MIDLANDS ENGINE

GREEN AND HYDROGEN JOBS IN THE MIDLANDS

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Green and Hydrogen Jobs in the Midlands

By

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60 Second Summary

An analysis of green and hydrogen jobs in the Midlands using data from the Labour Force Survey (LFS) revealed that up to 3.9% of all employment were in occupations can be classified as “pure green employment” or employment that have come into existence as a direct result of the growth and development of the green economy. 3.5% of online job vacancies fell into this category. 41% of employment in the Midlands region were in occupations classified as green (that is, either contributing to green activities, and those that are considerably influenced by the green economy), while up to 44% of online job vacancies can be categorised as green. The quantity of online vacancies which explicitly mention the word hydrogen is relatively small but has been increasing since end-2020. Of all vacancies that mentioned hydrogen in the UK since end-2020, on average, 17% of these were in the Midlands. However, compared to total number of job vacancies in the Midlands, the share that explicitly mentioned hydrogen only accounts for 0.08%. Green employment in occupations either related to the production, utilisation, or advancement of hydrogen, or in another green occupation which supports the hydrogen industry (collectively termed green Hydrogen occupations) accounted for about 10% of employment in the Midlands, with this share slowly increasing over time. The analysis distinguished three types of green jobs – New and Emerging Occupations or pure green jobs which are completely novel, Enhanced Skills and Knowledge Occupations which capture changing worker requirements in some existing jobs, and Increased Demand Occupations which result when green economy activities increase employment demand for some existing occupations. Hydrogen jobs were empirically mapped using online vacancy data which gave an indication of roles demanded in the hydrogen industry. Importantly, the vacancy data revealed that not all hydrogen jobs are green jobs.

New and Emerging green employment and job vacancies have been increasing, indicating a movement towards a greener economy. The data showed that green economic activities and technologies have been changing the requirements of workers in existing occupations and have increased demand for some existing occupations. Green jobs were clustered among professional occupations, skills trade occupations and process, plant and machine operatives, with a larger share of green employment in construction, engineering, manufacturing and transport industries in the Midlands than in the rest of the UK. Job vacancy data showed that both hydrogen green occupations and New and Emerging green jobs have relatively higher demands for technical skills/training, though a large share of green and hydrogen job vacancies also requires cross-sector transferable skills like communication skills, attention to detail and working in a team. The majority of these job vacancies also required some labour market experience. The findings provide a baseline for monitoring progress towards green

ambitions in the Midlands and suggest that the region is building from a solid foundation. Given the number of hydrogen-ready green jobs, the Midlands is well placed to embrace the growing hydrogen economy. To ensure further and sustained progress, it is recommended that: (i) the greening of jobs in non-green sectors should be encouraged, (ii) there should be targeted efforts towards more inclusive green employment – focusing on age and gender (e.g. through improved job quality and apprenticeships), (iii) there should be routine monitoring of the green economy and green employment (e.g. through follow-up studies to the present one which track similar indicators), and (iv) further qualitative research (e.g. interviews and focus group discussions) with firms in green and hydrogen industries would serve to understand and unblock constraints faced by companies who wish to expand employment.

Executive Summary

The UK Government has committed to a Net Zero Strategy by 2050. This means reducing the use of fossil fuels and moving towards greener alternatives. The Midlands Engine Partnership has translated these national goals into regional objectives with the 2021 Ten Point Plan for Green Growth and the 2022 Midlands Engine Hydrogen Technologies Strategy. In order to assess progress of these plans, a measurement of green jobs is needed, with a focus on hydrogen-related jobs. The Midlands Engine and HyDEX partnership commissioned the Warwick Institute for Employment Research (IER) to assess the extent and nature of jobs in the hydrogen industry across the Midlands. This report presents the findings from the analysis of green and hydrogen jobs in the Midlands conducted by IER.

The research methodology comprised of three parts. First, the concepts of green and hydrogen jobs were mapped. The analysis distinguished three types of green jobs – New and Emerging Occupations or pure green jobs which are completely novel, Enhanced Skills and Knowledge Occupations which capture changing worker requirements in some existing jobs, and Increased Demand Occupations which result when green economy activities increase employment demand for some existing occupations. Hydrogen jobs were empirically mapped using online vacancy data which gave an indication of roles demanded in the hydrogen industry. Throughout the report, the collective term “green hydrogen occupations” refers to green employment in occupations either related to the production, utilisation, or advancement of hydrogen, or in another green occupation which supports the hydrogen industry. Added to this, there are also administrative and support roles for the hydrogen industry. Second, an analysis of the current extent of green jobs in the Midlands was conducted, with a deep dive into jobs relevant to hydrogen-related economic activity. The analysis relied on two data sources: the ONS Labour Force Survey (LFS) over the period 2014-2022 and a database of online job vacancies collected and housed at the IER covering the period 2019-2023. Third, the demand for these jobs was assessed, and the range of skills needed in these jobs identified.

The analysis relies on SOC 4-digit level groupings, which was the best data available but has limitations in terms of granularity.[1] In this respect, the figures presented in this report should be regarded as upper-level estimates driven by current data limitations. Ideally, data

[1] For example, the Unit Group ‘2129: Engineering professionals’ envelops a broad range of occupations, including, for example, mining engineers, oil and natural gas engineers, petroleum engineers, sustainability engineers, turbine engineers.[1] Some of these petroleum engineers, for example, work on green activities, while some do not. Including all petroleum engineers as “green” is lumpy and possibly presents an upper-level estimate. IER is presently developing a methodology to allow the classification of green jobs at the SOC 5- and 6-digit levels.

disaggregated at the at the 5-digit or 6-digit level within the SOC is needed to better inform and policy to support reskilling and upskilling of specific occupations.

Table 1: Summary of Selected Key Findings, Midlands

	Description	LFS Employment Data (2014 – 2022)	Online Vacancies Data (2019 – 2023)
Share of vacancies explicitly mentioning "hydrogen"	Measures the share of vacancies from the online vacancy data which explicitly mentioning the term "hydrogen"	N/A	0.08%*
Average share of Hydrogen Green Jobs	Measures green employment/vacancies in occupations either related to the production, utilisation, or advancement of hydrogen or in another green occupation which supports the hydrogen industry	9.5%	10.2%
Average share of New and Emerging Green Jobs	Measures "pure green employment" or those that came into existence as a direct result of the growth and development of the green economy	3.9%	3.5%
Average share of all Green Jobs (New and Emerging + Enhanced Skills and Knowledge + Increased Demand)	Measures all green employment/vacancies, including three types. It is an inclusive measure of employment/ vacancies and captures employment that directly contribute to green activities, and those that are considerably influenced by the green economy	41.9%	44.2%
Average share of **new and emerging** h**ydrogen** green **jobs**	Measures the share employment/vacancies in new and emerging and Hydrogen green occupations	2.0%	2.0%

*Calculation based on the monthly average over the period November 2020 to February 2023.

The findings showed that New and Emerging green jobs stood at 189,500 jobs in 2022 (3.9% of all employment), and represents “pure green employment” or employment that have come into existence as a direct result of the growth and development of the green economy. New and Emerging green job vacancies stood at 3.5% have been increasing, indicating a movement towards a greener economy. 41.9% of employment in the Midlands is in occupations related to the green economy, that is they are either New and Emerging, Enhanced Skills and Knowledge or Increased Demand green jobs as defined above. 44.2% of job vacancies fit into these three green jobs categories. The existence of Enhanced Skills and Knowledge jobs and Increased Demand green jobs suggest that green economic activities and technologies have been changing the worker requirements of existing occupations and have increased employment demand for some existing occupations. Green jobs were clustered among professional occupations, skills trade occupations and process, plant and machine operatives, and there was a larger share of green employment in construction, engineering, manufacturing and transport industries in the Midlands than in the rest of the UK. With respect to gender and age, green jobs were more likely to be held by men and by older workers.

Specific to hydrogen employment, the explicit use of the word “hydrogen” in job vacancy descriptions has been trending up since 2021. Of all vacancies that mentioned hydrogen in the UK since end-2020, on average, 17% of these were in the Midlands. However, compared to total number of job vacancies in the Midlands, the share that explicitly mentioned hydrogen only accounts for 0.08%. The LFS data showed that green employment in occupations either related to the production, utilisation, or advancement of hydrogen, or in another green occupation which supports the hydrogen industry (collectively termed green Hydrogen occupations) accounted for about 9.5% of employment in the Midlands over the 2014-2022 period. Green hydrogen occupations (as previously defined) grew by 18% over the period in the Midlands, compared with 24% in the rest of the UK (excluding the Midlands). 2% of both employment (based on the LFS data) and job vacancies were in occupations classified as new and emerging hydrogen green jobs.

Hydrogen employment was mainly in skilled and technical occupational roles, with about 50% of hydrogen jobs concentrated in the manufacturing, construction, and professional, scientific, and technical sectors. The findings from the LFS data align with the vacancy data. The vacancy data showed that about 10.2% of all job vacancies in the Midlands can be classified as green hydrogen occupations. These figures indicate that around 10% of employment in Midland could be transitioned to hydrogen jobs. The most common hydrogen-related occupation from the job vacancy data were programmers and software development professionals, finance and investment analysts and advisers, metal working production and

maintenance fitters, vehicle technicians, mechanics, and electricians and finally, science, engineering and production technicians. As with green jobs overall, hydrogen jobs were predominantly held by males.

In general, both New and Emerging green jobs and hydrogen green jobs had relatively higher demands for technical skills/training than Enhanced Skills and Knowledge jobs, Increased Demand green jobs and non-green jobs; though a large share of green and hydrogen job vacancies also requires cross-sector transferable skills like communication skills, attention to detail and working in a team. The vast majority of New and Emerging and hydrogen green jobs required experience (over 70%), and the median wage for these types of jobs exceeded non-green and non-hydrogen occupations, respectively.

The findings provide a baseline for monitoring progress towards green ambitions in the Midlands and suggest that the region is building from a solid foundation. Given the number of hydrogen-ready green jobs, the Midlands is well placed to embrace the growing hydrogen economy. To ensure further and sustained progress, it is recommended that the greening of jobs in non-green sectors should be encouraged. One way of encouraging this greening of jobs will be through training that delivers up-skilling and re-skilling enabled by new micro-credentials (that is, small specific training qualifications), and which might also support the drive to a more inclusive net zero economy by drawing in a diverse range of workers into non-green sectors. Second, it is recommended that, there should be increased efforts towards more inclusive green employment, focusing on age and gender. For example, improving job quality is one way to attract under-represented workers and apprenticeship can be used to include younger workers. Third, there should be routine monitoring of the green economy and green employment (for example, through follow-up studies to the present one which track similar indicators). There should be periodic updates of the analysis using the methodology in this report to monitor trends and developments over time in the level/share and demand for green jobs and hydrogen green jobs in the Midlands. And fourth, further qualitative research (for example, interviews and focus group discussions) would serve to understand and unblock constraints faced by firms in green and hydrogen industries who wish to expand employment. This research might be with companies in targeted sectors in the Midlands (such as manufacturing, energy and transport). The findings from such a study would complement this report and feed into green policy and practice in the Midlands hydrogen industry (and beyond).

1. Introduction

Climate change and its impact on everyday life, the economy and society is now salient in policy and business debates in the UK and elsewhere. The UN has launched the "Race to Zero Campaign",[2] and world leaders have committed to the 2015 Climate Change Treaty (the Paris Agreement),[3] with Conferences of the Parties (COP) to the UN Framework Convention on Climate Change being held each year.[4]

In UK, the Government has committed to a Net Zero Strategy by 2050;[5] This means reducing the use of fossil foils and moving towards greener alternatives. The Government has also committed to a Green Industrial Revolution, with a ten-point plan to *Building back better, supporting green jobs, and accelerating our path to net zero.*[6] Regions within the UK, such as the Midlands, have translated these national goals into regional objectives and strategies. Examples include the Ten Point Plan for Green Growth launched by the Midlands Engine Partnership in 2021 and the 2022 Midlands Engine Hydrogen Technologies Strategy, with both intended to ensure a greener future for communities in the Midlands and contribute to national sustainability efforts. Both documents emphasise multiple goals of carbon reduction, added value to the economy and the creation of jobs.[7][8]

To assess progress of these plans, the measurement of green jobs, including hydrogen-related jobs, is required. Such measures also help to identify the skills needed for these jobs, which is vital for informing education and training plans and provision. This report estimates the extent of and demand for green jobs in the Midlands, with an emphasis on hydrogen jobs, and serves as a benchmark as the region sets out to achieve its strategies and policies around net zero. The report also compares the level/share of green and hydrogen jobs in Midlands to the rest of the UK (excluding the Midlands). Throughout the report, the rest of the UK is taken to mean the UK, excluding the Midlands.

The research was conducted in three stages. First, the concepts of green and hydrogen jobs were discussed with stakeholders, and empirically mapped, drawing on IER's previous work

[2] Race To Zero Campaign | UNFCCC

[3] The Paris Agreement | United Nations

[4] COP27: Delivering for people and the planet | United Nations

[5] UK Government (2021a)

[6] UK Government (2020).

[7] Midlands Engine (2021); Midlands Engine (2022a)

[8] The academic literature has noted the prospects of job creation effects from environmentally friendly technological change (Gagliardi et al. 2016; Martinez-Fernandez et al. 2010)

on defining and mapping green jobs.[9] Second, an analysis of the current levels/shares of green jobs in the Midlands was conducted using the Labour Force Survey (LFS), with a deep dive into jobs relevant to hydrogen related economic activity. Third, the demand for these jobs was assessed using IER's job vacancy database, and the range of skills needed in these jobs identified. This report therefore provides new evidence that will help: (i) build a better understanding of future job and skills needs to support the Midland Engine's delivery of its Hydrogen Technology Strategy, and by extension, the region's progress to net zero, and; (ii) drive awareness and action to support reskilling and upskilling.

The report is structured as follows. Section 2 gives a brief overview of the green economy and green policy in the UK and Midlands, with an emphasis on hydrogen. Section 3 conceptualises and maps green jobs, placing hydrogen jobs within a wider discussion of green jobs. Section 4 outlines the methodological approach used to identify the extent of, and demand for, both green and hydrogen jobs in the Midlands. Section 5 presents findings on levels/shares of green and hydrogen jobs in the Midlands, while Section 6 presents findings on demand for green and hydrogen jobs in the Midlands. The final section summarises the key lessons from the research and offers recommendations.

[9] Cardenas Rubio et al. (2022).

2. Background to the Green and Hydrogen-related landscape in the UK and Midlands

The UK's Net Zero Strategy aims to 'build back greener' and acknowledges the role of consumers, producers and the government in doing so.[10] By 2021, the government had mobilised £26bn of government capital investment for a green industrial revolution. This investment is intended to support regulation (for example, on emission and domestic energy usage), the creation of green jobs (190,000 jobs by 2025 and then 440,000 jobs by 2030) and leverage up to £90bn of private investment by 2030.[11] According to the most recent Office for National Statistics (ONS) data, progress has been made. Since the ONS began tracking the low carbon and renewable energy economy (LCREE) in 2015, the 2020-2021 period saw the highest turnover of income in the LCREE (an increase of 30.8%, from £41.6bn to £54.4bn), in part due to the COVID-19 recovery and easing of lockdown measures.[12]

The UK Net Zero Strategy recognises the role of hydrogen in contributing to sustainability objectives, while simultaneously driving growth and creating employment. Hydrogen has long been used in industrial processes. Some of the first hydrogen bubbles generated in electrochemical processes date back to 1800s, while during the 20th century, hydrogen was used in combustion engines, fertiliser production, airships and, most notably, in powering humans into space in the 1960s.[13] However, its reactivity makes hydrogen a difficult gas to manage, and makes containment and distribution challenging. Moreover, manufacture of hydrogen has been a polluting process and has only recently been seen to be acceptable with the advent of 'net-zero emissions' and not 'zero-emissions'.[14] Given advancements in the last decade, there is now international reconsideration of using hydrogen as a means to reduce fossil fuel consumption.

The strategic importance of hydrogen is evident in the Government's Ten Point Plan for a Green Industrial Revolution, which involves 'driving the growth of low carbon hydrogen.' It recognises that hydrogen is the lightest, simplest and most abundant chemical element.[15] Alongside its role in building back greener, hydrogen also plays a role in the British Energy Security Strategy which calls for energy independence.[16] These ambitions are brought

[10] UK Government (2021a)

[11] UK Government (2021a)

[12] ONS (2023)

[13] Manufacturing Technology Centre (2022)

[14] Manufacturing Technology Centre (2022)

[15] UK Government (2020)

[16] Department for Business Energy and Industrial Strategy (2022)

together in the 2021 UK Hydrogen Strategy, which sets out an approach for enhancing the production, distribution, storage and use of hydrogen across the UK, with emphasis on the industrial heartlands.[17] The policy focus is justified as recent research suggests that hydrogen can be integral to decarbonisation, with potential for green gains in transport, industry, electricity and heating; as well as storage for intermittent renewable energy.[18]

Hydrogen at a glance

- Hydrogen is manufactured in several ways, including the reaction of methane from natural gas with steam, cracking of crude oil fractions (hydrogen is a by-product of this process), and the electrolysis of water.
- Green hydrogen is not dependent on fossil fuel feedstock energy and can be generated from renewable sources.
- To date, hydrogen demand is primarily concentrated in the industrial sector, namely chemical processing and ammonia manufacture.
- Hydrogen is becoming a globally recognised energy vector to decarbonise hard-to-electrify sectors.

Source: BBC Bitesize; Manufacturing Technology Centre (2022)

The Midlands region remains the heartland of the UK manufacturing sector.[19] It is therefore instrumental in national green objectives. The Midlands is home to 22% of England's energy and low carbon businesses, employing 106,990 people across small, medium and large 23,000 businesses.[20] Each year more than £2.5bn capital investment is made in energy technologies and infrastructure (excluding buildings and transport) across the Midlands. A recent study found that low-carbon manufacturing was the fastest growing sector in the Midlands, even withstanding wider downturns in the Midlands economy from the COVID-19 pandemic.[21] The region is also home to several innovation-led organisations (or catapults), research technology organisations and universities, and innovative organisations in the net zero or green space. Against this backdrop, the Midlands Engine has organised a partnership of 65 Local Authorities, one Combined Authority, 20 universities, nine Local Enterprise

[17] UK Government (2021b)

[18] Chapman et al. (2019); Griffiths et al. (2021); Parra et al. (2019); Seck et al. (2022).

[19] Midlands Engine (2022b)

[20] Midlands Engine (2022b)

[21] West Midlands Combined Authority (2021)

Partnerships and over 800,000 businesses to safeguard the environment, grow the economy, and deliver a greener future for the communities in the Midlands (see Figure 1.1).[22]

Figure 1.1: Midlands Engine Partnership

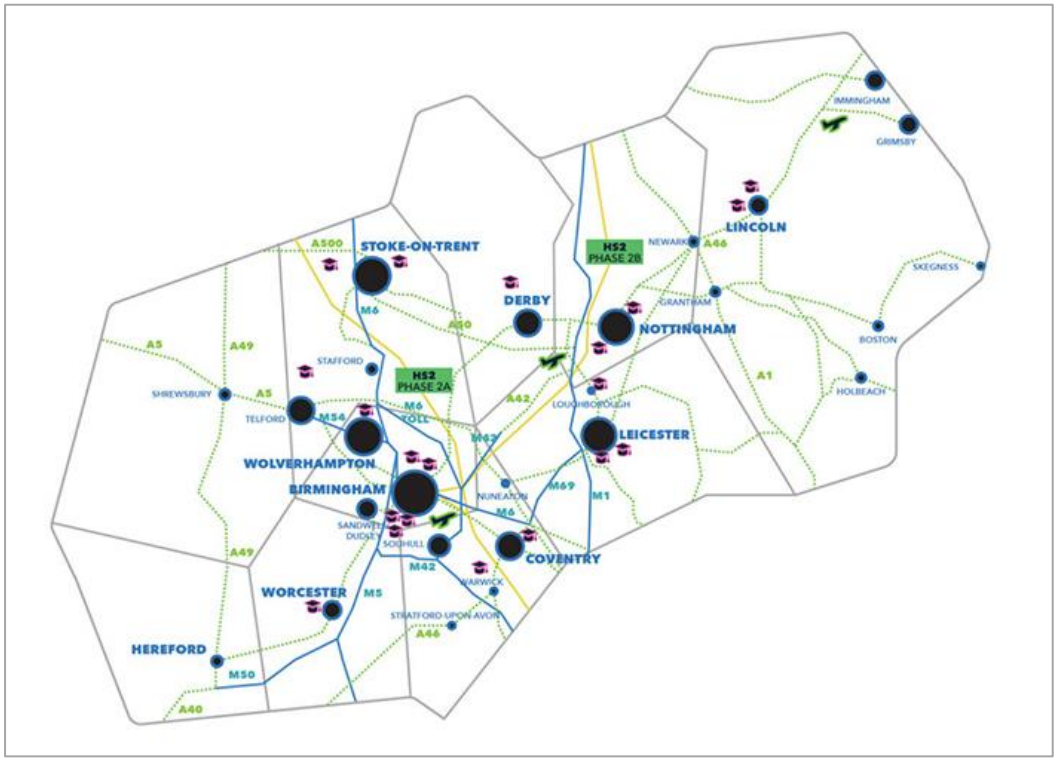

Image source: [Our Partners, Our Region | Midlands Engine]

In 2021, the Midlands Engine Partnership launched a Ten Point Plan for Green Growth setting out a regional vision and ambition for green growth, outlining key collaborative actions to deliver added value for partners pre-existing green activity.[23] The Plan outlines that the potential impact of this collaborative action for the region could be as much as 196,000 more jobs, a further 20.8m tonnes reduction in $C0_2$ emissions, and more than £24.2bn gross value added (GVA). The Midlands Engine Partnership has also taken a lead (in the Midlands region, and UK generally) to pioneer, commercialise and deliver technologies to unlock low carbon hydrogen opportunities. The Midlands region has the industrial capabilities to contribute to the hydrogen supply chain, including the technology which generates green hydrogen, provided that a holistic approach to the hydrogen value chain is adopted.[24]

[22] Midlands Engine (2021)

[23] Midlands Engine (2021)

[24] Manufacturing Technology Centre (2022)

Key to this plan is the 2022 Midlands Engine Hydrogen Technologies Strategy.[25] Similar to the 2021 UK Hydrogen Strategy, the Midlands Engine Hydrogen Technologies Strategy recognises the role of hydrogen in sustainability targets, alongside ambitions for economic growth and job creation. Underlying the Midlands Engine Hydrogen Technologies Strategy is a vision of a Midlands Hydrogen Technologies Valley with various partners across the Midlands. Such a 'Valley' links hydrogen production with end users and promotes the industrialisation of hydrogen technologies at scale - enabled through academic and supply chain development support. The Strategy has the potential to deliver a 29% reduction in CO_2 (17m tonnes), £10bn GVA, and 167,000 new or safeguarded jobs.[26]

[25] Midlands Engine (2022a)

[26] Midlands Hydrogen Technologies Factsheet.

3. Mapping green and hydrogen jobs

Until recently, measurement of the extent and demand for green jobs was a challenge due to lack of agreed definitions.[27] Previous attempts to define green jobs generally fit into one of two main camps: 'purist' or 'inclusive'.[28] Purist definitions are narrower in scope[29] and typically focus on a small number of jobs in typically green sectors such as the 'environmental sector', or those that are directly part of green activities.[30] Inclusive definitions, on the other hand, take into account the significant impact the transition to net zero will have on a much broader range of jobs that support that transition.

3.1. The GreenSOC

To address this issue, and bridge the gap between the two camps, the Warwick Institute for Employment Research (IER) working with the University of Strathclyde, developed the GreenSOC for the UK. To classify each occupation into its respective green category, a rigorous multi-stage research and screening process was employed. This process involved several key steps, including an extensive literature review of academic papers and reports from reputable sources on previously developed taxonomies, drawing on the US O*NET,[31] and stakeholder consultation.

Using the O*NET, Dierdorff and colleagues developed a framework to identify activities in the green economy.[32] Their framework recognises that green activities and technologies have different effects on different occupations. Specifically, the authors refer to the greening of occupations "to the extent to which green economy activities and technologies increase the demand for existing occupations, shape the work and worker requirements needed for occupational performance, or generate unique work and worker requirements." The GreenSOC builds on Dierdorff et al.'s framework. Under this framework, green jobs can be categorised into three types:[33]

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27 ILO (2018), ONS (2021).

28 Sofroniou and Anderson (2021).

29 Renner et al. (2008).

30 Hogarth (2012).

31 The O*NET is a comprehensive occupational classification system that extensively catalogues and consolidates information about occupations in the United States, including details about their tasks, required skills, and knowledge utilisation. It serves as a valuable resource offering detailed descriptions of various occupations. See: O*NET OnLine (onetonline.org)

32 Dierdorff et al. (2009)

33 See Cardenas Rubio et al. (2022) for more details on the classification, and Dickinson et al. (2022) for an application to the York area.

1. ***New and emerging:*** occupations that have come into existence as a direct result of the growth and development of the green economy and can be thought of as 'pure' green jobs;
2. ***Enhanced skills and knowledge:*** occupations subject to significant changes in work and worker requirements, and;
3. ***Increasing demand:*** occupations with an increase in employment demand levels without significantly changes in the job requirements.

Table 3.1 provides a more detailed description of the three types of green jobs discussed in this report.

Table 3.1: Green Occupational Categories

Green New and Emerging Occupations
The impact of green economy activities and technologies creates the need for unique work and worker requirements, which results in the generation of new occupations. These new occupations can be entirely novel or 'born' from an existing occupation. An example would be solar system technicians who must be able not only to install new technology but also to determine how this technology can best be used on a specific site.
Green Enhanced Skills and Knowledge Occupations
The impact of green economy activities and technologies can result in significant change to the work and worker requirements of existing occupations. This impact may result in an increase in employment demand for those occupations. The essential purposes of the occupation remain the same but tasks, skills, knowledge and external elements, such as credentials, have been altered. An example are architects, an occupation in which greening has increased knowledge requirements pertaining to energy efficient materials and construction, as well as skills associated with integrating green technology into the aesthetic design of buildings.
Green Increased Demand Occupations
The impact of green economy activities and technologies can increase employment demand for some existing occupations. However, this impact does not entail significant changes in the work and worker requirements of the occupation. The work context may change but the tasks do not. An example is the increased demand for electrical power line installers and repairers related to energy efficiency and infrastructure upgrades.

Source: Adapted from Dierdorff et al. (2009, pp. 4, 11 & 12)

The approach taken covers the narrow definition of pure green jobs, while simultaneously recognising the transformation of existing jobs as these jobs become greener, such as transportation occupations.

While the O*NET serves as a solid foundation for identifying green occupations, there are challenges associated with adapting this classification to other contexts such as the UK. First, the O*NET uses the US SOC which is different to the UK SOC. Second, since the O*NET system is primarily designed for the US labour market, it may not fully account for the nuances and specific characteristics of non-US labour markets, like the UK. To address these challenges and identify green occupations within the UK SOC2020, the following steps were undertaken to develop the GreenSOC:

1. Use of crosswalks: A crosswalk was employed to establish a connection between the US O*NET-SOC and the UK SOC2020. This mapping facilitated the identification of green occupations within the UK SOC2020 framework. Subsequently, the SOC2020 occupations were categorised into different green groups, including New and Emerging, Enhanced Skills and Knowledge, Increased Demand, and Non-Green occupations.
2. Manual examination by experts: A panel of experts from the University of Warwick and University of Strathclyde conducted a thorough manual examination of the occupational list. They reviewed and assessed the occupations to ensure their alignment with the green criteria and their appropriate categorisation within the green groups.
3. Review process with stakeholders: The identified list of green occupations at the SOC2020 4-digit level underwent a further review process involving Skills Development Scotland (SDS) and other key stakeholders. The purpose of this review was to obtain feedback, validation, and consensus on the final list of green occupations. Subsequent to these discussions, agreements were reached among SDS, experts from the University of Warwick and University of Strathclyde, and other stakeholders. This stakeholder consultation led to a careful revision of occupational classifications initially developed.

Given this approach, the GreenSOC usefully identifies UK SOC2020 occupations that are being transformed towards more sustainable and environmentally friendly practices. This mapping allows an approximation of the number of jobs in green occupations. It is important to acknowledge that the green economy is a dynamic and evolving concept. Occupations that were once considered non-green may undergo changes and be classified as green in the future. Moreover, given the evolving nature of the green economy and the difficulties in

disaggregating the information available, there are instances where coding occupations becomes complex, leading to blurred lines. In such cases, the expertise and opinions of domain experts play a vital role in accurately classifying these occupations as best possible.

3.2. Mapping green sectors using the SIC

The UK's Standard Industry Classification (SIC) groups the principal economic activity of a production unit, usually a business. Researchers often map the products businesses make onto these industries; for example, companies making wind turbines are grouped into the wind turbine industry. Similar industries are then sometimes clustered to suggest a 'sector'; for example, the 'manufacturing sector'. 'Green sectors' or the 'green economy' can then be identified based on a selection of industries that have a high proportion of businesses focused on producing environmental goods and services.

The Scottish Climate Emergency Skills Action Plan (CESAP) identifies sectors deemed critical to achieving net zero carbon emissions.[34,35] IER with the University of Strathclyde mapped these sectors into the SIC 2007 classification.[36] This mapping allows estimation of the number of jobs in green industries. An issue here is that not all jobs in green *sectors* are green *jobs*. Take, for example, a secretary working for a business that makes solar panels. The company is part of a green industry. However, if the secretary's work primarily involves computer usage drawing on non-renewably sourced electricity, it is difficult to classify this job as green in itself. The product to industry/sector approach also fails to acknowledge that there can be jobs within traditional, non-green industries (sometimes called brown jobs'), such as legal services, that also produce goods or services that contribute to net zero.

3.3. Combining the GreenSOC with green sectors classification

Given the above issues, the mapping of green sectors and GreenSOC can be combined to derive more accurate labour statistics for the green economy. This approach recognises that some businesses not usually categorised as part of the green sector should be included because they are part of the supply chain of those businesses whose end products are regarded as green. For example, under this approach some occupations related to steel manufacture would be considered part of the green economy as it forms part of the supply chain and can be used to make wind turbines to generate renewable energy.

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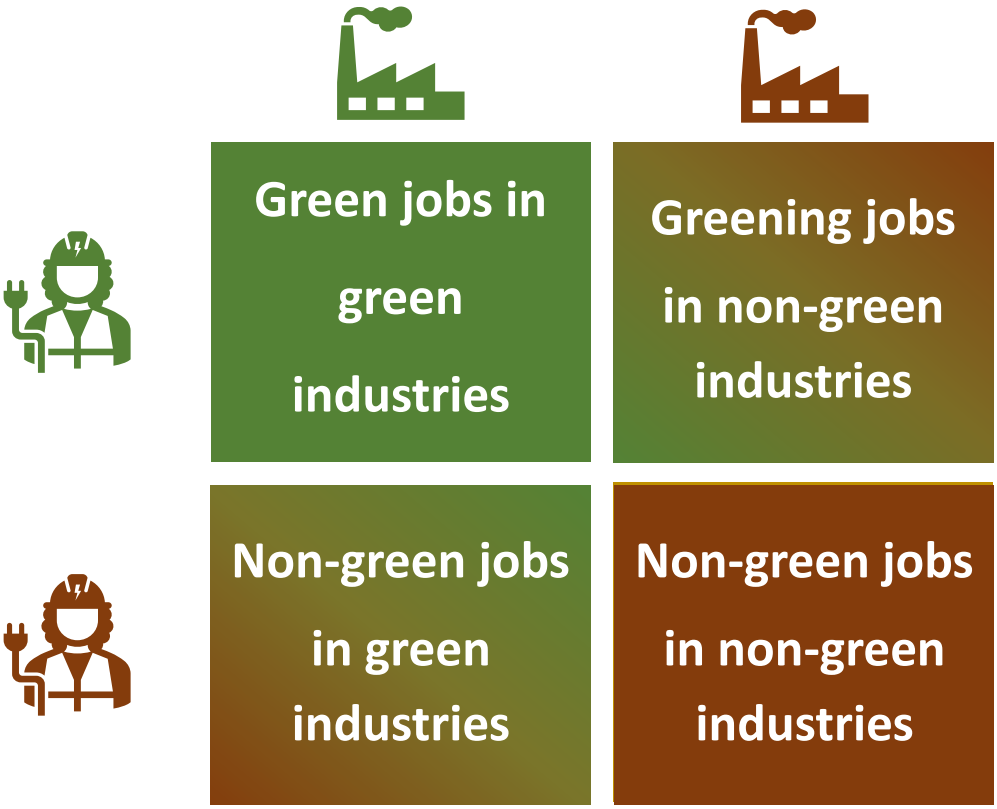
[34] Scottish Government (2020)

[35] The sectors identified under the CESAP are sectors that were either currently transforming or expected to change in a way that is critical for the green transition.

[36] For more details, see Cardenas Rubio et al. (2022).

Combining the GreenSOC with the green sectors classification, four categories of jobs are recognised in estimating green jobs (see Figure 3.1). These jobs include: 1) green jobs/occupations in what is regarded as green industries/sectors; 2) greening jobs in non-green industries/sectors, where greening is defined as the process of becoming more environmentally friendly; 3) non-green jobs in green industries/sectors; and 4) non-green jobs in the non-green industries/sectors.

Figure 3.1: Four types of jobs that need to be recognised in estimates of the extent of and demand for green jobs



Source: Cardenas Rubio et al. (2022)

3.4. Mapping hydrogen jobs

IER was asked by the Midlands Engine to evaluate the extent and demand for green jobs in the Midlands, particularly jobs involved in the hydrogen industry. However, due to the nascent nature of the hydrogen industry, there is currently no established sector classification or comprehensive information available on its occupations and required skills. In order to evaluate employment within the hydrogen industry, this project has drawn on multiple data sources and techniques, including artificial intelligence engines (AI) such as ChatGPT and

Bing, job vacancy descriptions,[37] and engagement with stakeholders. By leveraging these diverse sources, the research aims to identify and understand the occupations that are closely aligned with the hydrogen industry either related to the production, utilisation, or advancement of hydrogen, or administrative and support roles. Figure 3.2 summarises the approach.

[37] See Section 4 for a description of the vacancy database. It should be noted that there are inherent limitations with using AI in research e.g., historical nature of online searches.

Figure 3.2: Three-step approach to identifying hydrogen occupations

1. AI approach	2. Job vacancy descriptions	3. Stakeholder feedback
• Used chat GPT/Bing AI to identify a list of 10 occupations associated with hydrogen. • These were coded to SOC2020 using IER's Computer Assisted Structured Coding Tool (Cascot).	• Extracted vacancies from the vacancy database where the job description contained the word 'hydrogen'. • Removed vacancies from the Hydrogen recruitment group, PHDs and vacancies where the reference was to a 'hydrogen breath test' leading to about 750 unique job titles. • Used CASCOT (software) to code these job titles to the SOC2020 unit group (4-digit level). • Produced a frequency table of hydrogen vacancies by SOC2020 code. • Removed the unit group 9223 Cleaners and domestics from the list as these tended to involve the use of Hydrogen peroxide.	• Produced a first draft list of SOC2020 occupations, containing those identified via the vacancy database, AI and the list of hydrogen SOC2020 occupations suggested by the Midlands Engine Partnership. • Sent draft list to stakeholders in Midlands for their feedback. • Checked comments received and included relevant occupations not previously listed. • Produced final list of occupations in the hydrogen industry.

The final list of occupations within the hydrogen industry consists of 50 occupations at the SOC2020 4-digit level (see Table 3.1). These occupations can be categorised into two groups.

The first group comprises occupations that are directly related to the green economy within the hydrogen industry (increased demand, enhanced skills or those that are considered new and emerging occupations). These are green hydrogen jobs in green industries.

The second group includes occupations that are relevant for the hydrogen industry based on available evidence but are not inherently classified as green. These are non-green jobs in green industries (see Figure 3.1). These occupations are not primarily driven by the impact of green activities, and their skills and demand have not been significantly influenced by such activities. These activities predominantly involve administrative and support roles that have not undergone substantial changes due to the influence of green activities. While there is a correlation between green jobs and the hydrogen industry (with about 75% of selected occupations in the hydrogen industry also classified as green occupations), it is important to note that the industry comprises both green and non-green occupations. This classification highlights the fact that while the hydrogen industry is considered a green industry, it encompasses both green and non-green occupations.

Table 3.2: Occupations in the hydrogen industry

Green occupations			Non-green occupations	
Green type	**SOC2020**	**Label**	**SOC2020**	**Label**
Enhanced skills	1111	Chief executives and senior officials	2434	Business and related research professionals
Enhanced skills	1140	Directors in logistics, warehousing and transport	2439	Business, research and administrative professionals n.e.c.
Enhanced skills	1212	Managers and proprietors in forestry, fishing and related services	2440	Business and financial project management professionals
Enhanced skills	2111	Chemical scientists	3543	Project support officers
Enhanced skills	2112	Biological scientists	3549	Business associate professionals n.e.c.
Enhanced skills	2114	Physical scientists	3552	Business sales executives
Enhanced skills	2119	Natural and social science professionals n.e.c.	3554	Marketing associate professionals
New and emerging	2121	Civil engineers	3556	Sales accounts and business development managers
New and emerging	2122	Mechanical engineers	3582	Health and safety managers and officers
Enhanced skills	2123	Electrical engineers	4159	Other administrative occupations n.e.c.
New and emerging	2125	Production and process engineers		

Green occupations			Non-green occupations	
Green type	SOC2020	Label	SOC2020	Label
New and emerging	2126	Aerospace engineers		
New and emerging	2127	Engineering project managers and project engineers		
New and emerging	2129	Engineering professionals n.e.c.		
Enhanced skills	2134	Programmers and software development professionals		
Enhanced skills	2151	Conservation professionals		
New and emerging	2152	Environment professionals		
Enhanced skills	2161	Research and development (R&D) managers		
Enhanced skills	2162	Other researchers, unspecified discipline		
Enhanced skills	2311	Higher education teaching professionals		
Enhanced skills	2422	Finance and investment analysts and advisers		
Enhanced skills	2423	Taxation experts		
Enhanced skills	2431	Management consultants and business analysts		
Enhanced skills	2452	Chartered architectural technologists, planning officers and consultants		
Enhanced skills	2455	Construction project managers and related professionals		
New and emerging	2481	Quality control and planning engineers		
Enhanced skills	2483	Environmental health professionals		
Enhanced skills	3111	Laboratory technicians		
New and emerging	3113	Engineering technicians		
Enhanced skills	3116	Planning, process and production technicians		

Green occupations			Non-green occupations	
Green type	SOC2020	Label	SOC2020	Label
New and emerging	3119	Science, engineering and production technicians n.e.c.		
Enhanced skills	3544	Data analysts		
Enhanced skills	3581	Inspectors of standards and regulations		
Enhanced skills	5223	Metal working production and maintenance fitters		
Enhanced skills	5231	Vehicle technicians, mechanics and electricians		
Increased demand	5241	Electricians and electrical fitters		
Enhanced skills	5246	Electrical service and maintenance mechanics and repairers		
Enhanced skills	5315	Plumbers & heating and ventilating installers and repairers		
Enhanced skills	2151	Conservation professionals		
New and emerging	2152	Environment professionals		

Source: IER

The hydrogen industry is still in its early stages, and as such, in time there may be other occupations that could potentially be included in the classification of the hydrogen industry as it develops. For example, some stakeholders suggested the inclusion of certain occupations in the hydrogen industry (See Table 3.2); however, the available data, such as vacancy postings, currently does not provide sufficient evidence to support the inclusion of those occupations. Table 3.3 provides an indicative list of occupations that could be considered for inclusion in the hydrogen industry in the future. Continued monitoring and research will help to refine and expand the classification as the hydrogen industry further develops.

Table 3.3: Potential future occupations in the hydrogen industry

SOC2020	Label
2126	Aerospace engineers
3113	Engineering technicians
5119	Agricultural and fishing trades n.e.c.
5234	Aircraft maintenance and related trades
7115	Vehicle and parts salespersons and advisers
8213	Taxi and cab drivers and chauffeurs
8222	Fork-lift truck drivers
8234	Rail transport operatives

Source: IER

4. Data and Methodology

The analysis of green jobs with a focus on occupations related to hydrogen drew on various data sources. The different sources and methods employed in the analysis are explained below, followed by a description of how the different components of the analysis were combined.

- **Labour Force Survey (LFS)** is produced by the Office for National Statistics (ONS). The LFS is the largest household study in the UK and provides official measures of employment and unemployment. The LFS data for this study covered the period 2014 to 2022, ensuring a comprehensive timeframe for analysis.[38] The LFS data allows disaggregation at regional level.[39] For this study, data was grouped into two regions: Midlands (West Midlands and East Midlands) and the rest of the UK (excluding the Midlands).

- **Vacancy data:** Job portals are increasingly used by researchers and policymakers as a cost-effective means of obtaining valuable labour market information.[40] These online platforms serve as a hub where employers post job listings that provide comprehensive details; including job titles, salary information, required qualifications and experience. Using advanced web scraping and text mining techniques, IER has been routinely gathering extensive data on job vacancies from prominent UK job portals since February 2019. This data is then standardised to ensure consistency and usability for analysis purposes. The data used in this study spans February 2019 to February 2023, representing the most up-to-date version available at the time of preparing this report. The vacancy data also allows disaggregation at regional level. The data includes information on the location of each job opening, which can be specified by companies as a city, town, postcode, etc. The IER has developed different procedures to standardise this information at different geographical disaggregation (e.g., at Local Authority Districts, Local Enterprise Partnerships, Counties, etc.). This information was used to identify and analyse the vacancies available in the Midlands and the Rest of the UK.

As noted in the previous section, the GreenSOC and the hydrogen classification were devised using the SOC2020 classification. The vacancy and LFS data are coded using both the

[38] This period was agreed with the Midlands Engine Observatory and HyDEX.

[39] Official government regions include: North East, North West, Yorkshire and Humberside, East Midlands, West Midlands, East, London, South East, South West, Wales, Scotland and Northern Ireland.

[40] It should be noted that there can be challenges using such data - see Cardenas Rubio and Warhurst (2022).

SOC2020 and SOC2010. Both SOC2020 and SOC2010 were used as the ONS reported coding error of the SOC2020 occupational variable in the LFS data.[41] As a result, the SOC2010 classification was used in both the vacancy and LFS datasets to ensure analytical consistency.[42] IER, together with the ONS, has previously developed a link between the SOC2010 and SOC2020. This crosswalk shows the equivalent codes between the SOC2020 and SOC2010.[43] With the equivalent table, the GreenSOC and the hydrogen classification was mapped onto the SOC2010 and subsequently into the vacancy and LFS datasets. For this reason, the findings presented in this study are reported using the SOC2010 classification. It is not expected that the use of the crosswalk causes major issues in the green and hydrogen analysis. While minor variations in occupational distributions and labels may occur between classifications, these differences are not expected to be substantial.[44]

Using the SOC 4-digit level groupings has limitations in terms of granularity. For example, the Unit Group '2129: Engineering professionals' envelops a broad range of occupations, including, for example, mining engineers, oil and natural gas engineers, petroleum engineers, sustainability engineers, turbine engineers.[45] Some of these petroleum engineers, for example, work on green activities, while some do not. Including all petroleum engineers as "green" is lumpy and possibly presents an over-estimation. In this respect, the figures presented in this report, should be regarded as the upper-level estimate driven by current data limitations. Ideally, data disaggregated at the at the 5-digit or 6-digit level within the SOC is needed to better inform and policy to support reskilling and upskilling of specific occupations.

For the vacancy data, the data does not capture vacancies that may have been posted outside of the portals scraped, such as in print media or by word of mouth. Nevertheless, IER's vacancy data is one of the most comprehensive sources for demand-side analysis in the UK.

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41 See: The impact of miscoding of occupational data in Office for National Statistics social surveys, UK - Office for National Statistics (ons.gov.uk)

42 The miscoding issue only affected the SOC2020 variables. The ONS did not report any issues with the variable associated to the SOC2010.

43 The crosswalk between the SOC2010 and SOC2020 can be found here: The relationship between Standard Occupational Classification 2010 and Standard Occupational Classification 2020 - Office for National Statistics

44 See SOC 2020 Volume 1: structure and descriptions of unit groups - Office for National Statistics

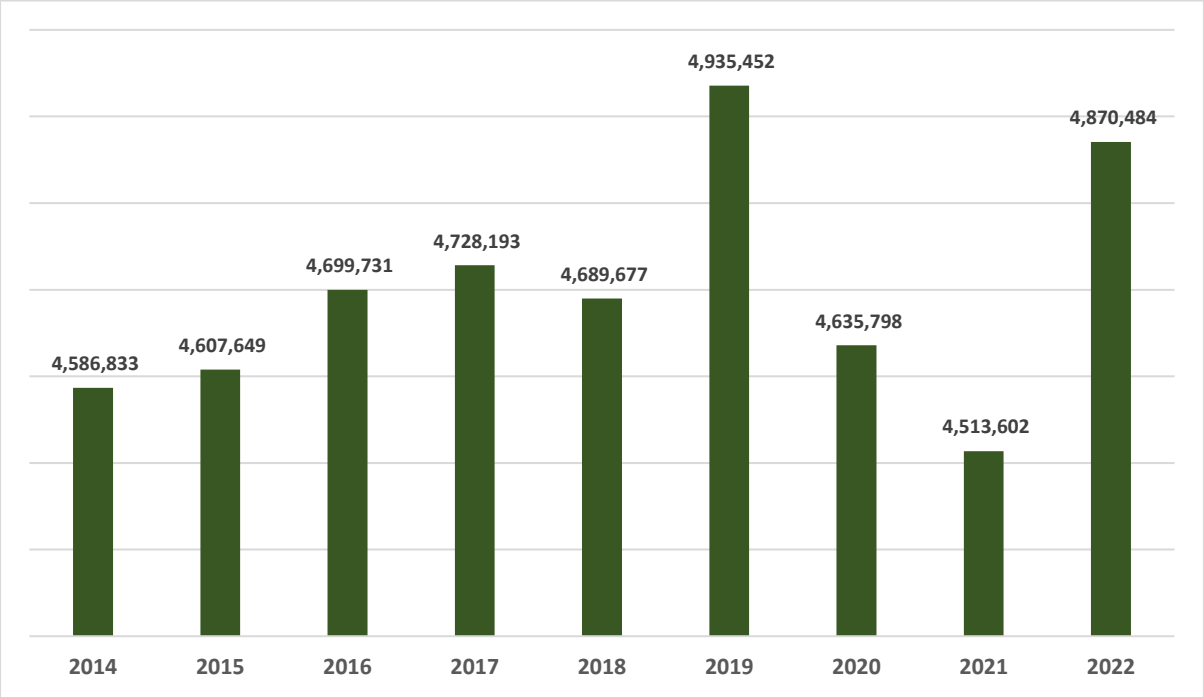
45 See SOC2010 volume 1: structure and descriptions of unit groups - Office for National Statistics

5. Mapping Green Jobs

This section provides estimates of the level/share of green and hydrogen jobs in the Midlands. Analysis for this section used data from the LFS over 2014-22. In referring to 'green jobs', we use the inclusive definition presented in section **Error! Reference source not found.**, that is, both purist green jobs and those jobs that are recognised as greening.

As of 2022, total employment in the Midlands stood at just over 4.8m or 15.2% of total UK employment (see Figure 5.1). This figure represents a growth of 6.2% over 2014-22. There was a noticeable decline in employment in 2020 and 2021 owing to the COVID-19 pandemic and associated policy responses which affected business activity. Employment recovered in 2022 and has nearly reverted to the period peak of 4.9m in 2019.

Figure 5.1: Yearly total employment in the Midlands, 2014-22



Source: ONS, Labour Force Survey

5.1. Green jobs

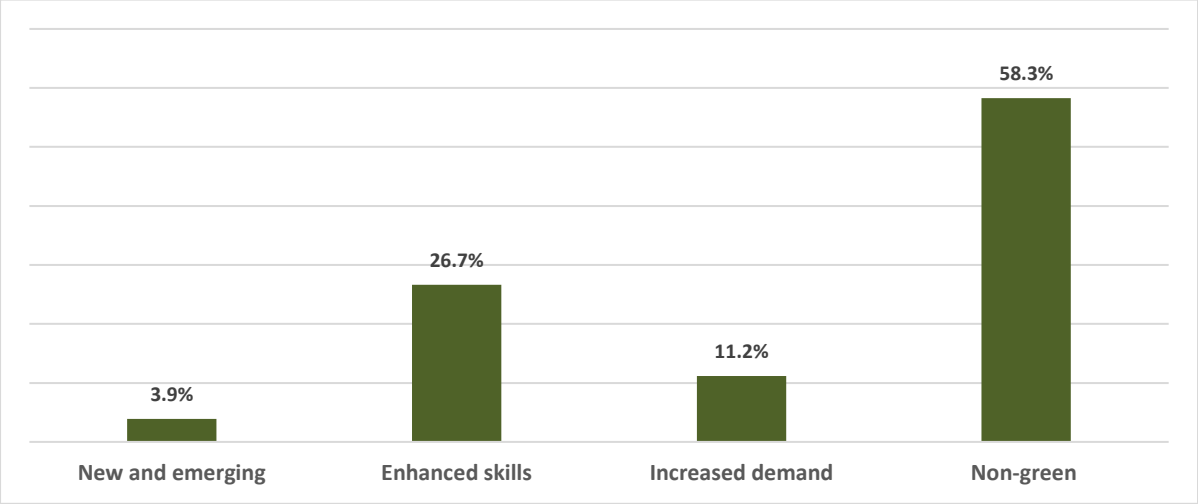
Over 2014-22, an average of 41.9% of jobs in the Midlands were in occupations classified as green (that is, either contributing to green activities, and those that are considerably influenced by the green economy), compared to 40.5% in the rest of the UK[46]. This share of total jobs

[46] It is important to note that not all people working in those occupations are not necessarily involved in the green economy. For instance, an architect may be involved in green activities such as environmental and sustainability

ranged from 40.5% in 2014 to a high of 42.7% in 2019. By 2022, using an inclusive definition there were 2.03m green jobs (41.7%) in the Midlands. Restricting the definition to a purist one, there were 189,460 jobs pure green jobs (or New and Emerging green jobs using the terminology of this report). The latter estimate is comparable to findings from a previous study which estimated green jobs in the Midlands Energy Hub Low Carbon and Environmental Goods and Services (LCEGS) sector at around 195,000 in 2019/20.[47]

The full range of green jobs as a percentage of total employment in the Midlands is shown in Figure 5.2. The majority of green jobs can be classified as Enhanced Skills and Knowledge (26.7% of all jobs – both green and non-green – or 1,298,462 jobs), followed by Increased Demand (11.2% or 543,606 jobs) and New and Emerging green jobs (3.9% or 189,460 jobs). As noted in section **Error! Reference source not found.** above, the estimates of green jobs here (New and Emerging, Enhanced Skills and Knowledge, and Increased Demand) are likely to be upper-level estimates given data limitations. However, the findings suggest a strong greening of jobs over time. Just over a quarter of jobs (26.7%) were Enhanced Skills and Knowledge jobs suggesting that green economic activities and technologies have been changing worker requirements within existing occupations; and more than one-tenth (11.2%) were Increased Demand jobs suggesting green economic activities and technologies have increased employment demand for some existing occupations (such as those working in installation and repairs). Most jobs in the Midlands (58.3%) did not fall into any of the three green job categories.

Figure 5.2: All types of green jobs plus non-green jobs, the Midlands (2022)



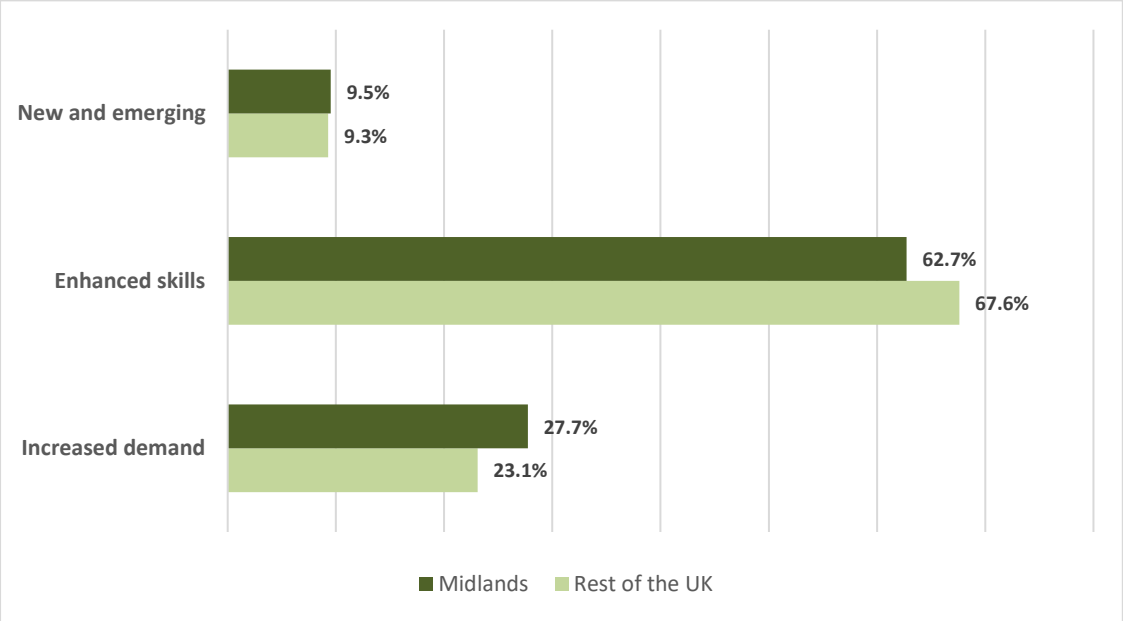
designs, whilst another architect may not be involved in any green-related activities. These figures indicate the occupations that are related to or influenced by the green economy and their respective employment shares. Consequently, these figures should be regarded as an upper bound of the number of green jobs.

[47] kMatrix Data Services Ltd (2021, p.8).

Source: ONS, Labour Force Survey

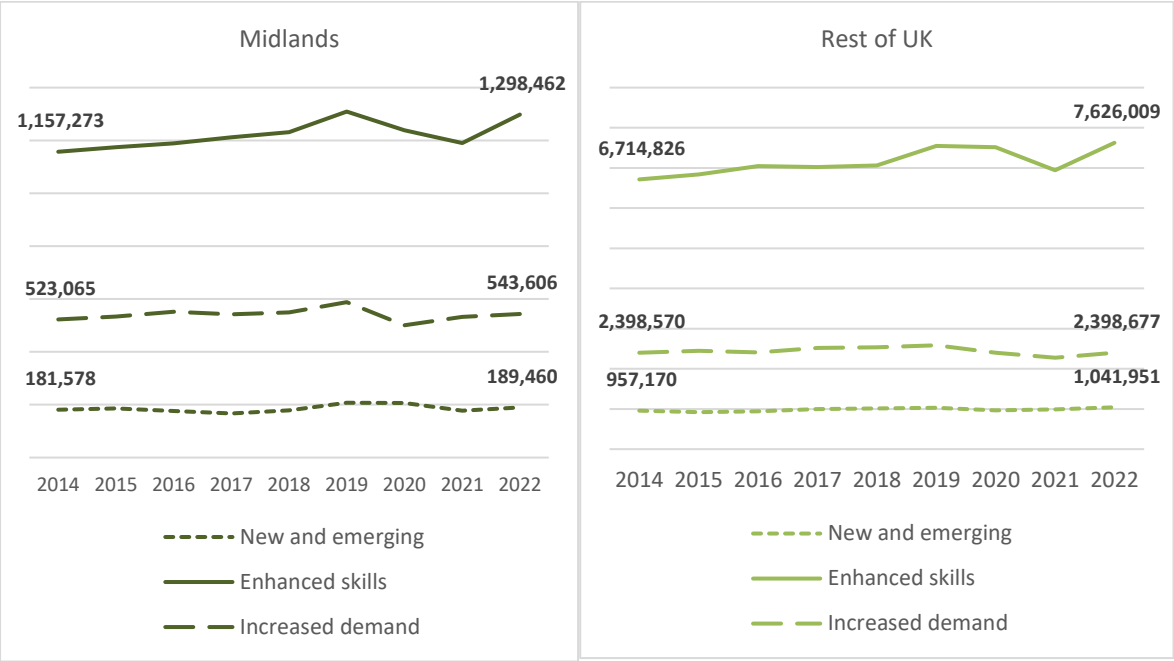
Limiting the base to green jobs only and expanding the period to 2014-22, New and Emerging green jobs accounted for an average 9.5% of all green jobs in the Midlands, which was marginally higher than for the rest of the UK (at 9.3%) – Figure 5.3. The Midlands had a lower share of Enhanced Skills green jobs than the rest of the UK (62.7% vs 67.6%) but a higher share of Increased Demand green jobs (27.7% vs 23.1%). The distribution of green jobs across these three categories changed little since 2014. Trends have been largely similar in the Midlands as in the rest of the UK, with the largest absolute gains in Enhanced Skills green jobs over the period. Enhanced Skills green jobs also had the strongest recovery since the COVID-19 pandemic (see Figure 5.4).

Figure 5.3: Green jobs by green category 2014-22, Midlands and Rest of the UK



Source: ONS, Labour Force Survey

Figure 5.4: Trend in types of green jobs 2014-22, Midlands and Rest of UK



Source: ONS, Labour Force Survey

5.2. Occupational groups

Table 5.1 shows the employment share of green occupations in the Midlands and the rest of the UK by Major Occupational Group (UK SOC2010). The largest share was professional occupations (27.5% in Midlands and 33.1% in the rest of the UK), followed by skilled trades occupations (19.5% in Midlands and 18.3% in the rest of the UK). Caring, leisure and other service occupations had the lowest proportion of green jobs (0.1% for both the Midlands and rest of the UK). Overall, the Midlands and the rest of the UK had a largely similar distribution of green jobs across occupational groups, with the most notable differences in the shares in professional occupations (Midlands lower by 5.7 percentage points) and process, plant and machine operative and elementary occupations (Midlands higher by 3.6 and 2.5 percentage points respectively).

Table 5.1: Green jobs by SOC2010 Major Occupational Group 2014-22, Midlands and Rest of UK (%)

Occupational group	Midlands	Rest of UK	Difference
Managers, directors and senior officials	11.8	12.4	-0.6
Professional occupations	27.5	33.1	-5.7
Associate professional and technical	12.4	13.5	-1.1

Administrative and secretarial	2.7	2.9	-0.2
Skilled trades occupations	19.5	18.3	1.3
Caring, leisure and other service	0.1	0.1	0.0
Sales and customer service	4.6	4.4	0.2
Process, plant and machine operatives	14.5	10.8	3.6
Elementary occupations	7.2	4.6	2.5
	100	100	

Source: ONS, Labour Force Survey

Table 5.2 shows that there is heterogeneity in the types of green jobs across different occupational groups. For example, the largest share of New and Emerging and Enhanced Skills jobs were clustered in the professional occupations group for both the Midlands and the rest of the UK. Of the New and Emerging green jobs, 38.9% in the Midlands and 41.9% in the rest of the UK were under professional occupations. Similarly, 37.9% (Midlands) and 43.3% (rest of UK) of Enhanced Skills and Knowledge green jobs were under Professional Occupations. On the other hand, there are no Increased Demand green jobs for this occupational classification.

New and Emerging green jobs were concentrated exclusively in five of the nine UK Major Occupational Groups; namely: Professional occupations; Associate professional occupations; Administrative and secretarial occupations; Skilled trades occupations; and Process, plant and machine operatives. Enhanced Skills jobs were spread across the widest range of occupations, with only the Administrative and secretarial group not recording any Enhanced Skills green jobs for both the Midlands and rest of the UK. Increased Demand jobs existed in all but three categories (Managers, directors and senior officials; Professional occupations and Caring, leisure and other services).

Table 5.2: Type of green jobs by SOC2010 Major Occupational Group 2014-22, Midlands and Rest of UK (%)

	New and Emerging		Enhanced Skills		Increased Demand	
	Midlands	Rest of UK	Midlands	Rest of UK	Midlands	Rest of UK
Managers, directors and senior officials	-	-	18.73	18.30	-	-

Professional occupations	38.87	41.91	37.86	43.25	-	-
Associate professional and technical	18.39	16.29	14.23	15.10	6.03	7.60
Administrative and secretarial	12.52	15.57	-	-	5.24	6.06
Skilled trades occupations	9.54	8.55	19.28	16.65	23.52	26.93
Caring, leisure and other service	-	-	0.10	0.08	-	-
Sales and customer service	-	-	0.82	0.66	14.69	17.09
Process, plant and machine operatives	20.68	17.68	7.64	4.75	27.76	25.88
Elementary Occupations	-	-	1.33	1.20	22.75	16.45
	100.00	100.00	100.00	100.00	100.00	100.00

Source: ONS, Labour Force Survey

Focusing on the 4-digit level of the ONS SOC2010 classification, Table 5.3 presents the occupations with the highest proportion of green jobs by category relative to total employment in the Midlands. There was a mix of occupations in the top five for each of the three types of green jobs, though some patterns are evident. New and Emerging green jobs had relatively more engineering related occupations, whilst Enhanced Skills green jobs had relatively more education and managerial occupations, and Increased Demand jobs had a high presence of skills trades and operatives.

Table 5.3: Top five occupations in each category as % of total employment the Midlands in 2022 by SOC2010 4-Digit Level

New & Emerging	Enhanced Skills & Knowledge	Increased Demand
4112 National government administrative occupations **2129** Engineering professionals n.e.c **8149** Construction operatives n.e.c **3113** Engineering technicians	**2315** Primary and nursery education teaching professionals **2314** Secondary education teaching professionals **1121** Production managers and directors in manufacturing	**9260** Elementary storage occupations **8211** Large goods vehicle drivers **7219** Customer service occupations n.e.c **5241** Electricians and electrical fitters

8133 Routine inspectors and testers	**1190** Managers and directors in retail and wholesale **8111** Food, drink and tobacco process operatives	**5315** Carpenters and joiners

Source: ONS, Labour Force Survey

The listing in Table 5.3 allows comparison overtime and can be used to monitor changing dynamics as the transition to net zero progresses. That said, as noted in section 4 above, the SOC2010 4-digit level groupings have drawbacks in terms of granularity. For example, the Unit Group, '2129: Engineering professionals' envelops a broad range of occupations, including, for example, mining engineers, oil and natural gas engineers, petroleum engineers, sustainability engineers, turbine engineers.[48] It is not possible at the 4-digit level to disaggregate the proportion of each engineer type as New and Emerging jobs are focused on green and non-green activities. A similar problem occurs with the Enhanced Skills and Knowledge jobs in relation to educational professionals for example. Ideally, data disaggregated at the at the 5-digit or 6-digit level within the SOC is needed to better inform and policy to support reskilling and upskilling of specific occupations.

5.3. Sectors and Industries

Table 5.4 shows that the sectoral distribution of green jobs was largely similar in the Midlands and the rest of the UK, though there are some small differences. In both the Midlands and the rest of the UK, the largest share of green jobs was in non-green industries (41.5% in the Midlands vs 46.3% in the rest of the UK). Overall, this figure offers a positive message in terms of the greening of jobs within traditional non-green sectors. Notably, there was a larger share of green employment in other manufacturing industries and transport in the Midlands relative to the rest of the UK, which is a positive sign given the Midlands Engine Partnership's emphasis on manufacturing, transport and energy related sectors in the 2022 Midlands Hydrogen Technology Strategy.[49]

The distribution of green jobs also reflects the economic structure of the UK. For example, agriculture employs a relatively small share of the UK workforce overall, and therefore a small share of the green jobs in both the Midlands and the rest of the UK (3.3% in both cases) was in this sector over the 2014-22 period. Bearing this in mind, it is useful to analyse the share of green jobs within each sectoral classification (Figure 5.3).

[48] See SOC2010 volume 1: structure and descriptions of unit groups - Office for National Statistics

[49] Midlands Engine (2022a)

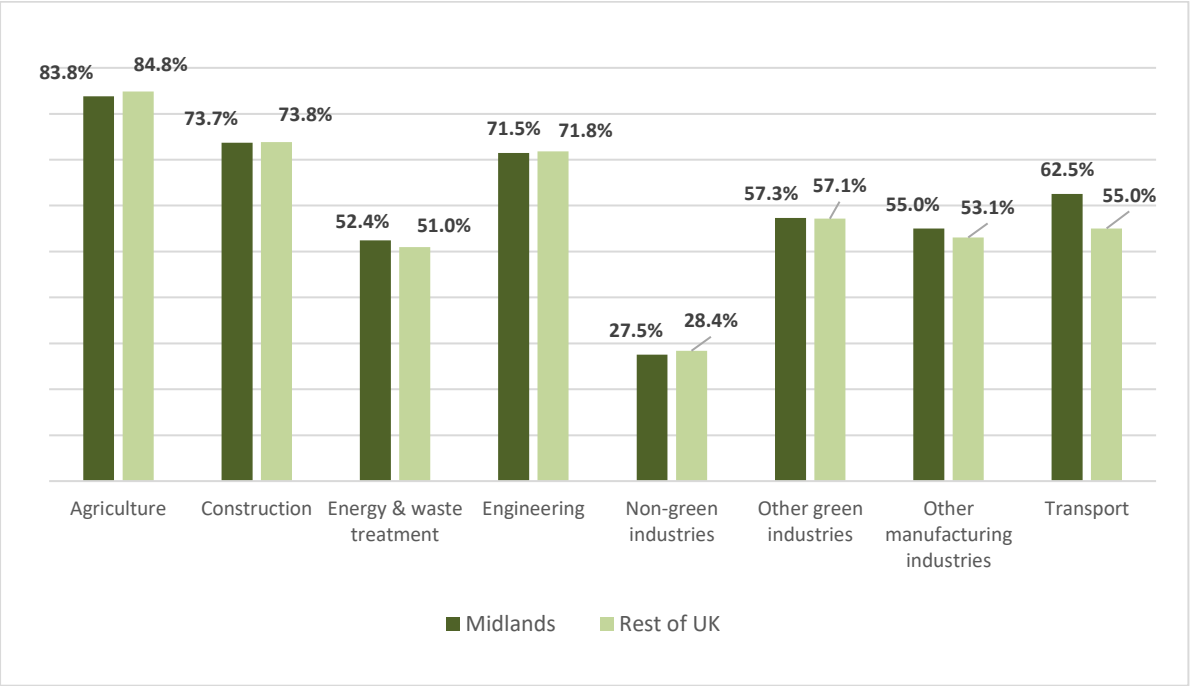
Table 5.4: Green jobs by SIC2007 Sectors 2014-22, Midlands and Rest of UK (%)

Occupational group	Midlands	Rest of UK	Difference
Agriculture	3.3	3.3	0.0
Construction	16.0	15.3	0.7
Energy & waste treatment	4.5	5.0	-0.5
Engineering	11.7	10.9	0.8
Non-green industries	41.5	46.3	-4.8
Other green industries	8.3	9.1	-0.8
Other manufacturing industries	7.7	4.6	3.2
Transport	6.9	5.4	1.4
	100	100	

Source: ONS, Labour Force Survey

As shown in Figure 5.3, although the agriculture sector accounted for a small share of jobs overall (and by extension, a relatively small share of all green jobs), within the agriculture sector the vast majority of employment was green (83.8% and 84.8% of agriculture jobs in the Midlands and rest of the UK, respectively). As expected, green jobs in non-green sectors accounted for a minority of all jobs in those sectors (27.5% and 28.4% of jobs in non-green sectors in the Midlands and rest of the UK respectively). That said, having nearly 30% green jobs (broadly defined) in non-green sectors is a solid foundation for further progress.

Figure 5.5: Share of green jobs within sector 2014-22, Midlands and Rest of the UK



Source: ONS, Labour Force Survey

Table 5.5 shows that there is heterogeneity in the types of green jobs across different sectors. For example, the largest share of New and Emerging jobs was clustered in Engineering related sectors (31.7% and 29% of all New and Emerging green jobs in the Midlands and rest of the UK, respectively). This corroborates the analysis in section 5.2 (specifically table 5.3), which highlighted engineering-related occupations as a key driver of New and Emerging green jobs. On the other hand, engineering-related sectors accounted for a relatively small share of Enhanced Skills and Increased Demand green jobs (under 10% for both types of green jobs in both the Midlands and rest of the UK). By contrast, the largest share of Enhanced Skills green jobs (49.6% in the Midlands and 53.6% in the rest of the UK) and Increased Demands green jobs (27.7% in the Midlands and 31% in the rest of the UK) were in non-green industries. Again, this gives an indication of the "greening" of non-green industries.

Table 5.5: Type of green jobs by SIC2007 Sectors 2014-2022, Midlands and Rest of UK (%)

	New and Emerging		Enhanced Skills		Increased Demand	
	Midlands	Rest of UK	Midlands	Rest of UK	Midlands	Rest of UK
Agriculture	0.8	0.4	4.6	4.4	1.3	1.6

Construction	15.9	16.4	13.5	12.0	21.8	24.8
Energy & waste treatment	9.2	10.9	3.8	4.1	4.6	5.0
Engineering	31.7	29.0	9.8	8.9	9.3	9.5
Non-green industries	28.3	30.9	49.6	53.6	27.7	31.0
Other green industries	3.9	3.5	9.2	10.7	7.5	6.9
Other manufacturing industries	7.7	5.3	7.2	4.1	9.0	5.4
Transport	2.5	3.5	2.3	2.2	18.7	15.7
	100.00	100.00	100.00	100.00	100.00	100.00

Source: ONS, Labour Force Survey

5.4. Equalities (gender and age)

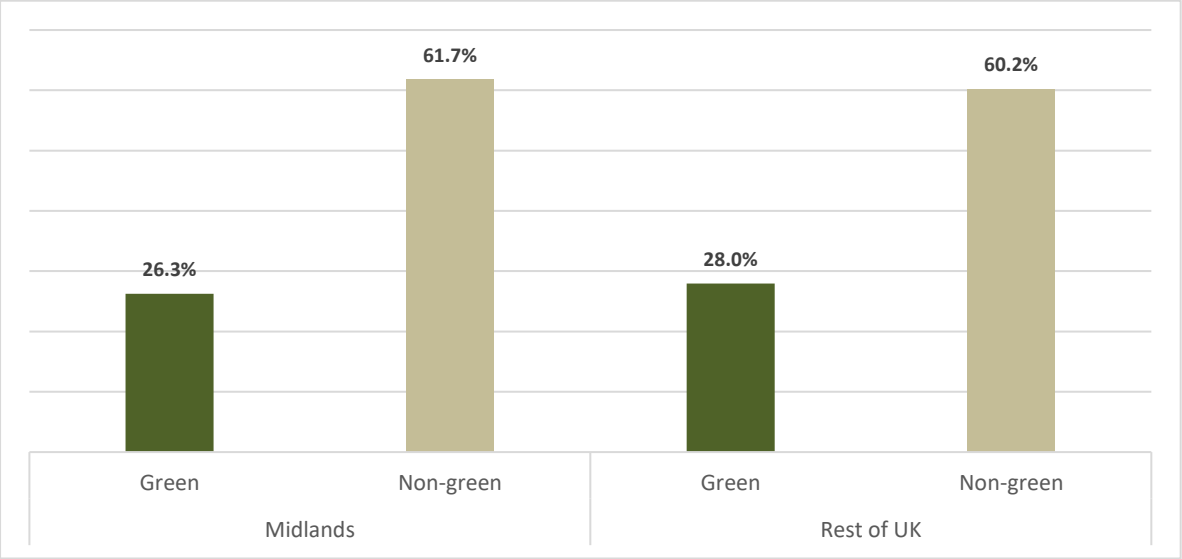
According to the ILO, a just transition towards an environmentally sustainable economy needs to contribute to the goals of decent work for all and social inclusion.[50] Delivering a just transition to net zero requires a consideration of issues related to equality. Whilst the LFS data at the regional level for the Midlands does not enable analysis of the full range of potential areas of inequality,[51] it is possible to disaggregate green jobs by gender and age.[52] The data showed that women are under-represented across green jobs (26.3% of green jobs in the Midlands are held by women vs 73.7% held by men) and over-represented in non-green jobs (61.7% held by females vs 38.3% by males) – see Figure 5.6. Overall, females make up about 47% of the economically active in the UK as a whole. Green jobs are therefore jobs that are disproportionately held by men. This pattern holds for both the Midlands and the rest of the UK.

[50] ILO (2015)

[51] For example, LFS data disaggregated by ethnicity and disability at the regional level are based on small samples, and therefore estimates are not very precise.

[52] The LFS data offer a binary classification – male vs female.

Figure 5.6: Share of green/non-green jobs held by women 2014-22, Midlands and Rest of UK

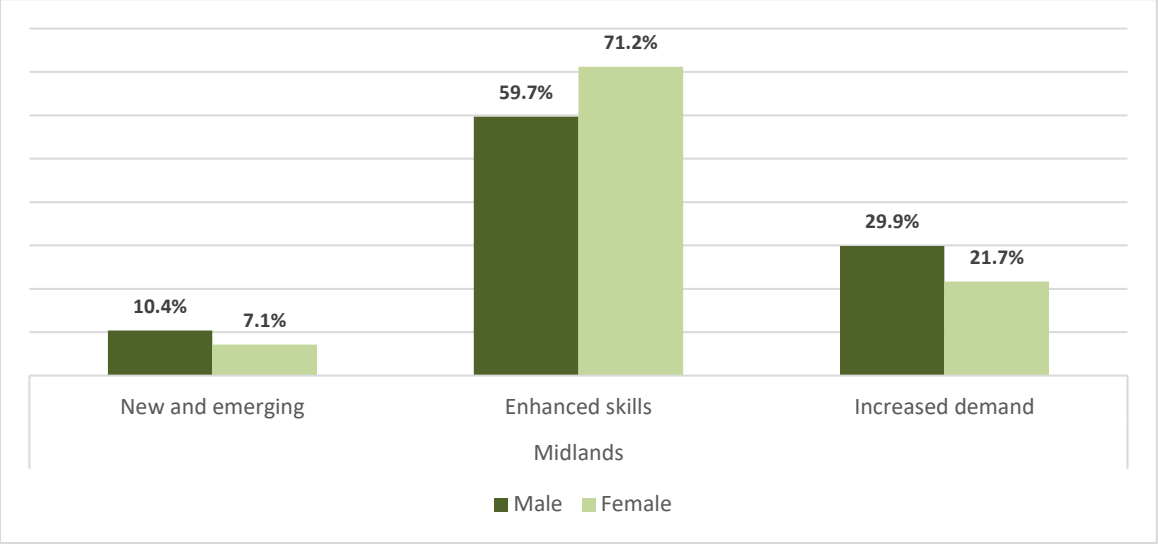


Source: ONS, Labour Force Survey

Turning to the distribution of women and men by green job category, Figure 5.7 and Figure 5.8 show that the distribution pattern in the Midlands and the rest of the UK were broadly similar. Over 70% of women working in green jobs were employed in the Enhanced Skills category (71.2% for the Midlands vs 75.6% for the rest of UK). This was higher than the share of men working in similar types of green jobs (59.7% for the Midlands vs 64.5% for the rest of the UK). The relative over-representation of women in Enhanced Skills jobs may, in part, reflect the fact that two of the top five occupations in this green job category are female dominated teaching occupations.[53] The category of green jobs with smallest share of both men and women was New and Emerging, with only 10% males and 7% females for both the Midlands and rest of the UK.

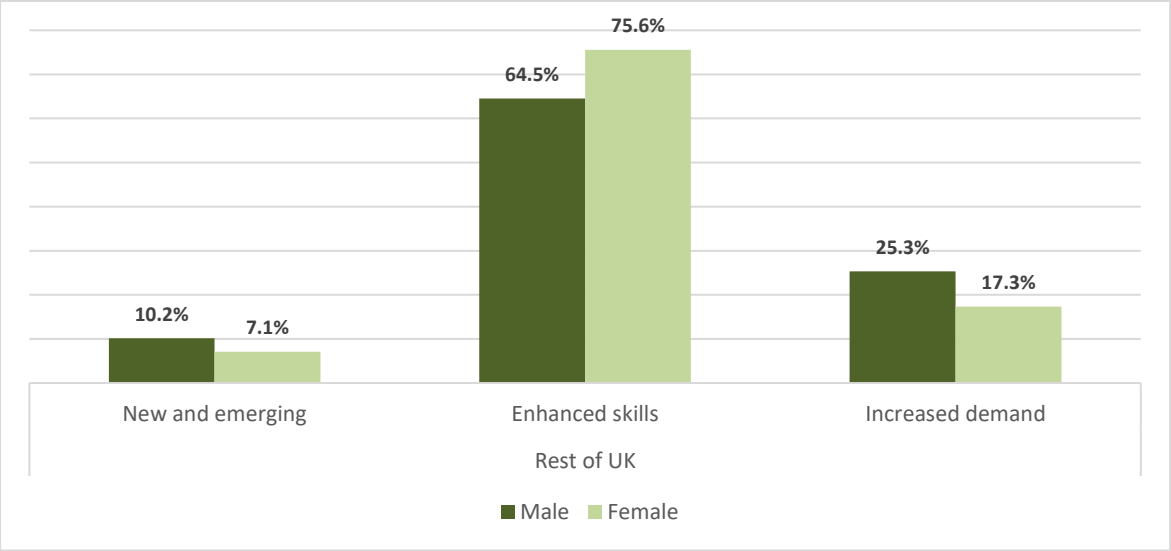
[53] School teacher workforce - GOV.UK Ethnicity facts and figures (ethnicity-facts-figures.service.gov.uk)

Figure 5.7: Relative distribution of women and men by green job type 2014-22, Midlands



Source: ONS, Labour Force Survey

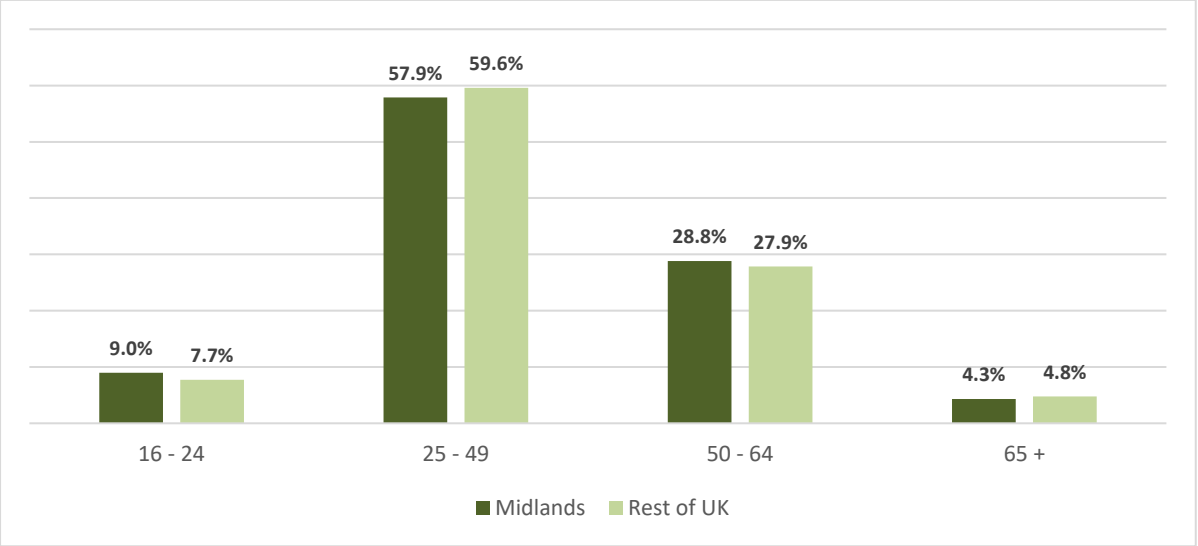
Figure 5.8: Relative distribution of women and men by green job type 2014-22, Rest of UK



Source: ONS, Labour Force Survey

There were also variations in green jobs by age. Figure 5.9 shows that the distribution of green jobs by age was largely similar in the Midlands and rest of the UK with 25-49 year-olds holding the largest share of green jobs (57.9% in the Midlands and 59.6% in the rest of the UK), followed by 50-64 year-olds (28.8% vs 27.9%). This distribution largely reflects the dynamics of the labour market, as these age groups form the largest share of workers.

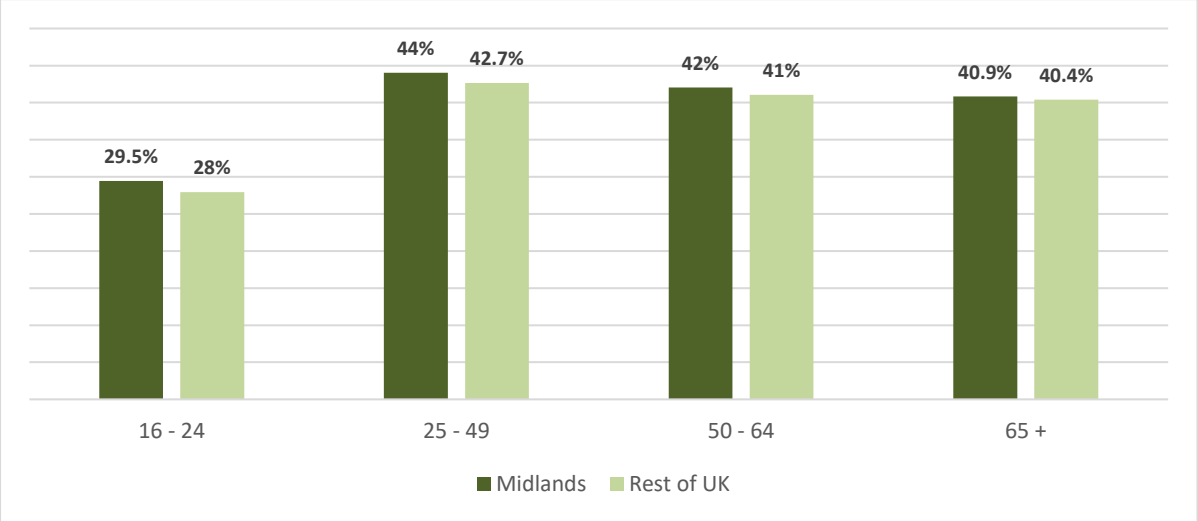
Figure 5.9: Green jobs by age 2014-22, Midlands and Rest of UK



Source: ONS, Labour Force Survey

Looking at the relative distribution of green vs non-green job within each age group, the 16-24 year-old group was markedly different to the other groups in both the Midlands and rest of the UK (see Figure 5.10). At least 40% of workers in the age groups 25-49, 50-64 and 65+ were employed in green jobs compared to under 30% of 16-24 year-olds (29.5% for the Midlands and 28% for the rest of the UK). This distribution may reflect the fact that most green jobs were clustered in more senior/professional occupations (see Table 5.1).

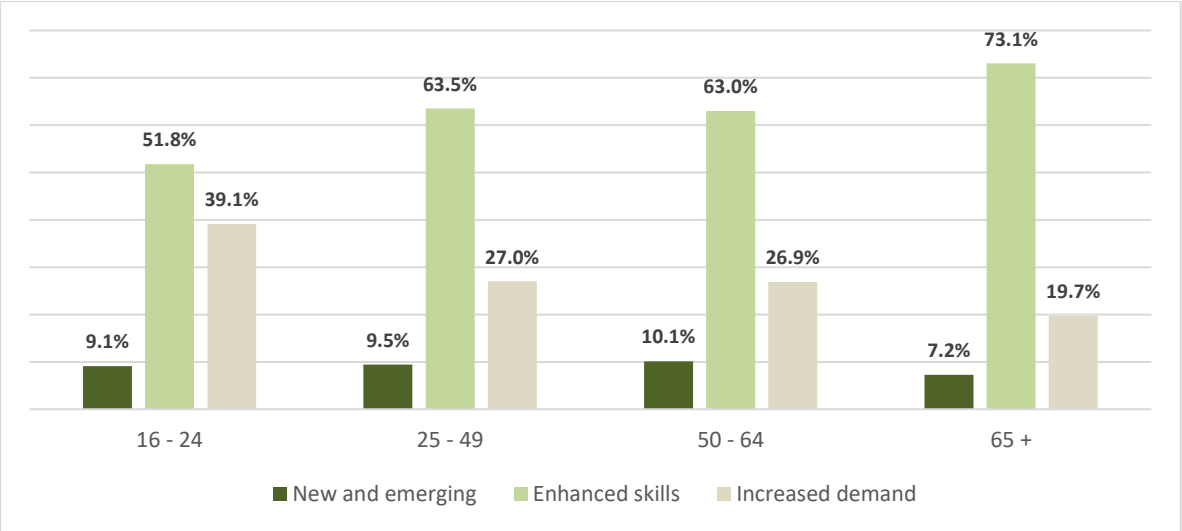
Figure 5.10: Relative distribution of green jobs by age 2014-22, Midlands and Rest of UK



Source: ONS, Labour Force Survey

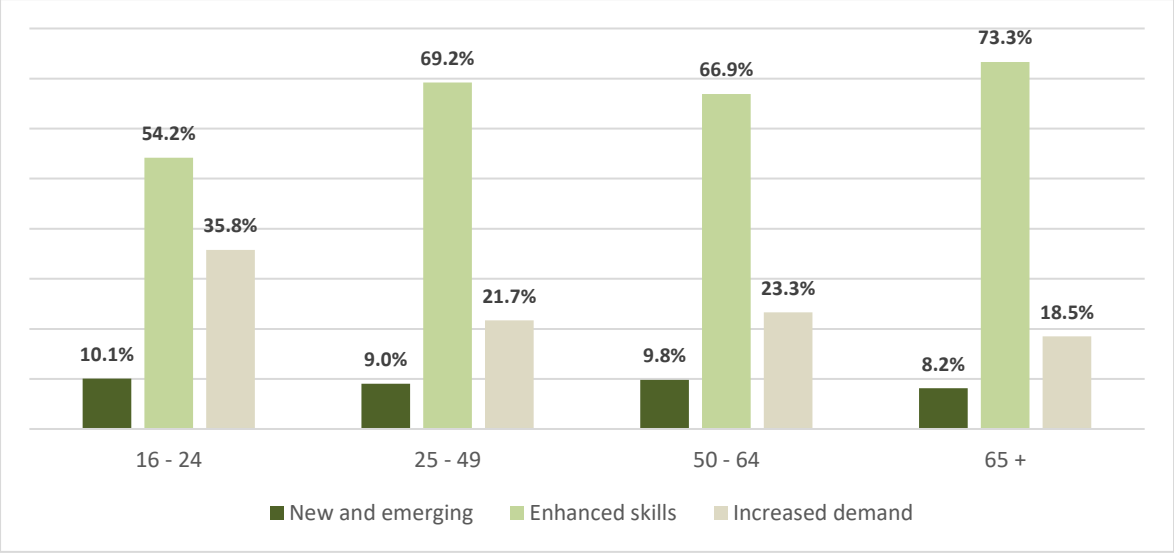
Figures 5.11 and 5.12 show the relative proportion of green jobs within age groups for the Midlands and the rest of the UK. In comparing the two figures, the patterns within age groups are similar. For all age groups in both the Midlands and rest of the UK, the largest type of green jobs is in the Enhanced Skills and Knowledge category. This share is unsurprising given that Enhanced skills green jobs formed the largest share of all green employment (Figure 5.3). New and Emerging jobs accounted for 10.1% of employment among the 50-64 age group in the Midlands and 16-24 age group in the rest of the UK but is below 10% for all other groups.

Figure 5.11: Green job categories within age groups 2014-22, Midlands



Source: ONS, Labour Force Survey

Figure 5.12: Green job categories within age groups 2014-22, Rest of UK

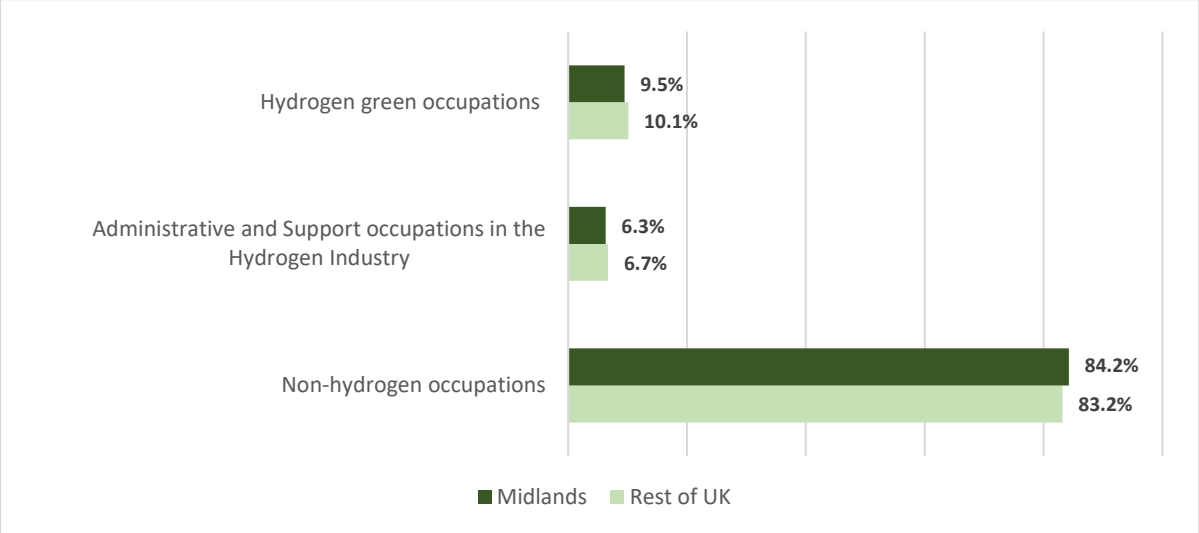


Source: ONS, Labour Force Survey

5.5. Hydrogen employment

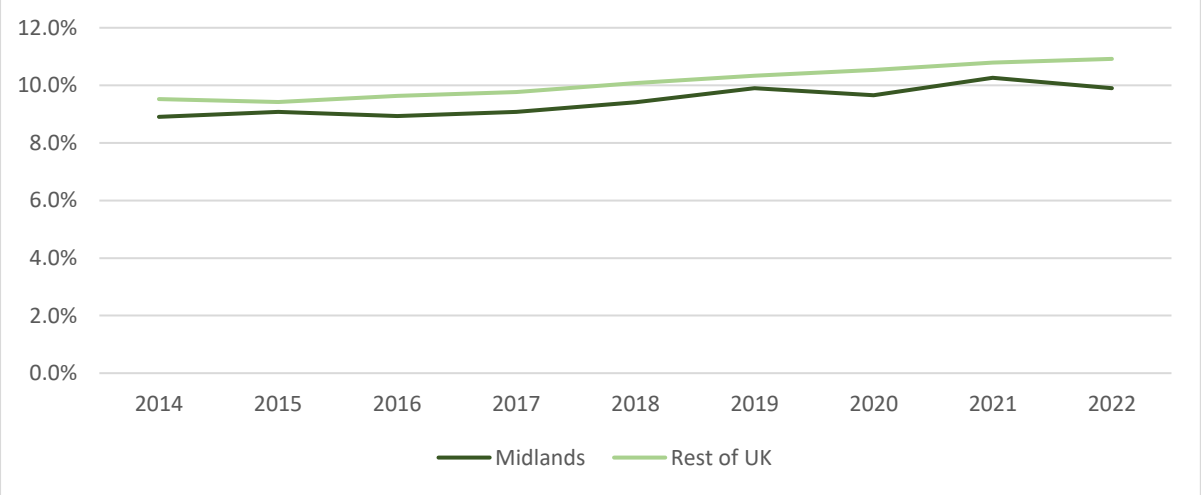
The above analysis has focused on green jobs in general. Again, drawing on the LFS data, similar analysis can be undertaken for hydrogen jobs. Some 9.5% of jobs in the Midlands (10.1% in the rest of the UK) can be classified as hydrogen green jobs. This 9.5% represent green employment in occupations either related to the production, utilisation, or advancement of hydrogen. Another 6.3% were administrative and support occupations in the hydrogen industry (6.7% in the rest of the UK) (Figure 5.13). The share of hydrogen green occupations has increased marginally over 2014-22 for both the Midlands and rest of the UK, though the increasing trend has been more consistent in the rest of the UK (Figure 5.14), with the Midlands regions seeing some fluctuations over the period.

Figure 5.13: Hydrogen vs non-hydrogen job 2014-22, Midlands and Rest of UK



Source: ONS, Labour Force Survey

Figure 5.14: Share of hydrogen green jobs 2014-22, Midlands and Rest of UK

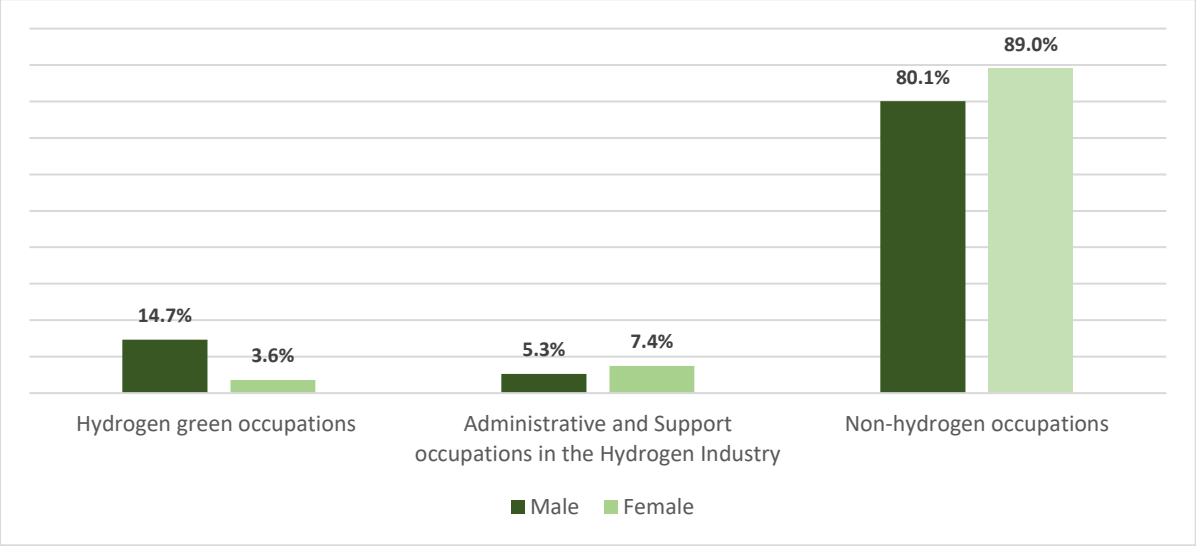


Source: ONS, Labour Force Survey

With respect to specific occupations (at the 4-digit level in SOCO2010), the most common hydrogen-related occupation in the LFS data was electricians and electrical fitters (9.3%). This occupation was followed by programmers and software development professionals (9%), metal working production and maintenance fitters (8.3%), higher education teaching professionals (6.6%) and vehicle technicians, mechanics and electricians (6.2%). At the sector level, the top five sectors of hydrogen employment in the Midlands were manufacturing (21.7%); construction (15.6%); professional, scientific and technical activities (10.7%); education (10.6%); with a joint fifth place of wholesale and retail trade and the repair of motor vehicles and motorcycles (both 9%).

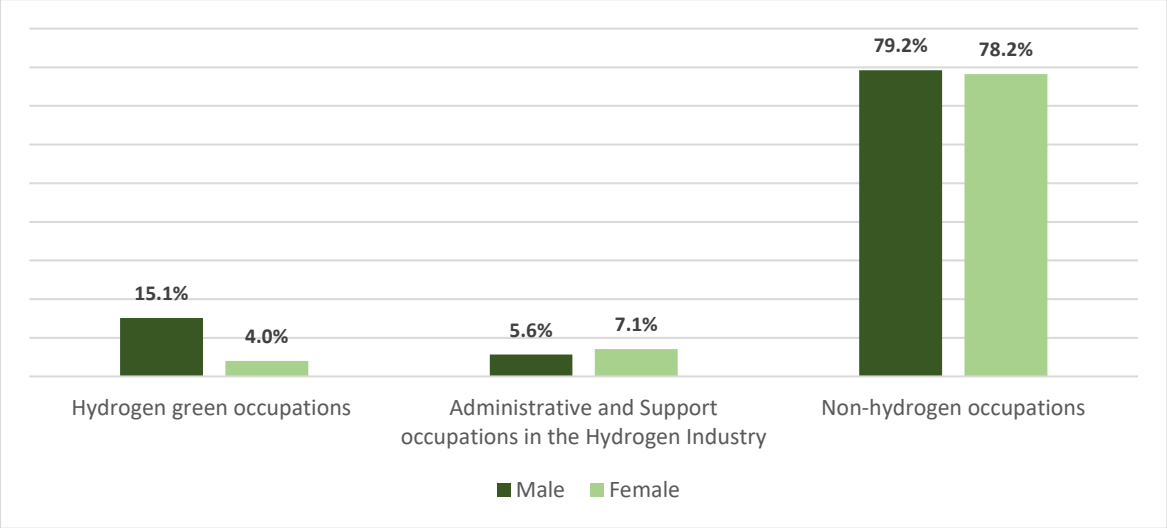
As with green jobs (Figure 5.6) hydrogen green jobs were largely held by males: 82% males and 18% females in the Midlands and 79% males and 21% females in the rest of the UK. That said, the vast majority of both men and women work in non-hydrogen green occupations in both the Midlands and rest of the UK (Figures 5.15 and 5.16).

Figure 5.15: Relative distribution of women and men by hydrogen job category 2014-22, Midlands



Source: ONS, Labour Force Survey

Figure 5.16: Relative distribution of women and men by hydrogen job category 2014-22, Rest of the UK



Source: ONS, Labour Force Survey

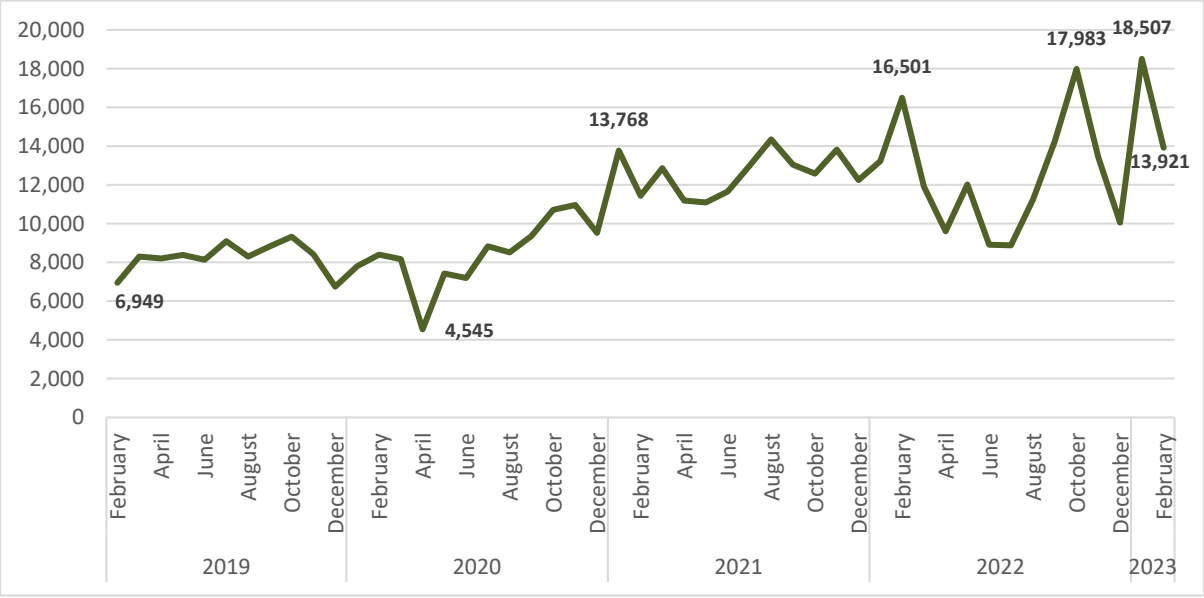
In sum, the LFS data show that employment in hydrogen related occupations accounted for about 10% of employment in the Midlands, with the share increasing modestly over the 2014-22 period. Employment in hydrogen related occupations was mainly in skilled and technical occupational roles, and about 50% of these jobs was concentrated in the manufacturing, construction and professional, scientific and technical sectors. Hydrogen jobs are predominantly held by males.

6. Changes in Demand

The LFS data captures the supply side of the labour market and offers insights into the types of jobs held by employees. Labour market demand (from employers) is dynamic and changes in response to economic conditions, the business cycle and business objectives. This section explores the demand side of green jobs through analysis of job vacancy data. As discussed in section 4 above, the data was collected from online vacancies sites using web-scraping techniques by IER researchers.[54] As with the previous section, the analysis used the inclusive approach to green jobs covering both 'purist' green jobs and those jobs that are greening. Data on hydrogen jobs is included in the final sub-section.

Job vacancy data for all jobs over the 2019-23 period revealed a general post-COVID-19 labour market recovery in the Midlands, with a total of 13,921 vacancies posted in February 2023 compared to 6,949 in February 2019 (Figure 6.1). That a recovery is underway is also seen in the data if annual averages are taken. The data also showed an element of seasonality with peaks in January for the years 2021, 2022 and 2023, suggesting a boom of new year vacancies that tappers off in February.

Figure 6.1 Job vacancy numbers in the Midlands, February 2019 to February 2023



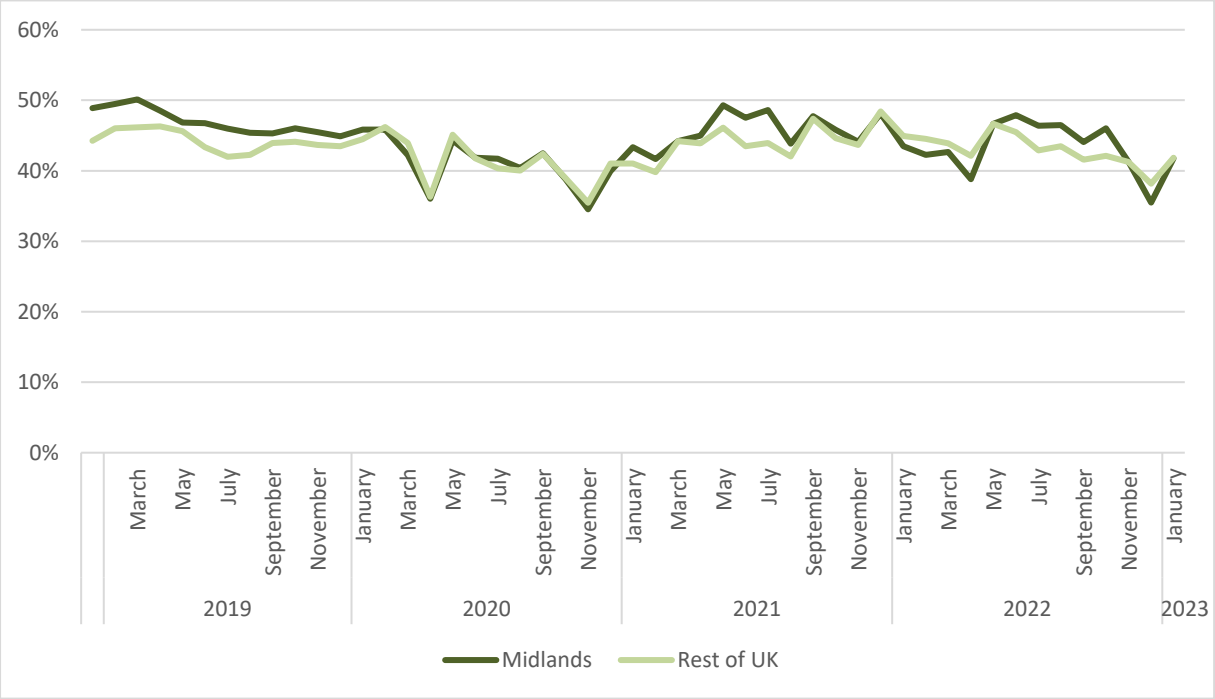
Source: IER - LMI for All vacancy dataset

[54] As noted in the methodology section, the data does not capture vacancies that may have been posted beyond the portals scraped, such as in print or by word of mouth. Nevertheless, IER vacancy data is one of the most comprehensive sources for demand-side analysis.

6.1. Green jobs

As a share of all vacancies over 2019-2023, vacancies in green occupations represented about 44.2% and 43.2% of job vacancies in the Midlands and the rest of the UK respectively. This estimate is consistent with the analysis from the LFS data presented in the previous section. As shown in Figure 6.2, there has been fluctuation in the share of green job vacancies on a monthly basis in both the Midlands and the rest of the UK, with both exhibiting similar trends. Though there has been variability, overall, the share fluctuated between 40-45% over the period, with relatively few dips below 40% and few increases above 45% for both the Midlands and rest of the UK.

Figure 6.2: Share of green job vacancies in the Midlands and Rest of UK, February 2019 to February 2023

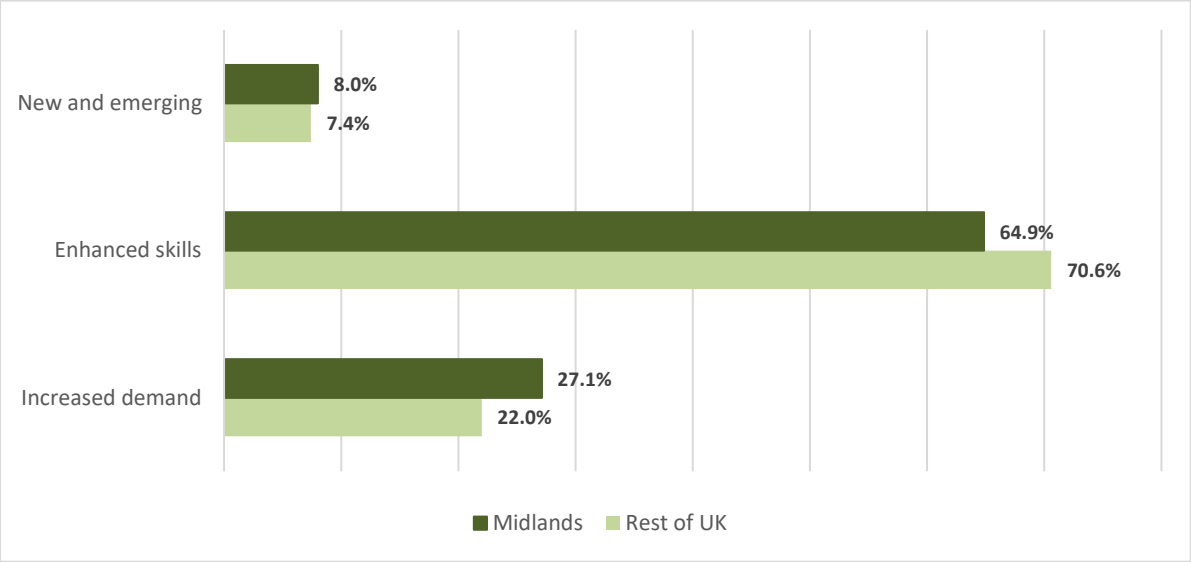


Source: IER - LMI for All vacancy dataset

The distribution of green job vacancies by green job classification was also similar to the results obtained from the LFS data in terms of ranking; that is, Enhanced Skills and Knowledge green jobs accounted for the largest share of green job vacancies (64.9% in the Midlands compared to 70.6% in the rest of the UK), followed by Increased Demand green jobs (27.1% in the Midlands compared to 22% in the UK), with New and Emerging green jobs third (8% in the Midlands compared to 7.4% in the rest of the UK) (Figure 6.3). Trends were largely similar in the Midlands and the rest of the UK, with both seeing the largest absolute increases in Enhanced Skills green vacancies over the period, though New and Emerging green job

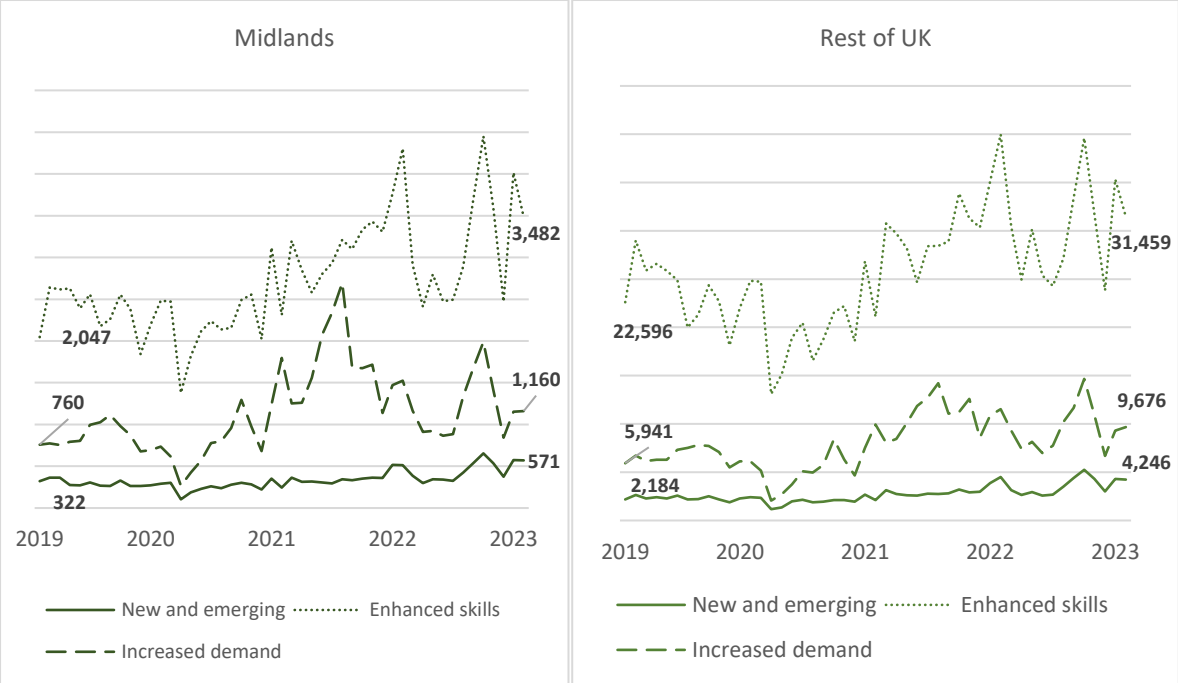
vacancies had the largest percentage increase, but from a relatively small base (see Figure 6.4). Compared to Figure 5.4 which shows employment by green job types, there has been significantly more fluctuation in the vacancy data than the LFS employment data.

Figure 6.3: Proportion of Green job vacancies by green category in the Midlands and Rest of UK, February 2019 to February 2023



Source: IER - LMI for All vacancy dataset

Figure 6.4: Trend in types of green job vacancies February 2019 to February 2023, Midlands and Rest of UK

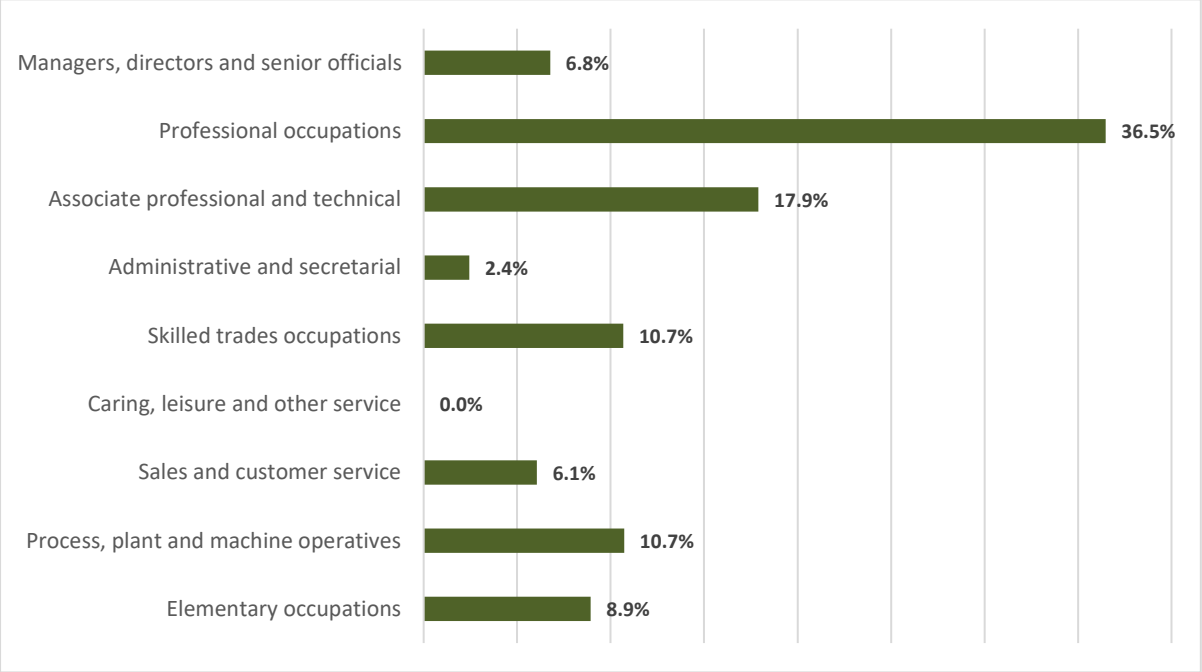


Source: IER - LMI for All vacancy dataset

6.2. Occupational groups

Similar to the results from the LFS data in Table 5.1, the occupational groups with the largest share of green job vacancies in the Midlands were professional occupations (36.5%), followed by associate professional and technical occupations (17.9%) – see Figure 6.4.

Figure 6.4: Green job vacancies by SOC2010 Major Occupational Group in the Midlands, February 2019 to February 2023



Source: IER - LMI for All vacancy dataset

The large share of green job vacancies observed in the professional occupations group (see Figure 6.4) was driven by New and Emerging and Enhanced Skills green vacancies. As shown in Table 6.1, the largest share of observed New and Emerging vacancies (37%) and Enhanced Skills vacancies (51.7%) in the Midlands existed in the professional occupations group. A similar pattern was observed for associate professional and technical occupations, which accounted for the second largest share of observed New and Emerging (29.6%) and Enhanced Skills (18.5%) vacancies. The distribution of Increased Demand vacancies differed in this regard, with the largest share in elementary occupations (32.1%), followed by sales and customer service occupations (21.2%). In contrast, there were no observed New and Emerging green jobs in these two occupational groups, and a very small share of Enhanced Skills vacancies (0.4% and 0.5%, respectively). The only three (of nine) occupational groups that recorded all three green job types in the vacancy data were associate professional and technical**,** skilled trades occupations, and process, plant and machine operatives.

Table 6.1: Types of green job vacancies by SOC2010 Major Occupational Group February 2019 to February 2023, Midlands (%)

Occupational group	New and Emerging	Enhanced Skills	Increased Demand
Managers, directors and senior officials	-	10.4	-
Professional occupations	37.0	51.7	-
Associate professional and technical	26.9	18.5	13.9
Administrative and secretarial	4.4	-	7.7
Skilled trades occupations	17.2	11.6	6.6
Caring, leisure and other service	-	-	-
Sales and customer service	-	0.5	21.2
Process, plant and machine operatives	14.5	7.0	18.5
Elementary occupations	-	0.4	32.1
	100	100	100

Source: IER - LMI for All vacancy dataset

Examining job vacancies at SOC2010 4-digit level provides more detailed information about the types of occupations within each green job category. Table 6.2 shows the top five occupations by the number of job vacancies for each category of green jobs. Like the analysis of LFS data (see Table 5.3), the vacancy data also showed that engineering occupations dominate the New and Emerging jobs category. Note that whilst '4112: National government administrative occupations' ranked first in the New and Emerging jobs category based on LFS data, this occupation does not feature in the top five by job vacancies. This may result from the different coverage periods of the two datasets (2014-22 and 2019-23) as well as the inherent differences is what each dataset covers, that is, current employment (LFS) compared to vacancies which proxy labour demand (vacancy database).

Again, it is important to note that the SOC2010 4-digit level has granularity limitations. Each occupational grouping at this level includes a broad range of jobs which focus on both green and non-green activities that are not easily detectable at the 4-digit level. Disaggregated data at the 5-digit or 6-digit level is needed to better support skills policy.

Table 6.2: Top five occupations by number of job vacancies in each category in the Midlands by SOC2010 4-Digit Level, February 2019 to February 2023

New & Emerging	Enhanced Skills	Increased Demand
2129: Engineering professionals n.e.c. **5249:** Electrical and electronic trades n.e.c. **3119:** Science, engineering and production technicians n.e.c. **8133:** Routine inspectors and testers **2121:** Civil engineers	**2136:** Programmers and software development professionals **8212:** Van drivers **2421:** Chartered and certified accountants **2314:** Secondary education teaching professionals **3534:** Finance and investment analysts and advisers	**9260:** Elementary storage occupations **7219:** Customer service occupations n.e.c. **3132:** IT user support technicians **8211:** Large goods vehicle drivers **3131:** IT operations technicians

Source: IER - LMI for All vacancy dataset

6.3. Skills, knowledge and experience in demand

Data on the skills in demand were extracted from the vacancy data and analysed. The top twenty skills cited in job vacancy adverts within each type of green job is presented in Table 6.3. Using the classification of European Skills, Competences, Qualifications and Occupations (ESCO),[55] skills can be further categorised as sector-specific skills, cross-sector skills and transversal skills.[56]

As shown in Table 6.3, the most demanded skill across all types of green job vacancies was 'communication skills'. It is also the most demanded skill among non-green job vacancies (though not shown in the table). This finding is unsurprising as workers' communications skills was named as a skill that businesses need to improve in a 2021 UK Skills Gap Report.[57] Communication skills are transferable and can be classified as a cross-sector skill. Other high demand cross sector skills that emerged in the top five across all types of green job vacancies were 'attention to detail' and 'working in a team'. A sector-specific skill (based on the ESCO classification) that was highly cited in job vacancy adverts was 'customer service'. Though the type of customer service provided is likely to be sector-specific, there are elements of this skill set that can be transferred across sectors.

Unique to green job vacancies was the demand for technical skills such as energy management/energy solutions, electronics, control systems, mechanical engineering,

[55] See ESCO: https://esco.ec.europa.eu/en/about-esco

[56] Table 6.3 draws on the ESCO skills taxonomy. Further work is required where stakeholders are engaged so as to localise and refine these green skills labels. Transversal skills can help employees to adapt to change.

[57] Department of Digital Culture, Media and Sport (2021)

electrical engineering, quality standards, Structured Query Language (SQL) and JavaScript. New and Emerging green job vacancies had a particularly high demand for technical skills such as chemistry, hydraulics, pneumatics and physics. This finding corroborates analysis earlier in the report which showed that professional, associate professional and technical occupation (particularly engineering occupations for New and Emerging green jobs) make up a large share of green jobs. The skills demanded also showed the 'greening' of some roles as discussed in section 3. For example, under Enhanced Skills job vacancies, skills in accounting and financial management were demanded, and project management skills featured under both New and Emerging and Enhanced Skills green vacancies.

Table 6.3: Top twenty skills demanded in vacancy data by type of green job, February 2019 to February 2023

New & Emerging	Enhanced Skills	Increased Demand
• Communication • Attention to detail • Customer service***** • Work as a team • Energy management/energy solutions • Electronics • Control systems • Mechanical engineering***** • Project management***** • Civil engineering • Personal development • Quality standards • Lead a team • Maintenance and repair • Logistics • Electrical engineering • Chemistry • Hydraulics • Pneumatics • Physics	• Communication • Customer service***** • Work as a team • Attention to detail • SQL***** • Accounting • JavaScript* • Logistics • Energy management/energy solutions • Lead a team • Project management***** • SQL Server***** • Manage a team • Quality standards • Computer science • Cyber security***** • Risk management • Financial management • Work independently+	• Communication • Customer service***** • Logistics • Attention to detail • Work as a team • Quality standards • Work independently+ • Contact customers***** • Lead a team • Manage a team • Meet deadlines • Use IT tools • Follow written instructions • Manage time+ • Adapt to change+ • Assist customers***** • Provide information • Use hand tools • Communicate with customers • Work in teams+

* denotes a sector-specific skill

\+ denotes a transversal skill. Transversal skills can help employees to adapt to change

Unmarked skills (the majority in Table 6.3) are cross-sector skills.

Source: IER - LMI for All vacancy dataset

The explicit demand for previous experience appears to be the norm across all types of jobs based on the vacancy data.[58] Interestingly, New and Emerging green job vacancies (the purist of the green job types) was the category for which the largest share of vacancies cited the need for experience (73.8%); only 0.5% of vacancies in this type did not require experience (Table 6.4). This need may be driven by the fact that the majority of New and Emerging green jobs and job vacancies are in the professional and associate professional occupational groups (Table 5.2 and Table 6.1). Compared to the other types of jobs, vacancies classified as Increased Demand green jobs had the largest share of postings that did not mention any experience requirement (37.4%) or did not require experience (4.3%). That said, most Increased Demand vacancies did require some experience (58.3%).

Table 6.4: Experience requirement by green job vacancy type and non-green jobs February 2019 to February 2023, Midlands (%)

	New and Emerging	Enhanced Skills	Increased Demand	Non-green
Experience not mentioned	25.7	27.7	37.4	34.3
Experience not required	0.5	2.8	4.3	2.1
Experience required	73.8	69.5	58.3	63.7
	100	100	100	100

Source: IER - LMI for All vacancy dataset

6.4. Pay

Based on the vacancy data, median advertised wages were higher in green jobs than in non-green jobs in the Midlands (£30,600 vs £26,500).[59] The same was true for the rest of the UK (£33,000 vs £27,750). Separating the data by type of green job (Figure 6.6), median wages were highest for Enhanced Skills and Knowledge jobs (£35,000 in the Midlands vs £37,000 in the rest of the UK), and lowest for Increased Demand jobs (£21,000 in the Midlands vs £22,750 in the rest of the UK).

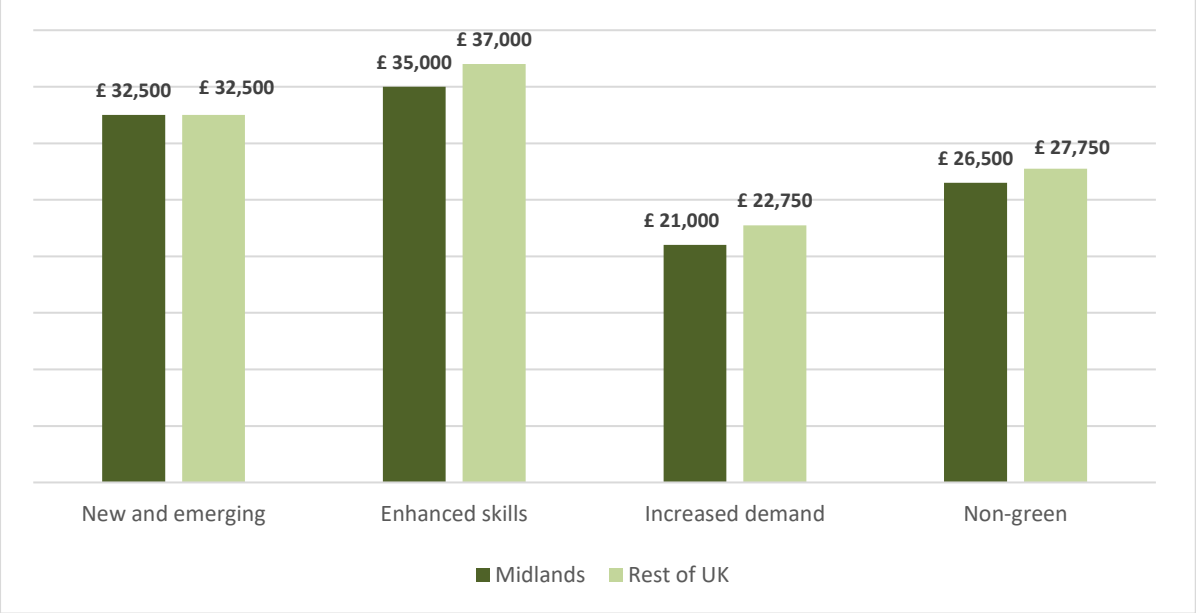
The higher median wage for Enhanced Skills and Knowledge jobs was likely driven by the fact that this type included more senior occupations, particularly managers, directors and senior officials as shown in Table 6.1. The median wage for all job types was higher in the rest of the

[58] This need not be green-specific experience, just some previous experience.

[59] Where a salary range is given in the job advert, the midpoint of the range is used for calculations.

UK compared to the Midlands, which was not to be unexpected as the London region likely affects the distribution and pulls up the median wage.

Figure 6.6: Green job vacancies by category and median wages February 2019 to February 2023, Midlands and Rest of UK



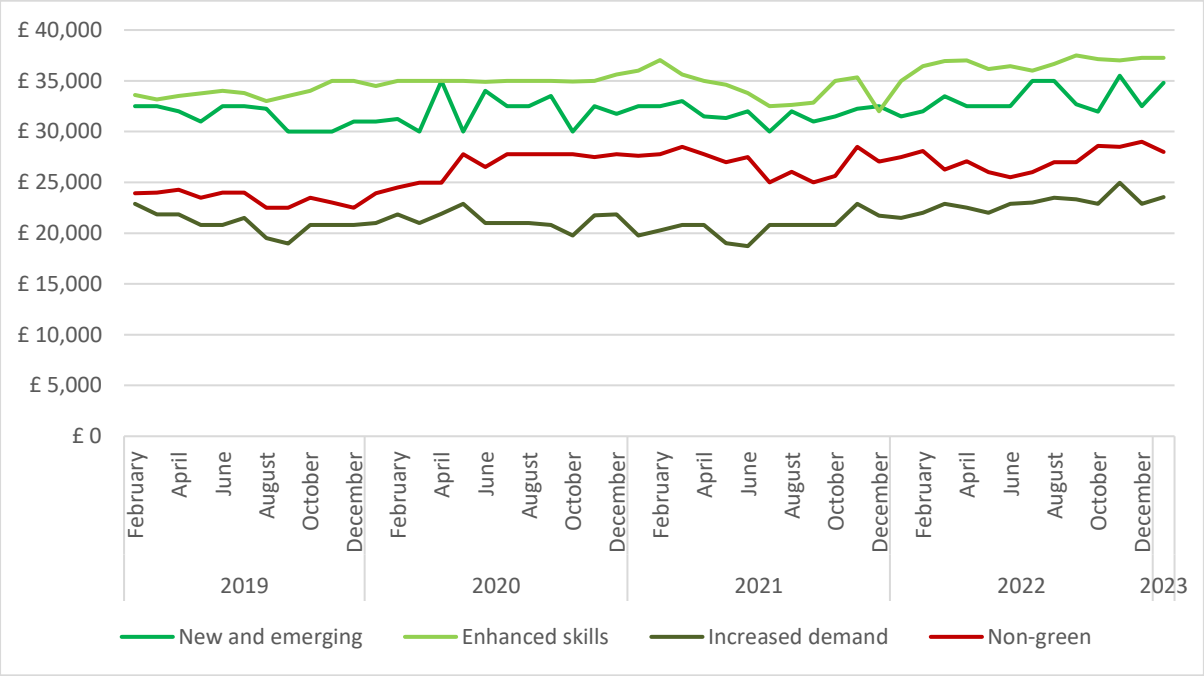
Source: IER - LMI for All vacancy dataset

The median wage for both green and non-green jobs increased over 2019-23, though there were differences across job type (see Figure 6.7). In absolute terms, based on the vacancy data, non-green jobs had the largest increase in over the period (+£4080), followed by Enhanced Skills and Knowledge jobs (+£3639), New and Emerging jobs (+£2300) and finally, Increased Demand jobs (+£669). Not only did Increased Demand jobs register the smallest increase, but the median wage remained below the other three job types over the entire period. The median wage for Increased Demand jobs also diverged from the median wage for non-green jobs, with the gap between the two increasing from £1040 to £4452 between February 2019 and February 2023.

Closer monitoring of vacancy data and mapping green jobs to other wage data sources such as the ONS's Annual Survey of Hours and Earnings (ASHE) is needed to better analyse and understand longer term trends.[60]

[60] See ONS Annual Survey of Hours and Earnings (ASHE) https://www.ons.gov.uk/surveys/informationforbusinesses/businesssurveys/annualsurveyofhoursandearningsashe

Figure 6.7: Green median wages over time in the Midlands, February 2019 to February 2023



Source: IER - LMI for All vacancy dataset

6.5. Hydrogen vacancies: trends and employer demands

The above analysis focused on green jobs in general, drawing on vacancy data. In the hydrogen industry, meanwhile, about 10.2% of all job vacancies in the Midlands are in green hydrogen related occupations (9.9% for the rest of the UK), with 8.4% of all job vacancies classified as administrative and support occupations in the hydrogen industry (9.1% for the rest of the UK). Figure 6.8 shows that the share of green hydrogen jobs fluctuated between 8-12% over the period, with the trend being largely similar to the rest of the UK[61].

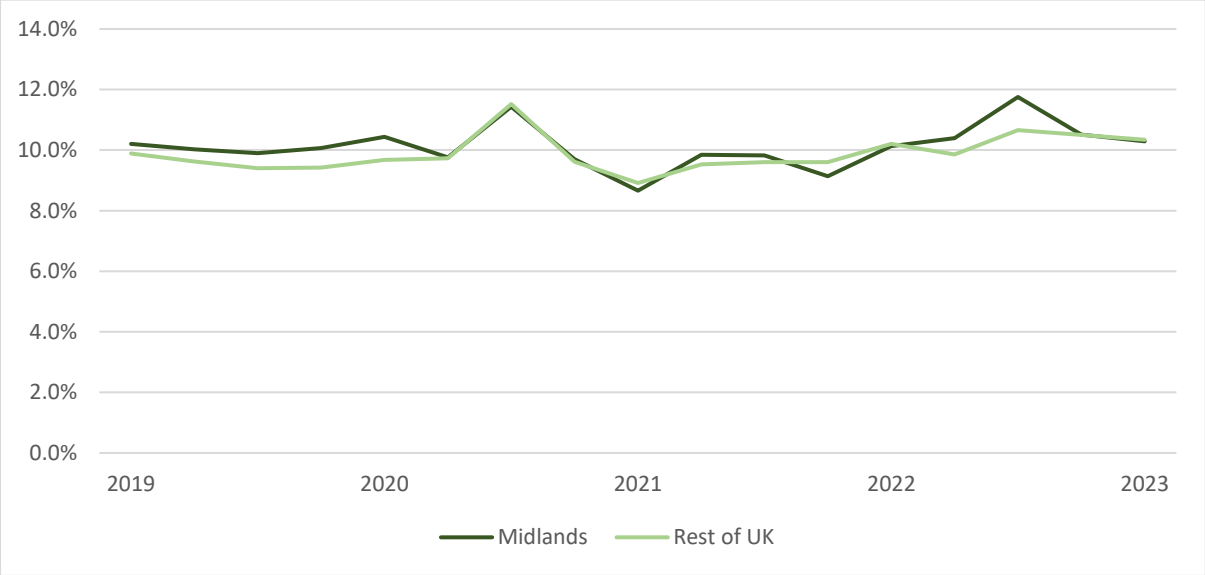
With respect to occupations (at the 4-digit SOCO2010 level), the most common hydrogen-related occupation in the job vacancy data was programmers and software development professionals (22% of all hydrogen vacancies). Second was finance and investment analysts and advisers (12.8% of all hydrogen vacancies), followed by metal working production and maintenance fitters (9.6%), vehicle technicians, mechanics and electricians (6.2%), and finally, science, engineering and production technicians (5.3%). As expected, there was some

[61] It is important to note that not all vacancies demanded in those occupations are not necessarily involved in the utilisation, or advancement of hydrogen. These figures indicate the share of vacancies in Midland could be transitioned to hydrogen jobs.

overlap between the top five hydrogen job vacancies and the top five green job vacancies, particularly New and Emerging and Enhanced Skills green jobs (see Table 6.2).

Compared to the top five occupations from the LFS data (section 5.5), the top vacancies were mostly similar, with three of the occupations appearing in the top five occupations from both the LFS and vacancy data: programmers and software development professionals, metal working production and maintenance fitters, and vehicle technicians, mechanics and electricians. This pattern suggests that there is a core set of occupations that currently exist and continue to be demanded in green hydrogen jobs.

Figure 6.8: Share of green hydrogen vacancies in the Midlands and Rest of UK, February 2019 to February 2023



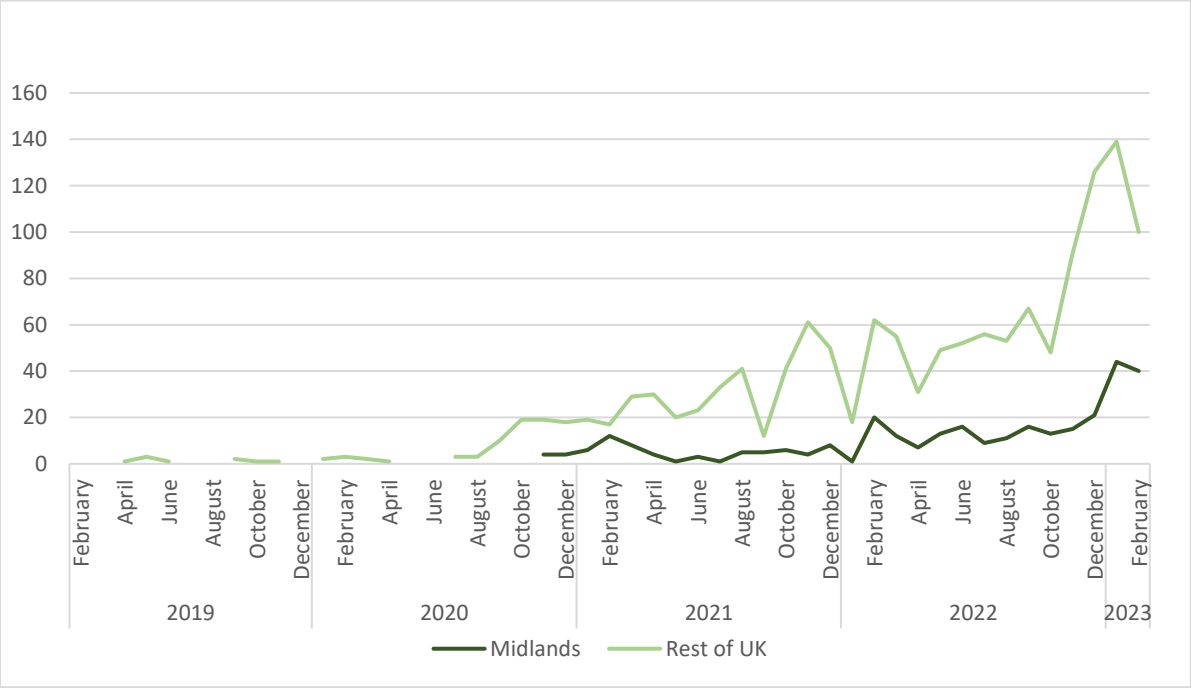
Source: IER - LMI for All vacancy dataset

Figures 6.9 and 6.10 show the job vacancies that explicitly mention the term 'hydrogen' in the job posting. It should be noted that it is possible that some jobs may be related to hydrogen technologies but may not explicitly mention the term hydrogen in the advert. In such cases, these vacancies would not be captured in the figures below. Despite this limitation, Figures 6.9 and 6.10 are a useful lower-level estimate of hydrogen-specific vacancies. Importantly, they show an upward trend of vacancies explicitly mentioning hydrogen in the job description in both the Midlands and the rest of the UK. The increase in hydrogen mentions starts in 2021, which coincides with the launch of the 2021 UK Hydrogen Strategy and 2022 Midlands Engine Hydrogen Technologies Strategy.

Of all vacancies that mentioned hydrogen in the UK since end-2020, on average, 17% of these were in the Midlands, although this figure fluctuated significantly, ranging from a low of 3% to

a high of 45%.[62] However, compared to the total number of job vacancies in the Midlands, the share that explicitly mentioned hydrogen only accounted for 0.08%, on average, since the end of 2020 (Figure 6.10).

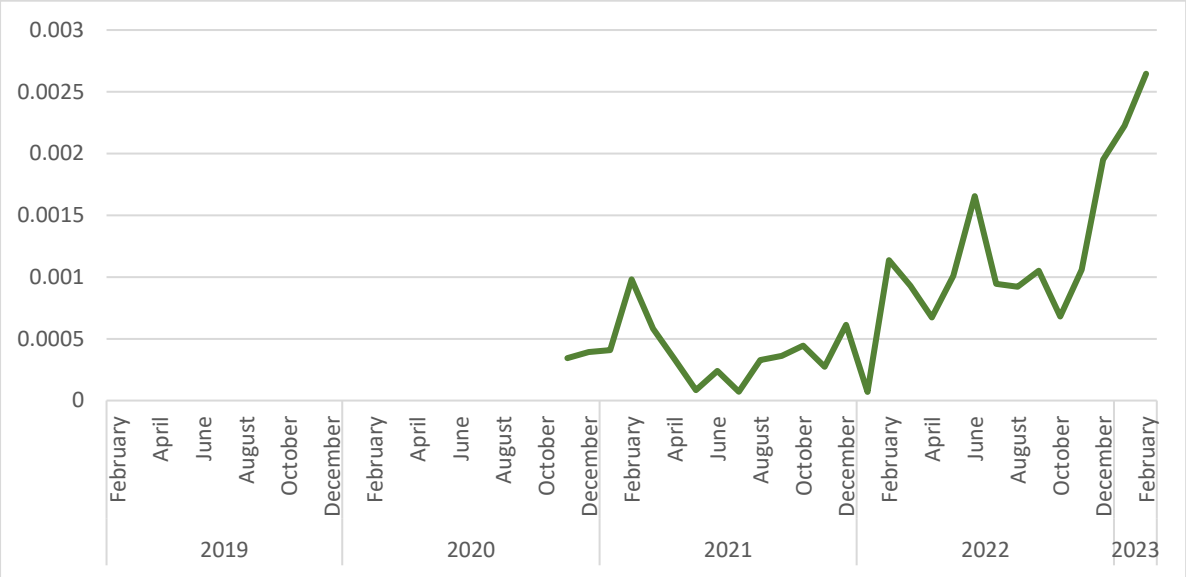
Figure 6.9: Vacancies explicitly mentioning 'hydrogen' in the Midlands and Rest of UK, February 2019 to February 2023



Source: IER - LMI for All vacancy dataset

[62] The large fluctuations are likely due to the relatively small number of job vacancies that explicitly mention 'hydrogen', rather than economic reasons.

Figure 6.10: Share of vacancies explicitly mentioning "hydrogen" in the Midlands, February 2019 to February 2023



Source: IER - LMI for All vacancy dataset

As with green jobs in general, data on the skills demanded was extracted from the vacancy data and analysed for hydrogen jobs. The top twenty skills mentioned by vacancies within each type of hydrogen job is presented in Table 6.5. As with green and non-green jobs, the most demanded skill across all types of hydrogen job vacancies was 'communication skills' - a cross-sector transferable skill. Again, similar to other green jobs (Table 6.3), other high-demand cross-sector skills that emerged in the top five across all types of hydrogen job vacancies were 'attention to detail' and 'working in a team'. Customer service also emerged - a sector-specific skill. Hydrogen green occupations (such as New and Emerging green jobs) had relatively higher demands for technical skills/training (versus soft skills) such as energy management/energy solutions, maintenance and repair, chemistry, physics, electronics, hydraulics, biology, and mechanical engineering.

Table 6.5: Top twenty skills demanded in vacancy data by type of hydrogen job, February 2019 to February 2023

Hydrogen green occupations	Administrative and Support occupations in the Hydrogen Industry	Non-hydrogen occupations
• Communication • SQL***** • JavaScript***** • Work as a team • Attention to detail • Customer service*****	• Communication • Customer service***** • Attention to detail • Promote yourself • Work as a team • Work independently**⁺**	• Communication • Customer service***** • Attention to detail • Work as a team • Logistics • Accounting

• Energy management/energy solutions • Logistics • Project management***** • Quality standards • Lead a team • Computer science • Maintenance and repair • Chemistry • Physics • Electronics • Hydraulics • Manage a team • Biology • Mechanical engineering*****	• Personal protective equipment • Project management***** • Logistics • Lead a team • Manage work • Manage a team • Market research • Contact customers***** • Sell products • Manage accounts • Identify opportunities+ • Achieve sales targets • Accounting • Work in teams+	• Lead a team • Manage a team • Project management***** • Person centred care***** • Manage work • Work independently+ • Risk management • Nutrition***** • Physiotherapy***** • Conveyancing • Cyber security***** • Work in teams+ • Financial management • Specialist nursing care*****

* denotes a sector-specific skill
+ denotes a transversal skill. Transversal skills help employees to adapt to change
Unmarked skills (the majority in Table 6.5) are cross-sector skills.
Source: IER - LMI for All vacancy dataset

As with green jobs (see Table 6.4), the vast majority of hydrogen job vacancies required some level of experience: 72.1% for hydrogen green occupations and 69.7% for administrative and support roles in the hydrogen industry (Table 6.6). A larger share of vacancies in these two categories required experience compared to non-hydrogen occupations.

Table 6.6: Experience requirement by hydrogen job vacancy type, Midlands (%)

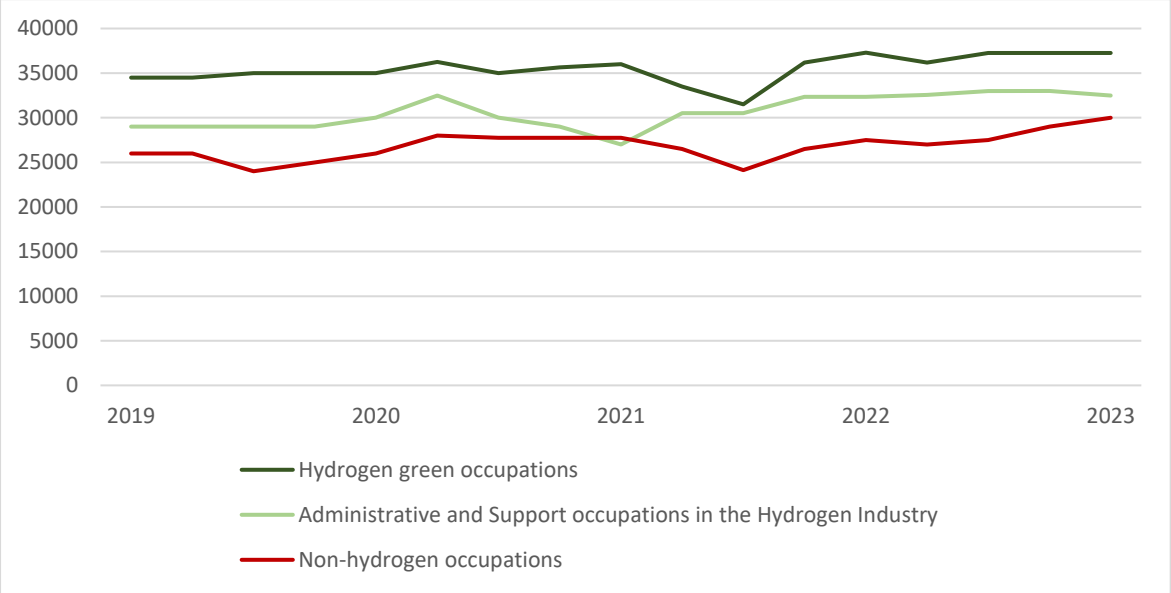
	Hydrogen green occupations	Administrative and Support occupations in the Hydrogen Industry	Non-hydrogen occupations
Experience not mentioned	26.9	29.4	33.8
Experience not required	1.1	0.9	2.7
Experience required	72.1	69.7	63.5
	100	100	100

Source: IER - LMI for All vacancy dataset

The median wage for hydrogen green occupations was higher than that of administrative and support occupations in the hydrogen industry and non-hydrogen occupations (Figure 6.11). The average over the period for hydrogen green occupations, administrative and support occupations in the hydrogen industry and non-hydrogen occupations was £35,360, £30,500

and £27,040, respectively. Relative to the rest of the UK, the average median wage for each type was lower in the Midlands, £37,500 for hydrogen green occupations, £32,370 for administrative and support occupations in the hydrogen industry and £28,595 for non-hydrogen occupations in the rest of the UK.

Figure 6.11: Hydrogen (vs non-hydrogen) median wages over time in the Midlands, February 2019 to February 2023



Source: IER - LMI for All vacancy dataset

In sum, the vacancy data showed that about 10% of all job vacancies in the Midlands can be classified as green hydrogen occupations and 8.4% of all job vacancies can be classified as administrative and support occupations in the hydrogen industry. Importantly, the explicit use of the word “hydrogen” in job vacancy descriptions has been increasing since 2021. The most common hydrogen-related occupation in the job vacancy data were programmers and software development professionals, finance and investment analysts and advisers, metal working production and maintenance fitters, vehicle technicians, mechanics and electricians and finally, science, engineering and production technicians. In general, hydrogen green occupations had relatively higher demands for technical skills/training (versus soft skills), though the most common skills demanded were related to communication. Most hydrogen jobs required experience, and the median wage for green hydrogen jobs exceeds non-hydrogen occupations.

7. Conclusions and recommendations

The Midlands region, similar to the UK as a whole, has embarked on a process to reach net zero and work towards having greener, more sustainable businesses and communities. In estimating the extent and demand for green and hydrogen jobs in the Midlands, this research has provided a baseline from which progress towards these ambitions can be measured.

The research presented in this report used the GreenSOC to categorise and analyse green employment (from the LFS) and green job vacancies (from the IER vacancy database). It also mapped hydrogen jobs in the Midlands region and identified existing hydrogen occupations and a list of potential future occupations in the hydrogen industry. The hydrogen industry is still in an early stage of development, and as such, there may be other occupations that could potentially emerge and be included in the classification of the hydrogen industry. This initial mapping is thus a useful benchmark at the onset of the 2022 Midlands Engine Hydrogen Technologies Strategy. This data is new and provides a better understanding of green jobs generally and hydrogen jobs specifically in the Midlands.

7.1. Summary of findings

The findings showed that about 41% of employment in the Midlands over the 2014-22 was in green occupations, being categorised as New and Emerging, Enhanced Skills and Knowledge or Increased Demand green jobs. Some 44% of all job vacancies between February 2019 and February 2023 fit into these green job types. The absolute number of New and Emerging green jobs and job vacancies have been increasing, indicating a movement towards a greener economy (in the purist definition sense). In addition, just over a quarter of jobs (26.7%) were Enhanced Skills and Knowledge jobs suggesting that green economic activities and technologies have been changing the requirements of existing occupations; and more than one-tenth (11.2%) were Increased Demand jobs suggesting green economic activities and technologies have increased employment demand for some existing occupations. With respect to hydrogen occupations, these occupations accounted for about 10% of employment in the Midlands, and the share has been slowly increasing in the past decade.

Green jobs were clustered among professional occupations, skills trade occupations and process, plant and machine operatives. For both New and Emerging green jobs and hydrogen green jobs, a large share of these jobs were in engineering and technician-type occupations. Notably, there was a larger share of green employment in construction, engineering, manufacturing and transport industries in the Midlands relative to the rest of the UK. This finding is positive given the Midlands Engine's emphasis on manufacturing, transport and energy related sectors in the 2022 Midlands Hydrogen Technology Strategy.

Both hydrogen green occupations and New and Emerging green jobs had relatively higher demands for technical skills/training (versus soft skills) such as energy management/energy solutions, maintenance and repair, chemistry, physics, electronics, hydraulics, biology, and mechanical engineering. A large share of green and hydrogen job vacancies also required cross-sector transferable skills such as 'communication skills', 'attention to detail' and 'working in a team'. The vast majority of these jobs (over 70%) also required some previous experience. On the whole, green and hydrogen jobs were relatively attractive financially, as these jobs have a higher median wage based on the vacancy data, though median wages were lower in the Midlands compared to the rest of the UK.

With respect to gender and age, green jobs were more likely to be held by men and older workers. The data revealed that women were under-represented across green jobs (26.3% of green jobs in the Midlands are held by women vs 73.7% being held by men) and over-represented in non-green jobs (61.7% held by females compared to 38.3% by males). The same is true in the rest of the UK. As with green jobs hydrogen green jobs were largely held by males - 82% males compared to 18% females in the Midlands and 79% males compared to 21% females in the rest of the UK. The distribution of green jobs by age was largely similar in the Midlands and rest of the UK with 25-49-year-olds holding the largest share of green jobs (57.9% in the Midlands and 59.6% in the rest of the UK), followed by 50-64-year-olds (28.8% compared to 27.9%). This distribution is unsurprising and largely reflects the dynamics of the labour market, as these age groups form the largest share of workers. That said, a just transition to net zero should see an improvement in the distribution of green jobs across age and gender.

7.2. Recommendations

The above findings provide a useful benchmark for monitoring the Midlands Engine Hydrogen Technology Strategy. It also demonstrates the advantage of using vacancy data to gather information on shifting employer demands with respect to occupations and skills. The report concludes by offering recommendations to ensure that the benefits of this type of research is fully maximised to meaningfully contribute to the Midlands Engine Partnership's strategic objective of green growth.

1 Encourage the greening of jobs in non-green sectors

'Purist' green or New and Emerging jobs in green industries, which a new and novel, will have an important role to play in furthering a net zero economy in the Midlands. However, most, if not all, jobs in the economy should contribute to the transition to a net zero economy. Already across the Midlands region there is a significant proportion of green jobs in non-green industries (41%). This presence shows that it is possible for non-green jobs to change.

Encouraging more of this change is important. One way of encouraging this greening of jobs could be through the provision of training that delivers up-skilling and re-skilling enabled by new micro-credentials (that is, small specific training qualifications)[63] to meet the demands of firms wishing to transition to greener activities. Such a strategy might also support the drive to a more inclusive net zero economy by drawing in workers in non-green sectors. In addition, the Midlands Engine Partnership can actively dialogue with companies in the traditionally non-green sectors to steer such companies toward greener working practices were possible.

It is only recently that policy thinking has turned attention to the desirability of the greening of existing jobs and not just advocating the creation of new green jobs as part of attaining net zero economies. As such, policies intended to support the transition to net zero still tend to focus on either the promotion of the new 'green sectors' or support regions away from reliance on declining old brown industries. Examples of such policy development include those for Europe's wind energy[64] and coal regions[65] respectively. In this respect, a policy gap exists in terms of developing and pursuing a strategic approach to the greening of existing jobs. Given that these jobs are both prevalent and likely to remain so, and they are likely to make a significant contribution to the transition, Midlands Engine/HyDEX might consider working with local authorities in the Midlands region to persuade them of the case for taking a policy lead on such a strategy.

2 Working towards more inclusive green employment

As noted above, women and younger workers are under-represented in green and hydrogen jobs. This pattern may, in part, be driven by the types of occupation that dominate these jobs. However, improvements in the number of younger and female workers are possible, and necessary if a just transition is to be delivered as part of the Green Industrial revolution. Improving job quality is one way in which under-represented workers can be attracted. For example, working conditions which enable flexible working and worker autonomy tend to attract young and female workers.[66] The evidence also shows that job quality is positively associated with innovation by companies,[67] hence a strategy to encourage an increase in the number of good jobs might provide dual benefits: a more inclusive green workforce and more innovative companies.

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63 See, for example, Karanovic et al. (2022).

64 See 'Greennovation' meets skills anticipation: policy lessons for making the green transition happen | CEDEFOP (europa.eu).

65 See Climate-KIC | The EU's main climate innovation initiative.

66 Chung and van der Lippe (2020).

67 Muñoz-de-Bustillo et al. (2022).

With respect to younger workers, the under-representation may be linked to the experience and skills requirements of green and hydrogen jobs, which older workers may be more likely to have. One way of mitigating this under-representation and recruiting more younger workers is through apprenticeship schemes which foster on-the-job training and learning by doing. There are a growing number of examples of apprenticeships for green and greening jobs. While the Institute for Apprenticeships & Technical Education (IfATE) lists no specific hydrogen job apprenticeships, it does list apprenticeships with green jobs titles.[68] Some of these apprenticeships are for New and Emerging green jobs. Examples include 'low carbon heating technician' and 'Sustainability specialist'. Tellingly, it also lists examples of apprenticeships for what might have previously been regarded as non-green jobs, but which are now greening through Enhanced Skills. Examples include: 'Sustainable silversmith', and 'Organic retail butcher'. There is thus a shift to more green-relevant apprenticeships, but the current trends do not yet include hydrogen related jobs. This gap might be one that the Midlands Engine/HyDEX takes a lead on addressing, working with IfATE.

3 Routine monitoring of the green economy and green employment

The GreenSOC is derived from an existing methodology that has international recognition amongst policymakers and is sensitive to academic debates about the problems in defining green jobs. It offers an academically rigorous, policy-useful methodology. There should be periodic updates of the analysis using this methodology to monitor trends and developments over time in the extent and demand for green jobs and hydrogen green jobs in the Midlands. The value of such studies would increase if the methodology expanded to incorporate 5- or 6-digit level SOC information in future updates.[69] In addition, continuous monitoring of skills demanded in the green sector and hydrogen industry could usefully inform education and training to meet those needs. As shown in this report, data scraping web-based job vacancy data provides an evidence base of the skills needed as well as changing skills needs.

4 Unblocking constraints faced by employers in green and hydrogen industries

Analysis of the vacancy data has identified key technical and soft skills demanded by green occupations and hydrogen occupations. Continuous monitoring of vacancy data can usefully identify changes in skills that employers demand. Beyond this use of the job vacancy data, further research that takes a deep dive into employer needs and experiences would shed light on any constraints to expanding green employment and activities on the demand side. For example, this report highlighted the types of skills demanded, but further research with firms

[68] See: About / Institute for Apprenticeships and Technical Education

[69] See Extended SOC 2020 - Office for National Statistics (ons.gov.uk)

can allow a better understanding of skills gaps faced, and the current ability to successfully recruit and meet labour demands. This research might be qualitative with companies in targeted sectors in the Midlands (such as manufacturing, energy and transport). The findings from such a study would complement this report and feed into green policy and practice in the Midlands hydrogen industry (and beyond).

8. References

Cardenas Rubio, J., & Warhurst, C. (2022). Big Data and the Shift Towards Real Time Labour Market Information, In New Direction *Artificial Intelligence*, pp.51-54 NDreportEN-Ai.pdf (newdirection.online)

Cardenas Rubio, J., Warhurst, C., & Anderson, P. (2022). Green Jobs in Scotland: An inclusive approach to definition, measurement and analysis. Skills Development Scotland. green-jobs-in-scotland-report_final-1.pdf (skillsdevelopmentscotland.co.uk)

Chapman, A., Itaoka, K., Hirose, K., Davidson, F. T., Nagasawa, K., Lloyd, A. C., Webber, M. E., Kurban, Z., Managi, S., Tamaki, T., Lewis, M. C., Hebner, R. E., & Fujii, Y. (2019). A review of four case studies assessing the potential for hydrogen penetration of the future energy system. *International Journal of Hydrogen Energy*, *44*(13), 6371–6382. https://doi.org/10.1016/j.ijhydene.2019.01.168

Chung, H., & van der Lippe, T. (2020) Flexible Working, Work–Life Balance, and Gender Equality: Introduction. *Soc Indic Res* 151, 365–381. https://doi.org/10.1007/s11205-018-2025-x

Department for Business Energy and Industrial Strategy (2022). British energy security strategy. BEIS Policy Paper. British energy security strategy - GOV.UK (www.gov.uk)

Department of Digital Culture, Media and Sport (2021). Quantifying the UK Data Skills Gap - Full report. Policy Paper. Quantifying the UK Data Skills Gap - Full report - GOV.UK (www.gov.uk)

Dickinson, P., Cardenas-Rubio, J., and Warhurst, C. (2022). Green Jobs and the Green Economy in York. IER, Coventry. york_green_jobs_and_skills_report_final_report.pdf (warwick.ac.uk)

Dierdorff, E., Norton, J., Drewes, D., Kroustalis, C., Rivkin, D. & Lewis, P. (2009). *Greening of the world of work: Implications for O* NET®-SOC and new and emerging occupations*. North Carolina, NC, National Center for O*NET Development.

Gagliardi, L., Marin, G. & Miriello, C. (2016). The greener the better? Job creation effects of environmentally-friendly technological change. Industrial and Corporate Change, 25(5), 779-807.

Georgeson, L. & Maslin, M. (2019). Estimating the scale of the US green economy within the global context. *Palgrave Communications*, 5(1), 1-12.

Griffiths, S., Sovacool, B. K., Kim, J., Bazilian, M., & Uratani, J. M. (2021). Industrial decarbonization via hydrogen: A critical and systematic review of developments, socio-

technical systems and policy options. *Energy Research & Social Science*, *80*, 102208. https://doi.org/10.1016/j.erss.2021.102208

Hogarth, T. (2012). *Green jobs and skills in Europe: Moving towards a statistical definition of green jobs*. Presentation to ILO. http://www.ilo.org/wcmsp5/groups/public/@dgreports/@stat/documents/presentation/wcms_195742.pdf

ILO. (2015). Guidelines for a just transition towards environmentally sustainable economies and societies for all. ILO, Geneva. https://www.ilo.org/wcmsp5/groups/public/---ed_emp/---emp_ent/documents/publication/wcms_432859.pdf

ILO. (2018). *World employment outlook 2018: Greening with jobs*. ILO, Geneva.

Karanovic, J. Sapic, J. and Kilhoffer, Z. (2022) Reshaping Work, Navigating Diverse Forms of Work: How to Advance Decent and Fair Work, Reshaping Work, www.dialogue.reshapingwork.net

kMatrix Data Services Ltd (2021). Midland Energy Hub Regional Report Low Carbon Environmental Goods and Services Market Snapshot: Midlands Energy Hub 2017/18 to 2019/20. kMatrix_LCEGS_MEH_Regional_Final_Report_March_2021.pdf

Manufacturing Technology Centre (2022). A review of how the Midlands region can support green hydrogen production, and the importance of a holistic approach. hydrogen-research-paper-a4-pdf-3.pdf (the-mtc.org)

Martinez-Fernandez, C., Hinojosa, C. & Miranda, G. (2010). *Greening jobs and skills: Labour market implications of addressing climate change*. Working document, CFE/LEED. Paris, OECD.

Midlands Engine. (2021). Green Growth: Ten Point Plan for Green Growth in the Midlands Engine. Ten-Point-Plan-for-Green-Growth-in-the-Midlands-Engine_V1-1.pdf (midlandsengine.org)

Midlands Engine (2022a). Green Growth: Hydrogen Technologies Strategy. February 2022.

Midlands Engine. (2022b). Review of Green Innovation in the Midlands Engine. Review of Green Innovation in the Midlands Engine

Muñoz-de-Bustillo, R., Grande, R. & Fernández-Macías E. (2022) Innovation and Job Quality. In C. Warhurst, C. Mathieu and R.E. Dwyer (eds) *The Oxford Handbook of Job Quality*, Oxford: Oxford University Press.

ONS. (2021). *The challenges of defining a "green job"*. Newport, ONS. https://www.ons.gov.uk/economy/environmentalaccounts/methodologies/thechallengesofdefiningagreenjob

ONS (2023). Low carbon and renewable energy economy, UK: 2021. Low carbon and renewable energy economy, UK - Office for National Statistics (ons.gov.uk)

Parra, D., Valverde, L., Pino, F. J., & Patel, M. K. (2019). A review on the role, cost and value of hydrogen energy systems for deep decarbonisation. *Renewable and Sustainable Energy Reviews*, *101*, 279–294. https://doi.org/10.1016/j.rser.2018.11.010

Renner, M., Sweeney, S. & Kubit, J. (2008). *Green Jobs: Towards decent work in a sustainable, low-carbon world: Report for United Nations Environment Programme*. UNEP: Nairobi, Kenya.

Scottish Government (2020). Climate Emergency Skills Action Plan 2020-2025: Key Issues and Priority Actions. climate-emergency-skills-action-plan-2020-2025.pdf (skillsdevelopmentscotland.co.uk)

Seck, G. S., Hache, E., Sabathier, J., Guedes, F., Reigstad, G. A., Straus, J., Wolfgang, O., Ouassou, J. A., Askeland, M., Hjorth, I., Skjelbred, H. I., Andersson, L. E., Douguet, S., Villavicencio, M., Trüby, J., Brauer, J., & Cabot, C. (2022). Hydrogen and the decarbonization of the energy system in europe in 2050: A detailed model-based analysis. *Renewable and Sustainable Energy Reviews*, *167*, 112779. https://doi.org/10.1016/j.rser.2022.112779

Sofroniou, N. & Anderson, P. (2021). The green factor: Unpacking green job growth. *International Labour Review*, 160(1), 21-41.

UK Government (2020). The Ten Point Plan for a Green Industrial Revolution: Building back better, supporting green jobs, and accelerating our path to net zero. The Ten Point Plan for a Green Industrial Revolution (publishing.service.gov.uk)

UK Government (2021a). Net Zero Strategy: Build Back Greener. net-zero-strategy-beis.pdf (publishing.service.gov.uk)

UK Government (2021b). UK Hydrogen Strategy. UK Hydrogen Strategy (publishing.service.gov.uk)

United Nations. (2006). *The Paris Agreement.* The Paris Agreement | United Nations

UNFCCC. (2006). *Race To Zero Campaign*. United Nations Climate Change. Race To Zero Campaign | UNFCCC

West Midlands Combined Authority (2021). Low-carbon manufacturing is fastest growing sector in West Midlands. Low-carbon manufacturing is fastest growing sector in West Midlands (wmca.org.uk)

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The Midlands Engine is a coalition of local authorities, local enterprise partnerships, universities and businesses across the region, actively working with government to build a collective identity, to enable us to present the Midlands as a competitive and compelling offer that is attractive at home and overseas.

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