duplication with, the pre-existing TPA review on green jobs. For each of four search strings we intend to extract the first 25 results, yielding 100 documents in total.

Table 1 Proposed search terms for scoping review

Employment and Labour Market	Energy and Environment	Policy
employment	energy	"net zero"
job	green	"just transition"
"green job"	"low carbon"	stimulus

"low carbon job"		
"net job creation"		
skill		
"supply chain"		

1.4 UK and international estimates on low carbon jobs

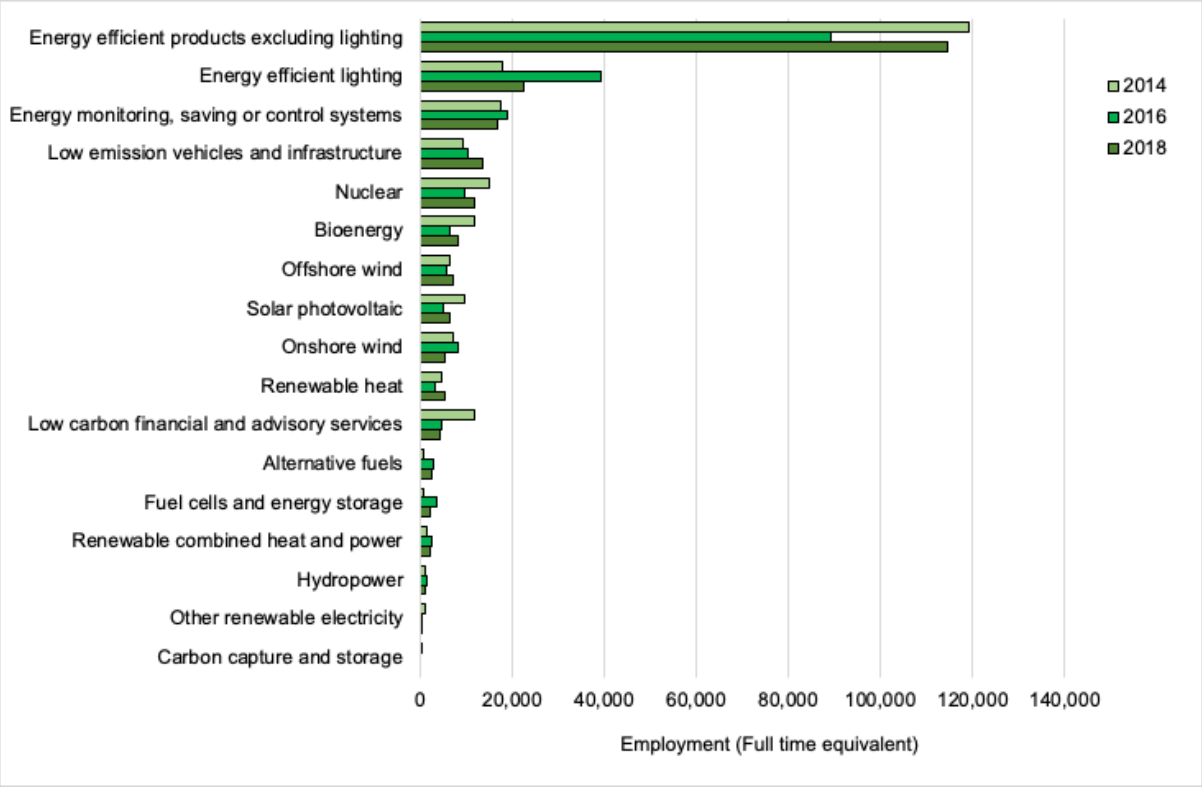
In order to inform this scoping note and as an initial task, we have extracted the latest key statistics on gross low carbon jobs from authoritative sources in the UK and internationally, and we make reference to these here. It is estimated that at least 11 million people are employed in renewable energy sectors worldwide, with the majority of these jobs concentrated in China, the EU, Brazil, the US and India (IRENA, 2019).

Figure 2 shows gross employment estimates for a range of low carbon and energy efficiency technologies, products and services in the UK. In terms of the net jobs outcomes of decarbonisation, some low carbon options may be more labour intensive than the fossil fuel options they replace (and hence create jobs per unit of energy), but the evidence is mixed. Wider economic effects also need to be accounted for, so that if a low-cost, high carbon fuel or energy system is substituted for a more expensive low carbon alternative then overall economic efficiency would be expected to fall. All else being equal this would reduce output and hence employment (Gross, 2020b).

Energy efficiency products and services, including lighting, currently comprise around 150,000 jobs in the UK (Figure 2): this equates to over two thirds of UK employment in low carbon and renewable energy businesses, according to a survey carried out by the Office for National Statistics (ONS, 2020). The Treasury has estimated that the Green Homes Grant, which would be spent over one year, could support more than 100,000 jobs (Murray, 2020).

Several reports have been published recently, for example by the Energy Efficiency Infrastructure Group (EEIG, 2020) and the Institute for Public Policy Research (Jung and Murphy, 2020; Webb et al., 2020), which make a strong case for the co-benefits of investing in home energy refurbishments. The UK has one of the oldest, most poorly insulated and draughty housing stocks in Europe (ACE, 2015). Space and water heating in buildings contributes around 40% of UK energy consumption and 20% of UK greenhouse gas emissions (CCC, 2016). Properly insulating UK homes and replacing fossil fuel boilers with heat pumps can help to alleviate fuel poverty, meet the UK's longer-term net zero climate target, and support a just transition: creating jobs in a distributed way around the country, including "levelling up" in regions most affected by unemployment and lack of investment (EEIG, 2020; Jung and Murphy, 2020; Webb et al., 2020). Low carbon energy technologies may vary in the extent to which they offer social and economic co-benefits similar to those arising from retrofitting buildings (Gross, 2020a).

Figure 2 Low Carbon and Renewable Energy Economy (LCREE) gross employment estimates by sector in the UK, 2014 to 2018



Source: ONS (2020)

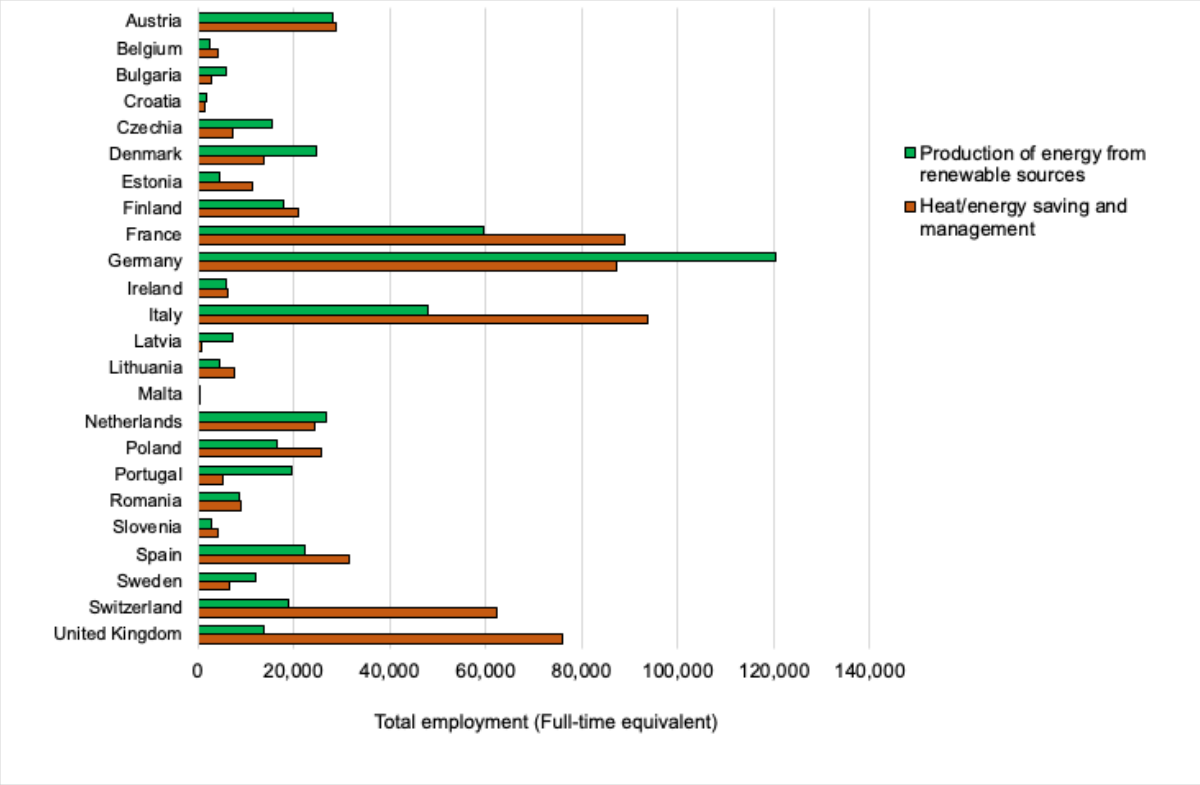
Notes to Figure 2

1. *Employment estimates are full-time equivalents (FTEs) and rounded to the nearest 100.*
2. *For carbon capture and storage in 2016 and 2018, employment was estimated to be less than 100 and is not shown in the chart.*
3. *All employment estimates are subject to uncertainty ranges not shown in the chart: coefficients of variation and 95% confidence intervals.*

The "environmental economy" is defined by Eurostat (2020b) as including *"activities and products that serve either of two purposes: 'environmental protection' — that is, preventing, reducing and eliminating pollution or any other degradation of the environment or 'resource management' — that is, preserving natural resources and safeguarding them against depletion."* The environmental economy in the EU 28 (including the UK) accounted for 4.6 million full-time equivalent (FTE) jobs in 2017, compared to 3.4 million in the year 2000 (Eurostat, 2020a). In 2017, 1.1 million FTE jobs were in heat / energy saving and management, and 600,000 in the production of energy from renewable sources. Employment in these two energy-specific sectors is shown by country in Figure 3. In terms of total number of FTE jobs, Germany stands out given that around 120,000 people there work in the renewable energy sector. The next highest are France and Italy, with 59,000 and 47,000 renewable energy jobs respectively. All three countries employ more than 87,000 people in heat / energy saving and management, with Italy having 94,000 FTE jobs in this sector in

2017. In the UK, full-time employment in heat or energy-saving is the 4th highest of the countries shown in Figure 3, at 76,000.

Figure 3 Gross employment in renewable energy production and heat / energy saving and management in selected European countries, 2017



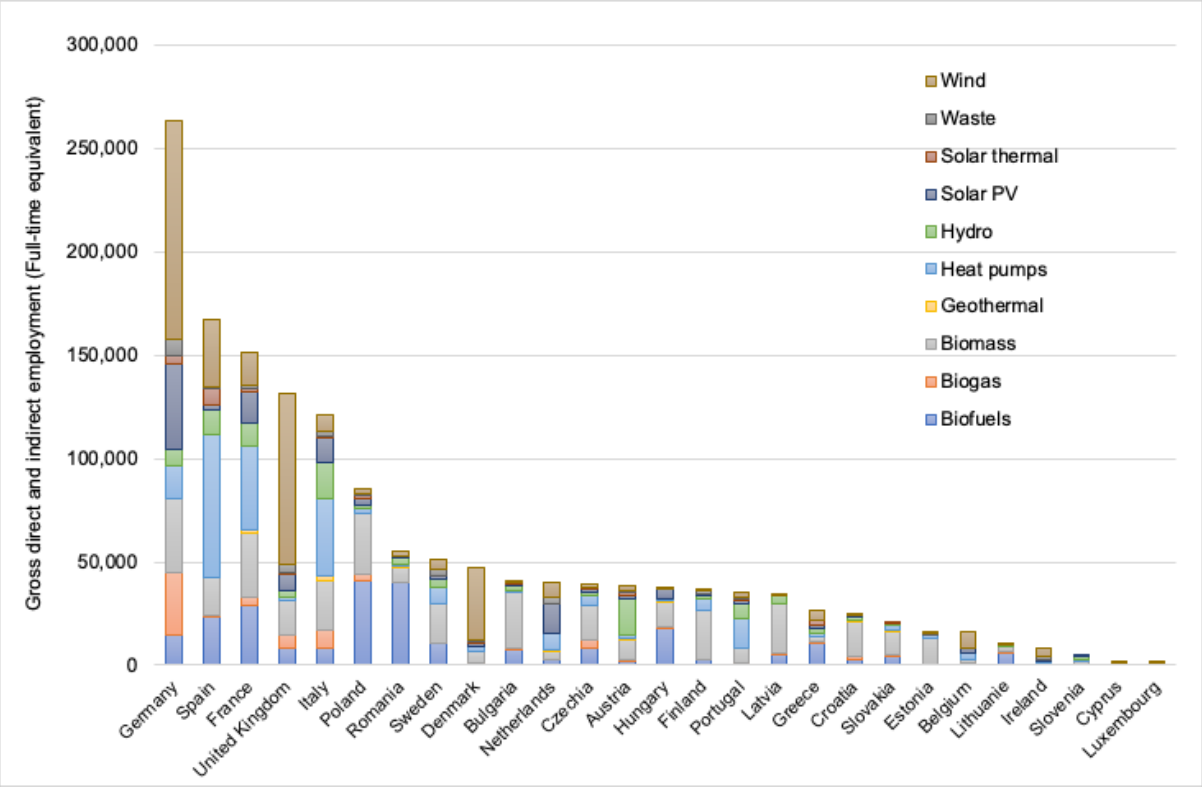
Source: Eurostat (2020b)

Notes to Figure 3

1. *Employment "is measured in full-time equivalents (total hours worked divided by the average annual hours worked in a full-time job)" (Eurostat, 2020b).*
2. *The two economic activities shown in Figure 3 (1. production of energy from renewable sources; 2. heat/energy saving and management - aka energy efficiency) have been categorised according to the Classification of Resource Management Activities (CReMA) (Eurostat, 2020c).*

Figure 4 shows sectoral renewable energy employment estimates produced by EurObserv'ER (2020). These are based on an employment modelling approach in which the economic activity of each renewable energy sector is accounted for and converted to full-time equivalent (FTE) estimates using input-output tables. According to this data, around 1.5 million people were estimated to be directly or indirectly employed in renewable energy in the EU28 in 2018. The UK had 131,900 renewable energy jobs according to this measure, the 4th highest total in the EU after Germany, Spain and France. In the UK, 63% of total direct or indirect renewable energy jobs were in wind power in 2018, equating to 82,800 FTE employees. These employment estimates do not include energy efficiency, energy storage or electric mobility.

Figure 4 Gross direct and indirect employment estimates for renewable energy sectors in EU 28 countries, 2018



Source: EurObserv'ER (2020)

Notes to Figure 4

1. *Employment estimates are full-time equivalents (FTEs) and rounded to the nearest 100.*
2. *Employment data includes both direct and indirect employment, but not induced employment. EurObserv'ER (2020) lists examples of direct employment as including "renewable equipment manufacturing, renewable plant construction, engineering and management, operation and maintenance, biomass supply and exploitation"; indirect employment is referred to as "secondary activities, such as transport and other services".*

The estimates presented in this section show gross (and not net) low carbon and energy efficiency jobs. The first definitional issue which this project will address is the distinction between 'gross' and 'net' jobs. Gross effects include only the positive impact on employment which may be associated with a particular investment. It is clear that gross jobs can in general be created when money is spent on projects that require manufacturing, installation, operation and maintenance of new equipment. What is relevant to this study is whether net jobs can be created when the potential negative impacts of those projects on the wider economy is taken into account. In particular, it is important when considering the net employment impacts of a renewable energy or energy efficiency investment to consider jobs that might be displaced in other parts of the economy as a result of the investment. For example, the number of gross jobs created through additional renewable energy deployment could be offset by the implied number of jobs that would be lost in other parts of the

power sector due to less power generation needed from gas and coal generation (Blyth et al., 2014).

1.5 Research questions

The overarching research question which this project will address is:

What is the evidence that policy support for investment in renewable energy and energy efficiency leads to net job creation?

Potential sub-questions which the project may consider include:

- What are the best policy options for net job creation? Which low carbon sectors / endeavours offer the best stimuli for net job creation? Which policy objectives could help to maximise low carbon jobs at least cost to society?
- Which aspects of the (latest) Clean Growth Strategy (BEIS, 2017) are likely to be the best for jobs and offer the greatest stimuli (comparative analysis)?
- To what extent might investment in the low carbon transition aimed at achieving the UK's net zero emissions target help or hinder post-COVID economic recovery?
- What lessons can be learnt from the impact of previous energy transitions on jobs and supply chain development?
- Quality of jobs (i.e. skills). How can the low carbon skills base be improved in regions that need it (e.g. regions affected by the decline of fossil fuel industries)?

The review will also need to set appropriate boundaries, for example which low carbon sectors are focused upon, and geographical coverage. These decisions will be informed by the scoping review and in consultation with the expert advisers (see section 2.4).

2. The UKERC TPA Approach

2.1 Overview

The TPA approach learns from the practice of systematic review, which aspires to provide more convincing evidence for policymakers and practitioners, avoid duplication of research, encourage higher research standards and identify research gaps. This *evidence based* approach is common in areas such as education, criminal justice and healthcare.

The goal is to achieve high standards of rigour and transparency. However, energy policy gives rise to a number of difficulties for prospective systematic review practitioners and the approach is not common in energy. We have therefore set up a process that is inspired by the evidence based approach, but that is not bound to any narrowly defined method or techniques.

This assessment protocol describes this process in detail. It provides a specification of the means by which we will consult stakeholders and solicit expert input, specifications for searching the literature, and criteria against which relevant findings will be assessed.

2.2 Assessment sequence

The TPA has identified a series of steps that need to be undertaken in each of its assessments. These steps, derived from the practice of *systematic review* in non-energy policy analysis, are outlined in Figure 5 below.

Figure 5 – typical process for TPA studies

Scoping prospective issues	Solicit expert input	Define criteria for assessment	Review literature	Synthesis and analysis	Prepare draft report	Consult, peer review and refine	Publish and promote
Questions/issues							
What are key problems and issues	Need to reflect a range of informed opinion	Ensure transparent, rigorous and replicable process	Need to review literature thoroughly	Need to apply rigorous criteria to evaluation of relevant studies	Need to identify key issues and discuss initial findings with stakeholders	Need to seek peer review and gain wide ranging criticism of initial work	Need to ensure report reaches key audience
Actions							
Write scoping note Seek feedback from advisory group Seek feedback from online listing of initial scoping	Appoint expert group Hold expert/ stakeholder workshop	Develop assessment protocols Discuss expert group and AG Place protocols in public domain	Apply protocol to literature search Detailed and transparent 'trawl' Identify relevant sources	Apply protocol to evaluation and synthesis of literature Detailed and transparent assessment of evidence base	Write preliminary draft assessment	Host stakeholder workshop to discuss draft report Send draft report for peer review Make appropriate revisions to draft report	Design and graphics Publication Launch events
Outputs							
Scoping note	Web publication of expert group	Assessment protocols			Draft report	Final report	Published report

Whilst this project will follow this generalised approach, developed for all TPA work, it will be adapted to reflect the fact that one of the aims in this instance is to update the UKERC 2014 report, which may mean that some of the steps in Figure 5 are not appropriate or may need to be revised.

2.3 Stakeholder engagement

The project will seek input and comment from relevant stakeholders in the academic, policy-making and industrial communities. The project scoping note will be published on the UKERC website.

2.4 Expert advisers

The project team will engage with a small group of expert advisers who can bring their experience and perspectives to bear on the subject. The expert advisers will be

asked to comment on the scope of the project and the proposed approach, advise and assist the project team in the selection of relevant evidence sources, and review draft results. The expert advisers will be announced in due course and will be listed in the main project report.

2.5 Research sources and review protocol

A systematic review protocol typically provides a rationale for the choice of sources and lists the main databases, bibliographies, catalogues, personal contacts and other sources that are to be searched. It will also specify the years to be covered and the search criteria that will be used. As identified in the Assessment Sequence section above, the project team will adopt an approach that is consistent with the available timescale.

The initial set of key words, search terms and evidence categorisation are set out in Table 2 below. These search terms are based on those used in the 2014 TPA on green jobs and the proposed scoping review search terms (Section 1.3). The searches will focus on the years 2014 to 2020 in order to provide an update to the 2014 review. The search terms may be revised as informed by the scoping review and following discussion with the expert advisers, and input from stakeholders where appropriate.

Table 2 Proposed search terms for full systematic review (Stage 1)

Employment and Labour Market	Energy and Environment	Policy
employment	energy	polic*
job*	environment*	subsid*
work*	green	support*
"green job"	“low carbon”	incentiv*
"low carbon job"	clean	"net zero"
"net job creation"	renewable*	"just transition"
skill*	efficiency	stimulus
"supply chain"	climate	

Part of the analysis in this study involves comparing low carbon job estimates with estimates of jobs in traditional (fossil-fired) power generation, in order to gauge the net job impacts of renewables and energy efficiency compared to fossil fuels. In order to reduce any bias that may arise in the ‘green jobs’ literature with respect to job estimates for fossil-fired technology, an additional literature search will be carried out combining search terms related to fossil fuel energy with employment or labour market related key words (Table 3). The policy-related search terms will be omitted in order to broaden this additional search, and to include job estimates for the sector that arise without policy stimulus.

Table 3 Proposed search terms for full systematic review (Stage 2)

Employment and Labour Market	**Fossil Fuels**
employment	coal
job*	fossil
work*	“natural gas”
skill*	“shale gas”
"supply chain"	

Relevance ratings

Returned results will be filtered manually for relevance based on their title and abstract. If this is not sufficient to determine relevance, further inspection of the main text will be performed. This will allow the project team to subsequently focus their attention only on those documents which are most directly useful in addressing the research question. Each document will be assigned a relevance rating from 1-4 according to the following criteria:

1. Article shows clear discussion and/or data that is directly focussed on some or all of the research questions;

2. Article shows clear discussion and/or data that is related to but is not directly focussed on any of the research questions;

3. Article mentions at least one of the search terms, but is of only limited relevance to the research questions;

4. Article is found to be irrelevant or duplicate on closer inspection.

Databases / sources

Science Direct

Science Direct provides access to Elsevier journals and e-books including on physical sciences and engineering and social science topics.

Google scholar

Note that searches using Google scholar include a range of relevant journal paper databases in addition to those published by Elsevier, such as Taylor & Francis, Wiley Online and IEEE.

Google

Documents published by the following institutions will be searched by using the combinations of search terms described above plus adding the name of the institution as an extra search term:

- BEIS
- Committee on Climate Change
- HM Treasury
- Office for National Statistics
- Institute for Public Policy Research
- Renewable Energy Association
- Association for Decentralised Energy
- Energy Efficiency Infrastructure Group
- European Commission
- Eurostat
- EurObserv'ER
- IEA
- IRENA
- OECD
- International Labour Organization
- IMF
- World Bank

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