



Evaluating Job Creation Potential in Renewable Energy and Energy Efficiency

Prof. Robert Gross^{1,2}; Dr. Richard Hanna¹

**¹Imperial College London
²UKERC Director**

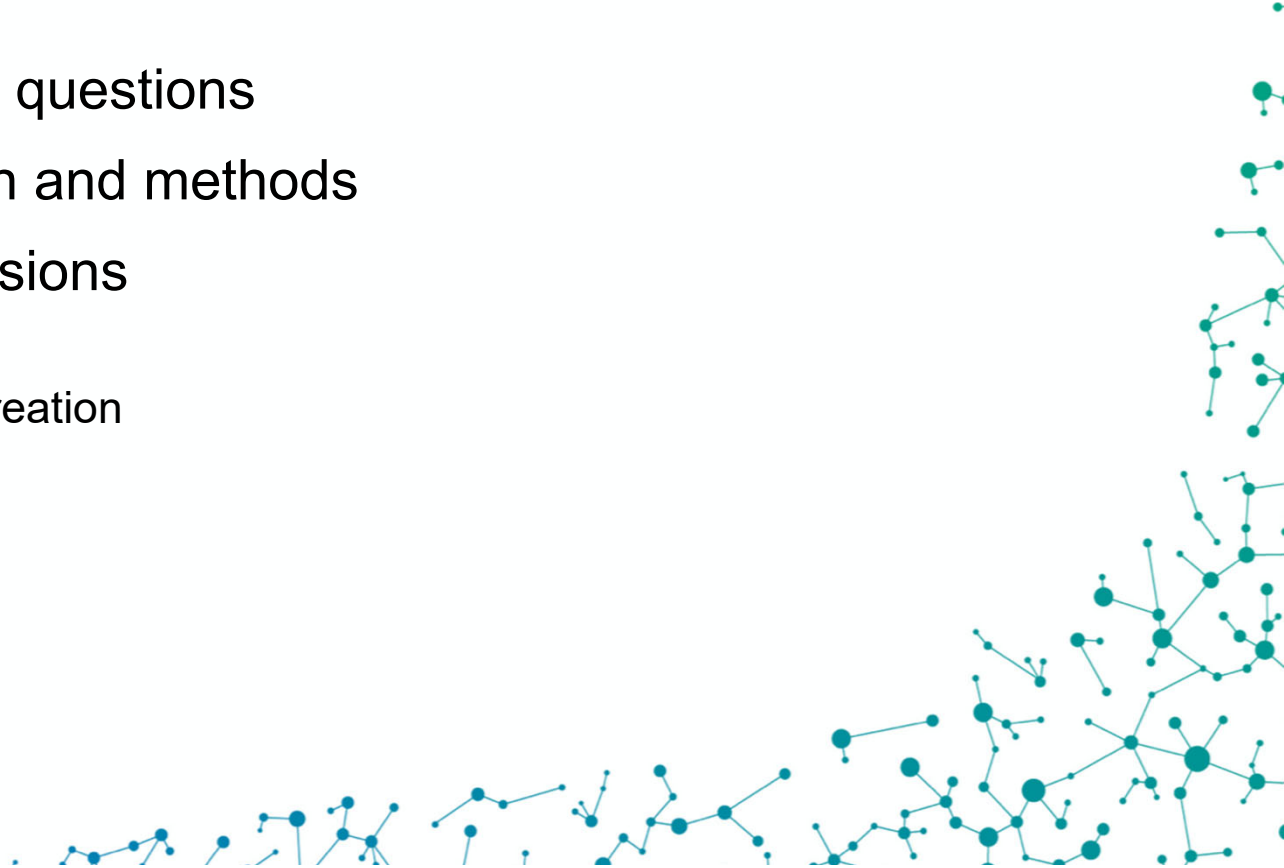
***LCS-RNet 12th Annual Meeting,
15 December 2021***

@UKERCHQ



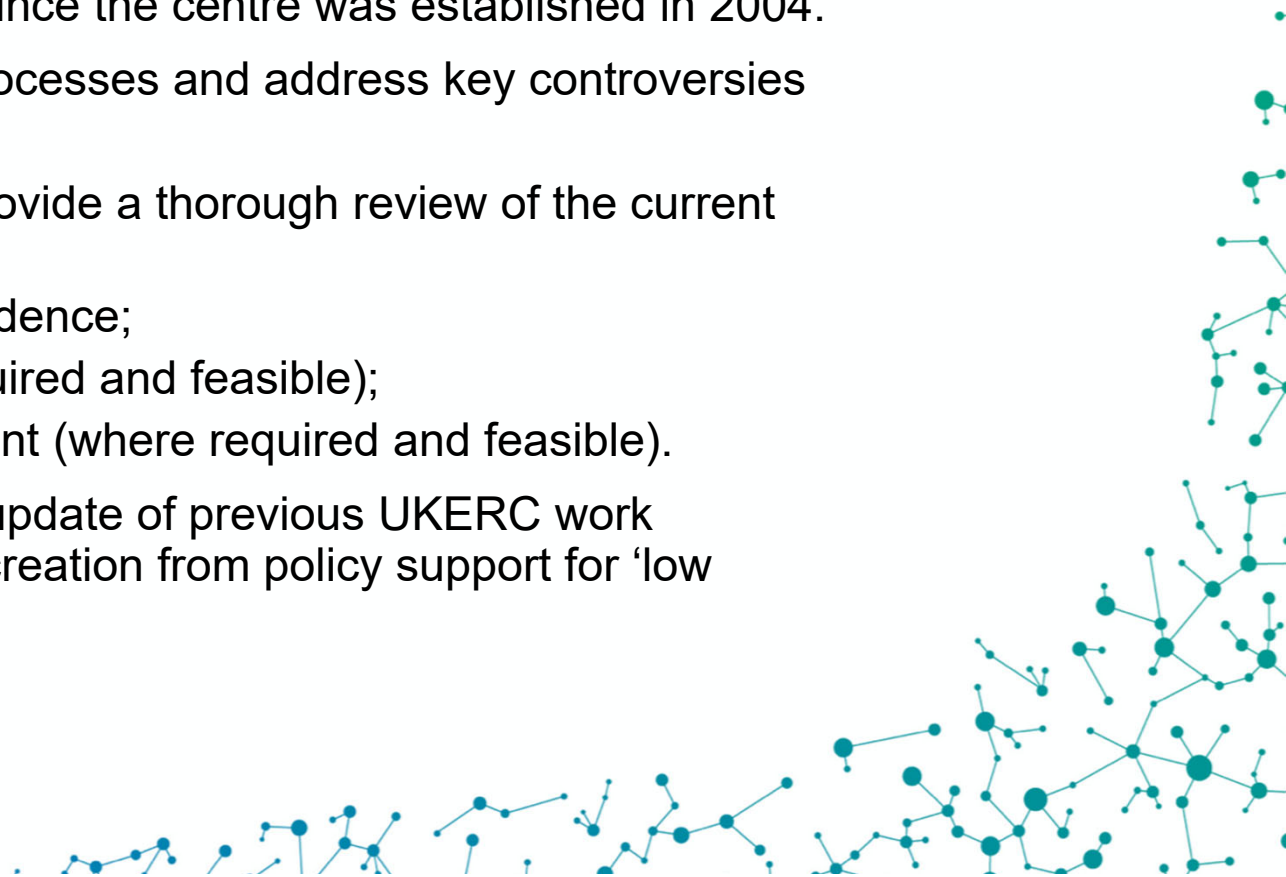
Presentation structure

1. Background
2. Project scope and research questions
3. Systematic review approach and methods
4. Review findings and conclusions
 - Quantity of job creation
 - Job quality, skills and local job creation



UKERC Technology and Policy Assessment (TPA)

- The TPA has been part of UKERC since the centre was established in 2004.
- Set up to inform decision-making processes and address key controversies in the energy field.
- Primary objective of the TPA is to provide a thorough review of the current state of knowledge through:
 - Systematic reviews of the evidence;
 - Primary research (where required and feasible);
 - Wider stakeholder engagement (where required and feasible).
- The research presented here is an update of previous UKERC work examining the evidence for net job creation from policy support for 'low carbon jobs' (Blyth et al., 2014).



Calculating net job creation



Mostly Input-Output analysis, some direct job surveys, some CGE / other approaches (Blyth et al., 2014)

Current project: research questions and scope

Overarching research question:

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

Research sub-questions:

Quantity of jobs created

- Which metrics have been used to quantify job creation in low carbon energy (including renewables and nuclear), energy efficiency and fossil fuel generation?
- How do the results of these studies compare, in relation to different units of analysis and life stages of technologies (e.g. manufacturing, installation, operation and maintenance)?

Quality of jobs created and skills

- What are the implications of low carbon job creation policies for the quality of jobs created?
- Which metrics have been used to assess quality and skill levels of low carbon job creation?

Regional / local job creation

- Is there evidence and relevant metrics in the literature on low carbon job creation at a local / regional level, and impacts on local economies?

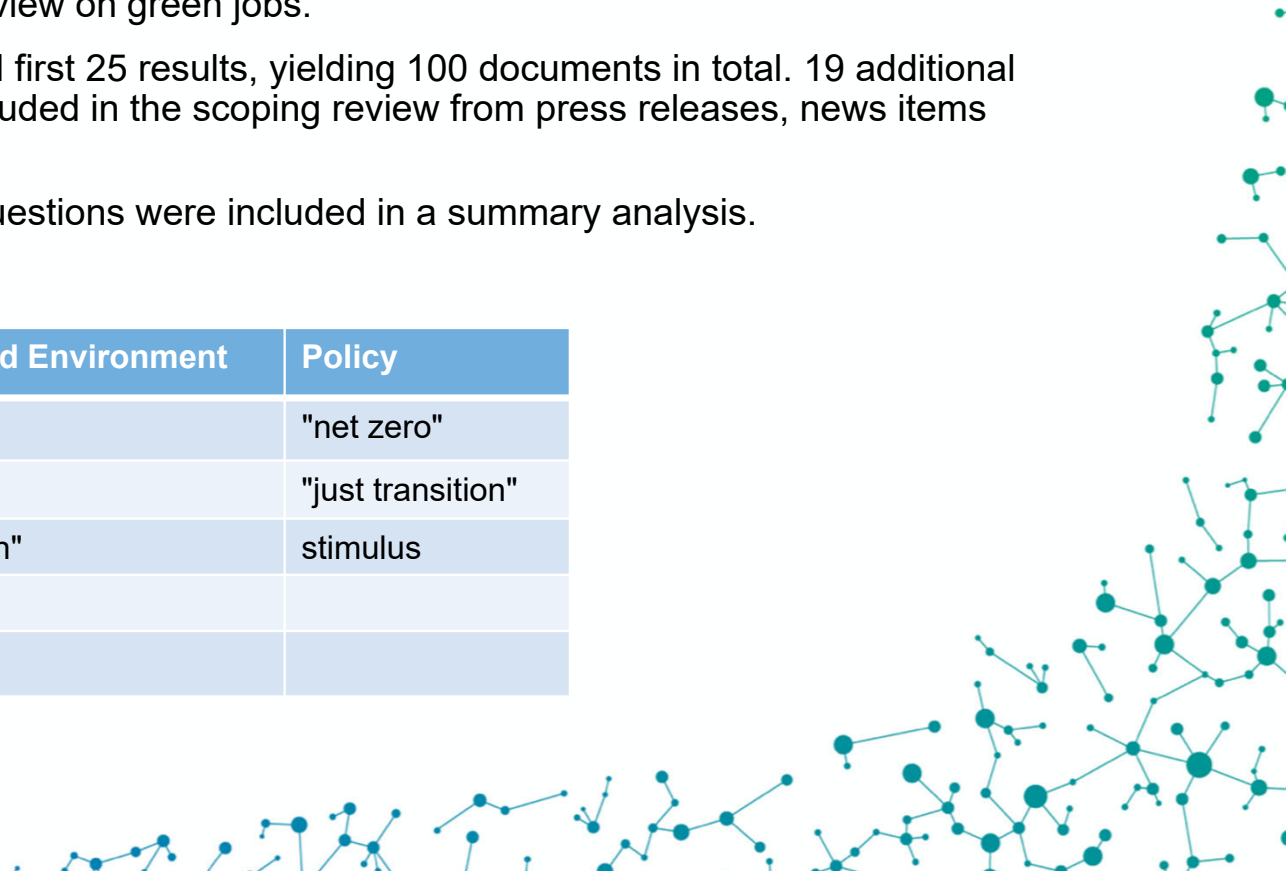
Sectoral scope: renewable energy, energy efficiency and end use energy demand sectors.

Geographic scope: international (limited to evidence available in English language).

(1) Scoping review: Approach

- We combined a small selection of key words or phrases shown in the table below, in search strings applied to two databases: Science Direct and Google Scholar.
- These initial searches were restricted to the years 2014 to 2020, as an update to, and in order to avoid duplication with, the pre-existing UKERC review on green jobs.
- For each of four search strings we extracted first 25 results, yielding 100 documents in total. 19 additional (mainly grey literature) documents were included in the scoping review from press releases, news items or peer recommendations.
- 62 of these most relevant to the research questions were included in a summary analysis.

Employment and Job Creation	Energy and Environment	Policy
job	energy	"net zero"
"green job"	green	"just transition"
"low carbon job"	"low carbon"	stimulus
skill	renewable	
"supply chain"		



(2) Systematic review: Approach

- Key words or phrases shown in the table below were applied in search strings to Google Scholar, selected for further searches due to its coverage of a range of academic databases. These searches were restricted to 2014 to 2021.
- For each of four search strings we extracted first 60 results, yielding 240 documents in total. Initial screening eliminated irrelevant results or duplicates, leaving 83 documents.
- Together the scoping and systematic reviews identified 145 relevant documents filtered from an initial sample of 359 documents.

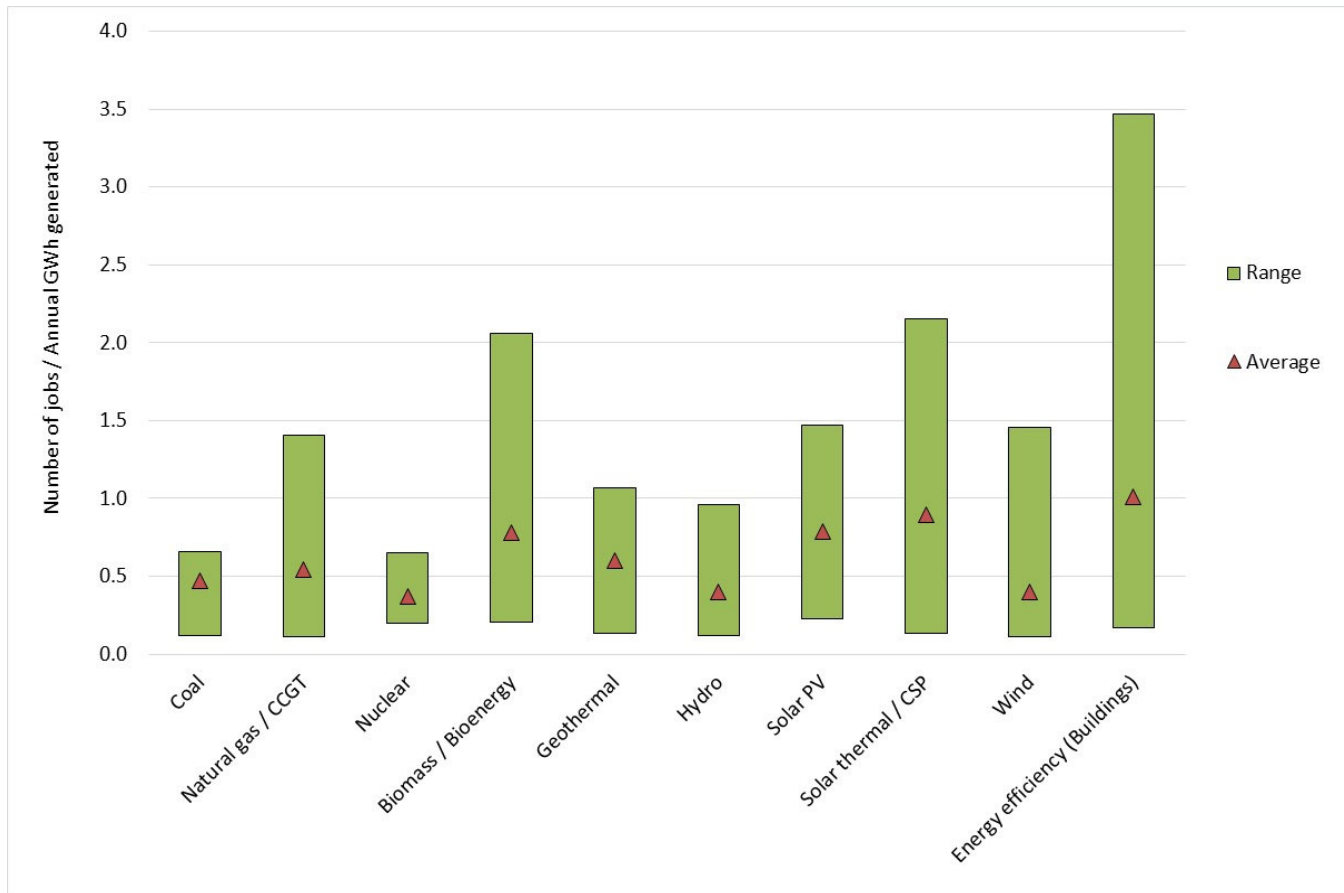
Employment and Job Creation	Energy and Environment	Fossil fuels / Nuclear	Job creation metrics	Policy / Techno-economics	Geography, quality and skills
job	energy	"natural gas"	jobs/MW	subsidy	local
employment	green	"shale gas"	jobs/GW	incentive	regional
"job creation"	"low carbon"	coal	direct	stimulus	location
"employment creation"	renewable	fossil	indirect	policy	geography
"renewable"	"energy efficiency"	nuclear	induced	invest	quality
			multiplier	spend	"decent work"
			"employment factor"	CAPEX	skill
				OPEX	qualification

Review findings

(1) Quantity of job creation



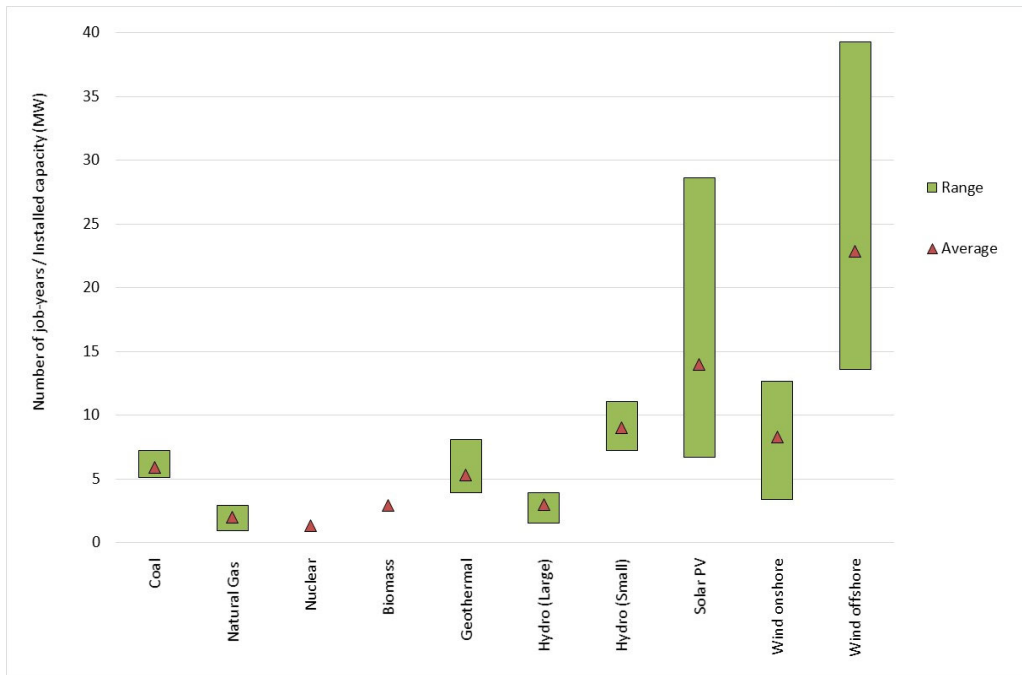
Gross jobs created per annual energy generated or saved (jobs / gigawatt hours – jobs/GWh)



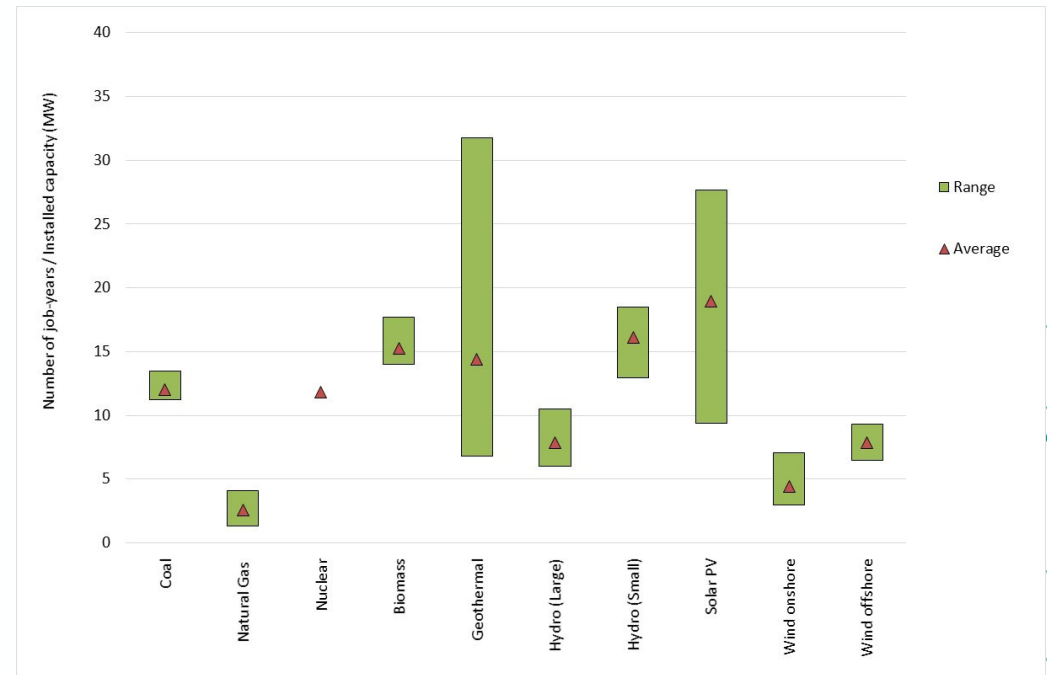
- This chart presents a range of job creation estimates from 14 studies pertaining to UK, Europe (including Germany), US, Australia and Chile.
- This indicates that job creation normalised by electricity generation (or energy saved) has potential to be greater for renewables or energy efficiency compared to fossil fuels or nuclear, particularly at higher end of estimates.
- The estimates vary in terms of whether they include direct, indirect and/or induced jobs.

Gross job-years created per MW of installed capacity

(a) Manufacturing

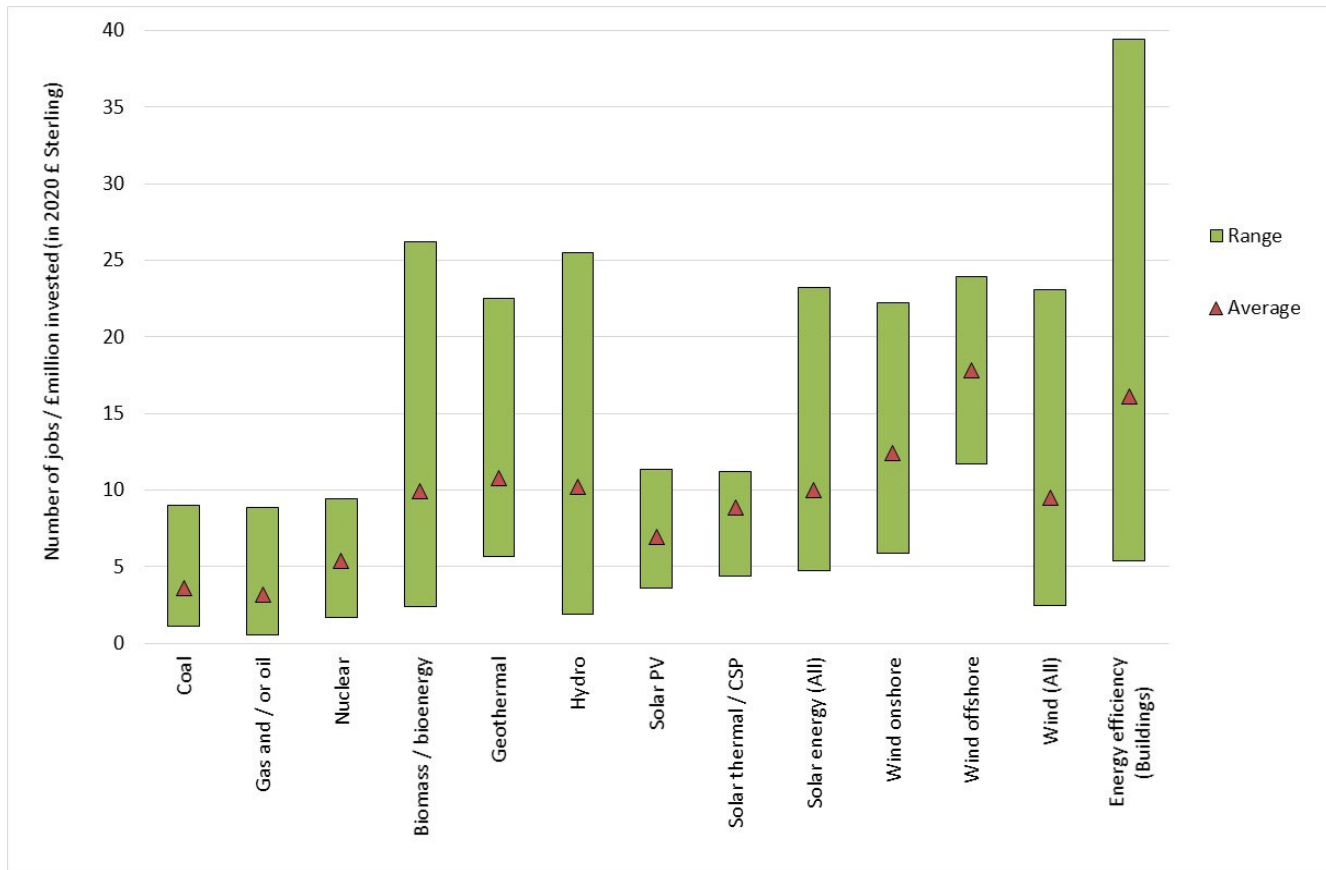


(b) Construction and installation



- One job-year is one full-time job for one person lasting for a year.
- Data shown is from eight studies relating to global scale, Europe (including Portugal) or Turkey.

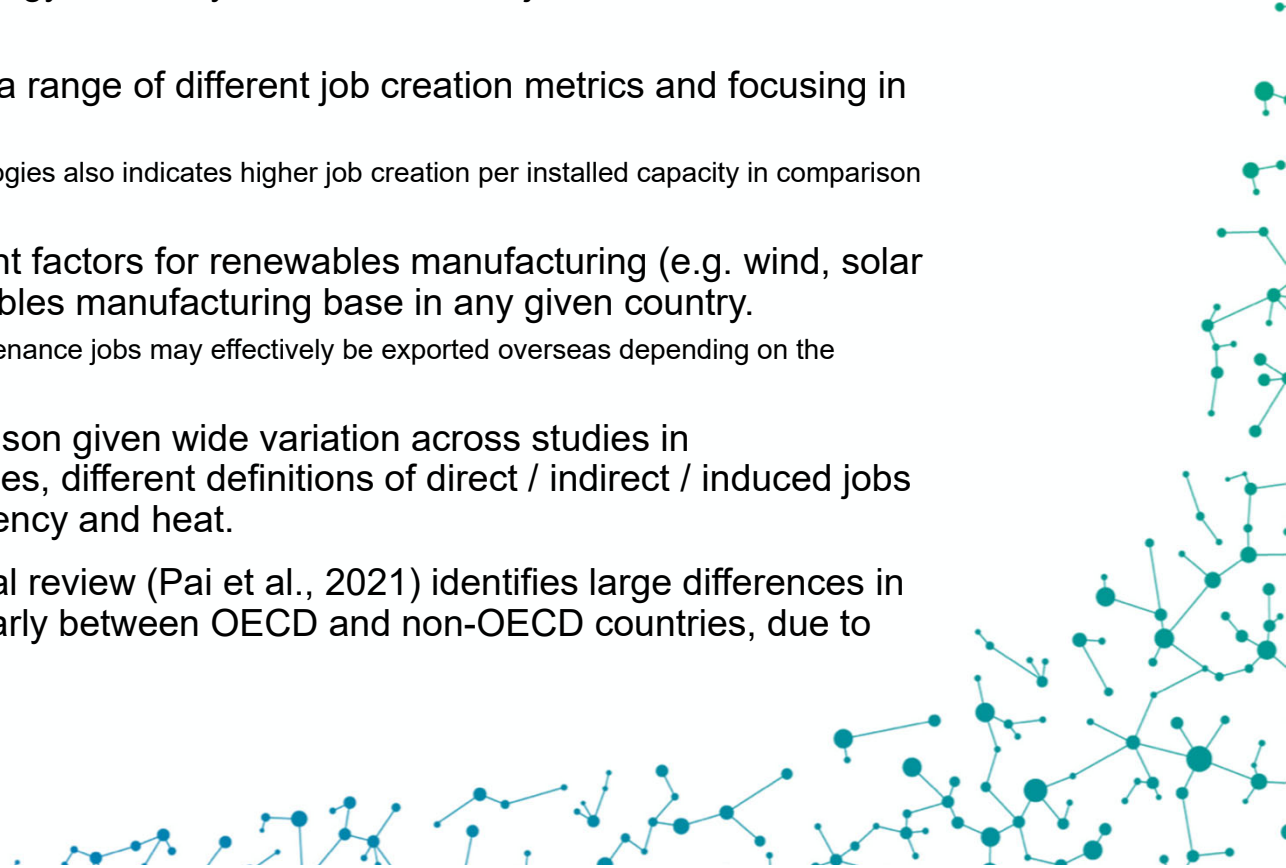
Gross jobs created per £million invested (jobs/£million)



- This chart shows identified evidence from 15 studies on number of gross jobs created per £ million invested for different energy technologies or interventions.
- The chart summarises a range of job creation estimates in studies published from 2009 to 2020, pertaining to US, UK, Europe (including Greece, Croatia, Spain and Germany) and India.
- This suggests that renewables or energy efficiency can generate more jobs per £ invested than fossil fuel generation or nuclear power.

Conclusions on quantity of job creation

- We compare a range of recent job creation estimates which indicate that overall, policy support for, and investment in, renewable energy and energy efficiency can deliver more jobs than fossil-fuel or nuclear power.
- This finding is consistently supported across a range of different job creation metrics and focusing in on different technology life stages.
 - Limited data available for low carbon heating technologies also indicates higher job creation per installed capacity in comparison to fossil fuel heating.
- The potential to make use of high employment factors for renewables manufacturing (e.g. wind, solar PV) depends upon the presence of a renewables manufacturing base in any given country.
 - Many construction / installation and operation / maintenance jobs may effectively be exported overseas depending on the development and size of an export market.
- Challenges with making a consistent comparison given wide variation across studies in methodologies, job creation metrics, timescales, different definitions of direct / indirect / induced jobs etc. Data availability is lower for energy efficiency and heat.
- Labour intensities vary internationally. A global review (Pai et al., 2021) identifies large differences in labour intensity of energy production particularly between OECD and non-OECD countries, due to disparate labour conditions.

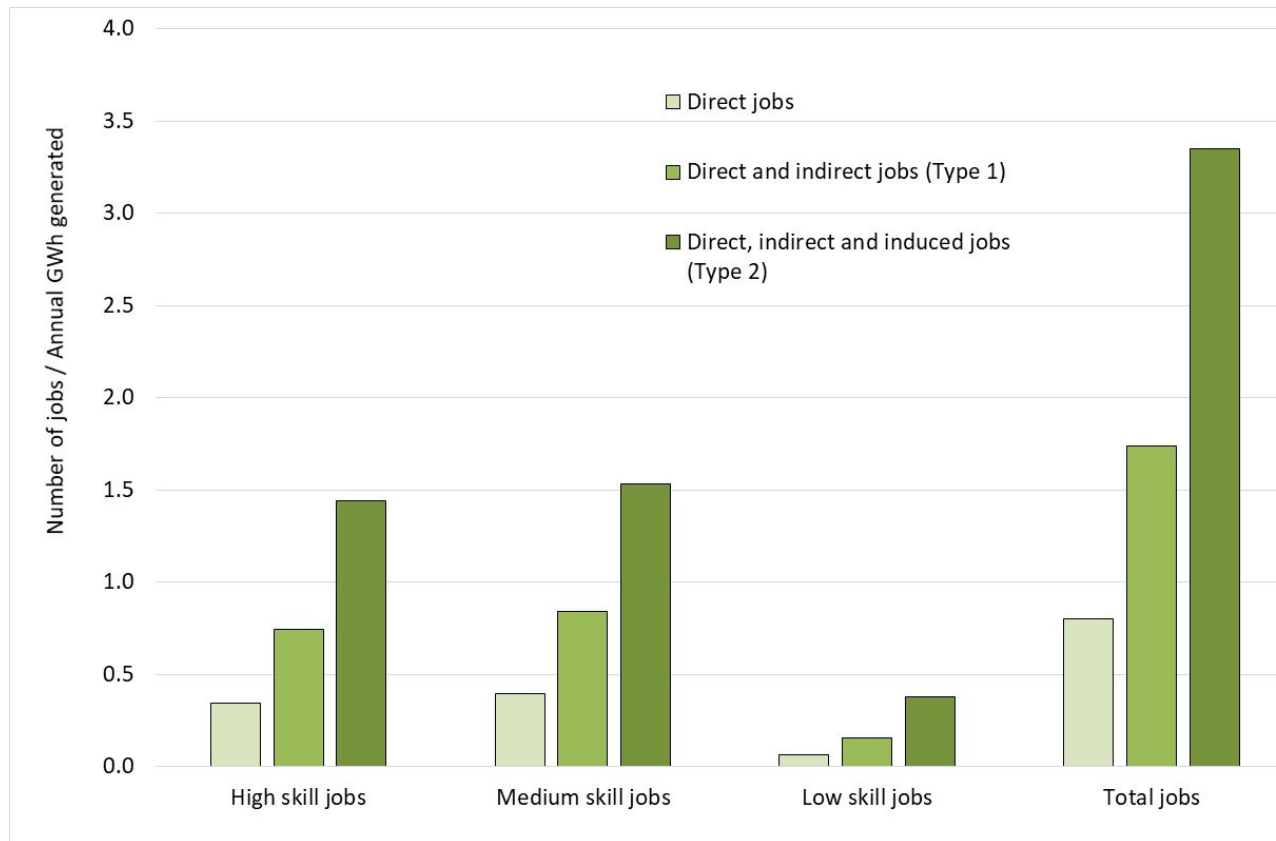


Review findings

(2) Job quality, skills and local job creation



Offshore wind in the UK: Gross jobs per GWh by skill level, direct, indirect and induced jobs



Data from: Allan et al. (2021); BEIS (2020)

Method: Extraction from UK input-output (IO) table

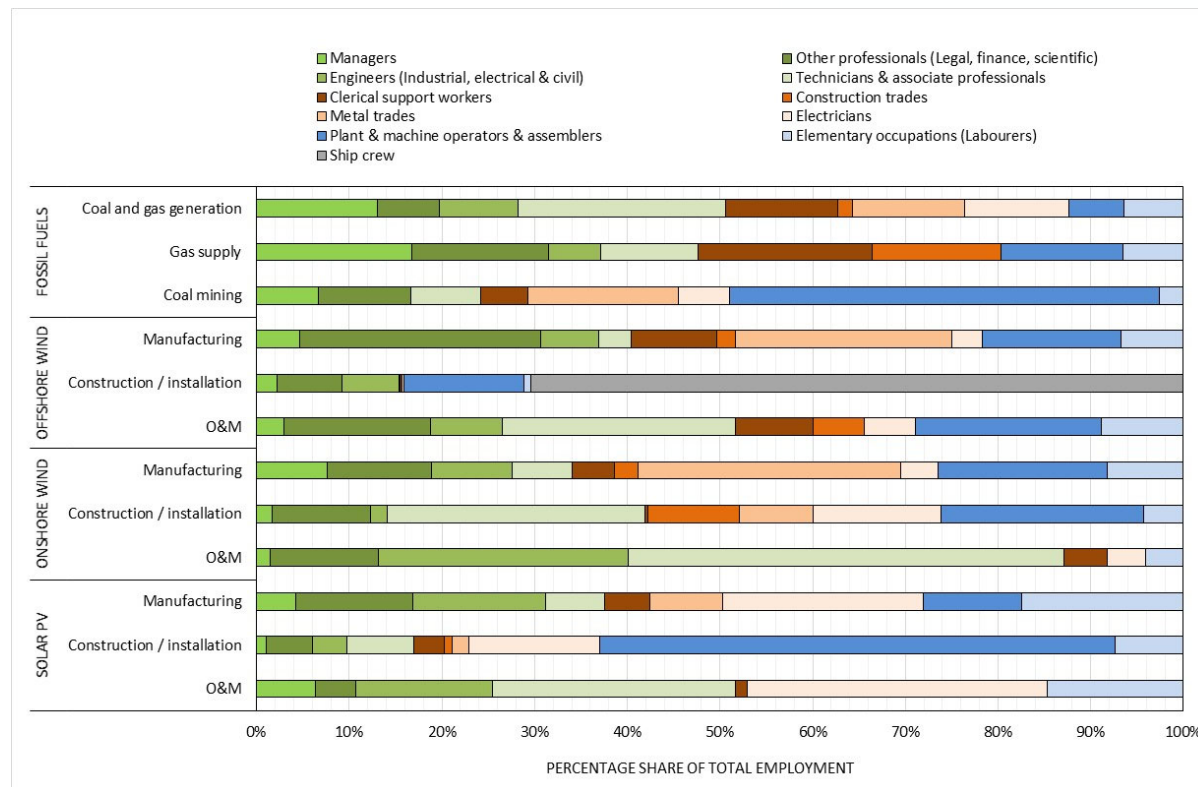
9 occupational (SIC) categories aggregated to skill levels:

High skill: Managers, directors and senior officials; professional; associate professional and technical occupations.

Medium skill: Administrative and secretarial; skilled trades occupations; caring, leisure and other services.

Low skill: Sales and customer services; process, plant and machine operatives; elementary occupations.

International share of occupational categories by electricity generation technology / fuel source



Data from: Dominish et al. (2019).

The occupational data is based on a survey of wind and solar PV industries in various developed and developing countries carried out by the International Renewable Energy Agency (IRENA 2017, 2018).

Occupational data for fossil fuels has been derived from labour statistics in the Australian 2016 national census, and adjusted using regional job multipliers to account for different labour intensities in different parts of the world (Dominish et al., 2019).

Conclusions on job quality, skills and local job creation

- Important to ensure that green jobs are quality jobs, e.g. adequate wages and employee rights, full-time employment, safe working conditions, permanent rather than temporary jobs.
 - Direct employment in renewable energy manufacturing, construction or installation has been linked to temporary or short-term work; operation and maintenance jobs are typically more permanent, lasting over technology lifetimes.
 - Labour intensity may fall as renewables mature and employment needs shift from construction to maintenance and servicing.
- Various literature suggests that green and low carbon jobs tend to be more highly skilled compared to higher carbon occupations.
 - However, some analyses (Allan et al., 2019; Dominish et al., 2019) identify that significant shares of employment in fossil fuel generation and extraction are in higher occupational categories.
 - There is also demand for lower-skilled, manual occupations which for example comprise the majority of solar PV installation and offshore wind construction activities.
- There is a need to co-ordinate the development and supply of training so that it takes full account of the wide range of occupational functions required for renewable energy technologies and infrastructure.
 - Sequential planning will be required to train and coordinate local workforces required for renewables expansion, minimising time gaps between projects and the need for construction workers to relocate.
- Renewable energy construction/ installation and operation/servicing jobs are generally created locally or in the countries where renewables are built / serviced. We note the potential for low carbon jobs to be located in areas where traditional industry may be in decline.
- Limited evidence identified which suggests that women and people with low-incomes or lower educational attainment are less likely to work in green / renewable energy sectors or have access to relevant training.



www.ukerc.ac.uk

[@UKERCHQ](https://twitter.com/UKERCHQ)

r.gross@ucl.ac.uk

r.hanna@imperial.ac.uk

[@UKERCHQ](https://twitter.com/UKERCHQ)

