Net Zero Transition in London and the UK: Evidence on Green Jobs and Green Skills

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Executive Summary

This report investigates the impact of the net zero transition on the labour market in London and the UK, with a focus on the evolution of green jobs and green skills. The study provides a comprehensive analysis of employment trends in the green economy, shedding light on key socioeconomic factors such as gender equality, age, ethnicity, wage inequalities, and the supply of green skills at the graduate level, over the 2017 – 2022 period, with some time variations due to data availability and reliability. The study provides a new methodology to understand which occupations are more intensive users of green skills, highlighting the presence of skill misallocations and proposing directions for future policies.

Key Findings

Growth and distribution of Green Jobs. Between 2017 and 2020, green jobs in London grew at an average annual rate of 4.02%, outpacing the UK average of 2.69%. However, growth slowed in 2020 due to the pandemic. A strong decrease is observed within the construction sectors (Construction and Building trade, Plumbers and heating and ventilating engineers), particularly in London. Green jobs in the capital are more concentrated in high-skilled, degree-intensive occupations.

Green jobs are concentrated among male workers. In 2020, 70% of all workers in green jobs in London identify as male. Women earn up to 30% less compared to their male counterparts with similar qualifications. In terms of ethnic background, green jobs are concentrated among white workers (71%), followed by Asian (18%) and black workers (4%). A white worker with a green degree, employed in a green job, earns approximately 26% more than a black worker with similar qualification.

Green Skills Supply. The number of workers with green skills—defined through degrees in STEM subjects such as engineering, biology, and environmental sciences—has increased steadily until 2020. London has a higher proportion of workers with green degrees than the UK average, though recent years show a **decline in growth**, particularly in biological sciences. Women are underrepresented in STEM fields.

Mismatch Between Skills and Jobs. A newly developed Green Skills Fit Index reveals a misallocation of green skills, with many graduates working in non-green roles. However, the mismatch is gradually improving, especially among new graduates entering green occupations like construction management and IT systems design.

Sectoral Insights. Strong alignment between green skills and employment is found in engineering, electricity production, and installation sectors. In contrast, retail and finance show weak integration of green skills.

Policy Recommendations

To support a just and effective transition to net zero, the report recommends supporting the creation of green jobs, particularly in sectors with high demand, such as the construction sector. This should be achieved through targeted training. At the same time, workers currently employed in high-carbon jobs should be retrained to help transition to green jobs. Measures should also be taken to facilitate access for women and ethnic minorities to green jobs. This can be achieved by further investing in STEM subjects, starting from the early stages of education. These investments should take place across the country, both in rural and urban areas, deepening regional disparities. Finally, improving reliability and access to the labour market and educational data is essential to better understand and monitor workforce transitions, and to inform timely and effective policy responses.

Contents

1. Introduction and Context

This report examines the effect of the net zero transition on the labour market in the UK and in London to advance towards a stronger Green Economy. This research is commissioned as part of London Councils' Green Economy programme. Driving the net-zero transition will require both significant and targeted investments in new green technologies and infrastructures as well as in human capital. This important socio-economic transformation will bring changes to the way we produce, consume and carry out our social activities. It has been compared to a technological transformation not only because new technologies are being developed but because, like all major transformations, it is likely to disrupt the existing job market. This challenge needs to be addressed through the creation of new jobs and the upskilling and reskilling of workers currently employed in carbon intensive industries. Here, the *supply* of Green Skills training equally requires a greater *demand*. To foster demand, greater carbon literacy is required as highlighted by recent research. That is, the supply needs to match the demand to avoid the loss of new and existing expertise on a local level through the provision of better opportunities elsewhere.

Our analysis provides an important contribution to this transition by presenting evidence of how the provision of green jobs and green skills in London and in the UK has evolved in recent years. Relying on existing classifications of green jobs and green skills, our work will focus on constructing the evidence and indicators that can guide policy intervention in achieving the sustainability targets for the Net-Zero transition.

Defining green jobs and green skills. Defining green jobs and green skills is challenging because they do not have a standardized classification and different definitions are used in the academic literature and in policy reports. The various dimensions of an occupation's 'greenness' are often determined by the availability of relevant data. For the purpose of the report at hand, our applied methodology in defining green jobs and green skills aligns with the one proposed by the WPI report, to offer a robust approach. Our analysis sheds light on key socioeconomic dimensions, such as gender, age and ethnicity, as well as skill endowments of those workers in green jobs and those trained with green skills. The analysis focuses on changes in green jobs and green skills from 2017 to 2022 with some variations due to data availability and reliability. Finally, we propose a new methodology to understand in which occupations green skills are used intensively, and we introduce and new indicator – the Green Skills Fit Index – that measures the match between the supply of green skills and their intensity of use within occupations. This indicator reveals the misallocation of green skills within occupations and highlights possible areas for policy interventions. Policy implications of our study are discussed in the concluding section.

2. Methodology

For the analysis of green jobs and green skills, our main reference is the WPI report *mission-based* approach. This adapts the Green Job Task Force definition of green jobs[1] to better represent London's labour market and business structure. The mission-based definition and the corresponding sectors with a Net Zero focus are reported in Table 1. These sectors are in

[1] Employment in an activity that directly contributes to – or indirectly supports – the achievement of the UK's net zero emission target and other environmental goals, such as nature restoration and mitigation against climate risks.

accordance with previous analysis for London, discussed in the WPI report. Columns (1) and (2) provide a definition and a description of the sector, while column (3) lists the corresponding most common industries operating within each sector. The last column reports the Standard Industrial Classification (SIC) codes at the 5-digit level.

Table 1. Green sectors

N.	Green economy sectors	Definition	Corresponding industries	Top SIC codes 5-digits
1	Climate adaptation	Including flood defence, retrofitting of buildings to be resilient to extreme weather/climate events, nature-based solutions to reduce climate impacts and civil and mechanical engineering for infrastructure adaptation.	(1) Environmental consulting activities (2) Engineering related scientific and technical consulting (3) Management consultancy activities other than financial	74901 71122 70229
2	Climate change research & development	Including private sector, academic and public research.	(1) Environmental consulting activities (2) Management consultancy other than financial (3) Other business support service activities n.e.c.	74901 70229 82990
3	Climate change strategy & monitoring	Including public, private and NGO sector strategy and policy, outreach to citizens, environmental monitoring and use of planning system to achieve net zero.		
4	Green finance	The concentration of financial activity in Central London means that, in our context, Green Finance could be a key area to identify separately.	(1) Management consulting activities other than financial (2) Other business support service activities n.e.c. (1) Financial intermediation n.e.c.	70229 82990 64999
5	Green and blue infrastructure	Within a London context this will focus on urban green infrastructure, and include activity aimed at increasing biodiversity directly or through offsetting.	(2) Other business support service activities n.e.c. (3) Landscape service activities (4) Environmental consulting activities	82990 81300 74901
6	Homes and buildings	Including retrofit, building new energy-efficient homes, heat pumps, smart devices and controls, heat networks and hydrogen boilers.	(1) Plumbing, heat and air-conditioning installation (2) Other business support service activities n.e.c. (3) Electrical installation	43220 82990 43210
7	Industrial decarbonization, hydrogen and CCUS	Including hydrogen production and industrial use, carbon capture, utilisation & storage (CCUS) and industrial decarbonisation.	(1) Engineering related scientific and technical consulting (2) Other business support service activities n.e.c. (3) Management consultancy activities other than financial	71122 82990 70229
8	Low carbon transport	Including low or zero emission vehicles, aviation and maritime, rail, public transport and walking or cycling.	(1) Electrical installation (2) Retail sales via mail order houses or via internet	43210 47910 82990

			(3) Other business support service activities n.e.c.	
N.	**Green economy sectors**	**Definition**	(1) **Corresponding industries**	**Top SIC codes 5-digits**
9	Power	Including renewables (such as wind, solar and hydropower), nuclear power, grid infrastructure, energy storage and smart systems technology.	(2) Production of electricity (3) Other business support service activities n.e.c. (4) Management consultancy activities other than financial	35110 82990 70229
10	Reduce, re-use and recycle	Including waste management and circular economy.	(1) Collection of non-hazardous waste (2) Recovery of sorted materials (3) Treatment and disposal of non-hazardous waste	38110 38320 38210
11	Reducing localized pollution	Including air pollution, water pollution and noise; London has ambitious goals across all three of these areas.	(1) Environmental consulting activities (2) Other professional, scientific and technical activities n.e.c. (3) Engineering related scientific and technical consulting	74901 82990 71122

Source: Edgar et al. (2021).

For the green jobs analysis, the WPI report combines the 11 sectors in Table 1 into 4 main areas: (1) Power, (2) Home, building and landscape, (3) Reduce, reuse, recycle and (4) Consultancy and finance. Within each area, they identify the top occupations, that is the occupations which account for the largest proportion of employment within each sector. The aggregation in 4 areas and the relevant occupations are reported in Table 2 so the definition of green jobs is a cross section of information from industries and occupations. Table 2 presents details of the top occupations within the four areas, while Table 3 shows the same occupations, following a hierarchical structure. This is our benchmark list of green jobs to conduct our analysis.

Table 2. Four areas for the 11 green industry groups and related occupations

Collapsed areas	Largest occupations (socs 2010)
Power	3539 (Business and related associate professionals n.e.c.), 2136 (Programmers and software development professionals), 2135 (IT Business analysts, architects and systems designers), 1132 (Marketing and sales directors plans, organize and direct market research and formulate and implement an organization's marketing and sales policies), 7220 (Customer service managers and supervisors).
Homes, building and landscape (including green and blue infrastructure and low carbon infrastructure)	5241 (Electricians and electrical fitters), 5113 (Gardeners and landscape gardeners), 5314 (Plumbers and heating and ventilating engineers), 1122 (Production managers and directors in construction), 5319 (Construction and building trades n.e.c.), 5231(Vehicle technicians, mechanics and electricians).
Reduce, reuse, recycle	5241 (Electricians and electrical fitters), 9236 (Vehicle valeters and cleaners), 1259 (Managers and proprietors in other services n.e.c.), 5223 (Metal working production and maintenance fitters).
Consultancy and finance (all others)	2423, 3543 (Marketing associate professionals), 3545 (Sales accounts and business development managers), 2424 (Business and financial project management professionals), 3539 (Business and related associate professionals n.e.c.).

Source: Edgar et al. 2021.

The analysis of green skills focuses on Higher Education and includes degrees in six subject areas: Biological Science, Agricultural Science, Engineering, Physics/Environmental Science, Technology, Architecture. These are all included in the STEM (Science, Technology, Engineering, Mathematics) classification. Higher level skills are crucial to achieve the Net Zero transition as they contribute to the development of new green technologies and to the adoption of technologies developed elsewhere (see section 3.1 and 3.4).

Table 3. List of green job (occupations). Hierarchical structure. Adopted from Edgar et al. (2021) top occupations within each green sector.

Areas	Description/occupation	SOC 4 dig
Home, building and landscape	Production managers & directors in construction	1122
Power	Marketing & sales directors	1132
Reduce, reuse, recycle	Managers & proprietors in other services	1259
Power	IT business analysts, architects & systems designers	2135
Power	Programmers & software developer professions	2136
Consultancy and finance	Management consultants & business analysists	2423
Consultancy and finance	Business and financial project management professionals	2424
Consultancy and finance	Business and related associate professionals n.e.c.	3539
Consultancy and finance	Marketing associate professionals	3543
Consultancy and finance	Sales accounts and business development managers	3545
Home, building and landscape	Gardeners and landscape gardeners	5113
Reduce, reuse, recycle	Metal working production and maintenance fitters	5223
Home, building and landscape	Vehicle technicians, mechanics and electricians	5231
Home, building and landscape	Electricians and electrical fitters	5241
Home, building and landscape	Plumbers and heating and ventilating engineers	5314
Home, building and landscape	Construction and building trades n.e.c.	5319
Power	Customer service managers and supervisors	7220
Reduce, reuse, recycle	Vehicle valeters and cleaners	9236

Source: Edgar et al. 2021.

3. Analysis

3.1 Introduction

The main part of our analysis is based on the Annual Population Survey (APS), which provides the largest coverage of any household surveys and allows the generation of statistics for small geographical areas, covering a sample of approximately 320,000 respondents in the UK overall. APS uses data combined from 2 waves of the main Labour Force Survey (LFS), collected on a local sample boost. Since the pandemic, the representativeness of the LFS has been affected by a decline in response rate, which makes figures post-2020 unreliable, particularly when considering the number of people employed within different occupations. These figures have also been affected by the update of the Standard Occupation Classification (SOC) in 2020, which presented miscoding issues. This makes results for 2021 and 2022 inconsistent with those of previous years, and they have not been included in the report.

Our study is conducted following the diagram presented in Figure 2. The first part of the analysis aims at providing evidence on green jobs. These are defined in terms of occupation (e.g., a job as an architect is a green job, while an LGV driver is not) and industries (e.g., a job in the environmental consulting industry is a green job, while a job in the oil extraction industry is not). Note that we do *not* develop a new methodology or definition of green jobs but, instead, aim to provide evidence based on existing definitions. As mentioned before, our main reference for the identification of green jobs and green skills is the WPI report, as discussed in the methodology section.

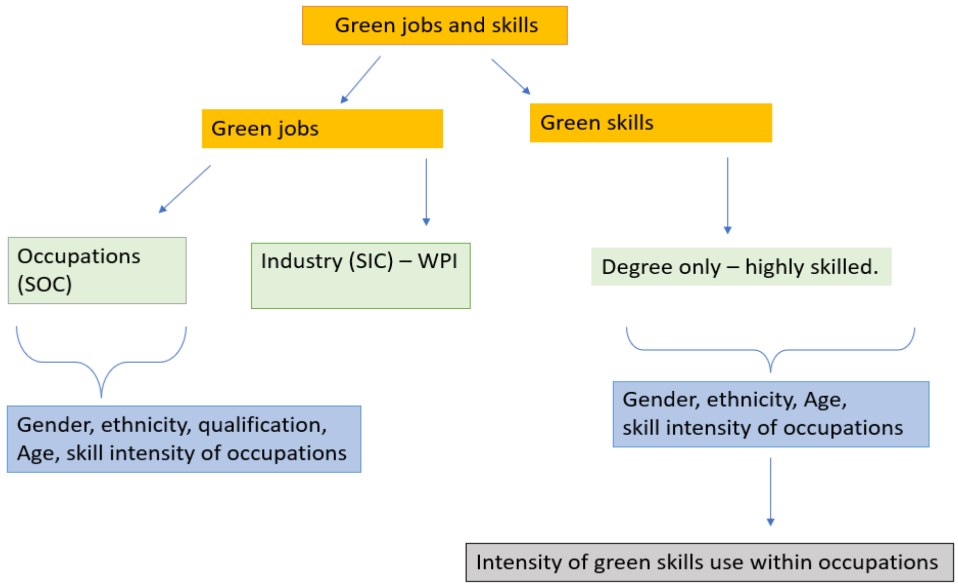
The second part of the analysis focuses on green skills at the higher education level – graduates and postgraduates. Focusing on high-level skills is important as they play a vital role in the net zero transition by boosting innovation and adaptation of green technologies. We consider six-degree subjects that represent 'core' green skills: Biological science, Agricultural science, Engineering, Physics/Environmental science, Technology, Architecture. Notably, these are all included in the STEM (Science, Technology, Engineering, Mathematics) classification. Other degree subjects may contain 'green elements' and contribute to the Net Zero transition. For example, the World Economic Forum[2] mentions the importance of legal skills to promote the understanding of environmental laws, regulations and policies to ensure compliance and to advocate for green initiatives. Hence, law degrees can also contribute to the stock of green skills. In the current analysis we focus on the six core subjects, hence our estimates are likely to be conservative. The content of university degree programs changes over time, and a correct evaluation of green skills needs to be regularly updated.

In a changing economic environment, it is important to ensure that the costs of the transition do not fall on the most disadvantaged communities and that the benefits of the Green Economy are shared by all. It is therefore important to understand how green jobs and green skills are distributed according to different characteristics of workers (gender, ethnic background, age) and whether the returns of investments in green skills are equally shared. Part of our analysis will address this issue and evaluate whether the Net Zero transition is also a Just Transition.

Having a good supply of green skills is important but, to fuel and eventually achieve the Net Zero transition, it is perhaps even more relevant that these skills are used in the right job. For instance, an engineer working in the financial sector is likely to contribute less to the green economy compared to an engineer working in the electricity industry, unless he/she is employed in green finance. However, although green finance is a fast-growing sector, both in the UK and in developing countries there are doubts on its effectiveness in reducing carbon emissions and contributing to the growth of green technologies. In the final part of our work, we focus on the distribution of green skills across green jobs, to understand whether these skills are correctly allocated within the economy. We developed a new indicator (Green-fit indicator) that provides a summary view of the green skills allocations.

[2] These are the skills young people will need for the green jobs of the future.

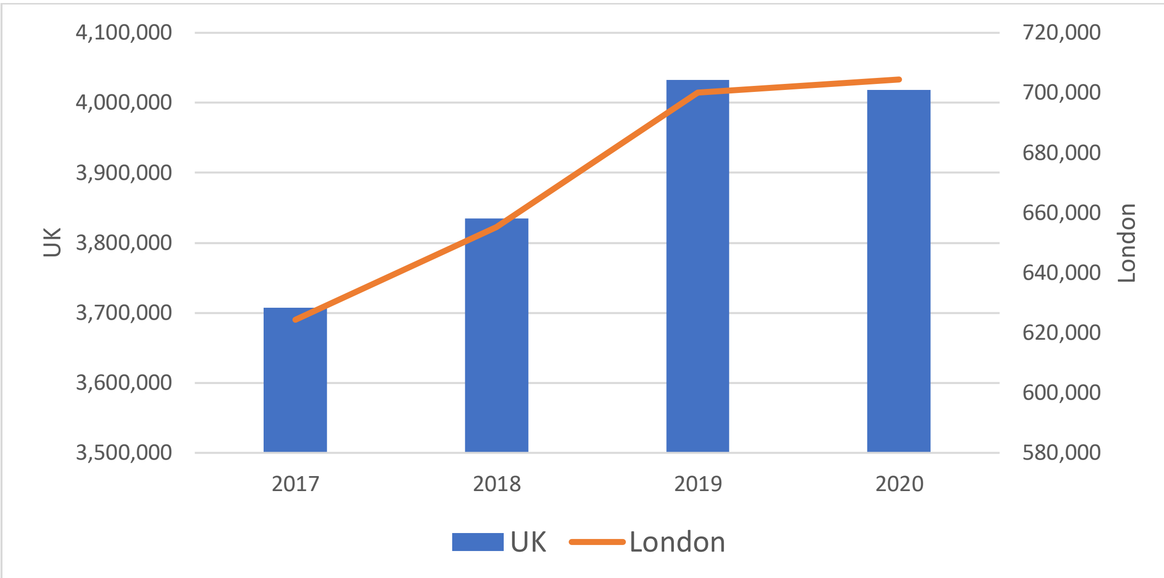
Figure 1. Mapping the analysis of green jobs and green skills.



3.2. Analysis of green jobs – occupation classification

Following Edgar et al. (2021) classification of green jobs (see Table 2), in 2020 there were 4,018,276 green jobs in the UK, and 704,443 in Greater London (see Figure 2). Over the 2017-2020 period, the growth in number of green jobs in London has been on average 4.02% per year, higher than the growth in the rest of the UK at approx. 2.69% per year. The increase in the number of green jobs slows down in 2020, due to the pandemic, something that we can observe both in the UK and in the London figures. Post-2020, the data reveals that the number of green jobs decreases by 10.74% between 2020 and 2021 and 3.11% between 2021 and 2022 nationally. In London, the decrease is by 1.83% between 2020 and 2021 and 7.85% between 2021 and 2022. As discussed on page 9, these figures are not consistent with previous years, as difficulties in data collection since the pandemic and issues related to changes in the classification of occupations in 2020, make the data unreliable, particularly when looking at the number of people employed within occupations. Hence, these results are not included in the report.

Figure 2. Number of green jobs in London and in the UK (Occupation based), 2017-2020



Data Source: APS, weighted estimates.

Columns 3 and 4 in Table 5 present the distribution of green jobs among the different occupations used to derive the overall estimates for the year 2020. In terms of occupation characteristics, green jobs tend to be concentrated in three areas, namely 'programmers and software development' (UK: 10.43%, London: 14.24%), 'sales accounts and business development' (UK: 11.52%, London: 12.93%) and 'business and financial project managers' (UK: 8.09%, London: 10.53%). In London, we observe a higher concentration of managerial-type jobs compared to the rest of the country, and a lower proportion of more technical jobs, such as electrician and electrical fitters (UK: 5.86%, London: 3.52%) and plumbers and heating (UK: 3.71, London: 1.68). This may have implications in terms of wages and living standards of those working in green jobs, with managerial jobs typically demanding higher wages. It can also exacerbate the documented regional wage inequalities in the country (see also here and here).

Table 5. Distribution of green jobs across different occupations (%) and average rate of growth

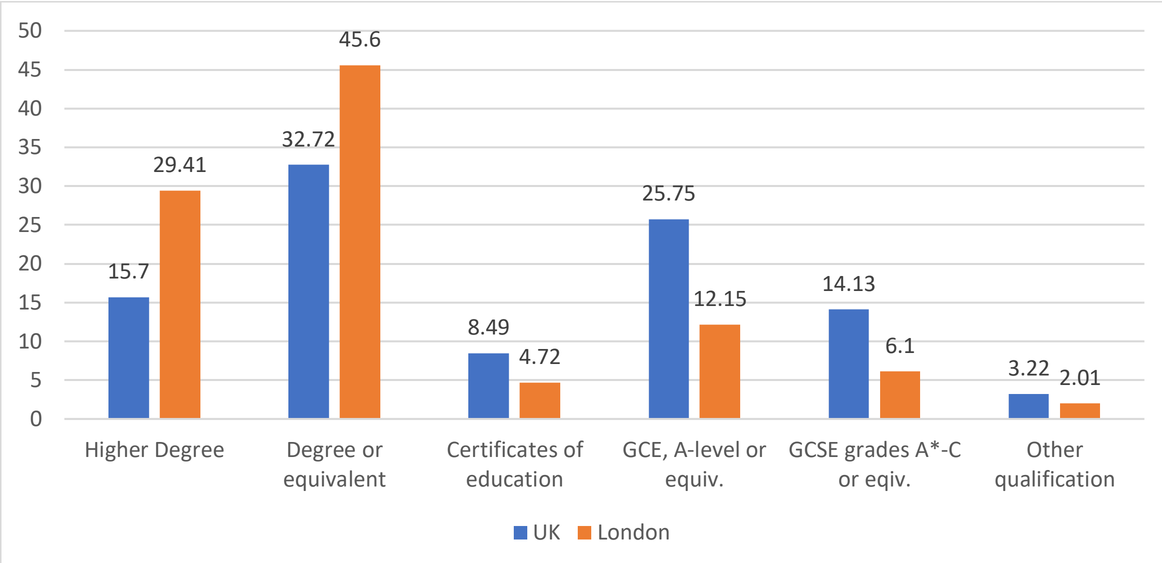
soc	Description	Distribution of jobs (2020) (%)		Average rate of growth 2017-2020	
		UK	London	UK	London
1122	Production managers & directors in construction	4.65	2.89	-1.79%	-5.27%
1132	Marketing & sales directors	6.05	8.43	0.69%	2.40%
1259	Managers & proprietors in other services	5.85	7.11	5.29%	9.58%
2135	IT business analysts, architects & systems designers	3.77	5.06	6.01%	12.33%
2136	Programmers & software developers professions	10.43	14.24	10.94%	13.99%
2423	Management consultants & business analysists	4.66	6.9	0.85%	-6.14%
2424	Business and financial project management professionals	8.09	10.53	11.08%	8.23%
3539	Business and related associate professionals n.e.c.	5.61	7.06	8.93%	14.95%
3543	Marketing associate professionals	6.04	7.85	6.12%	5.70%
3545	Sales accounts and business development managers	11.52	12.93	1.27%	4.31%
5113	Gardeners and landscape gardeners	3.92	1.61	-0.26%	-5.55%
5223	Metal working production and maintenance fitters	5.35	1.62	-1.53%	2.97%
5231	Vehicle technicians, mechanics and electricians	4.07	NA	-1.74%	NA
5241	Electricians and electrical fitters	5.86	3.52	-0.87%	3.58%
5314	Plumbers and heating and ventilating engineers	3.71	1.68	-7.18%	-16.99%
5319	Construction and building trades n.e.c.	5.1	4.16	-6.59%	-11.68%
7220	Customer service managers and supervisors	4.77	3.13	8.53%	-0.24%
9236	Vehicle valeters and cleaners	0.56	NA	-5.64%	NA

Data Source: APS, weighted estimates.

The last two columns of Table 5 report the average rate of growth of each green job over the period from 2017 to 2020. We observe a significant slowdown in the growth of the number of workers employed in sector 5314 (Plumbers and heating and ventilating engineers) and sector 5319 (Construction and building trades n.e.c.), both in the UK and in London. The construction and building sector is the second largest CO2 emitter, contributing 20.4% to total emissions in the UK in 2022 (the largest emitter is domestic transport, accounting for 27.9% of total emissions). The slow job growth in this sector identifies an area where further training and job incentives can support the Net Zero transition.

When considering the level of education of those employed in green jobs, we find that the higher concentration of 'top jobs' in London is linked to the higher proportion of workers qualified at the graduate and post-graduate level in the capital, as shown in Figure 3. Across the UK, green jobs are concentrated among those with a degree qualification (32.72%) and with GCE/A-Level (25.75%), while in London they are concentrated among those with degrees (45.6%) and higher degrees (29.41%). In other words, in London, green jobs are more *degree-intensive* than in the rest of the country.

Figure 3. Distribution of green jobs across different qualifications (%), London and UK (2020).



Data source: APS, weighted estimates

Another complementary approach to analysing skill requirements in green jobs is to consider the *skill content* of occupations. The ONS has established a classification that allocates all occupations to one of four skill groups, identified not only by workers' qualification but also by the length of time deemed necessary for a person to become fully competent in performing the tasks associated with a job. We present this classification in Table 6.

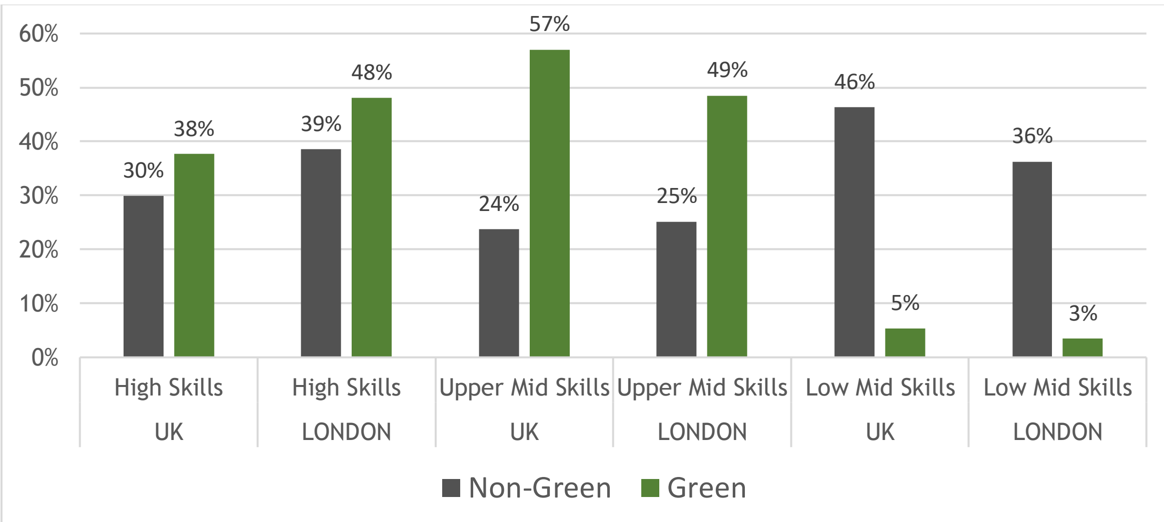
Table 6. Occupations Skills Taxonomy

	Description	Examples
Low skills	Competence associated with general education is usually acquired during compulsory education.	Postal workers, hotel porters, cleaners, catering assistants.
Lower middle	Require knowledge provided via a good general education, plus a longer period of work-related training or work experience.	Machine operation, driving, caring occupations, retailing, clerical and secretarial occupations.
Upper middle	Occupations that normally require a body of knowledge associated with a period of post-compulsory education but not normally to a degree level.	Trades occupations and proprietors of small businesses.
High skills	Occupations requiring a degree or equivalent period of relevant work experience.	High-level managerial positions in corporate enterprises or national/local government.

Source: ONS (2010)

For our analysis, we use this classification to map Green and Non-Green jobs into the different skill groups. For issues related to the number of observations, we merge the low and the lower middle skill groups. Results for the UK and London for the year 2020 (Figure 4), show that green jobs in London are more concentrated among workers with High and upper-mid skills, compared to the UK. This is consistent with the results reported in Figure 3.

Figure 4. Distribution of green jobs across skills groups (%), UK and London (2020).

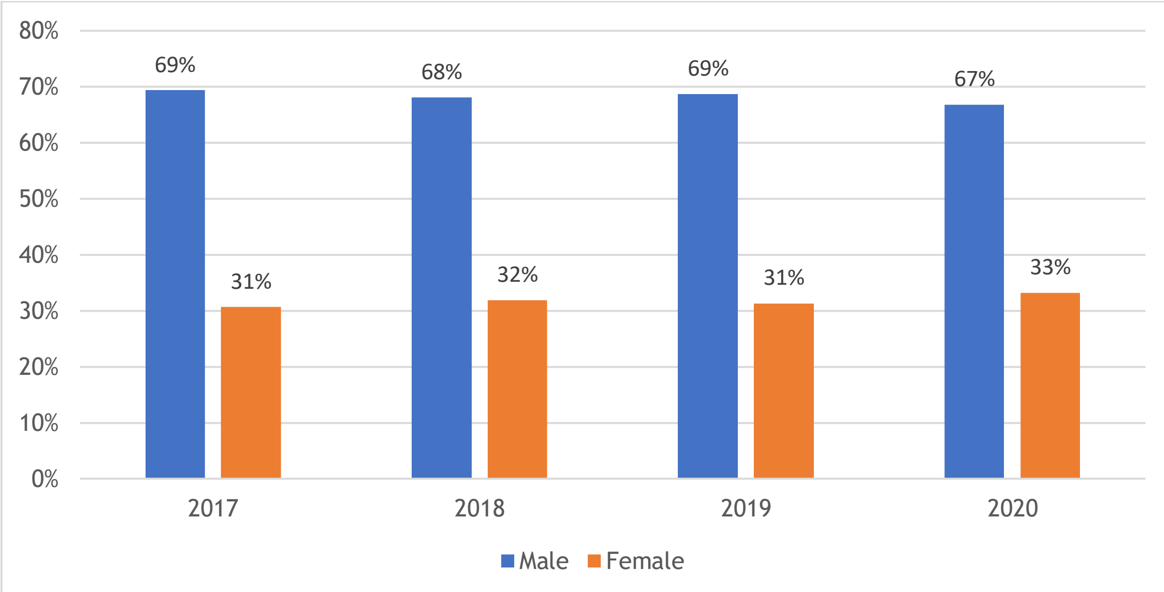


Data source: APS, weighted estimates.

Figure 4 reveals that out of all workers employed in green jobs in London, 48% are employed in high-skilled occupations, compared to 39% in non-green jobs. Similarly, 57% in upper mid skilled jobs in the UK are in upper mid skilled occupations, substantially higher than the 24% of non-green jobs in the same category. We also observe a lower representation of green jobs in lower skill groups: 3% in London and 5% in the UK overall. Finally, London shows a higher concentration of green jobs in the High Skills category than the UK (38% vs 30%).

Green jobs by gender. Figure 5 below presents the distribution of green jobs by gender in London. Green jobs are highly concentrated among male workers with approximately 70% of all workers in green jobs in London identifying as male. The proportion of women employed in green jobs has increased slightly from 31% in 2017 to 33% in 2020. However, the notable gap remains throughout the period of our analysis.

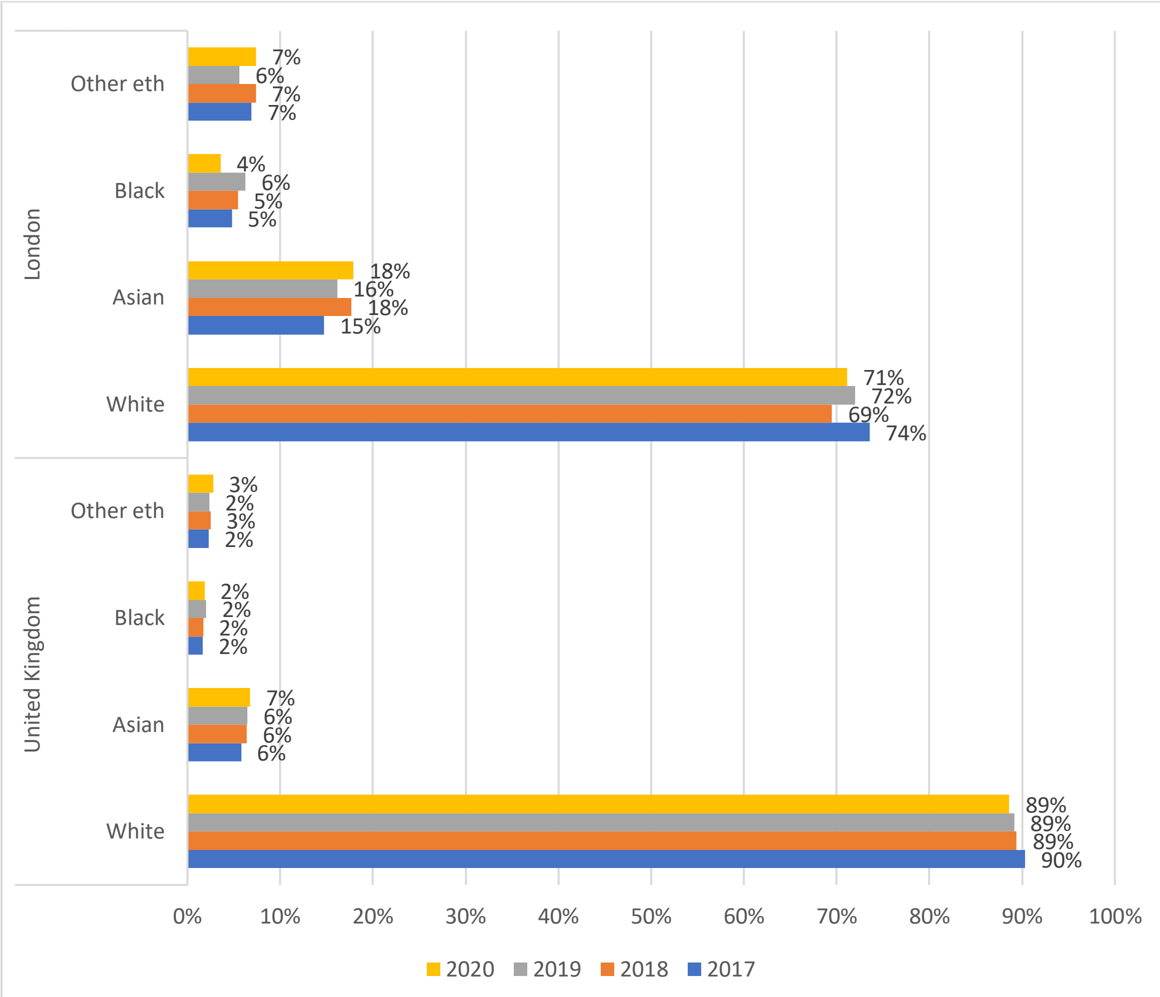
Figure 5. Proportion of green jobs in London (%), by gender, 2017-2020.



Data source: APS, weighted estimates.

Green jobs by ethnicity. The distribution of green jobs across different ethnic groups reveals that most green jobs are concentrated among white workers (London:71%. UK: 89%), followed by Asian (London: 18%. UK: 7%), and black workers (London: 4%. UK: 2%). Overall, in London, we observe a higher proportion of workers employed in green jobs from different ethnic background compared to the rest of the UK. This is expected as London is the most ethnically diverse region in the UK (see also here**).** As green jobs generally have a higher skill content and attract higher wages, the gender and ethnicity figures suggest that, to achieve a Just Transition, efforts should be directed to increase the representation of women and workers from non-white backgrounds in the green sector.

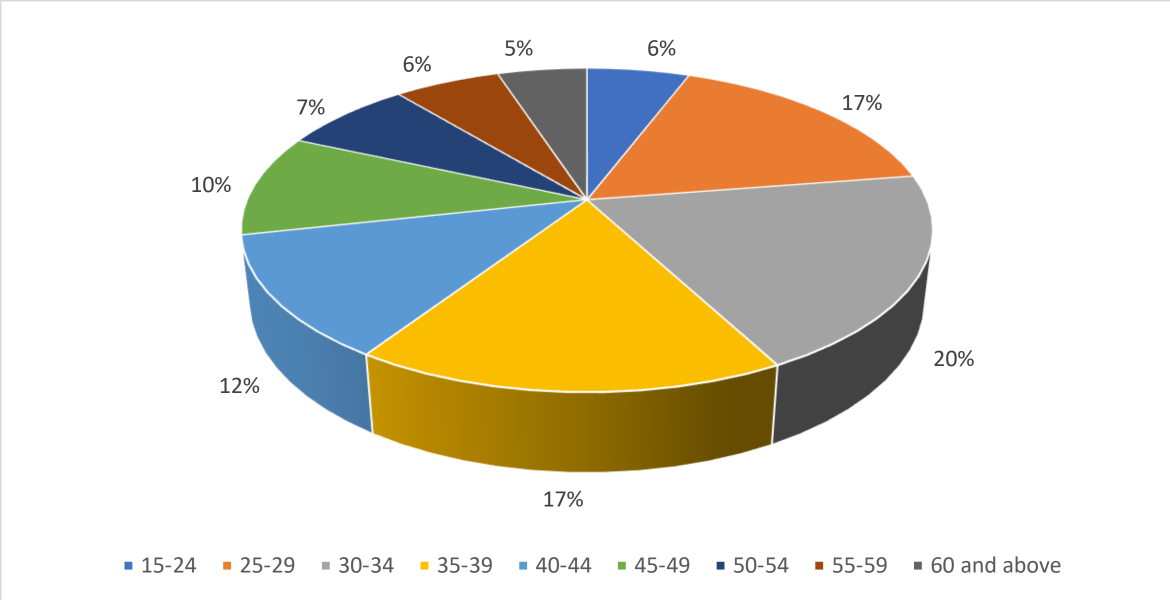
Figure 6. Distribution of green jobs over different ethnical background, 2017-2020.



Data source: APS, weighted estimates.

Green jobs by age. Next, we focus on how green jobs are distributed over different age groups. Figure 7 presents the distribution of the year 2019. This distribution does not vary substantially over time, so the figure below is understood as a good representation of the average trends. The data shows that green jobs are concentrated among prime working age workers, that is, those aged 25-29 (17%), 30-34 (20%), 35-39 (17%), and 40-44 (12%). In other words, the youngest and more mature workers are less intensively represented in green jobs.

Figure 7. Distribution of green jobs among different age groups, London, 2020.



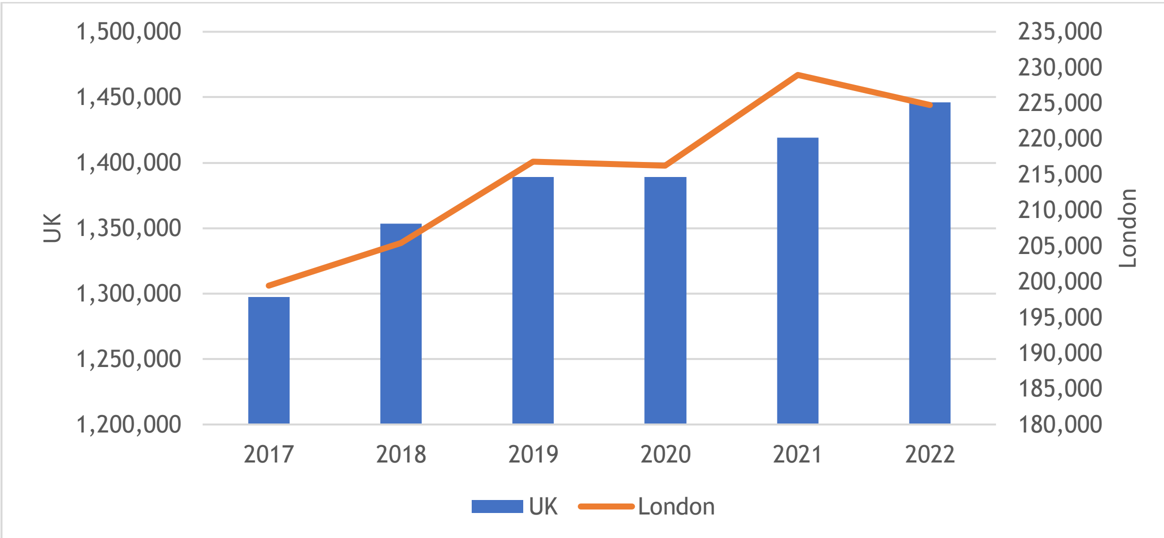
Data source: APS, weighted estimates.

3.3. Analysis of green jobs: industry definition

The analysis of green jobs usually refers to the number of those employed in green occupations, as previously described in Section 4. However, for comparison purposes, we also provide estimates of green jobs based on the industry definition. Therefore, the analysis in this section addresses how many people are employed in green industries, regardless of their specific roles within those industries. Our analysis provides estimates for London and the UK (see Figure 8). Different from the occupation classification, the industry classification has not been modified in the year 2020 and issues of data representativeness do not particularly affect our results post-pandemic. Hence, Figure 8 extends the analysis to the year 2022. In 2022 there were 224,748 green jobs in London and 1,445,949 in the UK.

Figure 8 also shows that, after an initial flattening in the number of green jobs in 2020, we can observe an increase particularly when considering the whole of the UK. In London, there is a slowdown in the number of green jobs between 2021 and 2022, from 228,956 to 224,748.

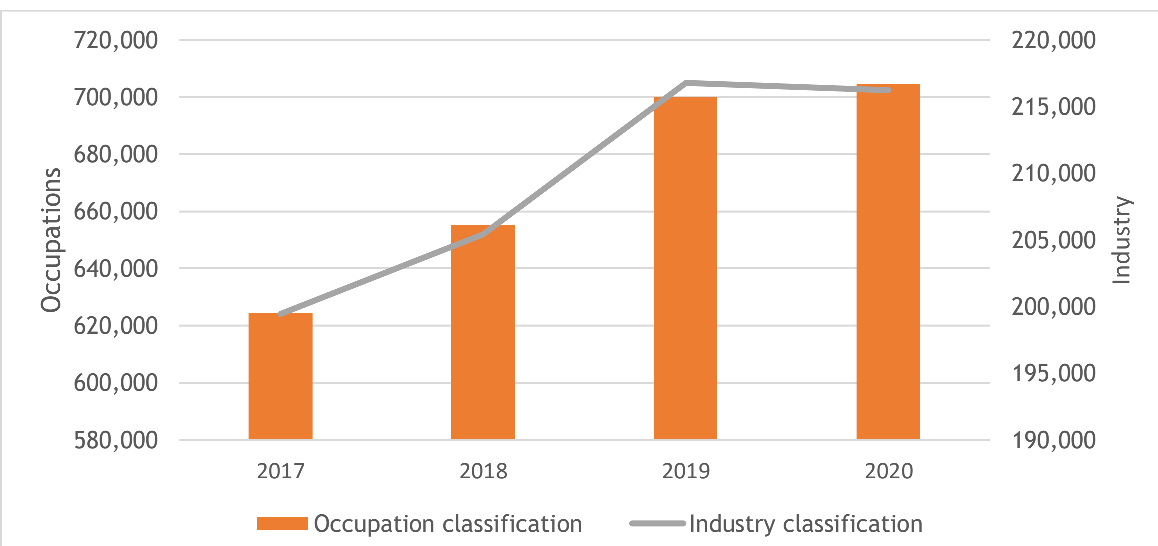
Figure 8. Employment in green industries in the UK and London (2017-2022).



Data source: APS, weighted estimates.

Up to the year 2020, we can compare the occupation and the industry classification. Figure 9 directly compares the number of green jobs using the industry and the occupation definition, for the London area. The occupation-based measure results in a larger number of green jobs, as green occupations can be found outside green sectors. However, the general trends are similar.

Figure 9: Comparison of green job across different classifications in London, 2017-2020.



Data source: APS, weighted estimates.

Defining green jobs in terms of occupations, rather than industries, is generally the preferred approach as occupations better capture the nature of the job. Hence, green jobs estimated in Section 3.2 are our benchmark figures as they are methodologically consistent with other studies. Occupations can also be linked to specific tasks performed on the job, hence deriving a more detailed description of what is meant by a green job[3].

3.4. Analysis of green skills

Green skills can be defined as the knowledge, abilities, values and attitudes needed to live in, develop and support a society which reduces the impact of human activity on the environment. Green skills encompass human capital and cognitive abilities required for the green transitions and Net Zero target by 2050. This importance of the analysis is further stressed through recent calls to urgently address the lack of skilfulness of workers in green industries and occupations. That is, to deal with green skills shortages in the UK market.

Whereas vocational training and on-the-job education are emerging as a driving force for contributing to the necessary human capital in the labour market for green skills, the net zero transition also requires innovations and investments in Research and Development (R&D) to boost green innovations and to promote the adoption and diffusion of technologies developed elsewhere, i.e. to promote absorptive capacity. Consequently, having the right high-level skills is important to face the changing structure of the labour market and to facilitate the move to a more sustainable system.

Our analysis of green skills thus focuses on higher education as key contributor of skills and includes university graduates and postgraduates. These are the most highly skilled people in the workforce, and their input can be crucial in addressing the challenges related to the net-zero transition.

Following the WPI report, we base our estimates of green skills on workers with university degrees in the following six subjects:

1. Biological Sciences
2. Agricultural Sciences
3. Physical/Environmental Sciences
4. Engineering
5. Technology
6. Architecture.

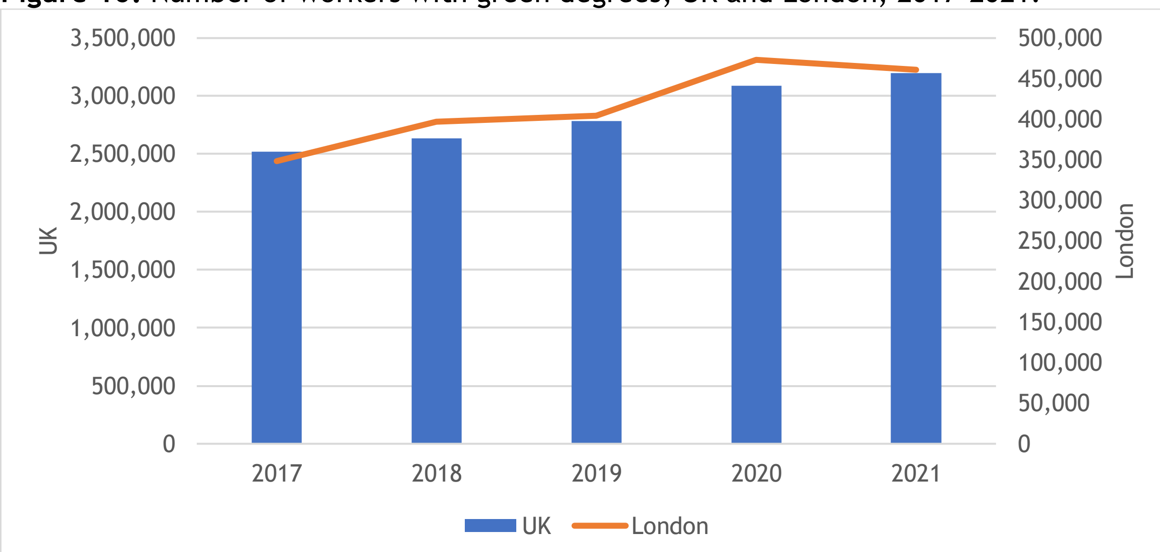
These are all part of STEM (Science, Technology, Engineering, Mathematics) subjects and we can refer to this classification as core green skills. Most of the analysis is based on the APS, hence we looked at stocks of workers with green skills. In the last part of the analysis, we

[3] For example, the analysis by Broome et al. (2021) identifies green jobs using the US O*NET classification of green tasks and green skills, mapped onto UK occupations. Using their classification of green jobs produces estimates that are very similar to the classification used in this report – see Appendix Figure A.1.

also refer to information on the flow of new graduates entering the labour market each year, using information from the [Higher Education Statistics Agency (HESA)](). Note that the stock of workers includes those who graduated at any point in time, together with new graduates entering the market every year. Hence, comparing stock with flows will provide further insights on the supply of green skills and their allocation in green sectors.

The stock of workers with green skills qualifications at the higher education level (graduates and postgraduates) is characterized by an increasing trend over the 2017-2020 period, both in London and in the UK – see Figure 10. In the year 2020, 4.7% of workers in the UK had a qualification in green subjects, against 5.22% in the London area, indicating a higher employment of green skills in London compared to the UK overall.

Figure 10. Number of workers with green degrees, UK and London, 2017-2021.



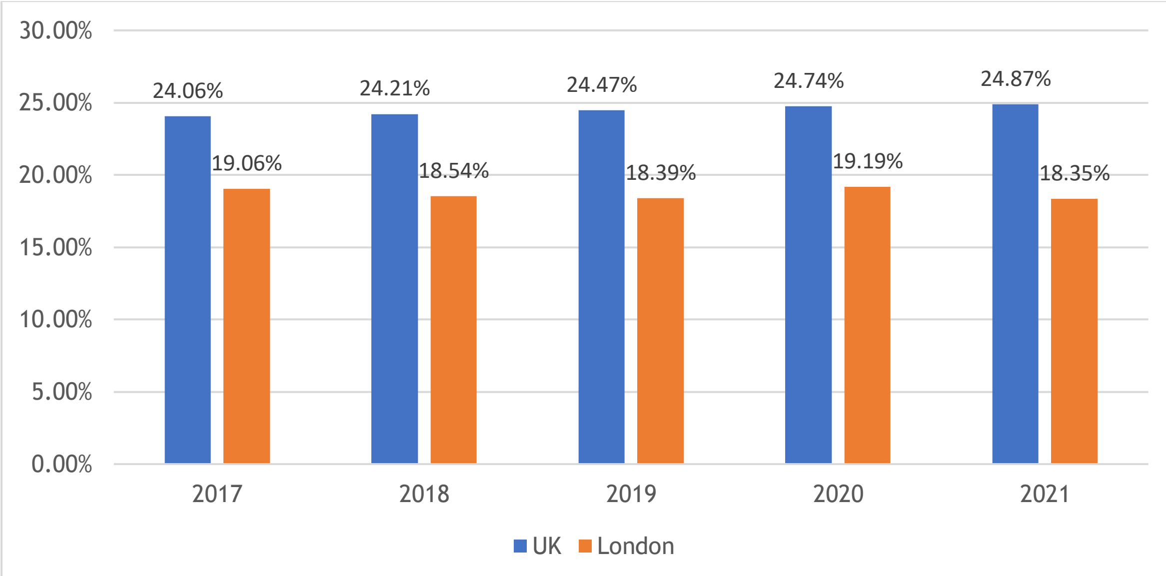
Data source: APS, weighted estimates.

Between 2020 and 2021, however, there is a decline in the number of workers with green skills in London and slower a growth in the UK. This matches the trend in green jobs, described in section 3.2, and it is mostly related to the disruptive effect of the Covid-19 pandemic on the labour market. Overall, in 2021 we estimate the number of workers with green skills at 460,834 in London and over 3 million in the UK[4].

The labour market in London is characterized by a lower proportion of workers with green skills compared to the UK overall throughout the whole period (Figure 11).

[4] Figure for the year 2022 are not presented because inconsistent with previous years. For example, nationally the number of workers with green degrees decline from 3,198,641 in 2021 to 200,466 in 2022.

Figure 11. Workers with green degree subjects, as a proportion of all degrees (%).



Data source: APS, weighted estimates.

Table 5 shows the yearly rate of growth of green skills, and we observe a particularly large increase between 2019-2020, when the number of workers with green skills in London grew at 15.68 % (10.33% in the UK). In 2021, after the pandemic, the growth declines, becoming negative in the London area (-2.65%). The growth in the rest of the country declines from 10.33% between 2019-2020, to 3.49% soon after Covid-19. Next to data issues, discussed above, this decline may also be due to structural changes in the labour market during the pandemic, when entire industries shut down and workers needed to relocate to different occupations; it could also be caused by the documented increase in the number of employees voluntarily leaving their job, a phenomenon referred to as the *great resignation* (ONS 2022)[5].

[5] Since the pandemic, 565,000 more people have left their job and have become economic inactive. This has been mainly concentrated among those aged 50 years and over.

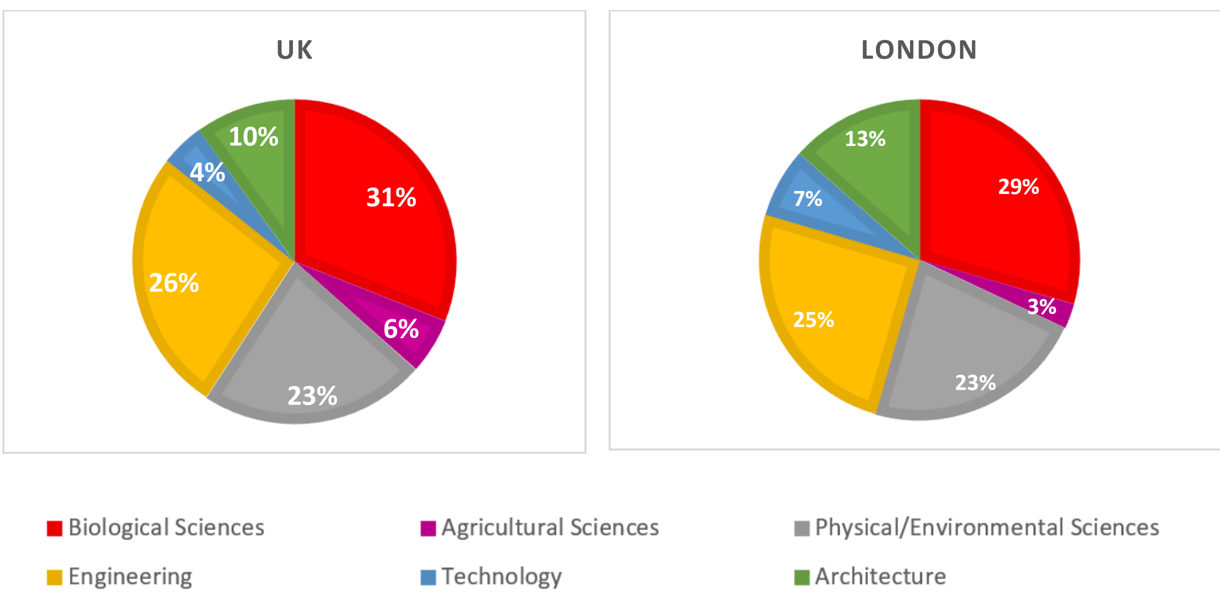
Table 5. Rate of growth (%) of green skills in London and in the UK, 2017 – 2021.

Year	Growth UK	Growth London
2017-2018	4.56	13.06
2018-2019	5.39	1.89
2019-2020	10.33	15.68
2020-2021	3.49	-2.65

*NB: annual logarithmic rate of growth, constructing as follows: growth rate of y = ($ln(y_t) - ln(y_{t-1})$) *100. Data source: APS, weighted estimates.*

Figure 12 shows how each of the six-degree subjects contribute to the overall stock of green skills. Both in the UK and in London, the availability of green skills is driven by biological sciences: among all workers with green skills, the majority hold a degree in biology (31% in the UK and 29% in London. The second most popular green degree is engineering (26% in the UK and 23% in London) followed by physical/environmental sciences (23% in both the UK and London). The distribution of green skills in London closely mirrors that of the UK.

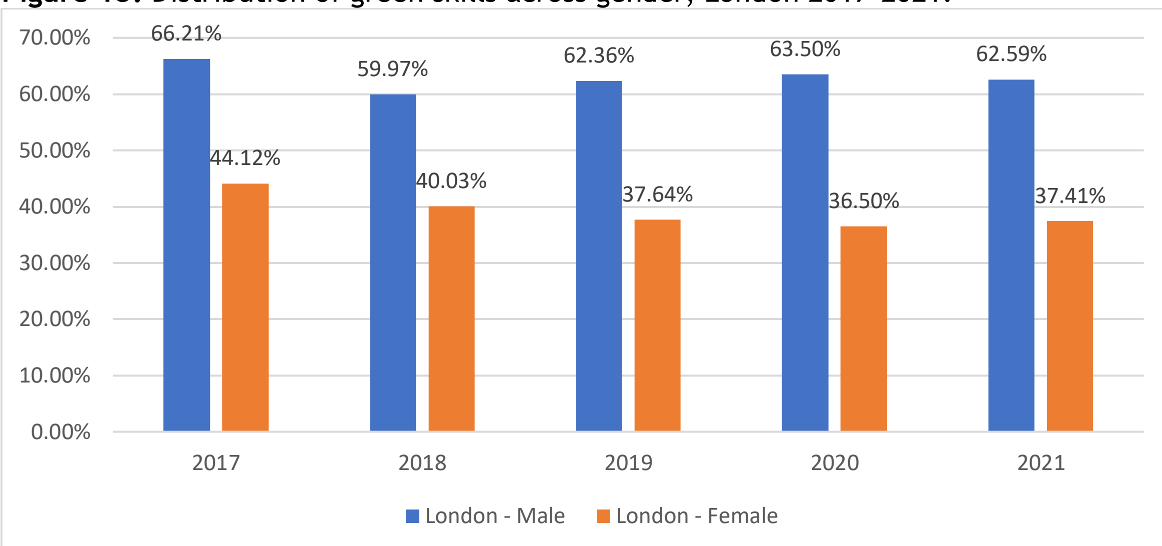
Figure 12. Distribution of graduates' green skills over the different degree subjects (2020).



Data source: APS, weighted estimates.

Green skills are not evenly distributed across male and female workers. Figure 13 illustrates that male workers in London are more likely to have a green skill qualification compared to female workers. In 2021, 62.59% of all workers with green degrees were male. The London figures closely align with those for the rest of the country, as indicated in Table 6.

Figure 13. Distribution of green skills across gender, London 2017-2021.



Data source: APS, weighted estimates.

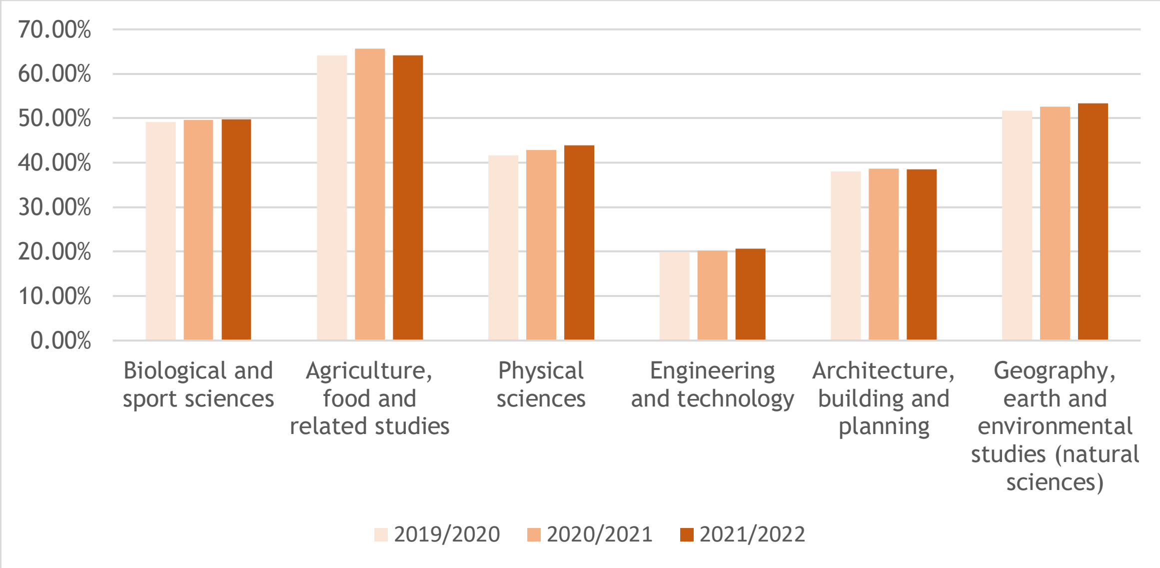
Table 6. Male-Female distribution of green skills: UK and London, 2017- 2021.

Year	UK - Male	London - Male	UK - Female	London - Female
2017	63.99%	66.21%	36.01%	44.12%
2018	64.02%	59.97%	35.98%	40.03%
2019	63.95%	62.36%	36.05%	37.64%
2020	63.01%	63.50%	36.99%	36.50%
2021	62.28%	62.59%	37.72%	37.41%

Data source: APS, weighted estimates.

These results are not surprising given that green degrees fall within STEM (Science, Technology, Engineering and Mathematics) fields where women are often underrepresented. Data from HESA, summarized in Figure 14, show that, except for agriculture and earth and environmental studies, female enrolment in green degrees is below 50%. The lowest enrolment occurs in engineering and technology (20.6% in 2021/2022), followed by architecture (38.5% in 2021/2022).

Figure 14. Percentage of women enrolled in Higher Education (by green degree subject).



Data source: HESA.

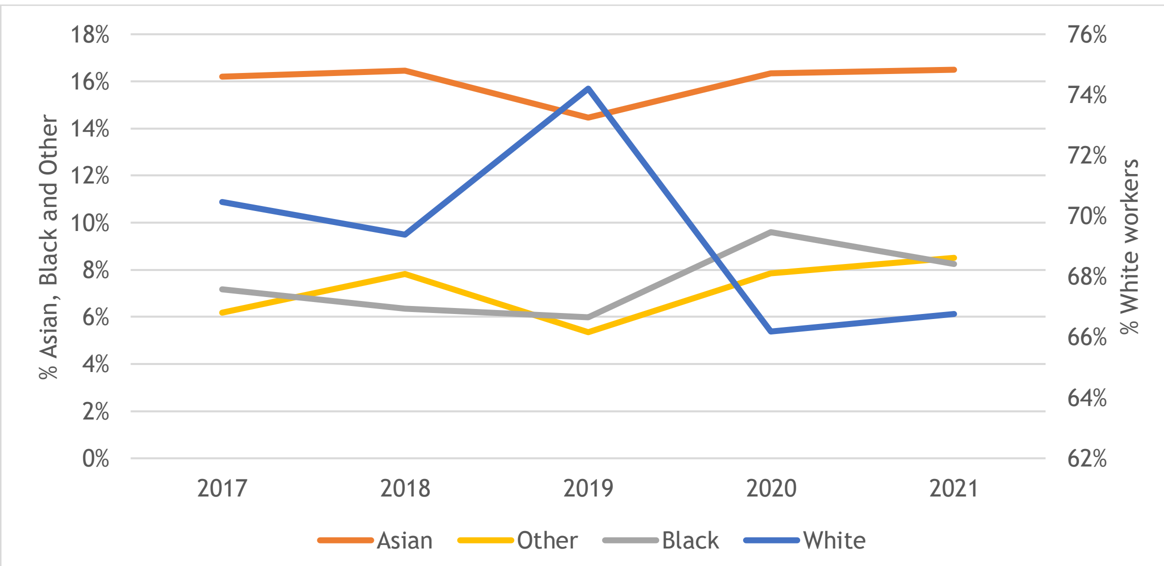
Improving recruitment, retention and training of STEM professionals has been a policy target for several years, due to the shortage of STEM skills in the UK. These skills are particularly important not only for the net zero transition but also to achieve economic growth and global competitiveness. The lower uptake by women has been a frequently discussed issue in the economic and sociology literature, and it is found not only at the higher education level but also earlier on in women's education journey, as fewer girls tend to study science at school. This suggests the need for policy interventions to attract more women to the study of STEM subjects at the different educational stages as this will promote a higher representation of women in green jobs and will help reduce gender gaps in both jobs and earnings.

3.5. Net-zero and just transition.

Climate change policies and carbon emission reduction can have different impacts on different groups of people. Workers in high carbon intensive industries such as utilities, construction, oil and gas production will be significantly under threat of losing their job and/or require significant retraining. Job displacements can result in groups of workers experiencing adjustment costs, such as earning losses, and these costs are exacerbated when the skills available do not match those required in new green occupations. If vulnerable groups in society are underrepresented in terms of green skills, they will bear the brunt of the costs during the net zero transition. As we transition towards a more sustainable economic system, policy interventions need to address possible inequalities and ensure that the benefits of the transition are shared equally within society. This implies understanding whether certain groups of people may be more affected by labour market changes taking place during the move to Net Zero.

As demonstrated previously, green jobs are highly concentrated among white workers (see Figure 15), with the highest proportion (74%) observed in 2019. Since then, the proportion of white workers with green skills has declined by 7 percentage points to 67% in 2021, but it still significantly larger compared to other ethnic groups, such as Asian and Black workers, who represent 16% and 8% respectively of all workers with green skills in London in 2021. Hence there is a lack of green skills among non-white workers, particularly among black workers.

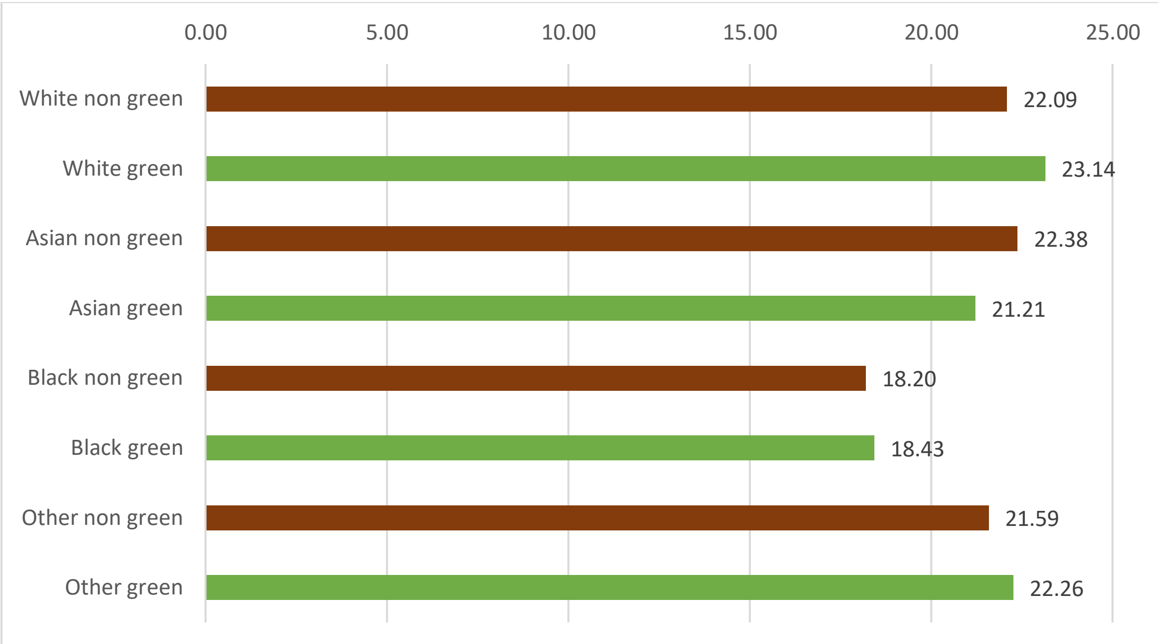
Figure 15. Distribution of workers with green skills across different ethnicities, London.



Data Source: APS, weighted estimates.

This uneven distribution of green skills has important implications for the welfare of different groups of people in society. In fact, returns to investments in green skills measured in terms of average hourly earnings tend to be higher compared to other degree subjects – see figure 16. In addition, there are differences across different ethnic groups. Figure 16 shows that, in 2021, white males with green skills enjoyed the highest average hourly earnings (£23.14), followed by returns to green skills among Asian workers (£21.21). The lowest returns to both green and non-green skills are among Black workers at £18.43 and £18.20 respectively. Hence, a white worker with a green degree earns approximately 26% more than a black worker with similar qualification.

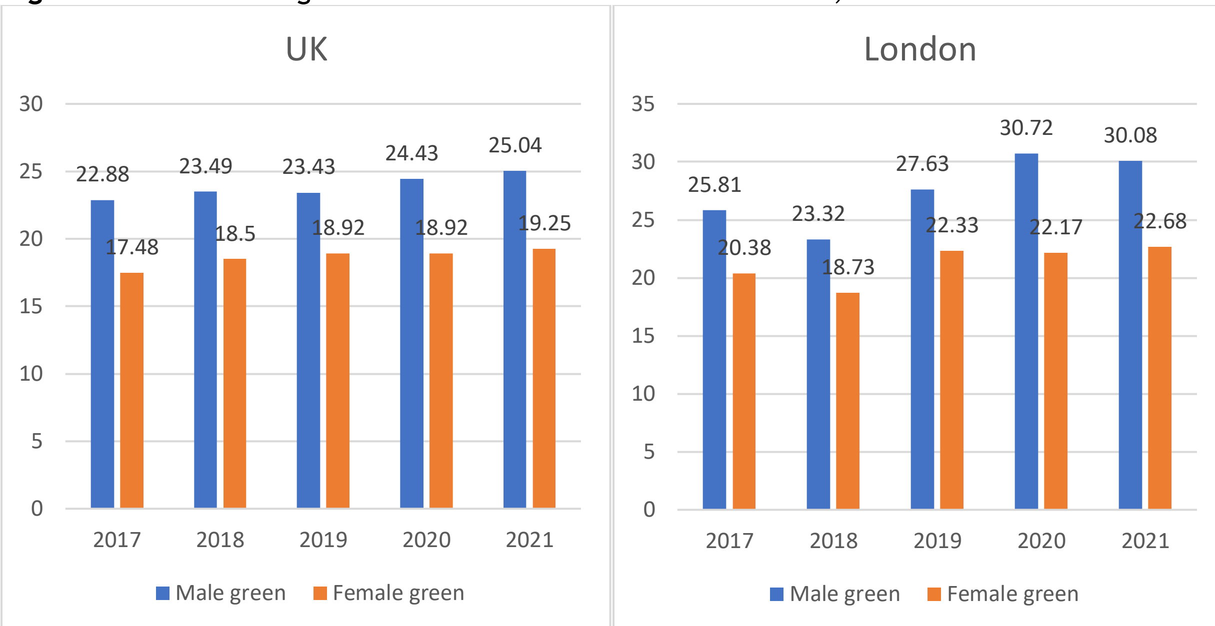
Figure 16. Returns to green and non-green skills by ethnic background, 2021.



Data Source: APS, weighted estimates.

We also find that among workers with similar skill levels, there is a gender pay gap related to green qualifications – see Figure 17. On average, male workers with green qualifications earn more per hour than their female counterparts, both in the UK and in London. This gap is both notable and substantial. In 2021, a male worker with a green qualification earned 32% more than a female worker with comparable skills in London. Overall, in the UK, the gender pay gap was approximately 30%, which is only 2% below than the London figures.

Figure 17. Returns to green skills for male and female workers, 2017-2021.



Data Source: APS, weighted estimates.

3.6. Green skills in green occupations: skills mismatch

Gathering evidence on the growth in green skills and green jobs is important; however, the two dimensions need to be brought together to understand whether green skills and green jobs '*match*', that is, whether workers with green skills are employed in green occupations. For example, if an engineer is employed in the finance sector, a person's specialized skills are not contributing to the Net-Zero transition, with the possible exception of green finance. Having the right skills in the country is important but, equally important, is their allocation to the right job.

In this part of our analysis, we map green skills to green occupation, following the list of green jobs presented in Table 3. The mapping for the year 2020 is presented in Table 7. This represents the overall stocks of green skills allocated to green jobs. Due to data constraints, this can only be estimated for the UK overall. To provide insights on the allocation of green skills to green jobs in London, in the next section, we extend our analysis using a large sample of graduates entering the labour market each year, from HESA.

Focusing on the stock of green skills, Table 7 shows that the largest proportion of graduates with green skills, working in green occupations, can be found in managerial and technical occupations such as Business and financial project management professionals (20% of graduates with green skills) and Management consultants business analysts (17 % of graduates with green skills). However, in all green jobs the largest representation is among workers who graduated in non-green subjects, suggesting that the greening of occupations via the employment of green skill at the higher education level still has a long way to go.

Table 7. Proportion of green and non-green skills across different green occupations, 2020.

SOC code	Occupation description	% Non-green skills	% Green skills
1122	Production managers & directors in construction	83%	17%
1132	Marketing & sales directors	88%	12%
1259	Managers & proprietors in other services	88%	12%
2135	IT business analysts, architects & systems designers	82%	18%
2136	Programmers & software developers professions	86%	14%
2423	Management consultants & business analysists	83%	17%
2424	Business and financial project management professionals	80%	20%
3539	Business and related associate professionals n.e.c.	86%	14%
3543	Marketing associate professionals	96%	4%
3545	Sales accounts and business development managers	92%	8%
5113	Gardeners and landscape gardeners	95%	5%
5223	Metal working production and maintenance fitters	93%	7%
5231	Vehicle technicians, mechanics and electricians	NA	NA
5241	Electricians and electrical fitters	94%	6%
5314	Plumbers and heating and ventilating engineers	NA	NA
5319	Construction and building trades n.e.c.	94%	6%
7220	Customer service managers and supervisors	91%	9%
9236	Vehicle valeters and cleaners	NA	NA

Data Source: APS, weighted estimates. The list of occupations is consistent with Edgar et al. (2021) as described in table 2.

For some occupations we do not have available data due to the different skill requirements of green jobs. In fact, some of the green occupations include jobs that do not typically require a university degree, such as vehicle valeters[6] (soc 9236) and plumbers (soc 5314). In these occupations there are not enough observations as very few graduates will cover these roles. For other occupations, such as gardeners (soc 5113) and electricians (soc 5241), we find a small proportion of graduates at the country level. Different types of education, such as FE colleges, which provide specific skills, are more likely to meet the demands of these sectors.

[6] While traditional car valeting can have an environmental impact due to the use of chemicals and water, vehicle valeting can be considered a "green" job when eco-friendly practices are adopted. This includes using biodegradable cleaning products, minimizing water usage, and responsibly disposing of waste.

To better understand the match between the demand and supply of green skills, we construct a green-skills mismatch indicator, green fit-index, based on information from Table 7, weighted by the share of each degree over the total number of degrees in the country:

$$Green\ fit\ index_{ij} = \frac{Share\ of\ green\ degrees\ among\ all\ degree\ fields\ in\ a\ given\ green\ occupation}{Share\ of\ green\ degrees\ among\ all\ degrees}$$

The indicator is based on the skill mismatch analysis in Vecchi et al. (2023), adapted to the green economy. The value of the indicator reveals where green degrees are intensively, and we generally refer to three main values or range of values:

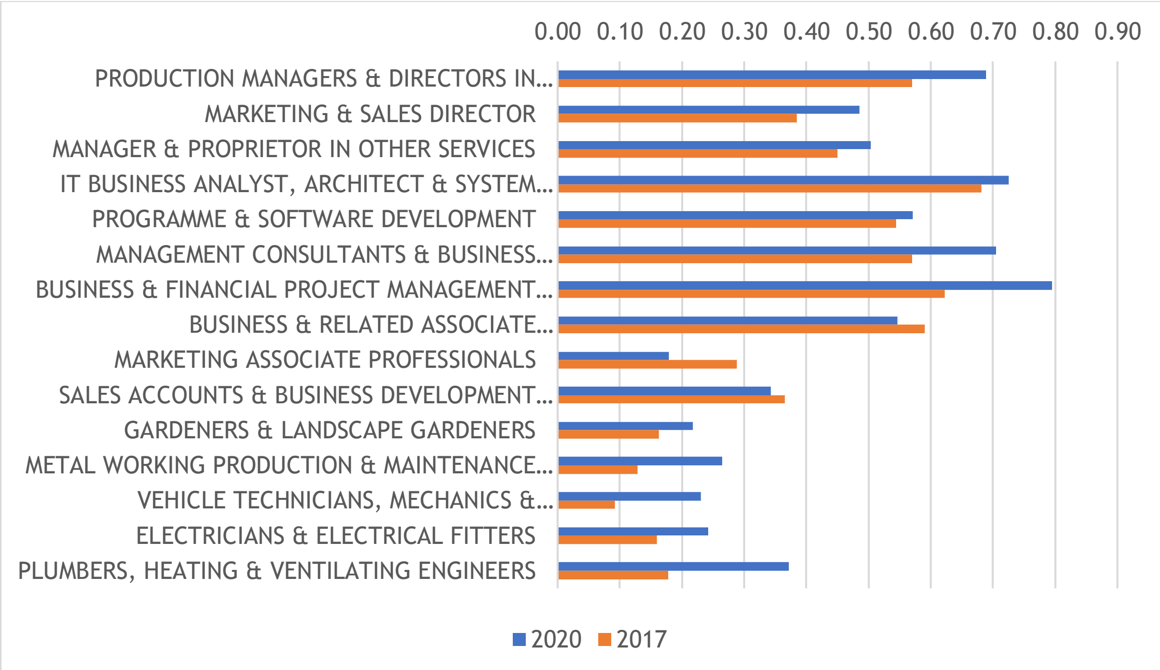
Green fit index = 1: this is the benchmark, and it indicates the same distribution of green degrees in green jobs and in the economy overall.

Green fit index >1: this indicates that there is a higher proportion of green degrees in green jobs, compared to the overall proportion of green degrees in the economy. This is also interpreted as a good match between supply and demand for green skills.

Green fit index <1: this indicates that there is a lower proportion of green degrees in green jobs, given the overall supply of green degrees in the country. This identifies a shortage of green skills or a mismatch, between the supply and demand.

The values of the indicator are plotted in Figure 18. We compared the year 2017, the first year in our sample, with the year 2020 to evaluate changes of the indicator over time. Two notable features stand out; first, there is a large variation of the index across the different occupations, with higher values corresponding to highly skilled managerial and high-skilled occupations. Given that our analysis focuses on graduates, this outcome is expected as these are primarily graduate jobs. Second, the index is below the benchmark value of 1 in all sectors, suggesting the presence of a misallocation of green skills. However, some improvements can be observed over time. In fact, except for 3 occupations (Business and related associate professions; Marketing associates and professionals; Sales accounts and business development managers), values of the indicators in 2020 are higher than in 2017, suggesting better matching of green skills in green occupations over time.

Figure 18. Green- Fit index, 2020 and 2017, UK.

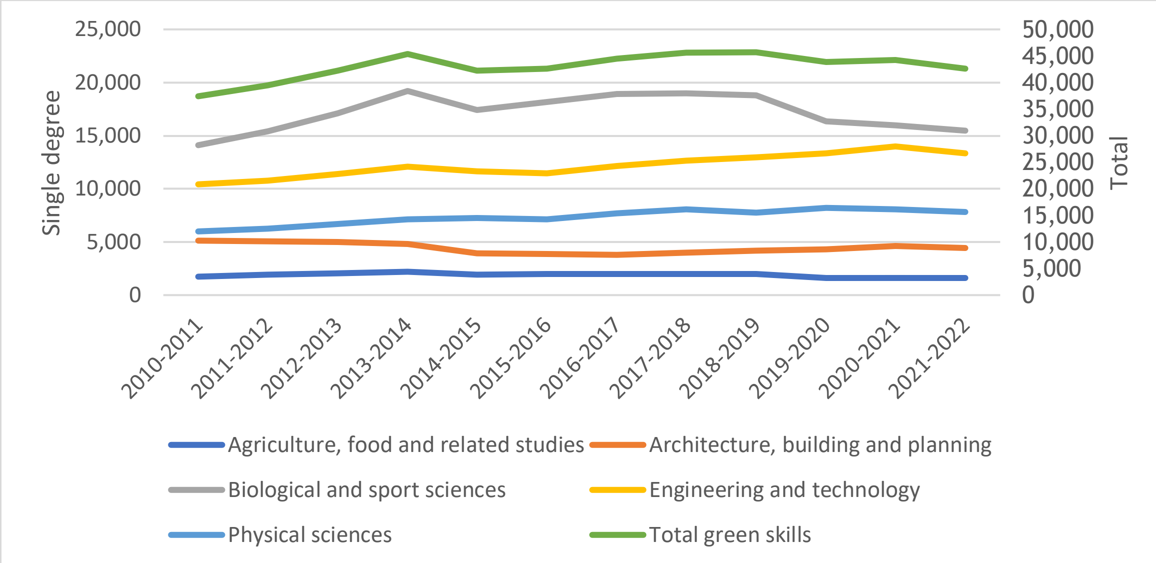


Data source: APS. Weighted estimates.

Overall, the analysis indicates the presence of a misallocation of high-level green skills in the UK. Understanding the reason for this misallocation is complex. One possible explanation is the distribution of wages across green and non-green occupations. Competition for STEM talents has increased in recent years and top scientists may move away from green jobs if better-paying opportunities arise elsewhere, such as in the finance sector. An increase in the supply of green skills could address this problem as it will help to realign wages across different sectors. For example, an increasing supply of workers with green skills going into finance will tend to reduce wages in that sector, leading to a realignment across the economy.

However, the supply of green skills has remained quite stationary in recent years. In fact, information on new graduates completing their degrees, extracted from the HESA website, and reported in Figure 19, shows that there has been an overall decline in the supply of green skills since the academic year 2018-2019. The decline in green skills is primarily due to fewer students graduating in biological sciences. As shown in Figure 8, although this subject attracted a higher proportion of students between 2010 and 2022 (on average 6.77%), that proportion has decreased in recent years. In contrast, other green degrees have seen modest increases over time. Only engineering and technology degrees show a slight increase since 2013-2014. Overall, there hasn't been substantial growth in the supply of green skills at the graduate level).

Figure 19. Graduates in green subjects, 2010 – 2022.



Data source: HESA.

Table 8. Graduates in green subjects (proportion of the total number of graduates), 2010 – 2022.

Academic year	Agriculture	Architecture	Biology	Engineering and Technology	Physical sciences
2010-2011	0.80%	2.30%	6.30%	4.60%	2.70%
2011-2012	0.80%	2.10%	6.50%	4.50%	2.60%
2012-2013	0.80%	2.00%	6.90%	4.60%	2.70%
2013-2014	0.80%	1.80%	7.30%	4.60%	2.70%
2014-2015	0.80%	1.60%	7.20%	4.80%	3.00%
2015-2016	0.80%	1.60%	7.40%	4.60%	2.90%
2016-2017	0.80%	1.50%	7.30%	4.70%	3.00%
2017-2018	0.80%	1.50%	7.20%	4.80%	3.10%
2018-2019	0.80%	1.60%	7.10%	4.90%	2.90%
2019-2020	0.60%	1.60%	6.20%	5.10%	3.10%
2020-2021	0.60%	1.70%	5.90%	5.20%	3.00%
2021-2022	0.60%	1.70%	5.90%	5.10%	3.00%
Average	0.75%	1.75%	6.77%	4.79%	2.89%

*Note: annual logarithmic rate of growth, constructing as follows: growth rate of y = ($ln(y_t)$ - $ln(y_{t-1})$)*100. Data source: HESA.*

3.7. Graduates in employment: evidence from HESA data

In this section, we replicate the construction of the mismatch indicator using data on new graduates entering employment each year. The dataset, provided by JISC Data Analytics and extracted from HESA, contains information on graduate outcomes 15 months after graduation. This enables us to capture the flow of new entrants into the labour market and assess how the supply of green skills at the graduate level is evolving over time. Compared to the APS data used in the previous section, this dataset offers a large number of observations and allows us to construct the mismatch indicator for both London and the UK as a whole. Additionally, the data is more granular which requires aggregating degree subjects to align with the classification used previously (see Appendix table A.1 for details).

3.8 Where are the new graduates finding employment?

Knowing where graduates with green skills are finding jobs matters for two key reasons: it helps us understand how well the workforce is supporting the UK's transition to net zero, and it shows whether graduates are entering meaningful, future-ready careers. This kind of insight can guide policies that connect education and training with real labour market needs, ensuring that investment in green skills leads to both environmental and economic benefits.

Table 9 shows the average proportion of new graduates with green skills over the total number of graduates (with green and non-green skills) who found work in green jobs between 2017 and 2022. More detailed year-by-year data is available in Appendix Tables A.3 and A.4, but since the figures do not change substantially over time, the average gives a reliable picture of how green skills are distributed across different types of jobs.

The results reveal clear differences across occupations. Disregarding the composite group (shown in the last row of table 9), the three most popular green jobs for graduates with green skills are:

1. Production managers and directors in construction, where in London 30% of all graduates working in this role has a green degree. The corresponding national figure is 24%.
2. IT business analysts, architect and system designers (29% in London and 31% nationally)
3. Programmers and software development professionals (23% in London and 26% nationally).

These are professional jobs that typically require a degree hence they attract a large number of graduates.[7] This implies that a substantial proportion of these graduates have a green degree. Other graduate jobs that also employ an important, albeit lower proportion of graduates with green skills are *management consultants and business analysts* (16% nationally and in London*), business and financial project management professionals* (15% nationally, 11% in London) and *business, research and administrative professionals* (11% nationally, 9% in London).

[7] Referring back to table 6, these jobs are in the high skilled and upper middle skilled groups.

Table 9. Graduates with green skills (percentage of all graduates) in full time employment in the UK and in London. Average (2017/2018 – 2021/2022).

SOC code	Occupation description	% Green skills UK	% Green skills London
1122	Production managers and directors in construction	24%	30%
1132	Marketing, sales and advertising directors	6%	5%
1259	Managers and proprietors in other services n.e.c.	7%	6%
2133	IT business analysts, architects and systems designers	31%	29%
2134	Programmers and software development professionals	26%	23%
2431	Management consultants and business analysts	16%	16%
2439	Business, research and administrative professionals n.e.c.	11%	9%
2440	Business and financial project management professionals	14%	11%
3554	Advertising and marketing associate professionals	4%	4%
3556	Sales accounts and business development managers	10%	7%
Composite group (5133, 5223,5231,5241,5314,5219 7220,9236)	Typically, non-graduate jobs	42%	27%

Data source: HESA[8].

The composite group includes roles such as gardeners, vehicle technicians, electricians, and plumbers, which typically do not require a university degree, therefore we do not find many graduates here. This explains the large share of graduates with green skills employed in these jobs (45% nationally, 27% in London). While these roles are important for the green economy, they require lower-level qualifications, and they are not representative of the role that graduates with green skills play in the economy.

Compared to the UK stock of workers with green degree subjects, presented in Table 7, graduates entering the labour market after every year find increasing employment in occupations such as *Production managers and directors in construction* (24% vs 17%), *IT business analysts, architects and systems designers* (31% vs 18%), *Programmers and software development professionals* (26% vs 14%). This increasing representation of green skills in green jobs becomes more apparent when we compute the Green fit index for the flow of graduates. Following the methodology described in the previous section, we standardize the figures in Table 9 above by benchmarking them to the overall supply of green degrees as a

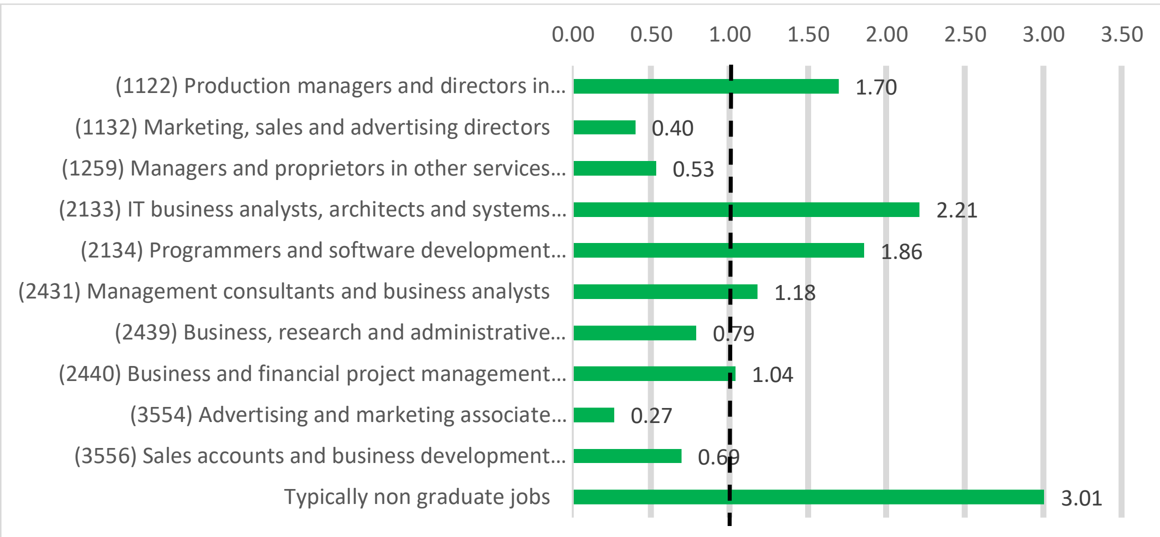
[8] The last occupational group includes SOC 5133 (Gardeners and landscape gardeners_ to SOC 9236 (Vehicle valeters and Cleaners). For each of these occupations there are not enough observations as these are typically non-graduate jobs. Some SOC codes differ from those in table 7 due to a revision of the occupation classification in 2020. A list of codes from the two classifications is provided in Table A.2

proportion of all degree subjects in the UK and in London. Figure 20 presents the results by averaging over the 5 years of data. Variations over time are presented in Appendix Figures A.2.

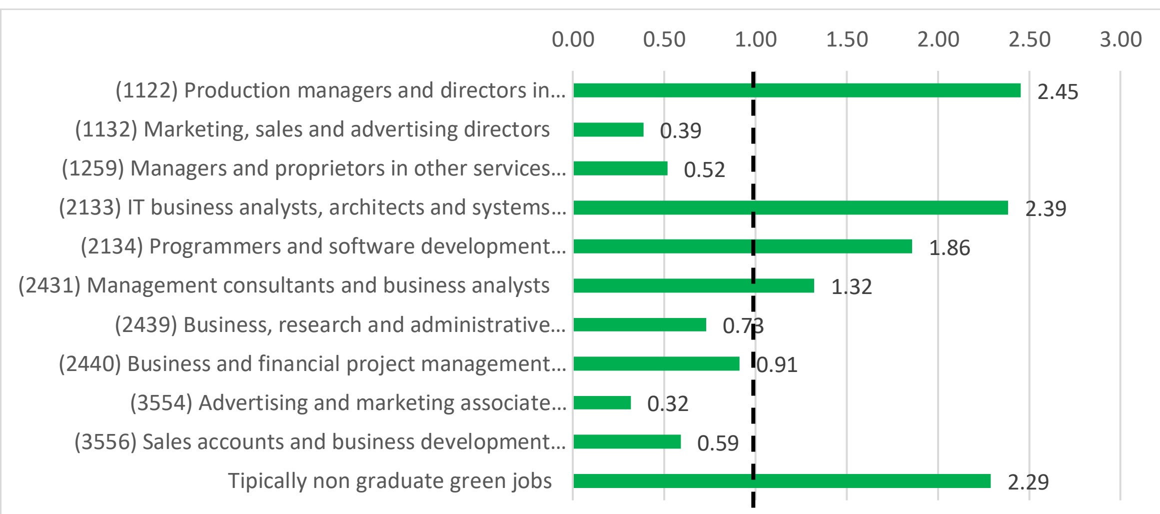
Figure 20. Green-Fit index for new graduates (occupation dimension).

Average 2017/2018 – 2021/2022

A. United Kingdom



London



Note: the benchmark value of 1 indicates that there the same distribution of green skills at the tertiary level in green jobs and in the economy overall. Values >1 indicate a higher proportion of green degrees in green jobs compared to the overall proportion of green degrees in the economy. This implies a good match between green skills supplied and demanded. Values <1 indicate a lower proportion of green degree in green jobs, given the overall proportion of green degrees in the economy. Data source: HESA.

Compared to Figure 18, which refers to the stock of workers with tertiary education in the UK, Figure 20 shows that the indicator is above the benchmark value of 1 in several occupations, for the flow of new graduates. This implies that the **market is gradually adjusting to the increasing demand for green skills**, and graduates in green subjects are increasingly finding employment in green occupations. The distribution in the UK is similar to London, although in the capital the indicator takes higher values in high skilled jobs, such as *production managers and directors in construction* and *IT, business analyst, architect and system designer*. This is consistent with our results in section 3.2 and confirm higher employment in high-skilled jobs in the capital. Occupations where the indicator is <1 indicate a shortage of green skills. This skill shortage is particularly evident in marketing and managerial positions (*marketing, sales and advertising directors, advertising and marketing associate directors*) in both the UK overall and in London.

Appendix Figure A.2 shows that the Green fit index varies over time. In some instances, values for the academic year 2021/2022 tend to be lower compared to previous years, indicating an increasing skill shortage. As discussed above, this is likely due to labour market disruption during the pandemic.

As a final extension of our work, we construct the Green fit index looking at the industry definition of green jobs to see in which industrial sectors graduates with green degrees are most likely to find employment. Results are presented in Figure 21, where for each industry we report the average values of the indicator over the 5 years of data. Appendix Figure A.3 reports variation of the indicator over time. For the UK overall we can present values of the indicator for all green industries. For London we merge the figures for three industries (*Treatment of disposal of non-hazardous waste, Recovery of sorted materials and Landscape service activities*) due to the low number of observations each of these sectors.

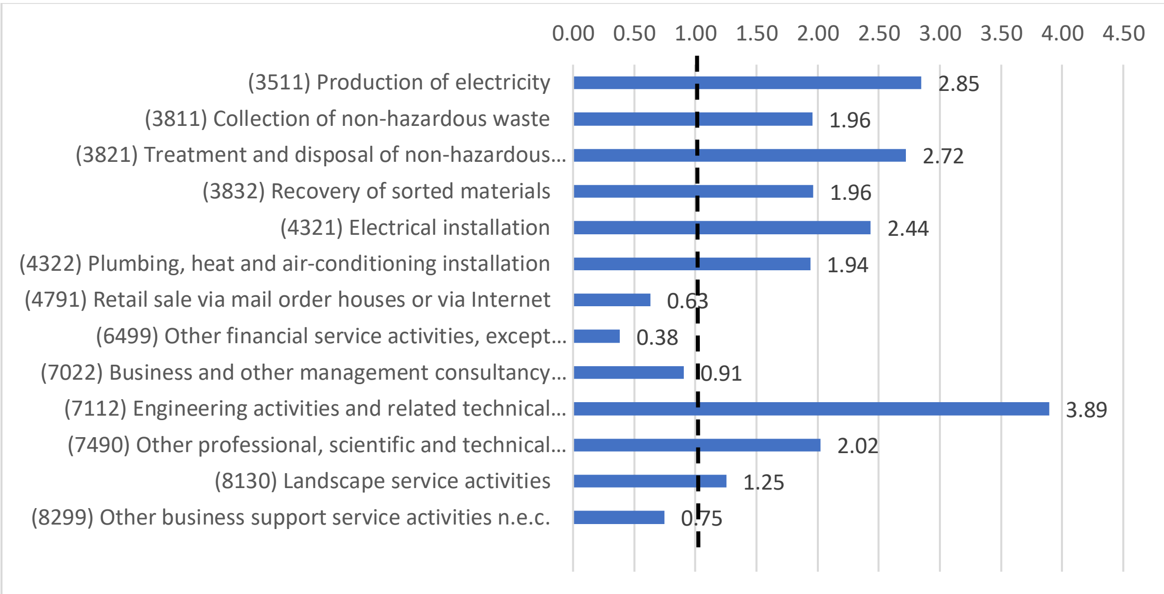
The Green fit indicator shows a strong alignment between green skills and job opportunities in several key industries. This is especially true in sectors like engineering (with a Green Fit Index of 3.89 for the UK and 4.21 in London), electricity production (2.85 in the UK and 2.11 in London), and electrical installation (2.44 in the UK and 3.06 in London). These figures suggest that graduates with green skills are finding relevant employment in areas where demand is high. This finding is consistent with international research based on job postings, which highlights the energy and utilities sectors as major hubs for green jobs. In both the UK and London, our analysis confirms that the supply of green skills is well matched with employers' demand in these sectors.

However, there are a few exceptions. In industries like retail sales and other financial services, the Green fit index falls well below the benchmark value of 1, indicating a weaker connection between green skills and job roles. This aligns with recent findings, which show that these sectors are lagging behind in creating green job opportunities. Our results further suggest that these industries are not yet making strong use of green skills in their workforce.

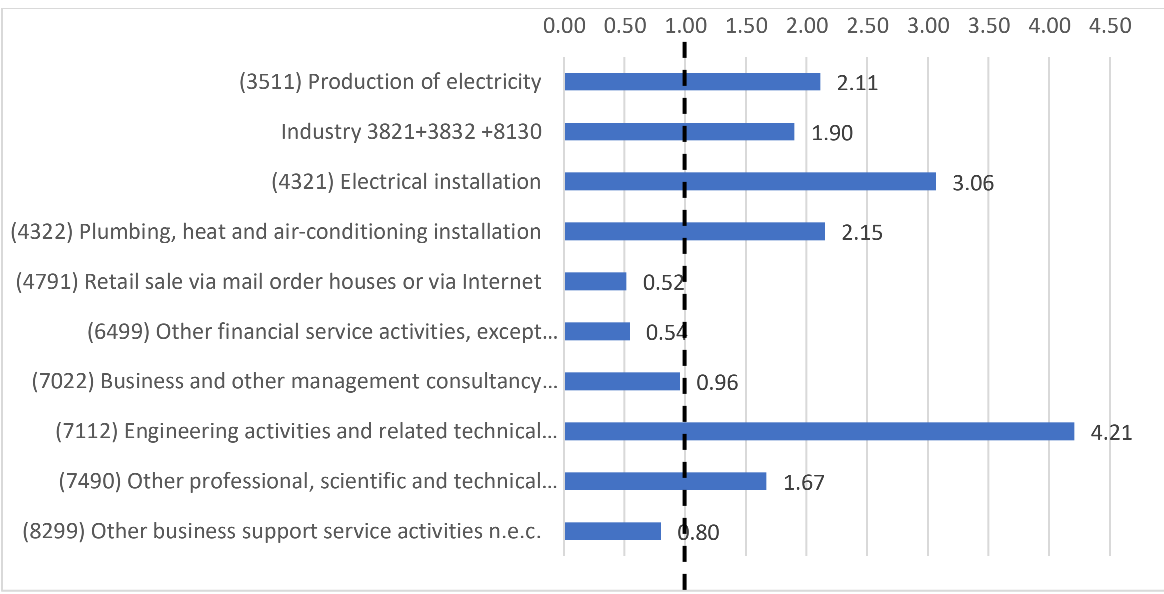
Figure 21. Green-Fit index for new graduate (industry dimension).

Average 2017/2018 – 2021/2022

A. UK



B. London



Data source: HESA.

When we compare the flow of recent graduates with green skills to the overall workforce holding green degrees (stock), we find that new graduates are more likely to be working in green jobs. This is not surprising, as awareness of environmental issues and demand for green skills have grown in recent years.

While our analysis is based entirely on data from the supply side of the labour market, we interpret sectors with a Green Fit Index above 1 as showing a good match between the supply of green skills and employer demand. This approach is widely used in research on skills mismatches. However, to gain a fuller picture, it would be valuable to include direct evidence of employer demand—such as data from job postings. More detailed information on graduate outcomes would also help identify where green skills are lacking for specific roles. This, in turn, could better inform education and training policies. To support this kind of analysis, statistical agencies and government departments should work together to improve access to high-quality data, especially when it relates to critical challenges like the transition to a net-zero economy.

4. Conclusions

As economies aim to draw down their carbon-intensive practices in an attempt to transition towards net zero, it is important to understand how the changes involved in the transition are affecting the labour market, particularly in relation to the growth of green jobs and green skills. Defining green jobs is a difficult task and different methodologies have been developed and employed in recent years. Our work has followed the identification of green jobs and green skills developed in the WPI report and has provided evidence for London and the UK.

When considering the characteristics of occupations in terms of skill requirements, our analysis shows that green jobs in London are predominantly highly skilled, often requiring a degree and/or several years of experience or specific training. This is consistent with information on the level of education of workers employed in green jobs who tend to be highly educated. In London, green jobs are more degree intensive compared to the average in the UK. Green jobs are not uniformly distributed across workers with different characteristics. A green worker is prevalently male and of white background, aged 25-44 years. As green jobs are generally better paid, women and workers from minority ethnic backgrounds are not fully enjoying the benefits of the net zero transition.

The analysis of green skills has focused on higher education and has identified six degree subjects as providing ‘core’ green skills. These fall within STEM and, consistent with existing evidence, they are most common among white male workers. Hence, similar to the distribution of green jobs, the distribution of green skills is uneven across different groups in society. This has significant implications for welfare, as investments in green skills tend to yield higher average hourly earnings compared to other degree subjects. In fact, earnings are generally higher for green skills than for non-green skills. However, when comparing individuals with similar qualifications, wage gaps remain as earnings are higher for men compared to women and for White workers compared to Asian, Black and other ethnical backgrounds.

The last part of the analysis has introduced a new methodology to measure whether green skills are intensively used in green jobs, that is, whether there is a good match between skills supplied and demanded. Our findings show that, although there are skill deficiencies in some jobs and industries, these are generally decreasing over time, suggesting that the labour market is changing and gradually adjusting to the demand for skills necessary for the Net Zero transition. While our focus here is on graduate skills, the methodology can also be applied to assess skill misallocations at various educational levels, including Further Education (FE) colleges, provided the data on the subjects studied are available. Additionally, this indicator can be expanded to analyse different types of skills, such as digital skills.

An increasing supply of green skills will further improve the match between skills demand and supply. When we consider the inflow of new graduates, we observe that the supply of green skills is either stationary or declining. This decline is mainly due to a decrease in the number of students graduating in biological sciences. Although this is the most popular green degree subject, the data show a declining growth in the supply of graduates with this particular skill.

4.1. Policy Recommendations

There is broad agreement that achieving a successful environmental transition will require significant and timely investment in green stimulus measures—those that support economic growth, job creation, and environmental sustainability. To ensure this transition is fair and inclusive, social policies must play an active role in Promoting Green Employment and Protecting Workers by:

- ***Providing support for green job creation***. This is especially important in sectors where growth has been slow, such as construction. This includes roles like plumbers, heating and ventilation engineers, and construction managers.
- ***Protecting workers in high-carbon ("brown") jobs***. Some sectors, such as coal and lignite mining, are expected to be phased out entirely, leading to sharp declines in labour demand.

Policies must also tackle existing inequalities in access to green jobs. Effective measures should:

- Increase the participation of women and ethnic minorities in green jobs;
- Encourage both younger workers (under 25) and older workers (over 44) to enter green jobs, as both groups are currently underrepresented;
- Support young people from disadvantaged backgrounds, who are more likely to pursue apprenticeships but still face barriers to entry.

Because green jobs tend to be higher-skilled and better paid, improving access for underrepresented groups can help reduce social and economic inequalities. Achieving this requires targeted investment in skills. This can be achieved by:

- Investing in education and training: this is one of the most effective ways to support both the economy and the net zero transition.
- Promoting STEM education, especially among women and minority groups. This should begin early in the education system—not just at university level—to help close wage gaps and support a just transition.

While some brown jobs require skills similar to those in green sectors, others—such as extraction work—do not. Workers in these roles may face greater challenges in finding new employment. In such cases, policy should:

- Provide retraining opportunities tailored to the needs of displaced workers;
- Ensure comparable working conditions in new roles.

This transition will take time and resources. Training a skilled net zero workforce is expected to take several years. Therefore, it is essential to:

- Complement training with social protections and career guidance, so that workers who lose their jobs during the transition can maintain financial security and successfully move into new roles.

In addition to national policies, regional development programmes are needed to support economic diversification across the UK. Our findings show that green jobs in London are more likely to require a university degree than in other parts of the country. This could widen regional income gaps, as higher-skilled green jobs tend to offer higher wages. To address this, policies should:

- Expand access to green skills training at the higher education level;
- Ensure green job opportunities are distributed more evenly across regions.

Besides our results, rural areas appear to face substantial environmental challenges including lack of grid connections, road and housing infrastructure, greater car dependency and ageing workforce causing skill shortage gaps due to higher proportions of retirees (see also here), which will require further interventions.

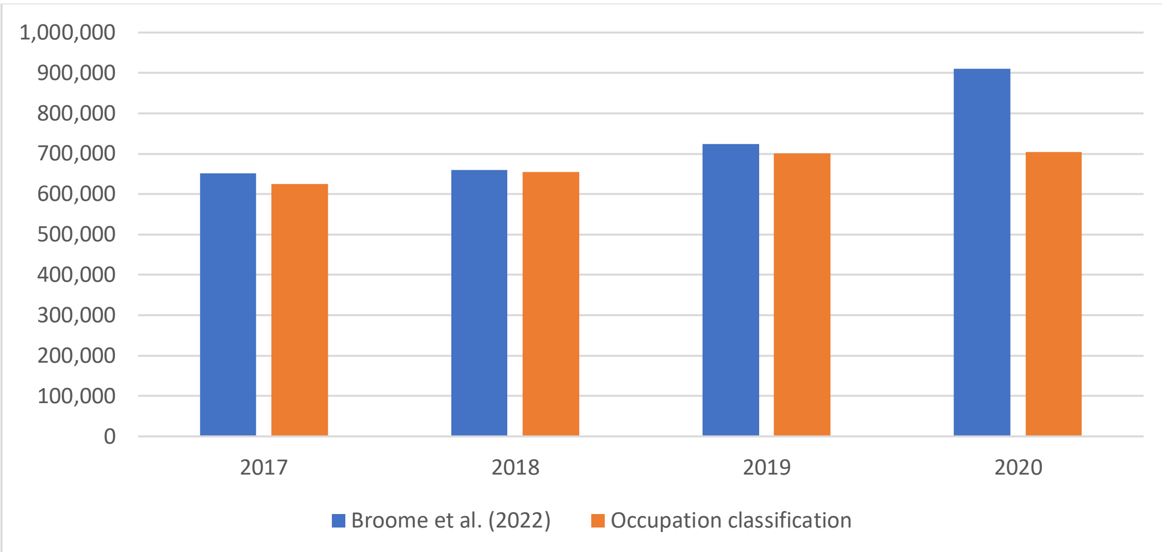
This report contributes to our understanding of green skills and jobs, and how they are evolving. However, **limited access to relevant data** has made it difficult to conduct more timely and detailed analysis. Green skills are harder to identify than, for example, digital skills, which creates uncertainty and delays in policy responses.

Improved data access would help resolve these uncertainties and deepen our understanding of how the net zero transition will affect the labour market in London and across the UK. **Policies that promote open access to data for researchers will support more informed decision-making and accelerate progress toward a just and inclusive green economy**, as called for by London Councils and others.

Appendices

Appendix A: Figures and tables

Figure A.1. Comparing estimates of green jobs based on Broome et al. (2022) and Edgar et al. (2021) classification – occupation based.



Data source: Annual Population Survey (APS), weighted estimates.

Table A.1 Common Aggregation Hierarchy (CAH) for green skills.

CAH1_Code	CAH1_Label	CAH3_Code	CAH3_Label
CAH02	subjects allied to medicine	CAH02-06-04	environmental and public health
CAH03	biological and sport sciences	CAH03-01-01	biosciences (non-specific)
CAH03	biological and sport sciences	CAH03-01-02	biology (non-specific)
CAH03	biological and sport sciences	CAH03-01-03	ecology and environmental biology
CAH03	biological and sport sciences	CAH03-01-04	microbiology and cell science
CAH03	biological and sport sciences	CAH03-01-05	plant sciences
CAH03	biological and sport sciences	CAH03-01-06	zoology
CAH03	biological and sport sciences	CAH03-01-07	genetics
CAH03	biological and sport sciences	CAH03-01-08	molecular biology, biophysics and biochemistry
CAH03	biological and sport sciences	CAH03-01-09	hair and beauty sciences
CAH03	biological and sport sciences	CAH03-01-10	others in biosciences
CAH06	agriculture, food and related studies	CAH06-01-01	animal science
CAH06	agriculture, food and related studies	CAH06-01-02	agricultural sciences
CAH06	agriculture, food and related studies	CAH06-01-03	agriculture
CAH06	agriculture, food and related studies	CAH06-01-04	rural estate management
CAH06	agriculture, food and related studies	CAH06-01-05	forestry and arboriculture
CAH06	agriculture, food and related studies	CAH06-01-06	food and beverage studies (non-specific)
CAH06	agriculture, food and related studies	CAH06-01-07	food sciences
CAH06	agriculture, food and related studies	CAH06-01-08	food and beverage production
CAH07	physical sciences	CAH07-01-01	physics
CAH07	physical sciences	CAH07-01-02	astronomy
CAH07	physical sciences	CAH07-02-01	chemistry
CAH07	physical sciences	CAH07-04-01	physical sciences (non-specific)
CAH07	physical sciences	CAH07-04-02	forensic and archaeological sciences
CAH07	physical sciences	CAH07-04-03	sciences (non-specific)
CAH07	physical sciences	CAH07-04-04	natural sciences (non-specific)
CAH10	engineering and technology	CAH10-01-01	engineering (non-specific)
CAH10	engineering and technology	CAH10-01-02	mechanical engineering
CAH10	engineering and technology	CAH10-01-03	production and manufacturing engineering
CAH10	engineering and technology	CAH10-01-04	aeronautical and aerospace engineering
CAH10	engineering and technology	CAH10-01-05	naval architecture
CAH10	engineering and technology	CAH10-01-06	bioengineering, medical and biomedical engineering
CAH10	engineering and technology	CAH10-01-07	civil engineering
CAH10	engineering and technology	CAH10-01-08	electrical and electronic engineering
CAH10	engineering and technology	CAH10-01-09	chemical, process and energy engineering
CAH10	engineering and technology	CAH10-01-10	others in engineering
CAH10	engineering and technology	CAH10-03-01	minerals technology
CAH10	engineering and technology	CAH10-03-02	materials technology
CAH10	engineering and technology	CAH10-03-03	polymers and textiles
CAH10	engineering and technology	CAH10-03-04	maritime technology

CAH10	engineering and technology	CAH10-03-05	biotechnology
CAH10	engineering and technology	CAH10-03-06	others in technology
CAH10	engineering and technology	CAH10-03-07	materials science
CAH13	architecture, building and planning	CAH13-01-01	architecture
CAH13	architecture, building and planning	CAH13-01-02	building
CAH13	architecture, building and planning	CAH13-01-03	landscape design
CAH13	architecture, building and planning	CAH13-01-04	planning (urban, rural and regional)

Table A.2 Correspondence between SOC 2010 and SOC 2020

Occupation description	SOC 2010	SOC 2020
Production managers & directors in construction	1122	1122
Marketing & sales directors	1132	1132
Managers & proprietors in other services	1259	1259
IT business analysts, architects & systems designers	2135	2133
Programmers & software developers professions	2136	2134
Management consultants & business analysists	2423	2431
Business and financial project management professionals	2424	2440
Business and related associate professionals n.e.c.	3539	2439
Marketing associate professionals	3543	3554
Sales accounts and business development managers	3545	3556
Gardeners and landscape gardeners	5113	5113
Metal working production and maintenance fitters	5223	5223
Vehicle technicians, mechanics and electricians	5231	5231
Electricians and electrical fitters	5241	5241
Plumbers and heating and ventilating engineers	5314	5315
Construction and building trades n.e.c.	5319	5319
Customer service managers and supervisors	7220	7220 + 4143
Vehicle valeters and cleaners	9236	9226

Table A.3 UK: proportion of new graduates with green skills (%): time variation

SOC	Occupation description	2017/18	2018/19	2019/20	2020/21	2021/22
1122	Production managers and directors in construction	23%	27%	20%	23%	25%
1132	Marketing, sales and advertising directors	5%	8%	4%	6%	5%
1259	Managers and proprietors in other services n.e.c.	7%	9%	6%	5%	10%
2133	IT business analysts, architects and systems designers	27%	29%	32%	34%	32%
2134	Programmers and software development professionals	24%	24%	27%	28%	27%
2431	Management consultants and business analysts	17%	15%	17%	16%	17%
2439	Business, research and administrative professionals n.e.c.	11%	10%	12%	9%	12%
2440	Business and financial project management professionals	18%	16%	14%	11%	13%
3554	Advertising and marketing associate professionals	4%	4%	4%	3%	3%
3556	Sales accounts and business development managers	9%	11%	10%	8%	10%
5133-9236	Typically, non-graduate jobs	42%	42%	40%	41%	44%

Data source: HESA.

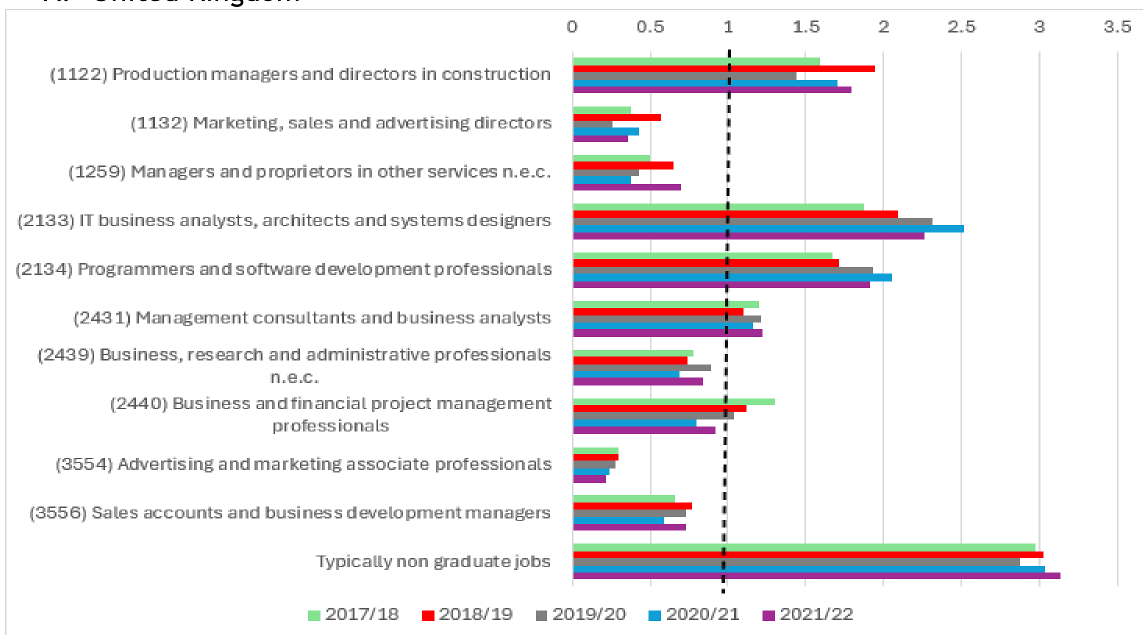
Table A.4 London: proportion of new graduates with green skills: time variation

SOC	Occupation description	2017/18	2018/19	2019/20	2020/21	2021/22
1122	Production managers and directors in construction	29%	41%	21%	32%	27%
1132	Marketing, sales and advertising directors	5%	6%	2%	5%	6%
1259	Managers and proprietors in other services n.e.c.	10%	5%	5%	4%	8%
2133	IT business analysts, architects and systems designers	27%	28%	30%	35%	27%
2134	Programmers and software development professionals	21%	21%	24%	26%	22%
2431	Management consultants and business analysts	18%	15%	16%	16%	17%
2439	Business, research and administrative professionals n.e.c.	9%	9%	10%	8%	9%
2440	Business and financial project management professionals	15%	13%	10%	8%	11%
3554	Advertising and marketing associate professionals	5%	5%	4%	3%	3%
3556	Sales accounts and business development managers	8%	7%	8%	5%	8%
5133-9236	Typically non-graduate jobs	29%	29%	32%	23%	23%

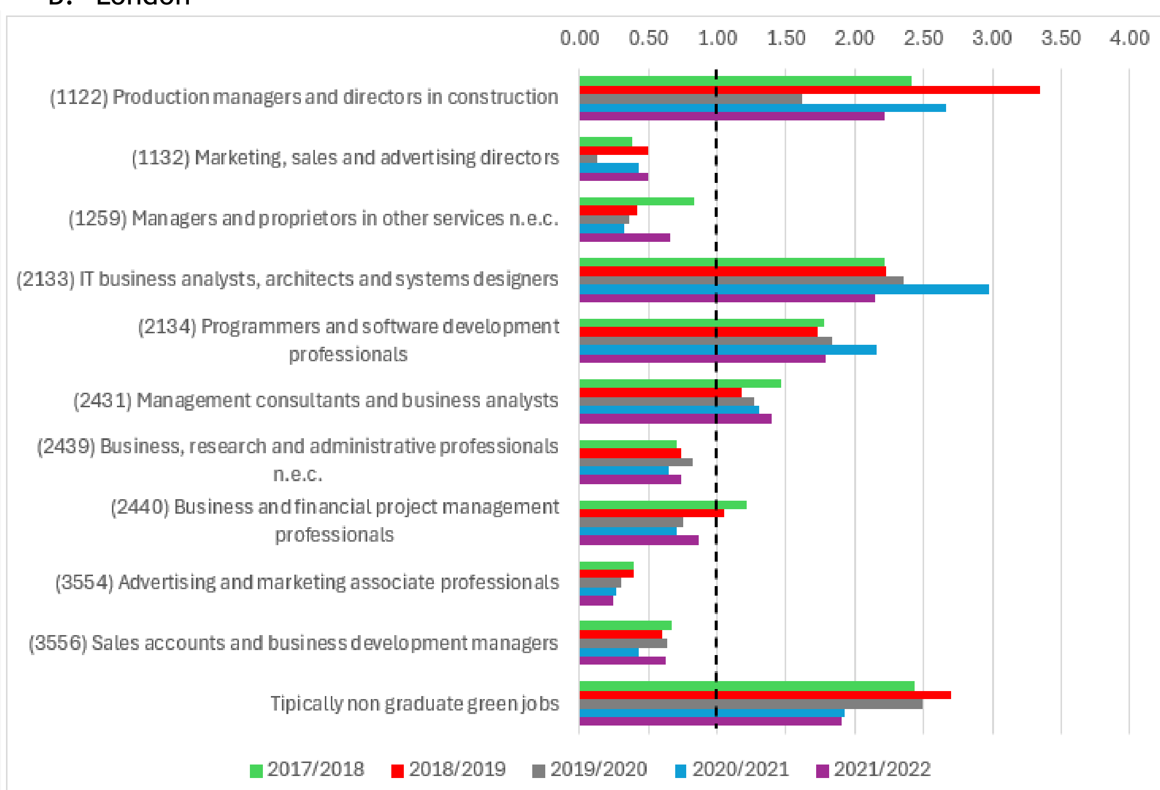
Data source: HESA.

Figure A.2 Green skills fit indicator (occupation dimension), time variations.

A. United Kingdom



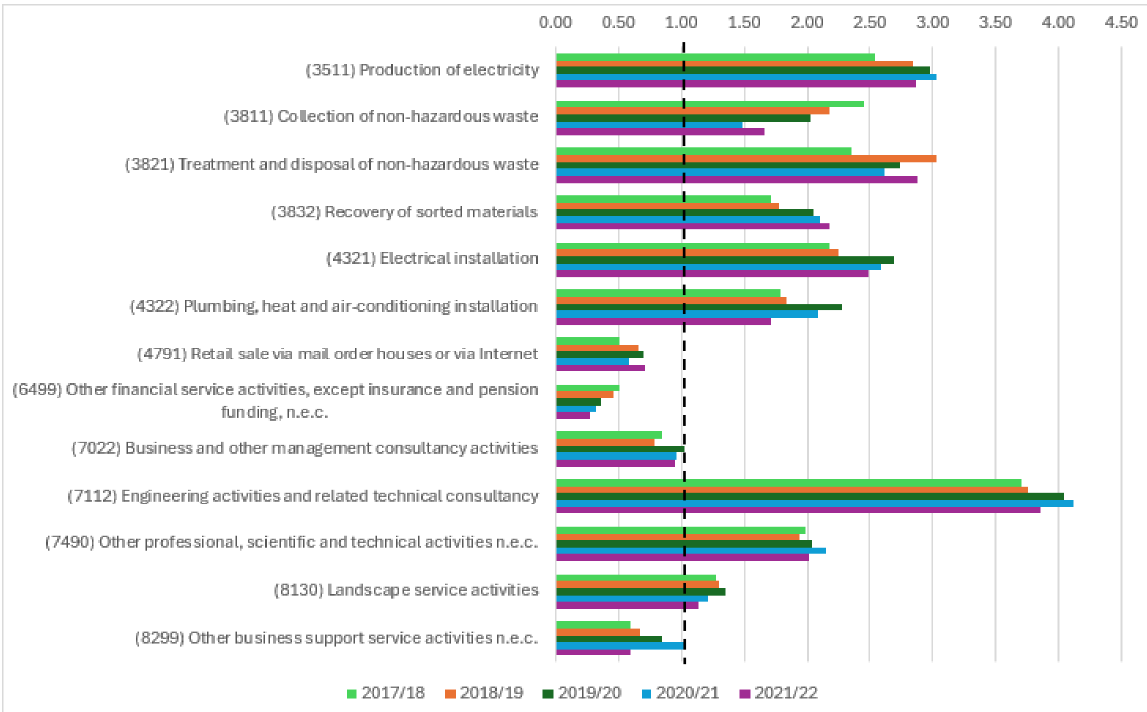
B. London



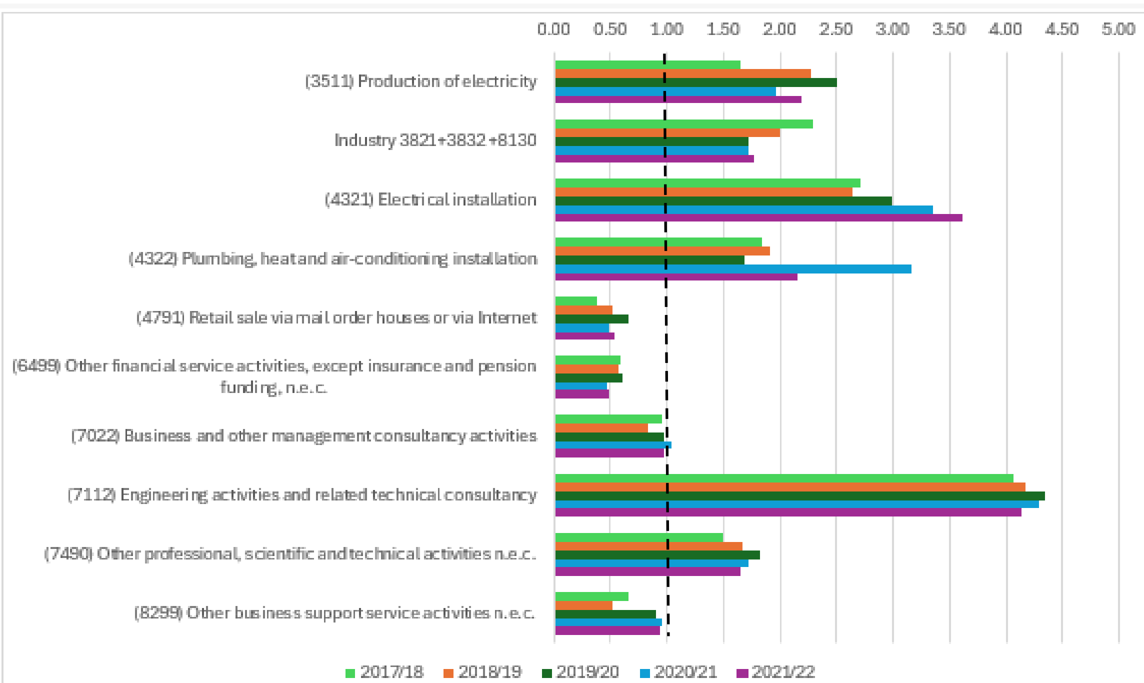
Data source: HESA.

Figure A.3 Green skills fit indicator (industry dimension), time variations.

A. UK



B. London



Data source: HESA.

Appendix B: References

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