Can the offshore energy sector be transformed to help the UK become a net-zero nation?

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In June 2019, the UK became the 1st major economy to legislate for net-zero by 2050. In September 2019, Scotland committed to be net zero by 2045. This article presents the current UK offshore energy picture, discussing future challenges and opportunities towards a just energy transition.

UK offshore energy picture

Oil and Gas

The UK offshore petroleum sector is in a state of transition. The National Audit Office (NAO, 2019) stated that over 44 billion barrels of oil equivalent (Bboe) have been produced so far, with an estimated 5.4 Bboe more still to be recovered. Yet it is anticipated that UK oil and gas will contribute ever less to meeting energy demand due to domestic petroleum production decline and increasing government support for cleaner energy to meet its net-zero emissions targets. **Figure 1** shows historical and forecast hydrocarbon production in the UK. The Climate Change Committee's net-zero scenarios (2019) give reduction in oil and gas consumption of 82% and 32%, respectively, by 2050.

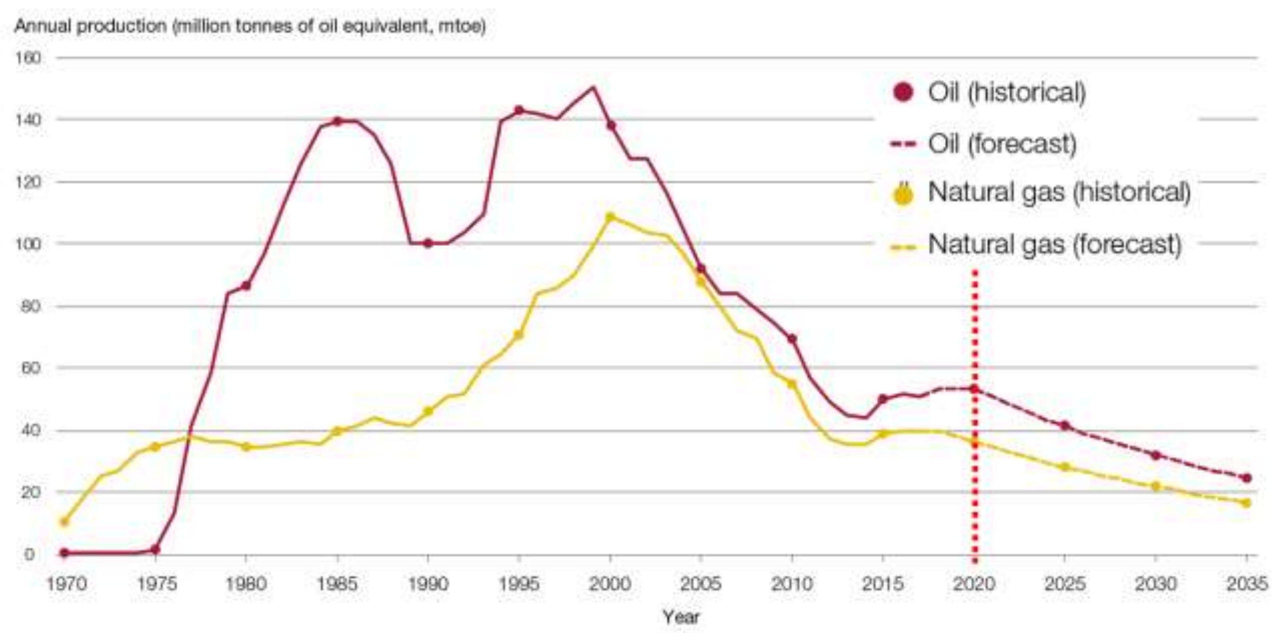

Figure 1: Historical and forecast hydrocarbon production in the UK (after NAO, 2019).

Since 1967, over 300 fields have produced oil and gas in UK Continental Shelf (UKCS) waters (see **Figure 2**), but the sector focus is turning increasingly to abandonment and restoration. 150 UKCS fields are forecast for decommissioning over the next decade, with approximately 100 platforms being completely or partially removed, 2000 wells plugged and abandoned, and 7500 km of pipeline decommissioned.

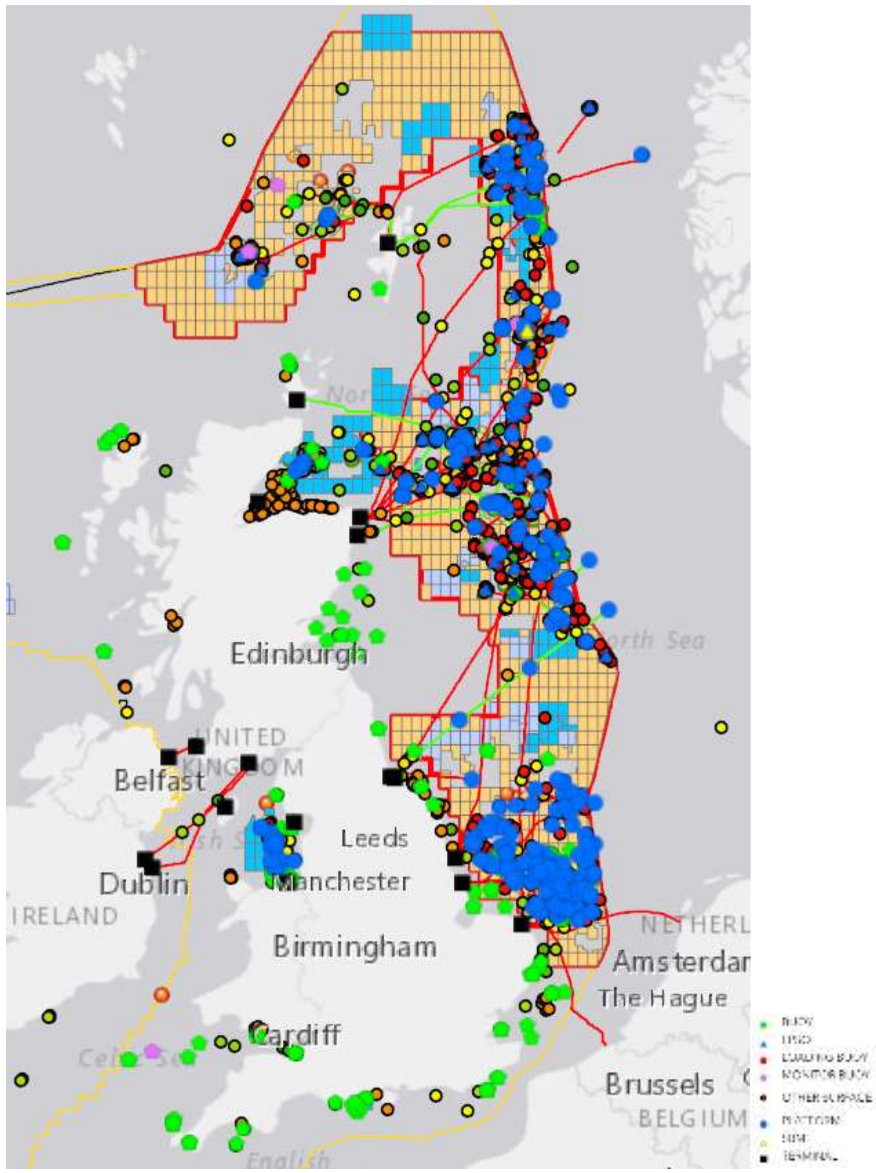

Figure 2: Oil and gas offshore infrastructure map (OGA, 2020)

The World Energy Council (WEC, 2017) forecasts that maximum activity is expected in the period 2020-2030, whilst the NAO reported that UK offshore operators have spent more than £1 billion on decommissioning in each year since 2014 and the Oil and Gas Authority (OGA, 2019a) estimates UKCS abandonment expenditure (abex) over the next decade will be £40-67bn. The WEC estimates that 50-80% of UK oil and gas abex may ultimately be borne by the taxpayer. With abandonment activity increasing, the UK government is paying out more in tax relief for decommissioning at the same time as tax revenues from oil and gas production are falling. These tax reliefs are part of the government strategy to support the industry to maximise economic recovery (MER) of petroleum resources due to its role in the economy, supplying energy and providing employment.

Wind

The UK's total offshore wind operational capacity is approximately 8.5 GW (Crown Estate, Crown Estate Scotland, 2020). See **Figure 3** for a map of current offshore wind installations in the UK.

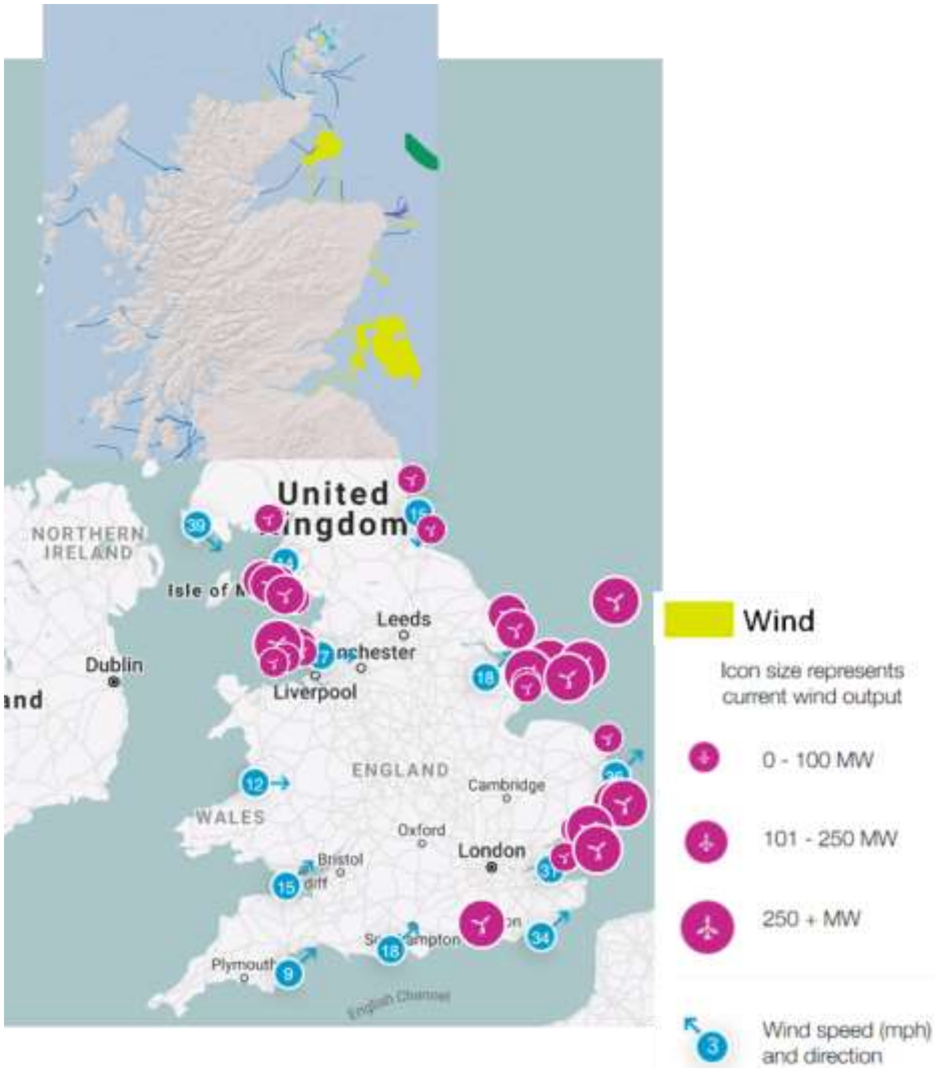

Figure 3: UK offshore wind installations (combined after Crown Estate and Crown Estate Scotland, 2020)

The 2019 Offshore Wind Sector Deal (BEIS, 2019a) set the ambition to deliver up to 30 GW of generating capacity by 2030, at 1-2 GW of new offshore wind per year. Arup (2018) estimated the costs of decommissioning 37 UK offshore wind farms at various stages of development as £1.28-3.64 billion, anticipating that abex would increase as more developments and bigger structures were being planned. A study by the University of Cambridge (Liu and Barlow, 2017) suggested that there will be 43 million tonnes of blade waste worldwide by 2050, with China possessing 40% of the waste, Europe 25%, the United States 16% and the rest of the world 19%. The blades, made with composites, are currently regarded as unrecyclable.

Both oil and gas and offshore wind operators, as well as the government, must prepare in advance for decommissioning, accurately estimate total costs, including site remediation and monitoring, and be fully aware of abandonment liabilities. The potential for synergies between mature offshore hydrocarbon installations and renewable energy projects is not being fully exploited. Delaying the decommissioning of some oil and gas infrastructure could trigger new circular economy options for the UKCS during the ongoing transition to a net-zero UK by 2050. On the other hand, procrastinating overdue decommissioning while many of the large E&P operators have already left the UK could lead to liabilities falling on taxpayers.

<u>Integration options for an energy transition</u>

There are complementary offshore energy generation and storage options that would benefit from existing oil and gas infrastructure. Identifying investment priorities and collaboration opportunities among multi-sector stakeholders will inform operators and the government on what oil and gas infrastructure should stay or go, and when. In many cases, there are neither prior examples, nor business models to allow oil and gas operators to co-produce 'green' energy and tap into the associated incentives via conventional hydrocarbon infrastructure. In addition, isolated demonstrators of such technologies seldom prove repeatability and scalability. **Figure 4** illustrates offshore energy integration options according to the OGA's UKCS Energy Integration Interim findings (2019b).

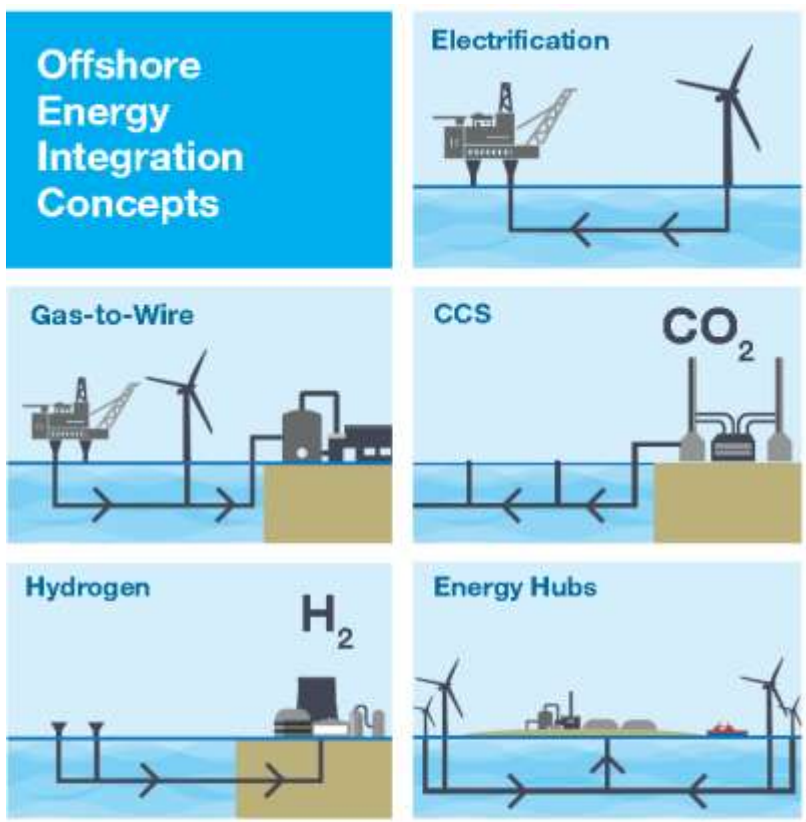

Figure 4: offshore energy integration options (according to OGA, 2019b).

Perhaps a better ~~to look~~ way of looking at integration options is shown in **Figure 5**, where prolonging the life of an asset means keeping it in production for longer, re-using it means that an asset is used for the same original purpose but in a different location, and re-purposing is when an asset is ~~used~~ employed in the same location, but for a new use. This allows one to clearly distinguish between options where hydrocarbon production is envisaged to continue, versus options where hydrocarbon production is ceased.

PROLONG	RE-USE	RE-PURPOSE
Electrification	Platform marketing	Carbon capture and sequestration (CCS)
Enhanced Oil Recovery (EOR)	Hotel accommodation for wind farm projects	Geothermal
	Recreational use	Power-to-gas (PtG)
		Gas-to-wire (GtW)
		Compressed air energy storage (CAES)
		Marine energy
		Research site / field laboratory
		Offshore island (host wind farm stations)

Figure 5: life extension options for oil and gas infrastructure (modified after WEC, 2017).

<u>What energy integration options are realistic?</u>

Assessing options that imply continuation of hydrocarbon production must be carefully assessed vis-à-vis the forecasts of **Figure 1**, as well as the urgency to achieve net-zero within the next 30 years. Some key questions are:

- How long can existing mature assets continue to produce?
- What commercially viable integration options are there towards net-zero operations?
- Can mature infrastructure become “living laboratories” for different stakeholder groups to effectively collaborate whilst exploring the above options?
- Can stranded “small pools” of oil and gas be brought online via facilities’ electrification with renewable energy? Full electrification remains a challenge; Equinor’s Hywind Tampen project, the world’s first renewable power for offshore oil and gas, will only meet about 35% of the annual power demand of the five Snorre and Gullfaks platforms and the project is only viable because of the large size and longevity of these fields.

For options that assume cessation of hydrocarbon production, a critical question is which infrastructure can be re-purposed and used now and beyond 2050? An example of the latter challenge is the re-use of oil and gas assets for carbon capture usage and injection projects, as raised by the recent Department for Business, Energy and Industrial Strategy consultation (BEIS, 2019b).

With or without continued hydrocarbon production, there is only a small window of opportunity to identify what should stay or go. It is likely that only a small percentage of infrastructure could be re-purposed. There is an urgent need for a realistic timeline to reflect actual opportunities and liabilities.

Investment must shift to renewables and energy efficiency

The energy transition needs investment for a shift towards renewables and greater energy efficiency. So far, however, investment in carbon capture, utilisation and sequestration (CCUS) worldwide has been small, as shown in **Figure 6**, and its deployment remains off track.

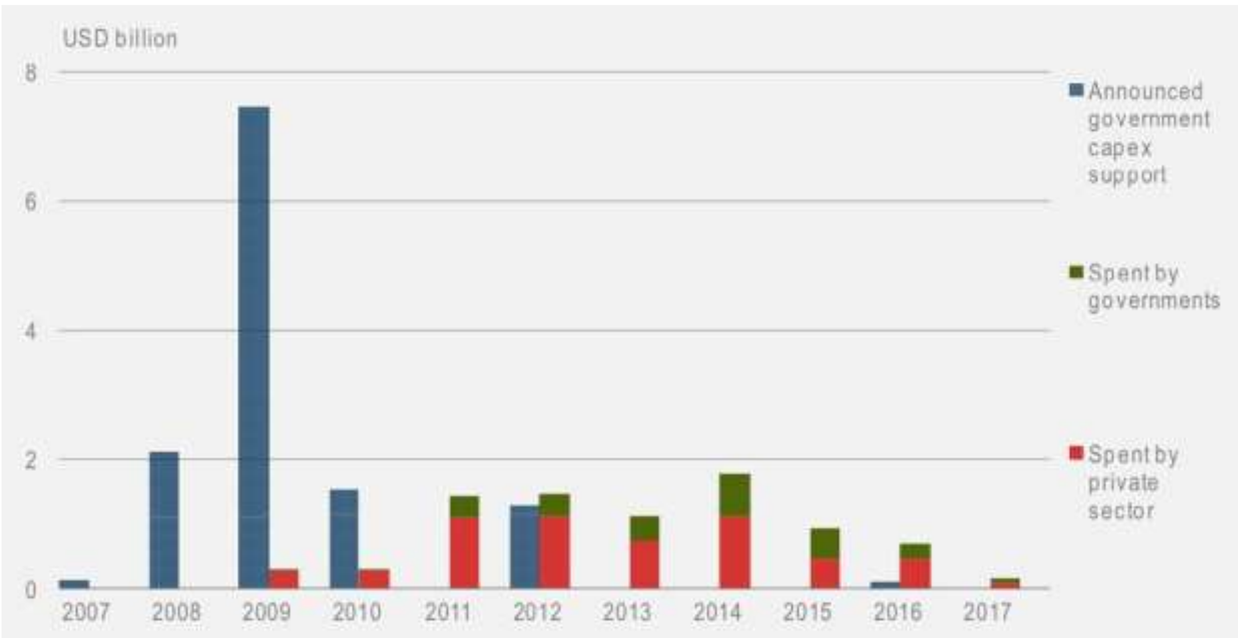

Figure 6: Investment in large-scale CCUS projects from 2007 to 2017 (IEA, 2018)

According to the Intergovernmental Panel on Climate Change (IPCC, 2018), net-zero can be achieved when CO_2 emissions are balanced by CO_2 removals over a specified period. Hence, net-zero cannot be achieved by only reducing emissions; it also requires their removal by CCS. However, large scale CCS implementation in the UK is still far away. For example, the Acorn CCS project is still progressing towards a final investment decision in late 2021, for a possible start in 2023, with first phase funding coming from the UK government (CCUS Innovation Programme), the European Union and the industry. Yet, its technical and commercial specifics may prove neither repeatability, nor scalability and, meanwhile, the net-zero deadline is looming.

Europe's Oil Majors' investment in renewables has also been disappointing so far, as shown in **Figure 7**.

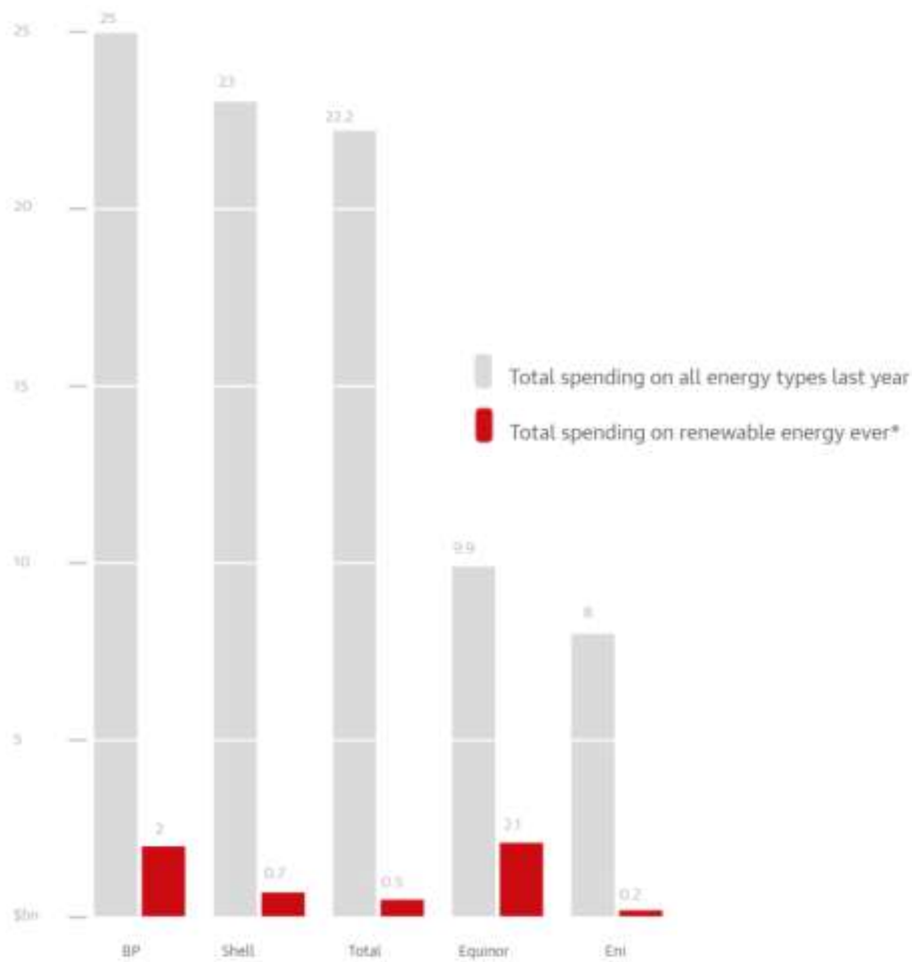

Figure 7: Europe's Oil Majors' investment in renewables (Guardian graphic, 2020 - Source: Rystad Energy, company data) * Rystad excludes R&D spending and clean energy technologies that are not renewable.

<u>The need for a 'Just Transition'</u>

According to the Office of National Statistics (ONS, 2020), there were 224,800 jobs in low carbon and renewable energy in the UK in 2018, including nuclear (**Figure 8**). BEIS (2019) set the ambition to increase offshore wind jobs from 7,200 today to 27,000 by 2030.

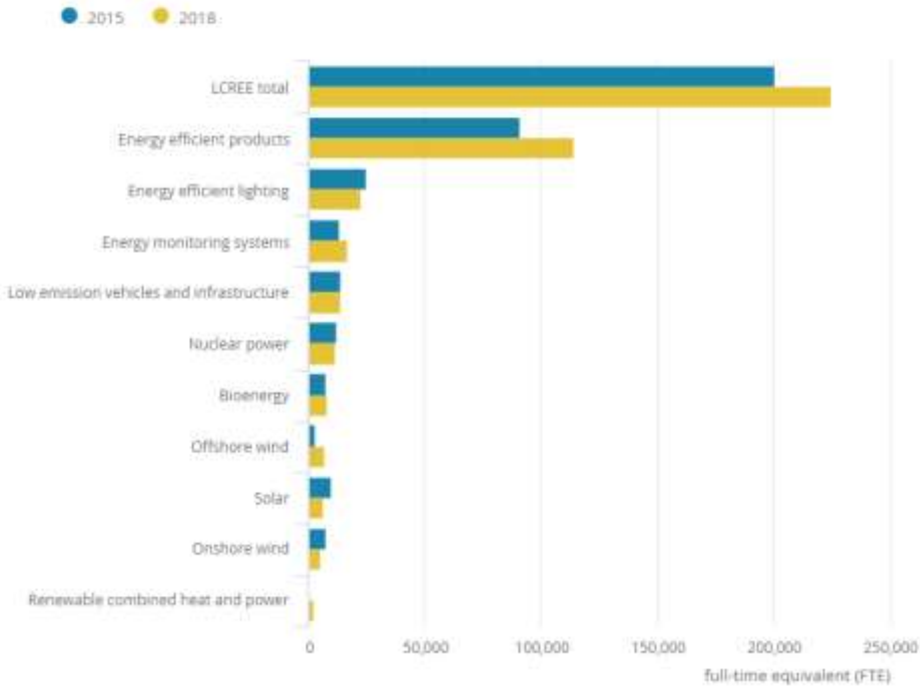

Figure 8: Low carbon and renewable energy economy employment, total and selected sectors, UK, 2015 and 2018 (ONS, 2020)

In comparison, from its 463,900 peak in 2014, the oil and gas offshore industry has lost 194,800 jobs across the UK (**Figure 9**), with relatively few professionals being redeployed within the energy sector.

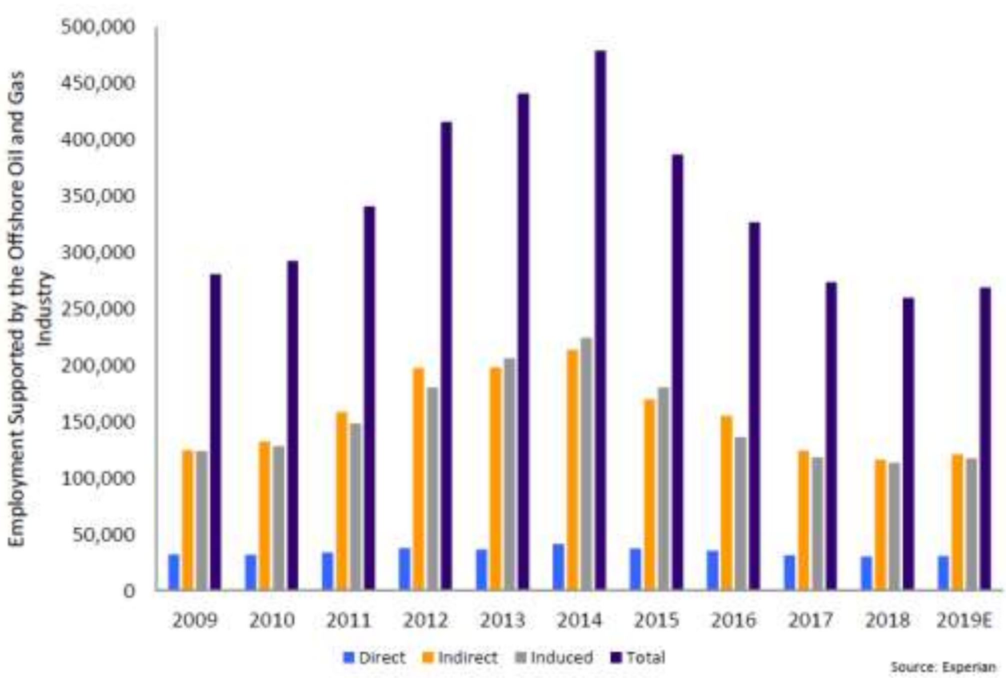

Figure 8: Total employment supported by the offshore oil and gas industry (Oil~~e~~ and Gas UK, 2019)

Currently, there is an imbalance between the number of employment opportunities in the renewable vs. conventional energy sectors. Thus, careful planning is needed to ensure a just and sustainable energy transition by 2050, considering geographical distribution of both natural and human resources.

Conclusions

The UK offshore energy sector is in a state of flux, which presents opportunities and challenges. Without an integrated approach to energy transition in the UKCS, it is unlikely that technically and commercially viable options for short, medium and long-term energy solutions will be identified in the available time window to create value and minimise abex. The limitations imposed by ageing hydrocarbon infrastructure, by supply/demand fluctuations and by the looming net-zero targets must be accounted for when developing a realistic timeline for energy projects' integration and prioritising abandonment liabilities. A project-by-project approach to decommissioning approval does not reflect the need for net-zero basin planning. There is a need to reconcile the MER strategy of extending hydrocarbon production with net-zero targets and potentially competing uses of infrastructure (e.g. pipelines for continued oil and gas production vs. CO_2/hydrogen transport and storage). Better coordination among multi-stakeholders of the UKCS and decommissioning actors could promote complementary and synchronised abandonment activities, which should lower associated costs by allowing the supply chain to organise itself optimally and help smooth the path towards energy transition.

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