Green Jobs and Skills in South Yorkshire

A report prepared for
South Yorkshire Mayoral Combined Authority

By

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Glossary

CASCOT	Computer Assisted Structured Coding Tool
FTE	Full-time equivalent
IER	Institute for Employment Research, Warwick University
ISCO	International Stanard Occupational Classification
LCREE	Low Carbon and the Renewable Energy Economy
nec	Not elsewhere classified
ONS	Office for National Statistics
O*NET	US Occupational Information Network
pp	Percentage point
SIC	Standard Industrial Classification
SOC	Standard Occupational Classification
SYMCA	South Yorkshire Mayoral Combined Authority

1. Introduction

1.1. Introduction

Warwick University Institute for Employment Research (IER) was commissioned by South Yorkshire Mayoral Combined Authority (SYMCA) to undertake an analysis of green jobs and skills in the SYMCA area.

The main aims of the research are to:

- Identify current and future workforce requirements;
- Identify potential investment priorities.

1.2. Defining green jobs

A key challenge in providing estimates of green jobs and skills is using an agreed definition. Definitions vary especially amongst those organisations that provide data.[1] Definitions tend to exist on a continuum between 'purist' and 'inclusive' definitions:[2]

- Purist definitions are narrower in scope. From this perspective, green jobs are those that "…contribute substantially to preserving or restoring environmental quality" [3], and typically focus on those sectors and occupations at the forefront of decarbonisation e.g. carbon capture;[4]
- Inclusive definitions include a broader range of jobs (such as electricians and accountants) who might be involved in the establishment, product manufacture, management and maintenance of the electrical power network to which all different types of energy generation – green and non green - are connected.

An example of a more purist approach to calculating green jobs is Office for National Statistic's (ONS) annual Low Carbon and Renewable Energy (LCREE) Survey. This is only targeted at those businesses in industries likely to have low carbon and renewable energy economic activity, and asks them about the extent of their activities in the low carbon sector.[5]

However, the zero-emission agenda is leading to changes across a range of different sectors and occupations in the UK, which would not ordinarily fall within this purist definition. For example, the UK banning petrol and diesel cars by 2030 will lead to considerable changes in the skills set of employees working in car production (making electric as opposed to diesel

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[1] For example see: ILO (2018). World employment outlook 2018: Greening with jobs. ILO, Geneva; and, ONS (2021). The challenges of defining a "green job". Newport, ONS..

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

[3] 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.

[4] Hogarth, T. (2012). Green jobs and skills in Europe: Moving towards a statistical definition of green jobs. Presentation to ILO.

[5] See, https://www.ons.gov.uk/economy/environmentalaccounts/methodologies/lowcarbonandrenewableenergyeconomylcreesurveyqmi

vehicles); as well lawyers who will need to understand how companies will comply with new zero-emission regulations.

Consequently, a green jobs definition should include those jobs directly related to preserving or restoring the environment and a broad range of critical jobs that will support the transition to a greener economy. The inclusive approach would include jobs that can indirectly contribute to decarbonisation.[6] For example, within the manufacturing sector this approach would include the manufacture of wind turbines as well the remanufacture and repair of goods which may not be 'green' products but would contribute to decarbonisation.

Using the purist:inclusive continuum leads to a four part classification of jobs, as used within the US Department of Labor's O*NET (Occupational Information Network):[7][8]

- **Green New and Emerging Occupations:** these are occupations that have unique requirements for working in or on decarbonisation goods, processes and services, such as electric vehicle power unit designers;
- **Green Enhanced Skills and Knowledge Occupations:** occupations that currently exist but require a change in their competencies for working in or on decarbonisation goods, processes and services e.g. maintenance of electric vehicles (EVs);
- **Green Increased Demand Occupations:** those occupations whose demand is increased due decarbonisation goods, processes and services, but does not entail significant changes to their competencies or context, for example electric power line installers for EV charging;
- **Other or non green jobs:** all other jobs.

1.3. Methodology

This study provides employment data on both the purist and inclusive method based on:

- The LCREE methodology. Employment by the LCREE distribution across the UK is applied to the structure of employment within the SYMCA area in 2019.[9] This gives an estimate of direct green jobs if the UK distribution of green sector employment were applied to the SYMCA area[10];
- The O*NET approach using the three-way categorisation of occupations as applied to occupation employment data for SYMCA in 2019. This provides data by occupation, type of green job and competencies (skills and knowledge);

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[6] Transition Economics. (2021). Green Jobs in Scotland. Glasgow, STUC.

[7] O*NET https://www.onetonline.org/

[8] O*NET focuses on economic activities: "…related to reducing the use of fossil fuels, decreasing pollution and greenhouse gas emissions, increasing the efficiency of energy use, recycling materials, and development and adopting renewable sources of energy". See 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.

[9] 2019 has been chosen as it is the last calendar year prior to the pandemic when the UK and SYMCA economies were not affected by the COVID-19 pandemic nor by the war in Ukraine.

[10] This approach has been used in other areas, for example see: Essex County Council (2022). Green Skills Infrastructure Review.

- Using the O*NET classification but applying it to online job vacancies. In an approach developed by IER, data is 'scraped' from online job adverts. This provides a time series of demand for occupations as well as the skills required by recruiting employers, and wages.

1.4. Structure of the report

The report is organised into four further sections focusing on:

- Section 2 provides estimates of green jobs in SYMCA based on a purist definition;
- Section 3 uses a broader more inclusive definition of green jobs and provides analysis of the occupations and skills of green employment;
- Section 4 presents analysis of online job vacancies, and presents trends in the number, characteristics, and wages of these jobs;
- Section 5 provides the conclusions;

2. Employment in green sectors

2.1. Introduction

This section is based on the LCREE method and definition of green jobs. The employment structure by Standard Industrial Classification (SIC) of LCREE specific green sectors is applied to the employment distribution for the SYMCA area in 2019.

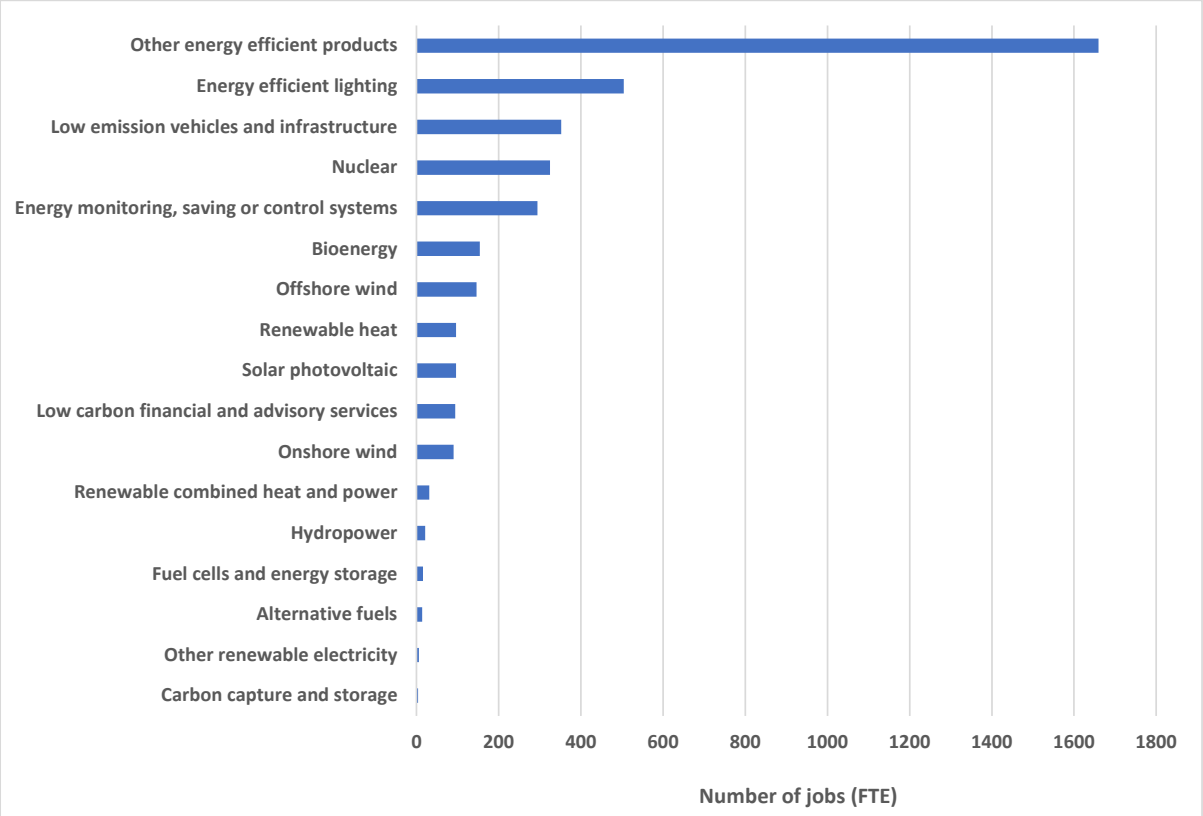
2.2. Methodology

ONS produces employment and turnover data based on the LCREE method.[11] This provides numbers of jobs (full-time equivalent [FTE]) by SIC and 17 specific green sectors for the UK. The researchers have taken the proportion of these green jobs per SIC and applied it to the numbers employed in SYMCA in 2019. SYMCA employment data (including self-employed people) was obtained from NOMIS.

2.3. Total green sector jobs

Using the LCREE method (which provides a narrow definition of green sector employment) it is estimated that in 2019 there were 3,900 people working in the sector in SYMCA. Figure 1 shows the distribution by specific green sector.

Figure 1: SYMCA employment by specific green sector, 2019



Source: Warwick IER. ONS LCREE estimates accessed June 2022; BRES employment data accessed June 2022

11 https://www.ons.gov.uk/economy/environmentalaccounts/bulletins/finalestimates/2020#:~:text=Turnover%20in%20the%20UK%20low,no%20significant%20change%20since%202014.

The largest number of people (1,660) work in the other energy efficiency products sector which accounts for more than two out of five green sector jobs (43%). The other most sizeable sectors are: energy monitoring, saving or control systems (504 or 13%); low emission vehicles and infrastructure (352 or 9%); nuclear (325 or 8%); and energy efficient lighting (294 or 8%).

Therefore, at present, employment in specific green sectors is very low level. The number of jobs amounts to only 1% of SYMCA employment, although this varies across sectors as Table 1 shows. Only in the utilities – power sector does green sector employment account for more than one in ten jobs (13%). In all other sectors green sector employment represents less than 5% of all workers in that sector.

Table 1: SYMCA green employment by SIC, 2019

SIC	No.	% of sector
A Agriculture et. al.[12]	-	-
B Mining and quarrying	-	-
C Manufacturing	1,662	3%
D Utilities - power	135	13%
E Utilities - water and waste	31	1%
F Construction	1,367	4%
G Wholesale, retail and repair	243	0%
H Transportation and storage	-	-
J Information and communication	25	0%
L Real estate activities	3	0%
M Professional/scientific/technical	295	1%
N Admin. and support services	138	0%
P Education	2	0%
S Other activities	-	-
All	**3,900**	**1%**

Source: ONS LCREE estimates accessed June 2022; BRES employment data accessed June 2022

2.4. Summary

This section is based on the LCREE methodology which provides a narrow definition of green sector jobs. Applying the UK distribution of jobs to SYMCA shows that, in 2019, specific green

[12] BRES data in three sectors was supressed from publication because of the small numbers in that sector: agriculture et. al.; mining and quarrying; and other activities.

sector jobs accounted for 1% of employment in SYMCA. The largest specific green sector was other energy efficiency products which accounted for 43% of green sector jobs.

3. Inclusive green jobs and skills

3.1. Introduction

This section provides an estimate of green jobs based on an inclusive definition as employed by O*NET. This approach classifies green employment into three categories (see Section 1.2 for definitions): green new and emerging occupations; green enhanced skills and knowledge; and green increased demand occupations. 'Green' occupations are identified depending on whether they are[13]:

- in businesses that produce goods or provide services that benefit the environment or conserve natural resources; and/or
- in which workers' duties involve making their establishment's production processes more environmentally friendly or use fewer natural resources.

O*NET is a database of 923 occupations and includes variables that describe work and worker characteristics, including skill requirements. Therefore the underpinning knowledge, skills and behaviours can also be identified for green occupations.

As O*NET is a US system it uses a different Standard Occupation Classification (SOC) system which needs to be converted into the UK SOC. IER, through its other work using O*NET, has developed a conversion system which translates US SOC into the UK classification.

Whilst there is generally a lot of similarity between the two, occasional differences do arise which affect the conversion, especially where the three green occupation types are concerned. For example, the UK SOC 1161 Managers and directors in transport and distribution equates to three O*NET occupations (because O*NET is more detailed): Hydroelectric production managers (which is a green new and emerging occupation); Logistics managers (which is a green increased demand occupation); and Storage and distribution managers (which is a green enhanced skills and knowledge occupation).

Therefore in the following sections, some occupations may have more than one green classification associated with them.

3.2. Green occupational employment in SYMCA

3.2.1. Broad occupation

Employment data for 2019 (i.e. the last full calendar year before COVID-19) was obtained from ONS at the 4-digit UK SOC level (hereafter in this Section referred to as SOC). The O*NET green occupation classification was applied to SYMCA employment data.

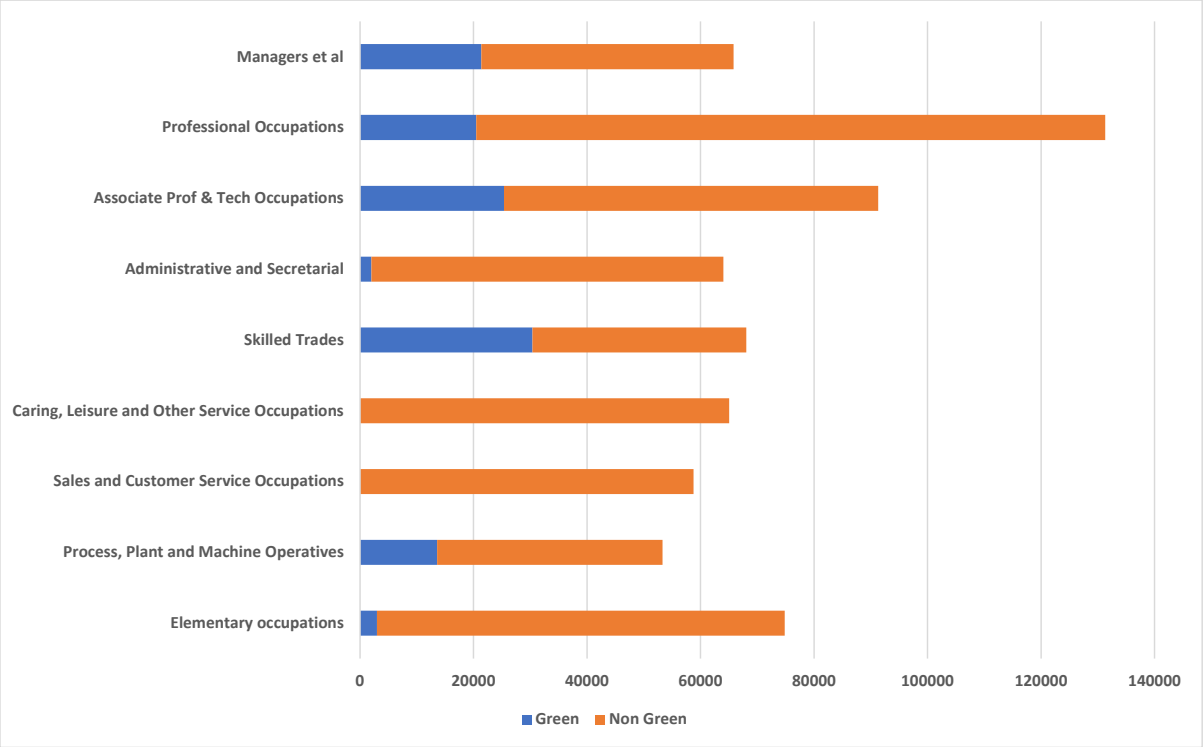
According to the APS, there were almost 670,000 people employed (employees and self-employed) in the SYMCA area in 2019 calendar year. According to this methodology, less than one in five people (17%) were working in green occupations. Figure 2 shows that in 2019, most green jobs were in four broad occupations: managers; professional; associate professional; and skilled trade occupations. Together these four occupations accounted for 84% of all green jobs, and their green component accounted for 15% of total employment.

Four broad occupations also account for a very small proportion of green jobs. Together, administrative and clerical, and elementary occupations together account for only 5% of green

[13] US Bureau of Labor Statistics https://www.bls.gov/green/home.htm

jobs. There are non green jobs in the caring, leisure and other service; and sales and customer service occupations.

Figure 2: SYMCA employment by broad occupation, 2019 - percent

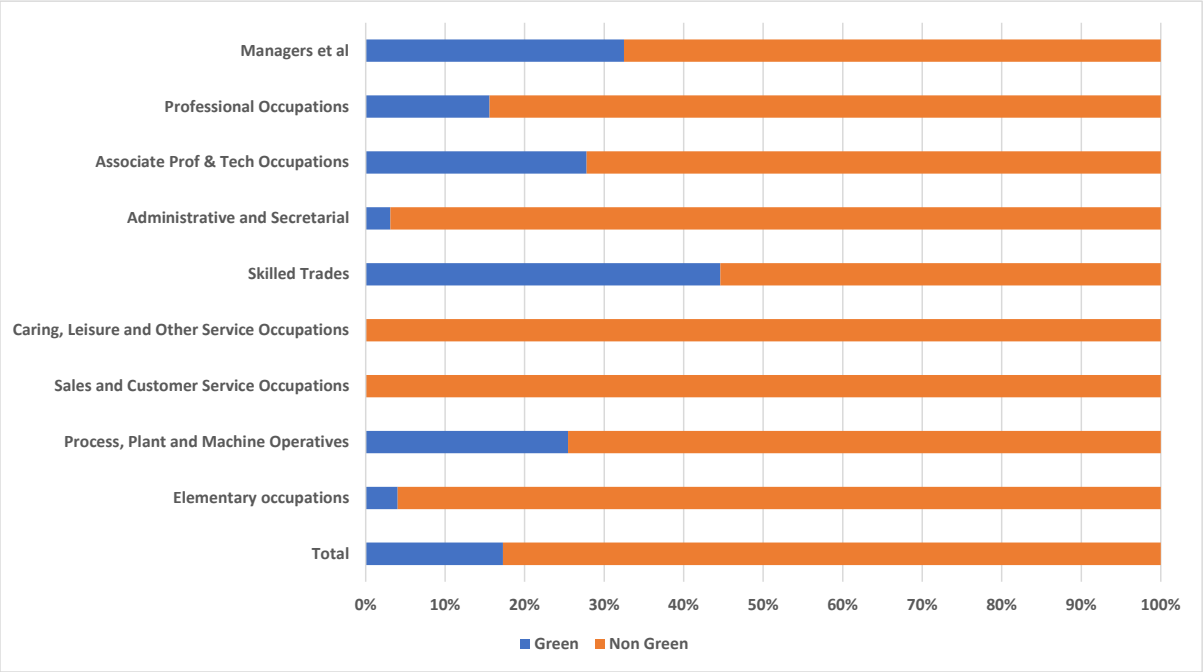


Source: Warwick IER analysis of ONS APS occupation data applied to O*NET green job classification

Figure 3 shows the proportion of each broad occupation group that are green or non green jobs. Almost half (45%) of skilled trades are green jobs, as are one third of managers (32%); around one quarter of associate professional (28%); and process, plant and machine operative (25%). Around one in six professional jobs are green jobs (16%).

There are a very small proportion of green jobs in administrative and clerical (3%), and elementary (4%) occupations.

Figure 3: SYMCA employment by broad occupation, 2019 - percent

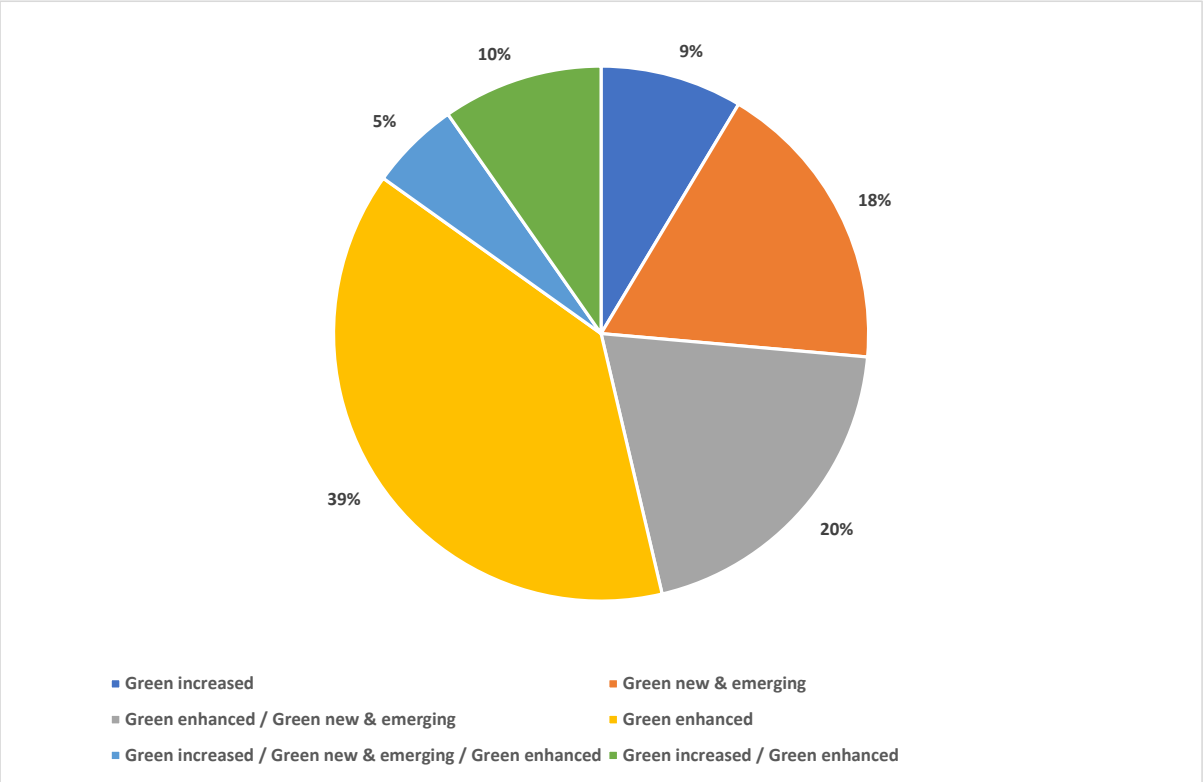


Source: Warwick IER analysis of ONS APS occupation data applied to O*NET green job classification

Figure 4 shows the percentage distribution by green job type in SYMCA in 2019. As mentioned in Section 3.1, the finer detail of O*NET occupations means that in some cases there are two or three green job types for the SOC classification and that is why Figure 4 includes groups of different green jobs.

The largest single green job type is green enhanced (39% of SYMCA green jobs), 18% are green new and emerging and 5% are green increased. However, one in five are green enhanced/green and emerging, and one in ten green increased/enhanced.

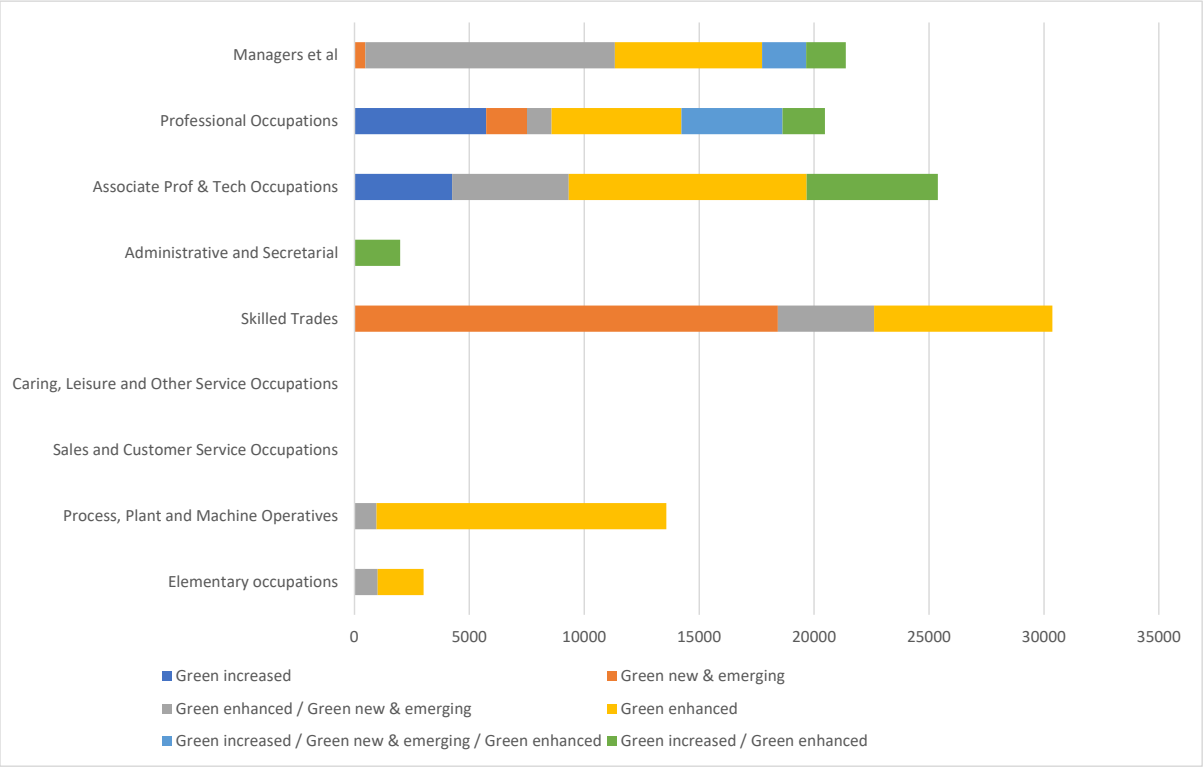
Figure 4: SYMCA green job type, 2019 - percent



Source: Warwick IER analysis of ONS APS occupation data applied to O*NET green job classification

Applying the green job typology to broad occupation produces Figure 5. This shows that the green job composition of different occupations varies. For example, most skilled trade green jobs are new and emerging whilst most process, plant and machine operative occupations are green enhanced. Manager, professional, and associate professional occupations tend to be a mix of different types.

Figure 5: SYMCA broad occupation green job type, 2019



Source: Warwick IER analysis of ONS APS occupation data applied to O*NET green job classification

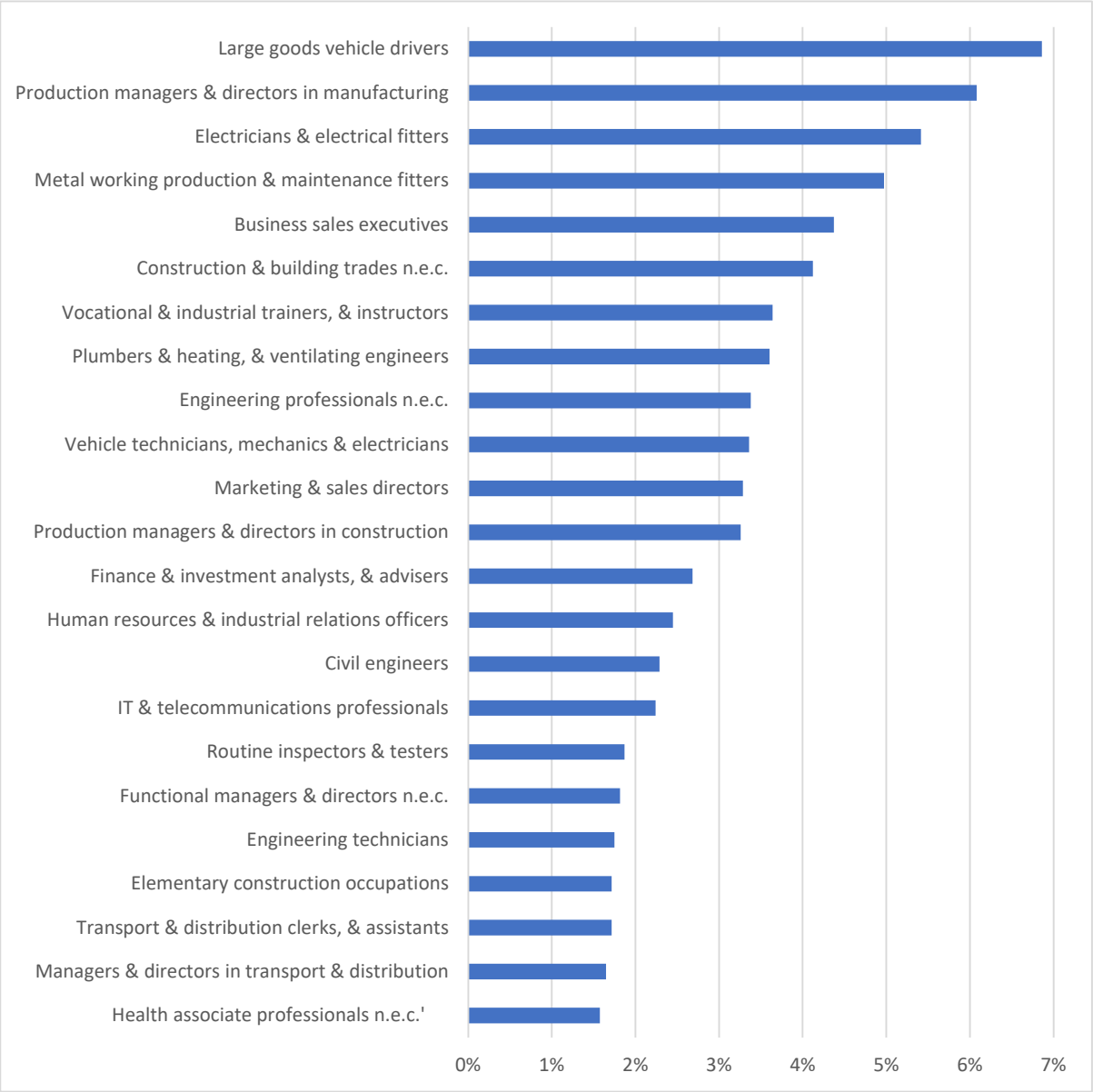
3.2.2. Detailed occupations

This section provides analysis of green jobs within detailed (4-digit SOC) occupations. There are just over 400 detailed occupations in the SOC, 369 of which are represented in the SYMCA area. Of these 305 are non green occupations and the remainder (64) are green occupations, according to the methodology used in this section.

Figure 6 shows the detailed green occupations that account for 2% or more or green jobs. The largest green occupation is large goods vehicle drivers which account for 7% of green jobs, followed by production managers & directors in manufacturing (6%), electricians & electrical fitters (5%), and metal working production & maintenance fitters (5%).

Most of the detailed occupations are green enhanced jobs. Three are solely green new and emerging: electricians and electrical fitters; metal working production and maintenance fitters; and construction and building trades not elsewhere classified (nec).

Figure 6: Detailed green occupations with at least 2% of green jobs, SYMCA 2019



Source: Warwick IER analysis of ONS APS occupation data applied to O*NET green job classification

Table 2 shows the top detailed occupations by green job type. The percentage column is the proportion of green jobs in the SYMCA area.

As mentioned above, some occupations may appear in more than one column and these are italicised. For example, production managers and directors in manufacturing appears in the green enhanced and green new and emerging columns. This is because production managers could be working in businesses focused on green products (such as biofuels) or those in businesses such as motor vehicle manufacture that produce a range of products some of which are green (e.g. EVs) or non green (diesel cars) but who could switch (and in some cases are switching) from the latter to the former.

Table 2: Detailed green occupations by type of green job, SYMCA 2019

Green enhanced	% green jobs	Green increased	% green jobs	Green new & emerging	% green jobs
Large goods vehicle drivers	7%	*Engineering professionals nec*	3%	*Production Managers/directors in manuf.*	6%
Production Managers/directors in manuf.	6%	*Finance & investment analysts, & advisers*	3%	Electricians & electrical fitters	5%
Business sales executives	4%	IT & telecommunications professionals	2%	Metal working production & maintenance fitters	5%
Vocational & industrial trainers, & instructors	4%	Engineering technicians	2%	*Business sales executives*	4%
Plumbers & heating, & ventilating engineers	4%	Transport & distrib clerks, & assistants	2%	Construction & building trades nec	4%
Engineering professionals nec	3%	*Managers/directors in transport & distrib*	2%	Plumbers & heating/ventilating engineers	4%
Vehicle technicians, mechanics & electricians	3%	Business & related associate professionals nec	1%	Engineering professionals nec	3%
Marketing & sales directors	3%	*Managers/directors in storage & warehousing*	1%	*Production Managers/directors in construction*	3%
Production Managers/directors in construction	3%	Mechanical engineers	1%	Managers/directors in transport & distrib	2%
Finance & investment analysts, & advisers	3%	Construction project managers & related professionals	1%	Construction & building trades supervisors	1%
Human resources & industrial relations officers	2%	Planning, process & production technicians	1%	Environment professionals	1%
Civil engineers	2%	QA & regulatory professions	1%	Refuse & salvage occupations	1%
Routine inspectors & testers	2%	Production & process engineers	<1%	Research & development managers	1%
Functional Managers/directors nec	2%	*Electrical engineers*	<1%	Energy plant operatives	<1%
Elementary construction occupations	2%	Natural & social science professionals nec	<1%	Chemical & related process operatives	<1%
Transport & distrib clerks, & assistants	2%	Electrical & electronics technicians	<1%	Production Managers/directors in mining & energy	<1%
Managers/directors in transport & distrib	2%	Inspectors of standards & regulations	<1%	*Electrical engineers*	<1%
Health associate professionals nec	2%	Electronics engineers	<1%	Advertising accounts managers & creative directors	<1%
Managers/directors in storage & warehousing	1%	Brokers	<1%	Actuaries, economists & statisticians	<1%
Metal machining setters & setter-operators	1%	Science, engineering & production technicians nec	<1%	Conservation professionals	<1%

Source: Warwick IER analysis of ONS APS occupation data applied to O*NET green job classification

NB: Occupations in italics appear in more than one column.

Table 2 shows that the green increased column contains the narrowest range of occupations at the 1-digit level. All detailed occupations are managerial, professional or associate professional jobs apart from one. Green enhanced detailed jobs cover all of the seven 1-digit broad occupations that cover green jobs (see Figure 1.5). Green new and emerging jobs cover all but one (administrative and clerical).

Table 2 also shows the broad range of occupations currently affected by the moves towards sustainable development. Whilst emphasis may have been placed on scientific and technical, skilled trades and process occupations, there are a range of other jobs that are also affected. For example, quality assurance and regulatory professionals (for environmental standards), vocational and industrial trainers and instructors (for skilling new and emerging skills, knowledge and behaviours), and human resources and industrial relations officers (for managing employment transitions and demands).

3.3. Green skills and knowledge

O*NET provides details of skills, behaviours, knowledge and tasks which are involved in each detailed occupation. This section focuses on occupational skills and knowledge[14], although a range of other details are available[15].

3.3.1. Green skills

O*NET uses a 35 categorisation of skills which cover a range of different skills including functional (e.g. maths), transferable (such as problem solving) and technical (for example, engineering)[16]. Within the O*NET system information on skills tends to focus on the first two (functional and transferable skills) whilst information on knowledge focuses on technical skills.

Table 3 shows the top ten skills required for green jobs by broad occupation. These are for all green occupations that employed someone in SYMCA in 2019. The top five skills required by green jobs are: critical thinking; active listening; reading comprehension; speaking; and monitoring.

There are a number of skills required that cut across a number of occupations. For example, judgment and decision making; speaking; reading comprehension; active listening; time management; critical thinking; and monitoring are required in five of the seven broad occupations. The level of skill will vary from occupation to occupation.

[14] O*NET defines skills as: "…proficiencies or competencies that are developed through training or experience". https://www.onetcenter.org/dl_files/AOSkills_21.pdf

[15] For example see https://www.onetonline.org/link/summary/17-1011.00

[16] "The 35 O*NET skills cover performance applicable to a broad range of jobs in the world's economy and are grouped into seven categories within the O*NET content model: content, process, social, complex problem solving, technical, systems, and resource management". https://www.onetcenter.org/dl_files/AOSkills_21.pdf

Table 3: Top ten skills required by green jobs in broad occupation, SYMCA 2019

Managers et al	Professional Occupations	Associate Prof & Tech Occupations	Administrative and Secretarial
Speaking	Reading Comprehension	Reading Comprehension	Speaking
Critical Thinking	Critical Thinking	Critical Thinking	Reading Comprehension
Monitoring	Active Listening	Active Listening	Monitoring
Active Listening	Judgment and Decision Making	Speaking	Time Management
Reading Comprehension	Complex Problem Solving	Writing	Active Listening
Coordination	Writing	Monitoring	Critical Thinking
Judgment and Decision Making	Speaking	Complex Problem Solving	Coordination
Complex Problem Solving	Systems Analysis	Judgment and Decision Making	Writing
Time Management	Active Learning	Active Learning	Service Orientation
Writing	Monitoring	Time Management	Judgment and Decision Making
Skilled Trades	**Process, Plant and Machine Operatives**	**Elementary occupations**	**All green occupations**
Critical Thinking	Operations Monitoring	Speaking	Critical Thinking
Speaking	Critical Thinking	Active Listening	Active Listening
Active Listening	Operation and Control	Operation and Control	Reading Comprehension
Monitoring	Monitoring	Coordination	Speaking
Time Management	Active Listening	Operations Monitoring	Monitoring
Operations Monitoring	Reading Comprehension	Monitoring	Judgment and Decision Making
Quality Control Analysis	Speaking	Critical Thinking	Complex Problem Solving
Reading Comprehension	Quality Control Analysis	Time Management	Writing
Judgment and Decision Making	Judgment and Decision Making	Reading Comprehension	Time Management
Coordination	Troubleshooting	Judgment and Decision Making	Active Learning

Source: Warwick IER analysis of ONS APS occupation data applied to O*NET green job classification

Table 4 shows the top ten skills by green job type. As with occupation a number of skills are applicable across job types. Of the eleven skills identified in Table 4, nine are common across all green job types: speaking; monitoring; active learning; active listening; reading comprehension; complex problem solving; writing; critical thinking; and judgment and decision making.

Not only are those skills most relevant to green jobs they are also most relevant to non green jobs. In fact there is only one skill difference. Social perceptiveness is a key skill in non green jobs (due to personal service and care, and sales occupations) and replaces active learning (more relevant for green jobs) as a top ten skill.

Table 4: Top ten skills required in green jobs by green job type, SYMCA 2019

Green enhanced	Green increased demand	Green new and emerging
Critical Thinking	Reading Comprehension	Active Listening
Active Listening	Critical Thinking	Reading Comprehension
Speaking	Active Listening	Speaking
Reading Comprehension	Speaking	Critical Thinking
Monitoring	Complex Problem Solving	Monitoring
Judgment and Decision Making	Judgment and Decision Making	Complex Problem Solving
Complex Problem Solving	Writing	Judgment and Decision Making
Writing	Monitoring	Writing
Active Learning	Active Learning	Coordination
Time Management	Time Management	Active Learning

Source: Warwick IER analysis of ONS APS occupation data applied to O*NET green job classification

3.3.2. Green knowledge

O*NET uses a 33 categorisation of knowledge. The knowledge requirements are the details which most correspond to technical skills e.g. engineering, marketing and management. Knowledge also includes English and maths as basic skills.

Table 5 shows the top ten knowledge requirements for green jobs by broad occupation. These are for all green occupations that employed someone in SYMCA in 2019. The top five skills required by green jobs are: English language; mathematics; computers and electronics; engineering and technology; and mechanical.

Table 5 also shows that there are a number of knowledge requirements that cut across a number of occupations. For example, English is a top knowledge requirement in all of the broad occupations. Customer and personal service; mathematics; computers and electronics; and administration and management are common across six broad occupations; and mechanical; public safety and security across five.

Table 5: Top ten knowledge requirements required by green jobs in broad occupation, SYMCA 2019

Managers et al	Professional Occupations	Associate Prof & Tech Occupations	Administrative and Secretarial
Administration and Management	English Language	English Language	English Language
Mathematics	Mathematics	Mathematics	Administrative
English Language	Computers and Electronics	Computers and Electronics	Mathematics
Production and Processing	Engineering and Technology	Engineering and Technology	Customer and Personal Service
Customer and Personal Service	Design	Customer and Personal Service	Transportation
Personnel and Human Resources	Physics	Mechanical	Geography
Computers and Electronics	Administration and Management	Physics	Administration and Management
Public Safety and Security	Customer and Personal Service	Design	Public Safety and Security
Economics and Accounting	Law and Government	Production and Processing	Law and Government
Education and Training	Mechanical	Administration and Management	Computers and Electronics
Skilled Trades	**Process, Plant and Machine Operatives**	**Elementary occupations**	**All green occupations**
Mechanical	Mechanical	Public Safety and Security	English Language
Building and Construction	English Language	Customer and Personal Service	Mathematics
English Language	Production and Processing	Mechanical	Computers and Electronics
Mathematics	Public Safety and Security	Administration and Management	Engineering and Technology
Customer and Personal Service	Mathematics	Transportation	Mechanical
Design	Education and Training	English Language	Customer and Personal Service
Engineering and Technology	Engineering and Technology	Production and Processing	Design
Public Safety and Security	Chemistry	Building and Construction	Administration and Management
Administration and Management	Computers and Electronics	Education and Training	Production and Processing
Computers and Electronics	Design	Personnel and Human Resources	Physics

Source: Warwick IER analysis of ONS APS occupation data applied to O*NET green job classification

Table 6 shows the top ten knowledge requirements by green job type. English and mathematics are the main knowledge requirement in all green job categories. As we have seen both skills and knowledge are relevant to a wide range of jobs. Of the eleven knowledge requirements identified in Table 6, nine are common across all green job types: mechanical; administration and management; engineering and technology; computers and electronics; customer and personal service; production and processing; design; mathematics; and English. Physics, and public safety and security are the only knowledge requirements not common to all types of green jobs.

As with skills, knowledge requirements necessary for green jobs are also most relevant to non green jobs. Seven knowledge requirements are required for non green jobs, all except for design, and engineering technology. These are replaced by education and training, and psychology in non green jobs.

Table 6: Top ten knowledge requirements required by green jobs by green job type, SYMCA 2019

Green enhanced	Green increased demand	Green new and emerging
English Language	English Language	English Language
Mathematics	Mathematics	Mathematics
Computers and Electronics	Computers and Electronics	Engineering and Technology
Engineering and Technology	Engineering and Technology	Computers and Electronics
Mechanical	Design	Mechanical
Customer and Personal Service	Physics	Administration and Management
Design	Mechanical	Design
Administration and Management	Customer and Personal Service	Customer and Personal Service
Physics	Production and Processing	Public Safety and Security
Production and Processing	Administration and Management	Production and Processing

Source: Warwick IER analysis of ONS APS occupation data applied to O*NET green job classification

3.4. Summary

Of the 650,000 jobs in SYMCA in 2019, around 115,000 or 17% are green occupations according to the O*NET classification. These tend to be concentrated in four broad occupations - managers; professional; associate professional; and skilled trade occupations - which together account for 84% of all green jobs.

Most green jobs are green enhanced or green new and emerging. Relatively few are green increased demand. But this varies between occupation group, for example, most skilled trade green jobs are new and emerging.

Analysis of detailed occupations shows that the largest green occupation is large goods vehicle drivers, followed by production managers & directors in manufacturing, electricians & electrical fitters, and metal working production & maintenance fitters.

As far as transferable and functional skills; and knowledge (i.e. technical skills) are concerned, green jobs do not necessarily require different competencies than non green jobs. The main difference appears to be in the type of occupation rather than the skills underpinning them. Green jobs are much more likely to be managerial, professional, associate professional and skills trades. Very few are administrative and secretarial; caring, leisure and other service; and sales and customer service occupations.

4. Green job vacancies

4.1. Introduction

This section provides information on the demand for green jobs in the SYMCA area from February 2019. It is based on an analysis of job vacancy data as it appears in online job vacancy advertisements.

In job vacancy websites, employers provide details of the number of vacancies and vacancies' characteristics such as job title, wage, experience and skills requirements etc. IER has been developing a large vacancy database from the main UK job portals since February 2019.

Using web scraping techniques[17], information is automatically collected from the main UK job portals. IER then cleans and standardises this information to ensure its consistency. As information is downloaded, the job vacancies are coded for statistical analysis using a number of variables e.g. experience required, wage offered, geographical area, sector and job titles.[18] IER then draws on CASCOT to identify occupational groups. CASCOT facilitates the classification of a large amount of job titles information into the ISCO 08 classification[19]. With the ISCO 08 variable, we can identify which vacancies are green or non green jobs. The designation of green and non green jobs is based on the O*NET classification used in the previous section.

4.2. SYMCA green job vacancies

Table 7 shows the number and proportion of job vacancies in SYMCA and England February 2019-December 2021. In SYMCA there were just under 45,000 vacancies of which 45% were green job vacancies[20]. This is slightly higher than the percentage for England.

[17] Computerised methods to automatically collect information from the Internet.

[18] In addition to vacancy information, job portals also provide company names. Alternatively, Companies House (https://www.gov.uk/government/organisations/companies-house) provides information such as the name and SIC code of companies registered in the UK. We use these names to combine both the vacancy and Companies House information and, by doing so, we identify the sector of the vacancy observations.

[19] Computer Assisted Structured Coding Tool (CASCOT) is software developed by the IER, see https://warwick.ac.uk/fac/soc/ier/software/cascot/. ISCO-is the International Standard Occupation Classification system which is similar to SOC.

[20] By green job vacancies we mean that there are vacancies in those jobs which have a green job designation i.e. they are either for green enhanced, increased demand, or new and emerging 4-digit occupations.

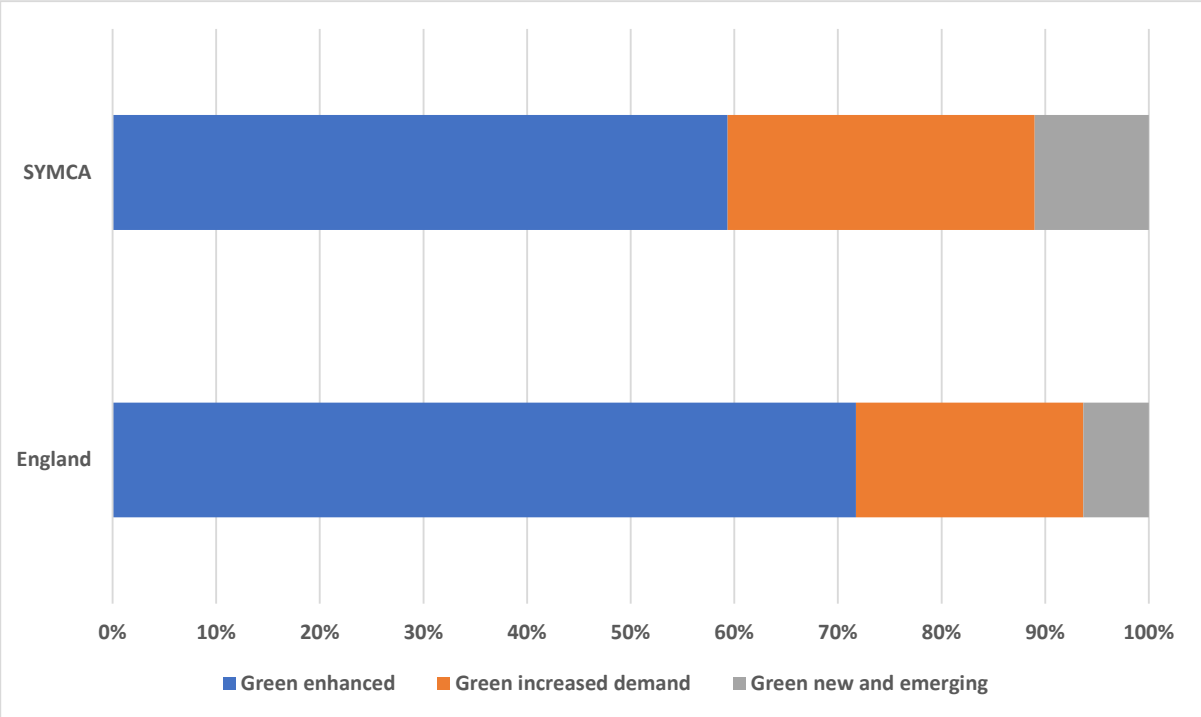
Table 7: Green and non green job vacancies in SYMCA and England (February 2019-December 2021)

	SYMCA		Rest of England	
	No.	%	No.	%
Non green	24,458	55%	1,257,358	56%
Green	20,189	45%	978,947	44%
Total vacancies	44,647	100%	2,236,305	100%

Source: Warwick IER

As previously mentioned, green jobs can be grouped into three types: enhanced, increased demand, and new and emerging green occupations. Figure 7 shows that in SYMCA most of the 20,189 green job vacancies were those classed as green enhanced (59%) around one in three were green increased demand (30%) and one in ten green new and emerging (11%). England has a much higher proportion of green enhanced job vacancies (72%) and concomitantly smaller proportions of green increased demand (22%) and green new and emerging (6%).

Figure 7: Percentage of green job vacancies by green job type in SYMCA and England (February 2019-December 2021)



Source: Warwick IER

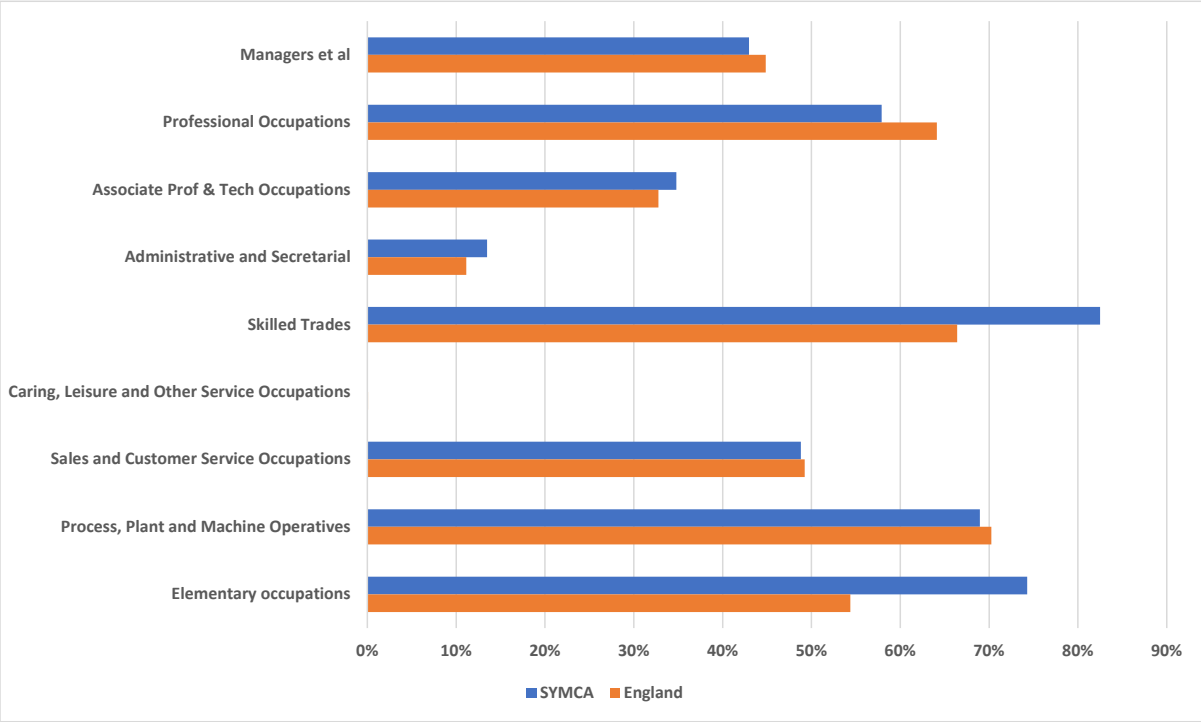
Figure 8 shows the proportion of broad occupation job vacancies that are for green occupations in SYMCA and England. For example, 43% of managerial vacancies in SYMCA were for green job occupations as were 45% in England.

Within SYMCA, green job occupations account for more than a half of vacancies within the skilled trades (82%), elementary (74%), process, plant and machine operative (69%) and professional (58%) occupations. Compared to England, most occupations have a similar

proportion of green job vacancies. SYMCA has a much higher proportion of green jobs in skilled trades and process, plant and machine operative occupations (+16 percentage points [pps] and +20 pps respectively), and a lower proportion of professional green job vacancies (-6 pps).

There are very few green job vacancies in administrative and secretarial, and caring, leisure and other service occupations because there are very few specific occupations defined as a green job.

Figure 8: Percentage of vacancies that are for green job occupations by broad occupation in SYMCA and England (February 2019-December 2021)[21]



Source: Warwick IER

Table 8 shows the proportion of green job vacancies by SIC for SYMCA and England. Over half of vacancies in manufacturing (67%), and accommodation and food (53%) were vacancies for green occupations. There are also large proportions of green job vacancies in five other sectors: information and communication (47%); professional, scientific and technical (47%); administrative and support service (47%); transportation and storage (47%); and arts, entertainment and recreation (46%). A number of these sectors is also where there were larger proportions of green job vacancies compared to England: manufacturing (+25 pps); accommodation and food (+21 pps); professional, scientific and technical (+11 pps); and arts, entertainment and recreation (+13 pps).

The sectors with the largest percentage of green job vacancies in England were in different sectors: transportation and storage (53%); utilities (48%); and administrative and support

[21] The reason why there are sales occupations in this chart but not in the analysis of green jobs in the previous section is because of the different coding of occupations between the UK SOC and ISCO. In the former, sales jobs such as brokers and sales representatives are coded in the 3 Associate professional and technical occupation group whereas the ISCO codes them within the sales and customer service occupations group.

services (44%). There were proportionally much larger green job vacancies in England compared to SYMCA in: Public administration and defence (-19 pps); utilities (-10 pps); and human health and social work (-9 pps).

Table 8: Green job vacancies by sector in SYMCA and England (February 2019-December 2021)

Sector (SIC)	SYMCA	England
Agriculture et al	17%	23%
Utilities	37%	48%
Manufacturing	67%	43%
Construction	20%	28%
Wholesale, retail	38%	36%
Transportation and storage	47%	53%
Accommodation and food	53%	32%
Information and communication	47%	40%
Finance and insurance	36%	29%
Real estate activities	29%	32%
Professional, scientific and technical	47%	36%
Administrative and support service	47%	44%
Public administration and defence	0%	19%
Education	35%	36%
Human health and social work	6%	16%
Arts, entertainment and recreation	46%	33%
Other services	33%	32%

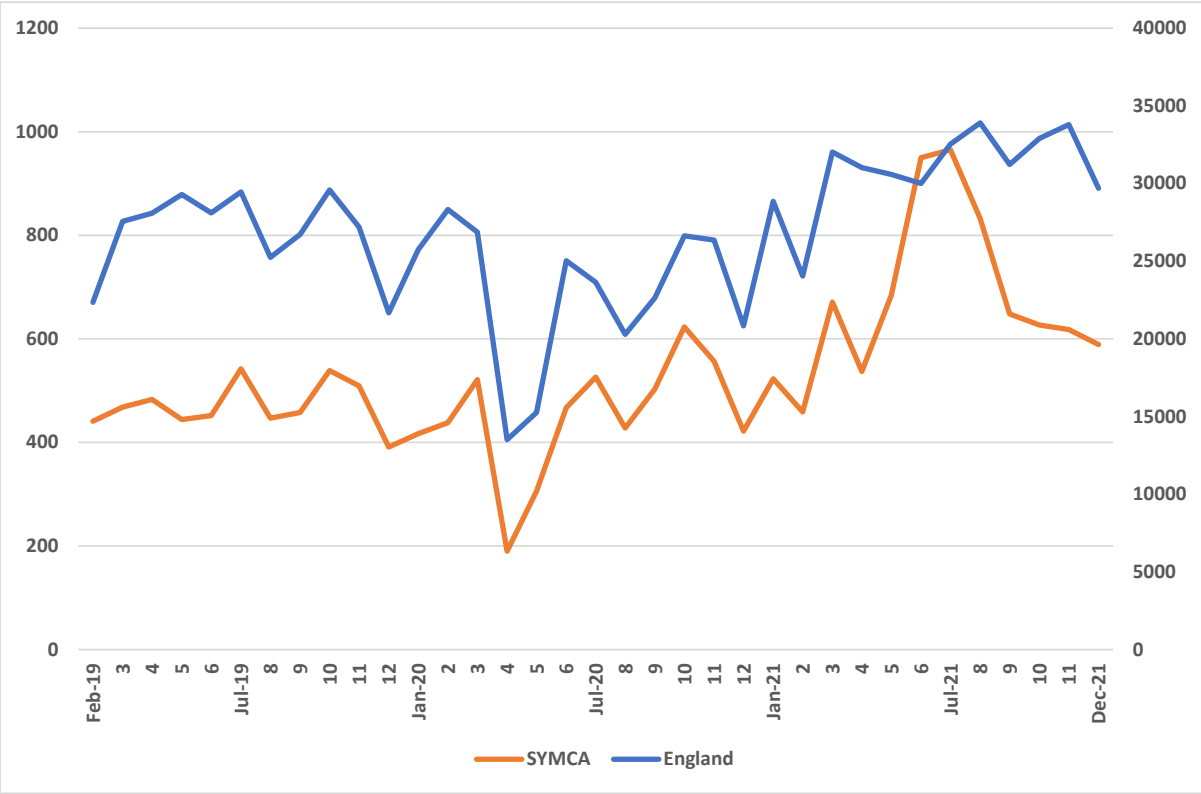
Source: Warwick IER

Figure 9 provides a time series of green job vacancies from February 2019 to December 2021. The Y-axis for SYMCA is on the left and for England on the right.

The trend in job vacancies over the three year period is very similar for SYMCA and England. The chart shows the large fall in job vacancies due to the first lockdown at the end of March 2020. It also shows the gradual (albeit uneven) recovery in job vacancies since then.

The largest difference occurs in June 2021 when there was a 40% increase in a month in SYMCA, which was then followed by a large fall of in August and September 2021. It is not known why this large change took place in SYMCA.

Figure 9: Total vacancies for green job occupations in SYMCA and England (February 2019-December 2021)



Source: Warwick IER

Figure 10 shows the time series of green and non green job vacancies from February 2019 to December 2021. Green job vacancies are on the left Y-axis and non green vacancies on the right. The trends are broadly similar with two exceptions. Firstly, non green job vacancies grew more strongly out of the first lockdown in the summer of 2020. Secondly, it was green job vacancies which caused the spike in summer 2021 but then declined thereafter.

Figure 10: Total green and non green job vacancies SYMCA (February 2019-December 2021)

Source: Warwick IER

Table 9 shows the top 20 specific green occupations for vacancies in SYMCA over the period February 2019 to December 2021. Most of the green jobs are green enhanced jobs where the skills of people working in these occupations have been, or will need to be, enhanced. Fourteen of the top 20 are such occupations.

Five of the remaining occupations are those where the occupations will be in increased demand due to the green economy but won't necessarily require any changes to the job. Only one occupation - science, engineering and production technicians nec. – is a new and emerging green occupation.

Warehouse operatives (14.4%) has the most vacancies. The top ten occupations account for 45% of all green job vacancies, whilst the next ten account for a further 16%.

Table 9: Top 20 green job vacancies by green job type in SYMCA (February 2019-December 2021)

Occupation (4-digit)	Green job type	% of green job vacancies	Total vacancies
Warehouse operatives	Increased demand	14.4%	2904
Programmers and software development professionals	Enhanced	6.6%	1327
Customer service occupations n.e.c.	Increased demand	4.4%	889
Finance and investment analysts and advisers	Enhanced	3.6%	720
Chartered and certified accountants	Enhanced	3.5%	705
Secondary education teaching professionals	Enhanced	3.0%	610
Metal working production and maintenance fitters	Enhanced	2.8%	574
Large goods vehicle drivers	Increased demand	2.5%	500
Primary education teaching professionals	Enhanced	2.4%	477
IT user support technicians	Increased demand	2.2%	454
Delivery drivers and couriers	Enhanced	2.0%	404
Higher education teaching professionals	Enhanced	1.9%	381
Records clerks and assistants	Increased demand	1.8%	361
Other vocational and industrial trainers	Enhanced	1.6%	329
Vehicle technicians, mechanics and electricians	Enhanced	1.4%	290
Production managers and directors in manufacturing	Enhanced	1.4%	282
Science, engineering and production technicians n.e.c.	New and emerging	1.4%	280
Solicitors and lawyers	Enhanced	1.4%	279
Metal machining setters and setter-operators	Enhanced	1.4%	276
Legal professionals n.e.c.	Enhanced	1.3%	260

Source: Warwick IER

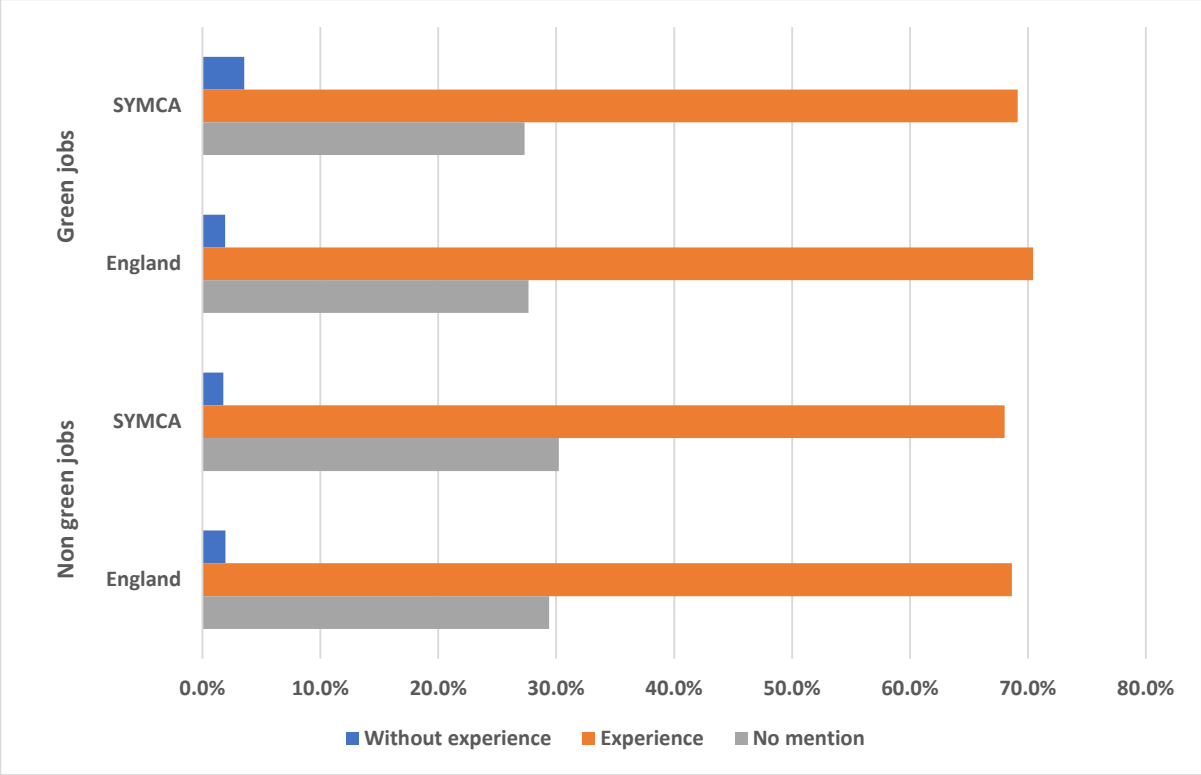
4.3. Employers' green job hiring criteria

This section uses information in the vacancy database to explore employers' hiring criteria with data presented on experience and skills.

Figure 11 shows whether green and non green job adverts state that prior experience is required or not. [22]

Most job adverts in SYMCA and England – green and non green – require job experience, around 70% in all cases. Very few job postings (around 2%-4%) state that none is required. Just over one quarter (27%-30%) don't mention whether experience is required or not. This again reinforces the point that to a large extent, green jobs are similar to non green jobs.

Figure 11: Whether prior experience is stated in job postings, SYMCA and England (February 2019-December 2021)



Source: Warwick IER

[22] The 'No mention' category indicates that nothing in the vacancy regarding job experience requirements. 'Without experience' means that the employer explicitly mentioned that no experience is required to apply for the vacancy. 'Experience' indicates that the employer explicitly mentioned that experience is required to apply for the vacancy.

Table 10 shows the top 20 skills sought in green and non green job postings in SYMCA[23]. Each skill is assigned a category based on the nature of that skill or knowledge[24]: cross-sector[25]; sector-specific[26]; or transferable[27].

Most of the top 20 skills are different for green and non green jobs. Only six skills are common to both types of jobs: communication; customer service; accounting; project management; financial management; work independently; and work as a team.

The top five skills relevant to green jobs specifically were: logistics; quality standards; SQL; JavaScript; accounting; and energy management. Whereas the top five skills relevant to non green jobs specifically were: disability care; primary care; nutrition; logistics; project management; and office administration.

These skills reflect the nature of the occupations in the green and non green designation, for example, no caring and personal service occupations are within the three green job categories. Most green occupations are managerial, professional, associate professional or skilled trade.

Whilst the skills may vary between green and non green jobs, most of the green job posting skills are cross-sector (12 of the 20) compared with just under half for non green jobs (9 of the 20). Non green job postings are more likely to mention sector-specific skills (9 of the 20) compared to green jobs (6 of the 20). Very few job postings – green and non green – require occupation-specific or transferable skills.

[23] The skill categories presented in this table are based on the ESCO classification. See, ESCO (2017) ESCO Handbook: European Skills, Competences, Qualifications and Occupations. Brussels: European Union.

[24] Skill is defined as "the ability to apply knowledge and use know-how to complete tasks and solve problems. Skills are described as cognitive (involving the use of logical, intuitive and creative thinking) or practical (involving manual dexterity and the use of methods, materials, tools and instruments)". Knowledge refers to 'the body of facts, principles, theories and practices that is related to a field of work or study. Knowledge is described as theoretical and/or factual and is the outcome of the assimilation of information through learning' (ESCO, 2017, p.6).

[25] Skills or knowledge that can be applied across a range of sectors, such as communication and team work.

[26] Sector- or occupation specific skills/knowledge refers to skills/knowledge that is specific to one sector or sector but are relevant for more than one occupation within a sector, or for one occupation across several sectors.

[27] Transferable skills refer to those skills that are relevant to a broad range of occupations. This category includes social interaction, attitudes and values, critical and innovative thinking, among other skills (ESCO, 2017, p.6).

Table 10: Top 20 skills in most demand in green and non green job postings in SYMCA (February 2019-December 2021)

Green occupations			Non green occupations		
Skills	**Skill type**	**Frequency**	**Skills**	**Skill type**	**Frequency**
Communication	cross-sector	4537	Communication	cross-sector	6550
Customer service	sector-specific	2054	Customer service	sector-specific	2354
Logistics	cross-sector	1776	Accounting	cross-sector	789
Quality standards	cross-sector	1020	Disability care	sector-specific	709
SQL	sector-specific	757	Primary care	cross-sector	484
JavaScript	sector-specific	714	Nutrition	sector-specific	451
Accounting	cross-sector	572	Logistics	cross-sector	432
Energy management	cross-sector	533	Project management	sector-specific	325
Project management	sector-specific	397	Office administration	sector-specific	307
Mechanical engineering	sector-specific	325	Work independently	transferable	296
Electrical engineering	cross-sector	273	Psychology	cross-sector	290
Financial management	cross-sector	260	Statistics	cross-sector	278
Computer science	cross-sector	198	Financial management	cross-sector	273
Work independently	transferable	196	Provide learning support	sector-specific	257
Risk management	cross-sector	193	Show empathy	sector-specific	255
Team building	occupation-specific	193	Person centred care	sector-specific	235
Work as a team	cross-sector	173	Physiotherapy	sector-specific	212
Contact customers	sector-specific	172	Specialist nursing care	occupation-specific	210
Provide leadership	cross-sector	171	Support managers	cross-sector	195
Hydraulics	cross-sector	147	Work as a team	cross-sector	188

Source: Warwick IER

As was mentioned in Section 1, there are more 'purist' definitions of green job and thereby skills, that can be applied to the job postings data. Table 11 applies such a purist definition of green skills[28] to the jobs postings data. As the table shows purist green skills are not frequently

[28] Strietska-Ilina, O., Hofmann, C., Haro, M.D., & Jeon, S. (2012) Skills for green jobs: A global view. Geneva: International Labour Organisation.

mentioned. However, three skills - environmental protection/processes; recycle; and renewable energy – would make it into the top 20 green job skills in Table 10 (see above).

Environmental protection/processes is the skill most frequently mentioned (46% of all purist green skill mentions), followed by recycling (16%) and renewable energy (14%).

Table 11: Purist green skills in green job postings in SYMCA (February 2019-December 2021)

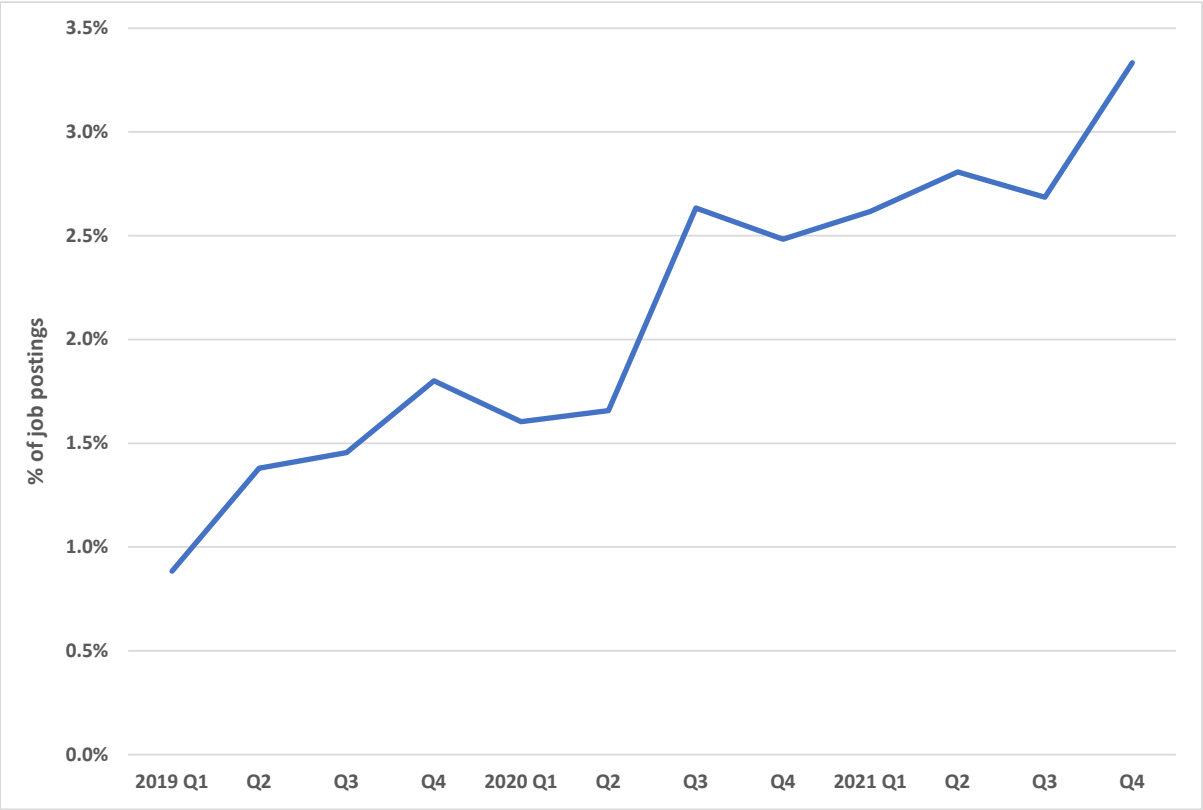
Skills	Frequency
Environmental protection/processes	672
Recycle	230
Renewable Energy (wind, turbine, wave, hydrogen, etc. power generation)	207
Decarbonisation/ low carbon emissions	83
Solar technologies	68
Climate Change	68
Public Transport Planning	41
Segregation	27
Cascading	17
Waste Monitoring	10
Biodiesel	5
Materials Specification	4
Hazardous Waste Management	4
Leak Detection	4
Green Manufacturing	3
Water Management Systems	3
Effluent Treatment	1
Waste Audit	1
Life Cycle Costing	1

Source: Warwick IER

Figure 12 shows the number of jobs postings that use such purist green terms in the job description. Whilst still only a small proportion of job postings contain such terms (3.3% in Q4 of 2021) there has been a significant increase over the past three years. At the beginning of the period less than one percent of jobs included such green skill terms.

Most quarters have seen a one pp increase from the same quarter in the previous year (e.g. Q3 in 2019 compared to Q3 in 2020).

Figure 12: Purist green skill terms used in job postings, SYMCA (February 2019-December 2021)

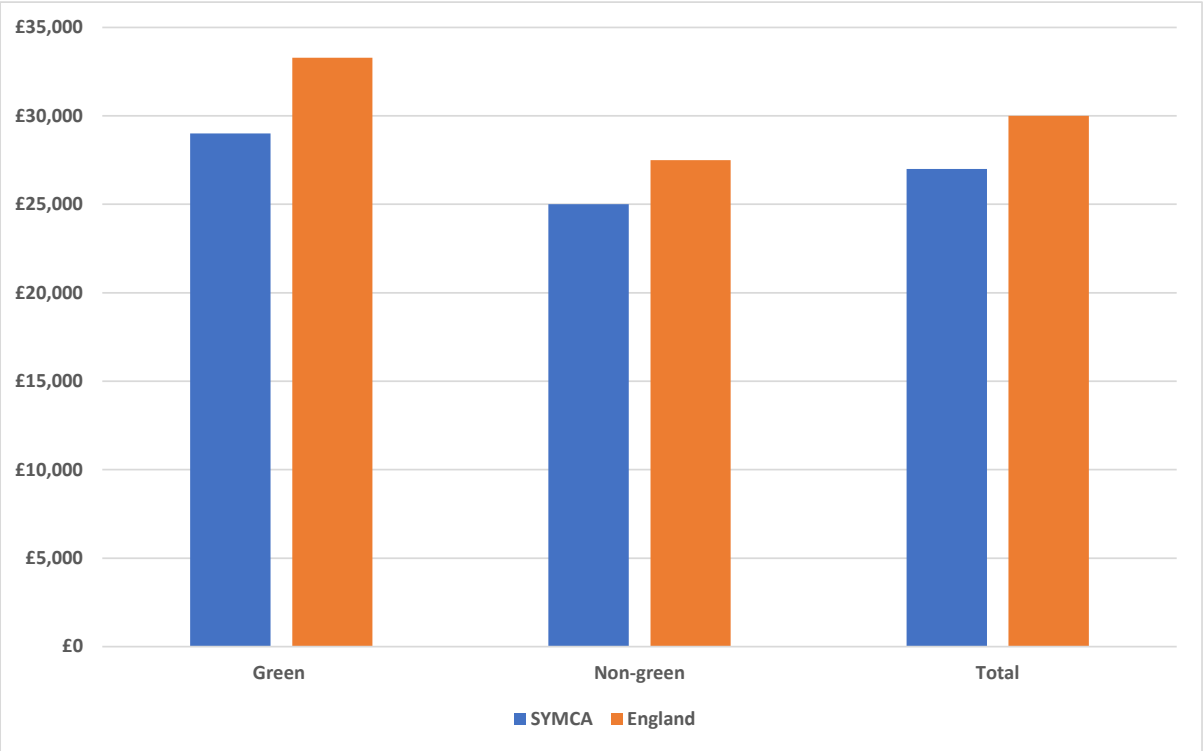


Source: Warwick IER

4.4. Wages

Figure 13 shows the median annual wages mentioned in job postings for SYMCA and England. Overall, job postings in SYMCA have annual median wages that are 90% below the national average (£27,000 compared to £30,000). The difference is narrower for non green than green jobs. In SYMCA non green jobs are paid at 91% of the national average and green jobs 87%.

Figure 13: Median annual wages in job postings, SYMCA and England (February 2019-December 2021)



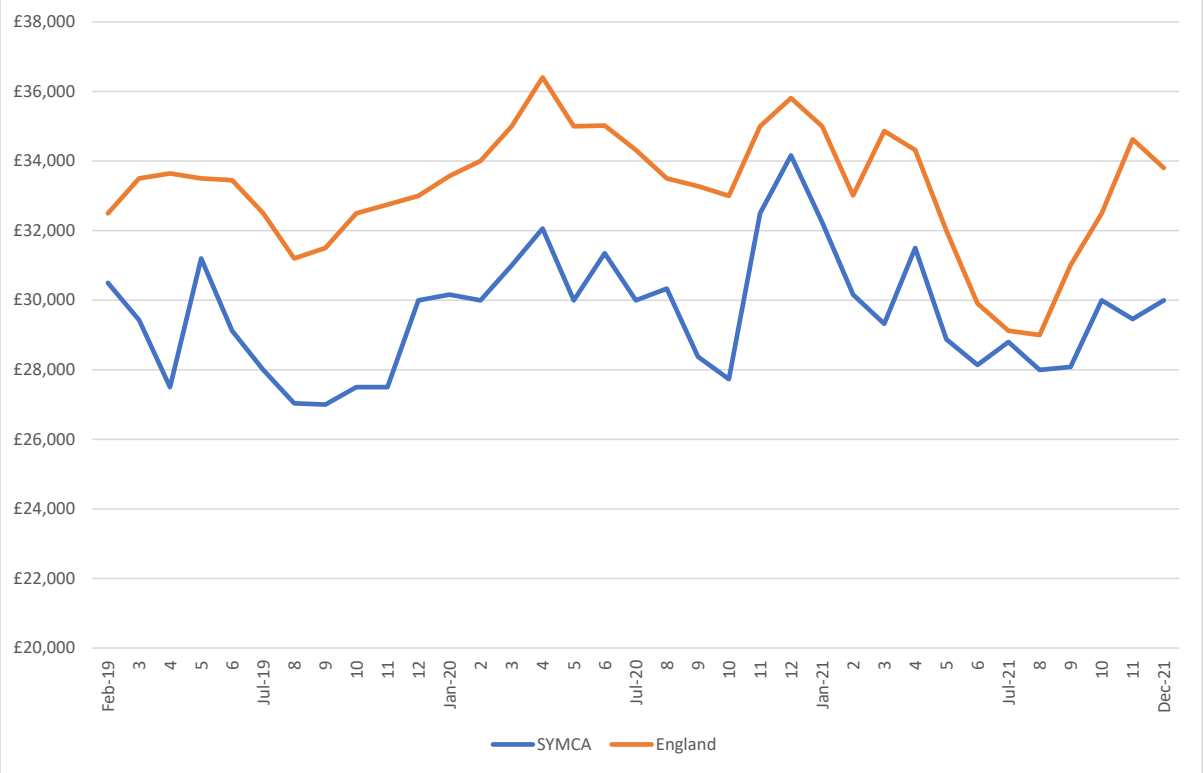
Source: Warwick IER

Figure 14 shows how green job wages have changed over the past three years in SYMCA and England. In the first period (February-December 2019) the average gap was a -£4,114 wage deficit in SYMCA. However, this has narrowed over the three years so that in January-December 2021 the average wage gap was -£2,881.

The largest narrowing of the green job wage gap came towards the end of 2020, as the UK entered its second lockdown. In the first ten months of 2020, the average gap was -£4,209, whereas it was -£2,302 between November 2020 and January 2021.

The gap narrowed due to a larger decrease in the median wage in England. Median wages also fell in SYMCA during the first eight months of 2021, but not as much as in England. Since August 2021 wages increased, but at a much faster rate in England.

Figure 14: Median annual wages in job postings, SYMCA and England (February 2019-December 2021)



Source: Warwick IER

4.5. Summary

Based on an inclusive definition of green jobs, around 45% of SYMCA job vacancies were for green jobs, which is very similar to England. The trend in job vacancies over the three year period (February 2019-December 2021) is very similar for SYMCA and England.

In both areas, most green job vacancies are for green enhanced occupations. The occupation distribution of green jobs in SYMCA is very similar to England, except that SYMCA has a higher proportion if vacancies in skilled trades and elementary occupations for green jobs.

Green job vacancies in SYMCA are most common in manufacturing, and accommodation and food, and this is much higher than in England. England tends to have greater proportions of green job vacancies in transportation and storage, and utilities.

In SYMCA, most of the detailed green job occupation vacancies are for green enhanced jobs. The top ten detailed occupations account for 45% of all green job vacancies, whilst the next ten account for a further 16%.

Job postings for green and non green jobs share a number of skills, such as, communication, and customer service. The top five skills relevant to green jobs specifically were: logistics; quality standards; SQL; JavaScript; accounting; and energy management. Most skills for both green and non green jobs are cross-sector.

Applying a more purist definition of green skills shows that three skills - environmental protection/processes; recycle; and renewable energy – are the most sought. Whilst these

purist green skills only appear in 3% of job postings, this proportion has increased significantly over the past three years.

Green wages are higher than non green wages in both SYMCA and England. England wages are higher than SYMCA but the gap is narrower for no green jobs. The gap between SYMCA and England did narrow, but it has started to widen since the summer of 2021.

5. Conclusions

The analysis of green jobs and skills is not an exact science. This is because there are different definitions of green jobs – purist and inclusive – which lead to different estimates.

On a more purist definition, there were 3,902 green jobs in SYMCA, this amounts to less than 1% of total employment, with most working in one sector: other energy efficient products. Such green jobs also make up small proportions of employment in any sector. Using a broader more inclusive definition increases the number of green jobs to around one in five (17%) of total employment in SYMCA. Most of these represent existing jobs that require enhancements to their competencies in order to contribute to the green economy. They are mostly in managerial, professional, associate professional and skilled trade occupations. As most green jobs are green enhanced occupations. This means that the green economy will require a range of transferable, functional and technical skills that for the most part are existing skills and knowledge that will require enhancing and/or updating rather than a bank of new competency requirements. They have much in common with the skills and knowledge in non green jobs.

Green jobs are a much larger proportion of vacancies (45%) than employment (17%). This may suggest that green jobs are in more demand. Green jobs in both SYMCA and England have increased since the first UK lockdown ended in Summer 2020. However, in SYMCA non green jobs were in greatest demand post-lockdown and, apart from certain peaks and troughs, this trend has continued.

In both SYMCA and England, green jobs pay more because they tend to be located in better paid occupations i.e. managerial, professional and associate professional occupations. Therefore it is not the green content of jobs per se that attracts a wage premium but the fact that most green jobs are in better paid occupations.