# Green Jobs in Scotland: An inclusive approach to definition, measurement and analysis

By

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## Executive Summary

The Scottish Government declared a climate emergency in April 2019 and subsequently increased the legislative ambition for Scotland to reach zero greenhouse gas (GHG) emissions by 2045 and 75 per cent reduction by 2030. In response, the Climate Emergency Skills Action Plan[1] (CESAP) was developed by SDS and published alongside the SG's Climate Change Plan update in December 2020. The CESAP is underpinned by a multi-agency response, including Scottish Government (SG), Economic Development Agencies, Scottish Cities Alliance (SCA), Industry Bodies, Unions, and the SFC.

To ensure that everyone has a chance to benefit from the transition to net zero, it is critical that we develop a better understanding of what constitutes a green job and determine what the current and future green jobs and skills needs are for people living, learning and working in Scotland.

**This research provides a new evidence-base that aims to do just that i.e. through a new, inclusive definition of green jobs, estimate the extent of and demand for green jobs in Scotland.** The research offers a significant new support tool for Scottish policy development and policy evaluation in the transition to a net zero economy. Drawn from a body of existing research and adapted to Scottish circumstances, it offers a robust method of monitoring and assessing the development of green jobs in Scotland. An inclusive definition is important because it takes account of the significant impact the transition to net zero will have on a much broader range of jobs.

During the transition to net zero, this research defined three different categories of Green jobs:

1. **New and emerging**
2. **Enhanced Skills and Knowledge**
3. **Increased demand**

**New and Emerging:** The impact of green economy activities and technologies creates the need for unique work and worker requirements, which results ***in the generation of new occupations***. These new occupations can be entirely novel or 'born' from an existing

[1] https://www.skillsdevelopmentscotland.co.uk/media/47336/climate-emergency-skills-action-plan-2020-2025.pdf

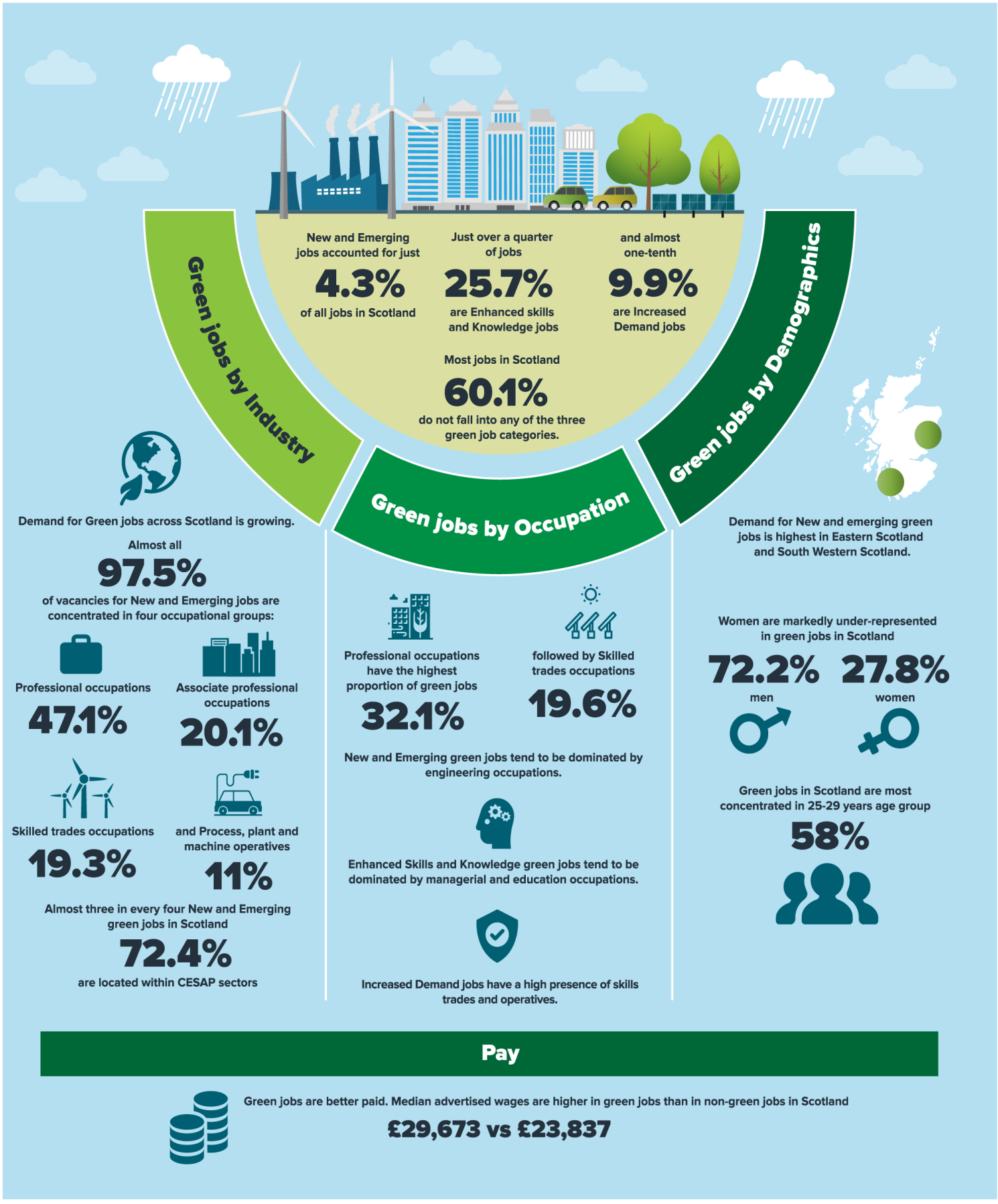
occupation. An example is solar system technicians who must be able not only to install new technology but also to determine how this technology can best be used on a specific site.

**Enhanced Skills and Knowledge**: The impact of green economy activities and technologies can result in ***significant change to the work and worker requirements of existing occupations***. This impact may result in an increase in demand for these occupations. The essential purposes of the occupation remain the same but tasks, skills, knowledge and external elements, such as credentials, have been altered. An example is architects, an occupation in which greening has increased knowledge requirements pertaining to energy efficient materials and construction, as well as skills associated with integrating green technology into the aesthetic design of buildings.

**Increased Demand:** The impact of green economy activities and technologies can ***increase employment demand for some existing occupations***. However, this impact does not entail significant changes in the work and worker requirements of the occupation. The work context may change but the tasks do not. An example is the increased demand for electrical power line installers and repairers related to energy efficiency and infrastructure upgrades.

This research has developed a new green occupational definition, or a ‘GreenSoc’. The GreenSoc is based on an adaption of the three types of green occupations, and then applied to Labour Force Survey (LFS) data and data scraped from job vacancy websites. Analysis of web-scraped job vacancy data provides a picture of dynamics of change in ‘real time’, and is especially useful given that green jobs are an unfolding development within the labour market i.e. job vacancy data can usefully capture changes in jobs as signalled by the demands from employers.

## Key Findings



## Limitations

Challenges remain in developing a comprehensive GreenSOC for Scotland and thereby better estimating the extent of green jobs. This research highlights the problem of understanding what businesses do in terms of green and non-green economic activity because of a lack of sensitivity in the Standard Industry Classification (SIC). A similar problem exists with Standard Occupational Classifications (SOC). SOC2020 4-digit level is blunt in terms of providing detailed information on the exact tasks, skills and knowledge of any occupation. This problem exists for a number of the occupations within the classification used in this research. What is ideally required to better inform and drive awareness and action to support reskilling and upskilling is data disaggregated at the 5-digit or even 6-digit level within the SOC. Given the data limitations, the number of green jobs in Scotland is likely to be an overestimate.

## Recommendations

The research undertaken for this report has demonstrated proof of concept for the new GreenSOC. Furthermore, a number of recommendations arise:

- The new GreenSoc is suggested as a method for estimating green jobs in Scotland.
- Analysis of green jobs and skills should incorporate web-scraped job vacancy data.
- Develop and maintain a Scotland-focused green skills taxonomy drawing on repeat web-based job postings data scraping.
- Map the green skills of the GreenSOC onto existing skills frameworks/maps developed for use in the Scottish context.
- Apply the GreenSOC to analyses of regions and industries within Scotland.
- Explore the GreenSOC further in relation to Fair Work in Scotland.
- Encourage the greening of jobs in all sectors.

# 1. Introduction

This report provides a definition of green jobs and then estimates the extent of and demand for green jobs in Scotland. Environmental resource depletion and climate change render a range of current economic activity unsustainable.[2] International commitment to greener, cleaner production and consumption is not new[3] but there is now a sense of urgency of the need to address ecological challenges through sustainable economies and societies. This earnestness is embodied in the UN's *Race to Zero* campaign, which calls for national governments to set ambitious targets for net zero carbon emissions. *Race To Zero* also usefully captures a more general shift in global and national policy focus to better support and create 'decent' jobs/'fair' work and deliver inclusive growth:[4]

> 'Race To Zero is a global campaign to rally leadership and support from businesses, cities, regions, investors for a healthy, resilient, zero carbon recovery that prevents future threats, creates decent jobs, and unlocks inclusive, sustainable growth'

The Scottish Government has set an ambitious target of net zero carbon emissions by 2045 and a 75% reduction by 2030. Its 'just transition' agenda, and ongoing commitment to 'Fair Work',[5] aims to help deliver 'a fairer, greener future for all'.[6] In the recent past, green growth was positioned as integral to economic recovery following the global financial crisis of 2007-2008.[7] Now in Scotland, the transition to net zero is aligned to the Government's COVID-19 recovery and economic transformation strategies[8] and with a sharp focus on jobs and skills:[9]

> 'The economic downturn and consequent unemployment brought about by COVID-19 has provided an opportunity for a green recovery, with Scotland's strategic response to recovery and renewal reinforcing the need for a focus on jobs and skills'

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2 European Commission (2011), ILO (2015), IPCC (2022).

3 UNFCCC (2006).

4 The UN https://unfccc.int/climate-action/race-to-zero-campaign

5 Scotland's Fair Work Convention (2016) defines Fair Work as effective voice, opportunity, security, fulfilment and respect https://www.fairworkconvention.scot/

6 Scottish Government https://www.gov.scot/groups/just-transition-commission/

7 Martinez-Fernandez (2010), Poschen and Renner (2015).

8 Scottish Government (2021), Scottish Government (2022)

9 SDS (2020).

Whilst a sharper policy focus on jobs and skills is to be welcomed, announcements about the number of green jobs that will be created in the transition to net zero are often ambitious and, to date, typically light on detail. Indeed, projections about the impact of green jobs and skills tend to run ahead of the evidence. As significant government support will likely be required to deliver it,[10] more evidence is needed on how the transition to net zero is changing demand for jobs and skills.[11]

Scotland has a relatively 'joined-up' skills system and the recently established Climate Emergency Skills Action Plan (CESAP) Implementation Steering Group reflects its collaborative approach to skills planning and action. Scotland is therefore well-placed to ensure that the generation of the necessary evidence will help support more informed and responsive policy and practice around green skills and jobs – including consideration of implications and actions needed to better anticipate and support reskilling and upskilling. In particular, there is a need to understand, and have a more a detailed analysis of, the green workforce in Scotland now, and assess changing demand for green jobs and skills. It is important to ensure that support for skills development and (re)training matches investments in green innovation to avoid skills gaps and shortages, and deliver an inclusive transition. A focus on key sectors is also needed, as is the disaggregation of regional and equalities data. Evidence is needed too about the impact of COVID-19 on the demand for green jobs.

This report provides a new evidence-base that will help 1) build a better understanding of future job and skills needs to support Scotland's transition to net zero, and 2) drive awareness and action to support reskilling and upskilling. Section 2 next discusses the challenges in defining green jobs, using this discussion to offer an amended new green job classification (GreenSOC). Section 3 outlines the methodological approach used to identify the extent of and demand for green jobs in Scotland. Section 4 presents findings on the extent of green jobs in Scotland and Section 5 findings on demand for green jobs in Scotland. The final section summaries the key lessons from the research, makes a number of caveats and offers a number of recommendations.

[10] Hogarth (2012), Lenox and Duff (2021), Sofroniou and Anderson (2021).

[11] Gagliardi et al. (2016), Poschen and Renner (2015).

## 2. Defining green jobs

A key challenge in providing the evidence base is that, to date, there is no agreed definition of a green job.[12] Attempts to define green jobs generally fall into one of two main camps: the 'purist' camp and the 'inclusive' camp.[13] Purist definitions are narrower in scope[14] and typically focus on a few industrial sectors such as the 'environmental sector' and/or specific jobs within these sectors.[15] Inclusive definitions, on the other hand, take account of the significant impact the transition to net zero will have on a much broader range of jobs. This section discusses these definitions and provides an adapted definition of green jobs that offers a new GreenSOC appropriate to Scotland.

### 2.1. Challenges in counting green jobs

In trying to define green jobs, an important distinction between product and production process needs to be emphasised. Businesses are concerned with production processes that create an end product – that is, a good or service. A job might involve, for example, welding in the manufacture (production) of wind turbines (product). This distinction commonly features in current approaches to classify and calculate green jobs.

#### *2.1.1. Products approach*

The UK's Standard Industry Classification (SIC) is a classification of the principal economic activity of a production unit, usually a business. The products that businesses make are often mapped by researchers onto these industries, e.g. companies making wind turbines are grouped into the wind turbine industry. Similar industries are then sometimes clustered to suggest a 'sector', e.g. most obviously in the past, the 'manufacturing sector'. This approach is common in trying to classify green jobs.

Of course not all products, whether a good or service, directly contribute to net zero. Thus, a wind turbine is a green good but a television not; building insulation advice is a green service but a haircut not. This distinction is used to identify a 'green sector' or 'green economy' consisting of a selection of industries that have a high proportion of businesses focused on

[12] ILO (2018), ONS (2021).

[13] Sofroniou and Anderson (2021).

[14] Renner et al. (2008).

[15] Hogarth (2012).

producing environmental goods and services. To estimate the number of green jobs, some researchers simply sum the number of employees within the selected industries or sector.[16]

This 'products-to-industries/sector approach' is narrow or 'purist' in its approach to counting green jobs.[17] It is an approach adopted in its estimation of green jobs in Scotland by Transition Economics[18], by the UK Office for National Statistics (ONS) in its annual Low Carbon and Renewable Energy (LCREE) Survey, and by the EU through Eurostat's Environmental Goods and Services Sector (EGSS) classification.[19] By way of example, after consultation with experts about which industries to include, the LCREE survey was targeted at only those businesses in industries likely to have low carbon and renewable energy economic activity.[20]

However, this approach can create 'false positives'[21] as current industrial classification schemes, such as SIC, are not able to sufficiently distinguish between businesses producing green and non-green products.[22] This problem can be compounded if only a high-level of SIC is used, providing only the general economic activity of businesses rather than detail of that activity. One method to overcome this problem is to cross-reference product data with other data, for example company tax reports.[23] However limitations remain.

Moreover, what this products-to-industries/sector approach fails to acknowledge is that there can be jobs within traditional, non-green industries, such as legal services, that also produce goods or services that contribute to net zero. In this respect, to return to the LCEE example, it is telling that the survey was not sent to businesses in all industries in the economy regardless of activity and therefore it is not able to deduce if those businesses also contain some green jobs. Such jobs thus escape detection and so are not counted, potentially giving 'false negatives' in the number of jobs classed as green.

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16 Georgeson and Maslin (2019).

17 Hogarth (2012), Sofroniou and Anderson (2021).

18 Transition Economics (2021).

19 Georgeson and Maslin (2019).

20 See https://www.ons.gov.uk/economy/environmentalaccounts/methodologies/lowcarbonandrenewableenergyeconomylcreesurveyqmi

21 Peters et al. (2011).

22 Peters et al. (2011).

23 Georgeson and Maslin (2019).

### *2.1.2. Production approach*

A second approach focuses on the production process. The starting point is recognition that some businesses not usually categorised as part of the green sector ought to be included because they are part of the supply chain of those businesses whose end product is regarded as green. This possibility is recognised by Transition Economics when it flags that some industries that are included in its calculation are not directly green end product but contribute to that end product. Its estimation then includes steel manufacture for example because, as a part of the supply chain, steel manufacture can be used to make wind turbines to generate renewable energy.

This extension is useful but partial because there is an additional, very important point that needs to be made about production: ideally, all production processes in whatever industry, whether part of the green sector supply chain or not, should contribute to net zero aims. What this approach does not consider is the production processes *within* both the renewable energy and steel industries, to use the Transition Economics example, and whether these processes also contribute to decarbonisation.

It might be that the production process used in businesses making green products is not itself green. Take, for example, an administrator working for a business that makes solar panels. The company is part of a green industry. However, if the secretary's work primarily involves computer usage drawing on non-renewably sourced electricity, it is hard to classify this job in itself as being green. Classification of this job as a green job, even if within a green industry, would create another form of 'false positive' in estimates of the number of green jobs. Conversely, there can be production processes in traditional, non-green industries that are environmentally friendly. Indeed, traditional industries, such as steel manufacturing, also need to change and are being encouraged to change with the push to net zero, and harness technological innovations to produce 'clean steel' for example.[24] Not including jobs in these traditional industries, as they support the transition to net zero, will result in another form of 'false negative' in the estimation of the extent of green jobs.

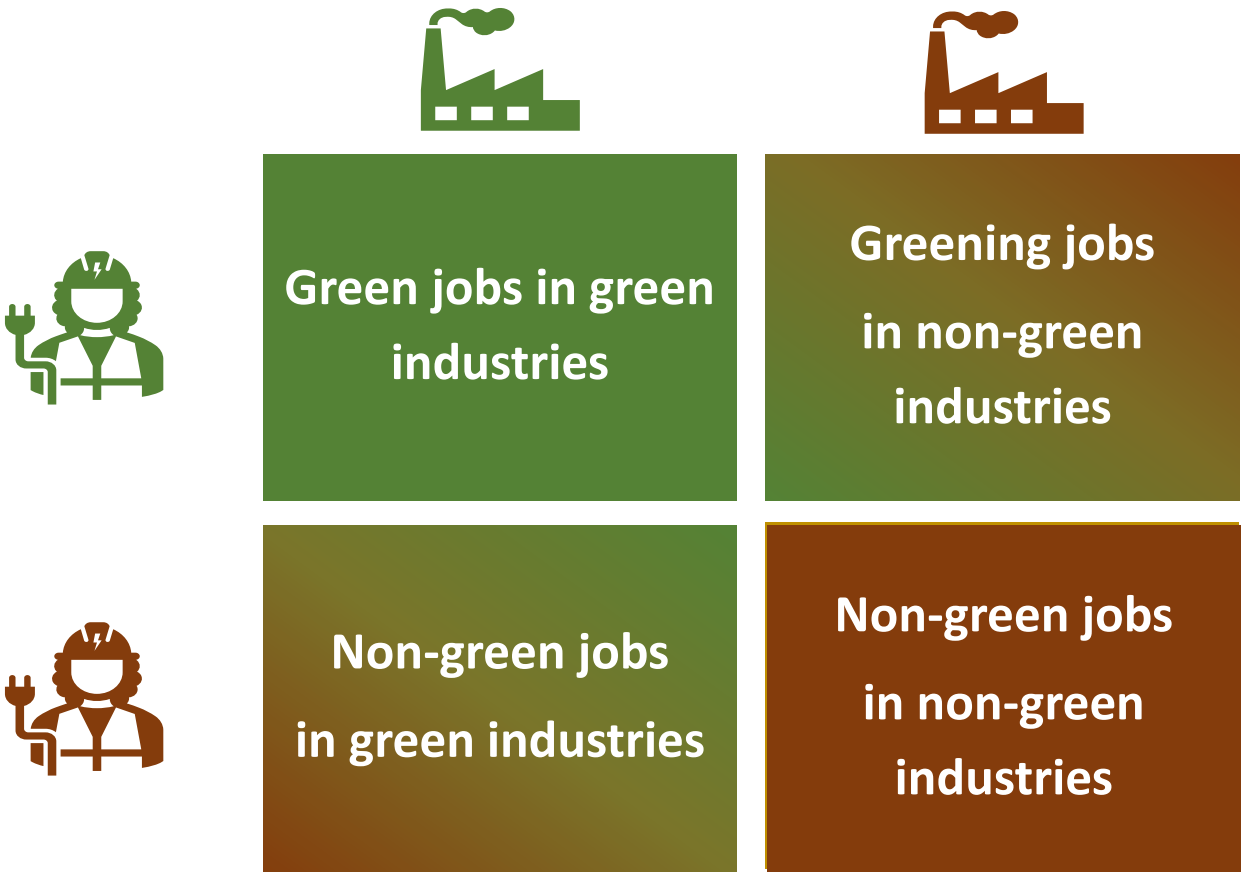
### *2.1.3. Products and production processes matter*

There cannot be a simple binary divide between, on the one hand, new, green industries and on the other hand, traditional, non-green industries. All industries need to contribute to net

[24] European Commission (2019).

zero targets and the green agenda must be mainstreamed in all economic activity. As such the production processes, not just the products, of the new green industries must comply with net zero aims. Likewise, the production processes of traditional non-green industries must also change to become more environmentally friendly through the use of renewable energy and/or energy efficiency for example. The new technologies and regulations that support the development of the green economy mean that there will be not just new occupations but also changes to the way that some existing occupations work. Occupations within traditional industries, whilst not green jobs in the narrow, purist sense, will experience 'greening'[25] and need to be included in estimates of green jobs. As the matrix below (Figure 2.1) shows, there are thus four types of jobs that need to be recognised in estimates of green jobs: 1) green jobs in what is regarded as the green industries or sector, 2) non-green jobs in these green industries or sector, 3) non-green jobs in the non-green industries, and 4) greening jobs in these non-green industries.

**Figure 2.1: Four types of jobs that need to be recognised in estimates of the extent of green**




[25] Dierdorff et al. (2009).

## 2.2. Challenges in capturing green skills

Much debate about the transition to a green economy or net zero economy is premised on job creation. However, as with any innovation, there will likely be job destruction as well as job creation and the issue will be the net effect on jobs.[26] Such debate is therefore focused on the quantitative impact on jobs – that is, whether the stock of jobs will rise or fall as a result of the transition to net zero. At the same time, as we noted above, there will also be qualitative changes to jobs arising from the transition. These qualitative changes occur because new 'know-how' is required in those jobs which emerge out of or develop within new green economic activities.

For Consoli et al. (2016) the focus is skills and whether the skill levels required of green jobs will be higher, lower or expanded compared to traditional, non-green jobs.[27] Much in the way that developments in ICT shaped the demand for jobs and skills (skills-biased technological change) from the 1970s and 1980s onwards,[28] efforts to reduce carbon emissions is altering demand for jobs and skills (skills-biased green change) – and over time likely to affect all jobs to some extent.[29] As a consequence, and resonating with the point made earlier about the greening of some jobs, an inclusive definition of green jobs is needed to better map, anticipate and address these changes.

### *2.2.1. The importance of skills and knowledge*

In trying to develop a taxonomy of green skills, there are also a number of challenges. A job is an occupation within an industry. It consists of terms and conditions of employment within which work is undertaken by the employee. This work consists of a bundle of tasks, usually carried out by one person, underpinned by skills and knowledge – or, respectively, 'know how' and 'know what'. Jobs are classified into occupational groups on the basis of the skills and knowledge required for competent performance of the associated tasks.[30]

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[26] Muñoz-de-Bustillo et al. (2022).

[27] Consoli et al. (2016).

[28] Acemoglu (2002), Hogarth (2012).

[29] Hogarth (2012), Sofroniou and Anderson (2021).

[30] https://www.eurofound.europa.eu/publications/report/2015/labour-market/upgrading-or-polarisation-long-term-and-global-shifts-in-the-employment-structure-european-jobs,

https://ilostat.ilo.org/resources/concepts-and-definitions/classification-status-at-work/icse18-manual/

A first problem is that skills and knowledge are sometimes conflated, in part because being skilled involves 'knowledgeable practice'.[31] However, skills and knowledge are conceptually and practically distinct. A salesperson, for example, might know what methods by which sales ought to be made but not personally have the skills, or know how, to use that knowledge and make sales.

### *2.2.2. Recognising what types of skills are demanded*

A second problem is that, in the UK context, 'skill' is a very loose term. It can refer to achieved and ascribed skill.[32] To understand what skills are demanded by employers it is important to be aware of both types of skills.

Achieved skill comes through education and training and is usually codified in a qualification, for example a Higher National Diploma (HND) in Electrical Installation. Qualifications then become a proxy for skills, whilst also implicitly including knowledge. Accredited with a qualification, these skills are made 'hard' and can be easily quantified through administrative datasets.

Ascribed skills are people's capacities and capabilities that are socially categorised as a skill e.g. 'teamworking' or 'communication' skills. Traditionally, these skills are less easy to quantify and are often called 'soft', or in the Scottish context, 'meta'[33] skills. However, it is these skills that employers also demand because they can be essential for the successful execution of a task.[34]

Because they are important to doing the job, many employers signal them in job adverts and the text outlining these skills can now be more easily captured through data-scraping web-based adverts.

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[31] Thompson (1989).

[32] Warhurst et al. (2017).

[33] See https://www.skillsdevelopmentscotland.co.uk/media/44684/skills-40_a-skills-model.pdf

[34] Grugulis et al. (2004).

### 2.3. Using the Standard Occupational Classification (SOC)

The bundle of skills and knowledge as well as the entry qualifications of any occupation are listed in the UK's Standard Occupational Classification (SOC). A revised full SOC is published every ten years to take into account the emergence of new occupations. As a supplement to this publication the SOC now makes ad hoc minor amendments on its website to its index as new information about occupations emerge. SOC gives every occupation a descriptor and number. The SOC system also disaggregates the same occupation by level, adding a number as the disaggregation drills down.[35] So, Professionals are Group 2. Within Professionals, the Science, Research, Engineering and Technology Professionals are sub-group 21. Within 21, Engineering Professionals are 212. Within 212, Mechanical Engineers are 2122. The use of this last, '4-digit' level is common in analyses of occupations and their skills, and helpful in classifying green jobs.

As a consequence of the new technologies, there will be new 'know how' (skills) and new 'know what' (knowledge) required within occupations. Capturing both in classifications of green and greening jobs is important, not least because these new and changing skills and knowledge requirements will both need to be reflected in education and training system curricula as they adapt to the transition to net zero. Using the SOC captures these needs in the UK.

### 2.4. Towards a new definition of green jobs for Scotland

The mantra that there is no agreed definition of green jobs is true but changing. There is now increasing academic and policymaking agreement on the need for a broad, inclusive definition of green jobs.[36] Reflecting the points made above, the US Bureau of Labor Statistics argues that a definition of green jobs needs to cover two components:[37]

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

[35] A similar levels of analysis approach exists for the SIC, with the LCREE survey, for example, focused on the SIC 2-digit level.

[36] ONS, (2021), Sofroniou and Anderson (2021).

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

The first component aligns with the product focus that is common in definitions and draws upon industry classifications to delineate where green jobs are. It includes businesses concerned with producing energy from renewable sources or using energy more efficiently for example.

The second component aligns with the production focus and draws upon awareness of the tasks of occupations. It includes jobs concerned with research, development or use of technologies to lessen the impact of production on the environment and resources e.g. involve the use of renewable energy or result in energy efficiency and reduce pollution. The Green Economy programme within the US Department of Labor operationalises this approach using O*NET (Occupational Information Network).[38]

O*NET is a well-resourced classification of occupations that identifies and collates information on occupations in the US including their tasks, skill sets and knowledge use. In essence, it provides rich descriptions of occupations. As part of the Green Economy programme, 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'.[39] This definition allows inclusion of narrowly perceived green jobs but broadens the classification to include the greening of other jobs.

This approach thus takes account of the significant impact the transition to net zero will have on a much broader range of jobs. It provides an inclusive approach to defining green jobs and can underpin methodological frameworks designed to better capture the impact of the transition to net zero on jobs and skills.[40] This approach to defining green jobs identifies three broad categories (or a 'taxonomy') of 'green' occupations i.e. Green New and Emerging Occupations, Green Enhanced Skills and (we would add) Knowledge Occupations; and Green Increased Demand Occupations (see also below Table 3.1).[41]

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

[39] Dierdorff et al. (2019: 3).

[40] Cambridge Econometrics/GHK/Warwick Institute for Employment Research (2011), Hogarth (2012), ONS (2021), SDS (2020), Sofroniou and Anderson (2021).

[41] O*NET 'Green Occupations' https://www.onetcenter.org/dictionary/22.0/excel/green_occupations.html

**Table 3.1: Green occupational categories**

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

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

Drawing on the O*NET approach and its identification of three main categories of 'green' occupations, green jobs are therefore best defined as follows:

Green jobs are jobs that, through an ongoing process of 'greening', can be classified as either 1) new and emerging, 2) subject to significant changes in work and worker requirements, or 3) increasing in demand

### *2.4.1. Adapting the O*NET classification for Scotland*

The O*NET classification system is the global benchmark in its ability to capture the tasks undertaken within and skills and knowledge needed by occupations. The O*NET-derived definition and classification of green jobs, broadly defined, is gaining traction amongst researchers and policymakers.[42] However, any GreenSOC that is to be derived from it needs to adapt the O*NET categorisation and its data gathering for three reasons.

First, O*NET is US-focused and therefore not necessarily sensitive to non-US labour market contexts.[43] Some tasks with their skills and knowledge vary for the same occupation in different countries due to differing regulatory regimes and training and education systems.[44] Thus, it is possible that the tasks that characterise an occupation, and so the skills and knowledge required to execute those tasks, in one country might not hold in another country. For this reason, it is useful to have additional expert input or analysis in non-US countries drawing on O*NET in order to check and, if necessary, amend any US-derived green occupations' classification. This additional input is not unusual in attempts to create new occupational classifications. It was used for example, in finalising the UK's GradSOC[45] and in determining the impact of digitalisation on particular occupations.[46]

Second, more explicit inclusion needs to be made of knowledge within jobs. The current O*NET categorisation of green occupations rightly makes explicit reference to the skills of those occupations. However, all occupations comprise tasks underpinned by skills and knowledge and both O*NET and SOC outline these skills and knowledge. However that important knowledge component of jobs is dropped in current labelling and needs to be instated. Ignoring it would underplay some of the changes occurring to some jobs as a result of the transition to net zero. It may seem like a cosmetic change to include it in the title of this category of occupations but that knowledge component needs to be made explicit in order to signal the importance of knowledge in any understanding of both what constitutes occupations generally and in order not to underplay changes occurring to some jobs as a result on the transition to net zero. Making this label change both aligns with the broader, inclusive definition

[42] Consoli et al. (2019), Green Jobs Taskforce (2021), Valero et al. (2021).

[43] Christoph et al. (2020).

[44] Richard et al. (2012).

[45] Elias and Purcell (2013).

[46] Frey and Osborne (2013).

of green and greening jobs, and helps explain why any particular job is classified as green, greening or otherwise.

Third, whilst data gathering for O*NET in the US is well-resourced compared to similar classification systems in the UK and elsewhere, its classification update, although more frequently than in the UK, can still be limited. Every year, some but not all occupations are reviewed.[47] There is a need therefore for it to be complemented by quicker or at least time sensitive data collection. Green jobs are an unfolding development within the labour market that is continually changing demand for jobs and related tasks, skills and knowledge requirements. A key limitation of O*NET is its inability to sufficiently capture this dynamic.[48] Anticipating changing demand for green jobs and skills therefore requires methodological approaches that can capture the dynamics of change ‘real time’. Using web-scraped job vacancy data can help deliver more effective, timely understanding and so action to support reskilling and upskilling[49], and mitigate against potential issues likely to impede a 'just' transition.

This triple adaption provides a new GreenSOC that is more inclusive, more responsive and more sensitive to Scottish circumstances. It also means that analysis needs to extend beyond the jobs in industries that directly contribute to net zero to other industries and their jobs that indirectly support this aim. In the next section we outline how this approach is operationalised methodologically for Scotland.

47 Handel (2017).

48 Christoph et al. (2020).

49 Cardenas Rubio and Warhurst (2022).

# 3. Methodology

High-level details of the methodological approach and data sources used in this research are outlined in this section.

### 3.1. Data sources

Two reputable data sources were used to analyse the extent of green jobs in Scotland and the demand for these jobs:

- Labour Force Survey (LFS) data conducted by the Office for National Statistics (ONS) (extent). LFS data covers the period 2014 to the third quarter of 2021.[50]
- Web-based job vacancy data, collected by IER from February 2019 (demand). This data addresses time-lag limitations of O*NET i.e. need to capture dynamics of change 'real time'.

### 3.2. Development of a GreenSOC

Dierdorff and his colleagues developed a green occupational taxonomy and mapped these occupations primarily using the US O*NET-SOC 2006 (204 occupational groups are categorised as 'green').[51] This exercise was conducted through a multi-stage research and screening process. Consequently, the US O*NET-SOC 2006 is the starting point for mapping the green occupations with the recently released UK Standard Occupational Classification (SOC) 2020 (UK SOC2020).[52] However O*NET and SOC are not the same and the former has to be translated to align with the latter in order to use it to analyse the Scottish labour market.

Although the O*NET-SOC provides a robust basis for green occupations identification, there are some challenges around the adaptation of this classification into the Scottish context.[53] The O*NET is a US-based system and therefore not necessarily sensitive to non-US labour market contexts generally, and the distinctive characteristics of the Scottish labour market

[50] Note: this period was selected because a previous study of green jobs on Scotland by Sofroniou and Anderson (2021) used LFS data up to 2014.

[51] Dierdorff et al. (2009).

[52] The SOC2020 replaced the SOC2010. SOC2020 introduced three main improvements: 1. a review of the classification of roles as professional or associate professional; 2. reclassification of occupations associated with information technologies; and 3. disaggregation into less heterogenous Unit Groups.

[53] E.g. Sofroniou and Anderson (2021).

specifically. A further challenge is that whilst there are crosswalks[54] between the O*NET and the UK SOC2010 (the old version of the SOC), no crosswalk (comparative/equivalance 'table') is yet available between the O*NET and UK SOC2020. Furthermore, Dierdorff and his colleagues' mapping was conducted in 2009, and it is important to ensure this work is not outdated. In light of these challenges, a number of steps were taken to identify the green occupations in the UK SOC2020.

### 3.3. Green sectors mapping using SIC

The Climate Emergency Skills Action Plan (CESAP) highlights the areas of economic activity that are key to meeting net zero carbon emissions targets. The CESAP qualitatively defined these key sectors and this research project mapped these key sectors into a standard industrial classification in order to estimate the share of people working in them.

The UK SIC 2007 is a framework used to classify businesses' economic activity. It has five levels i.e. it drills down to the 5-digit level.[55] A number of steps were taken to provide an indication of the share of workers in green (CESAP) sectors using the SIC 2007 at the class level (4-digit level).[56] This operationalisation of the CESAP sectors resulted in the following green sectors being identified.

- Engineering (mainly based on 'key sector definitions'[57]).
- Construction (mainly based on 'key sector definitions').
- Energy & waste treatment (based on 'key sector definitions' and complemented with the text mapping)
- Other manufacturing sectors (manufacturing SIC codes not included in the previous categories).[58]

[54] A crosswalk is a comparative/equivalance 'table' that shows the equivalence between two or more classifications.

[55] UK SIC 2007 https://www.gov.uk/government/publications/standard-industrial-classification-of-economic-activities-sic

[56] Level at which the LFS data are coded. In addition to the general guidelines provided by CESAP, a literature review and text mining of the SIC2007 was undertaken to operationalise the qualitative definition of the CESAP sector.

[57] A list of SIC 2007 sectors that SDS previously identified as key sectors.

[58] Categories are mutually exclusive to avoid double counting. Engineering, Construction and Energy & waste treatment categories were prioritised since these categories are based on the 'key sector definitions' developed by SDS. For instance, 'manufacture of batteries and accumulators' was coded as 'Engineering' because SDS previously identified this sector in this category.

- Transport (transport SIC codes not included in the previous categories). This category was complemented with the text mining exercise.
- Agriculture (Section A of the SIC2007).
- Other green sectors (e.g. computer programming activities, agents involved in the sale of agricultural raw materials, etc.) based on Shapira et al.[59]
- All other sectors are referred to as 'all other sectors' in this report.

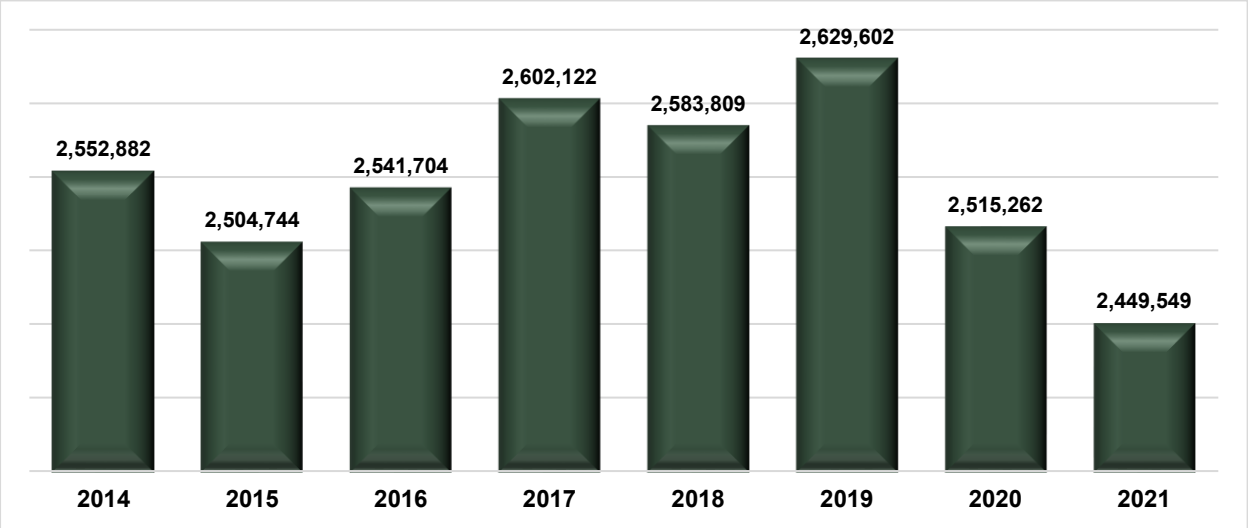
[59] Shapira et al. (2014) list some sectors with relatively large number of companies related to the green economy. Sectors that were not included in the previous categories and were listed by Shapira et al. (2014) composed this group.

# 4. Mapping Green Jobs

Using the first data source (the LFS), this section provides a new estimation of the extent of green jobs in Scotland. In referring to 'green jobs', we use the inclusive definition, which means both jobs that are labelled 'purist' green jobs and those jobs that are recognised as greening.

Total employment in Scotland currently stands at just under 2.5m. In the period 2014 to 2021 (see Figure 4.1), there was a discernible dip in total employment after 2019. However this drop is not as sharp as might have been expected given the economic impact of COVID-19 from 2020.[60]

**Figure 4.1: Yearly total employment in Scotland, 2014 to 2021**




*Source: Labour Force Survey*

## 4.1. Green jobs

Of the total 2.5m jobs in Scotland, just over 100,000 (109,645) are new and emerging green jobs.[61] However some caution needs to be exercised with this figure. Using the SOC2020 4-digit level, current LFS data does not provide sufficient detail of the specific economic activity – green or non-green – of many of these jobs. For example, Mechanical Engineers are classified as a New and Emerging green job as they work on both new products and processes focused on renewable energy or energy efficiency. Including all Mechanical Engineers in this category is possibly an over-estimate as not all Mechanical Engineers will focus on these

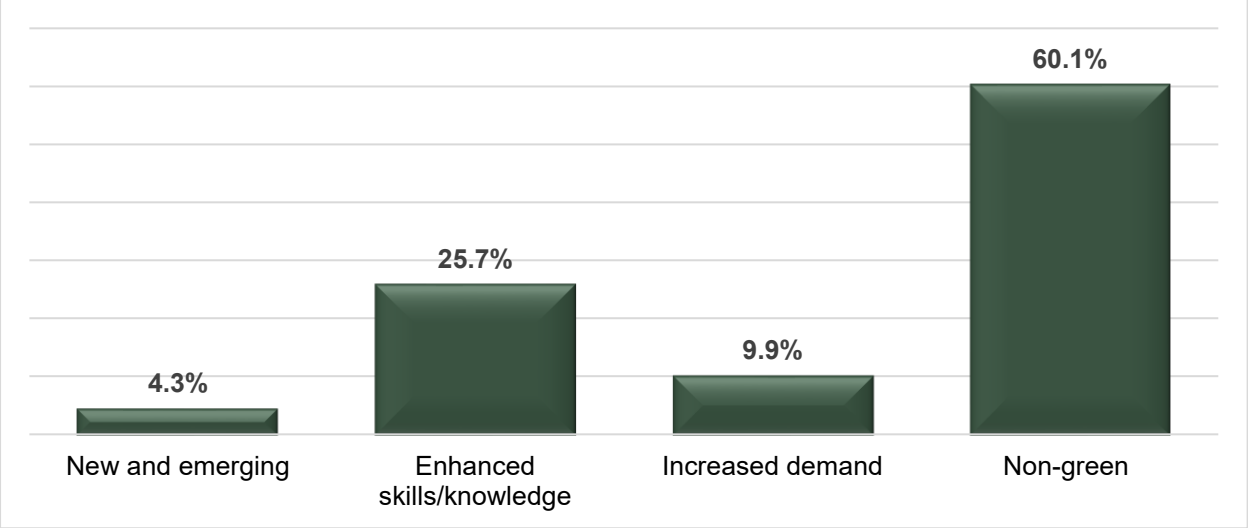
[60] See full timeline https://spice-spotlight.scot/2022/04/08/timeline-of-coronavirus-covid-19-in-scotland/

[61] As at 2021.

products and processes; some remain focused on non-green products and processes. As a consequence, the 100,000 new and emerging green jobs, and indeed all green job figures presented here, should be regarded as the maximum of the estimate driven by current data limitations.

Using the adapted O*NET classification, the full range of green job types as a percentage of total employment in Scotland are shown in Figure 4.2. New and emerging green jobs account for just 4.3% of all jobs in Scotland. However, the findings suggest a strong greening of jobs. Just over a quarter of jobs (25.7%) are Enhanced Skills and Knowledge jobs and almost one-tenth (9.9%) are Increased Demand jobs. Most jobs in Scotland (60.1%) do not fall into any of the three green job categories and therefore can neither be described as 'green' or 'greening' – and thus are currently outwith the scope of policy efforts to support the transition to net zero.

**Figure 4.2: All green job categories plus non-green jobs in Scotland**

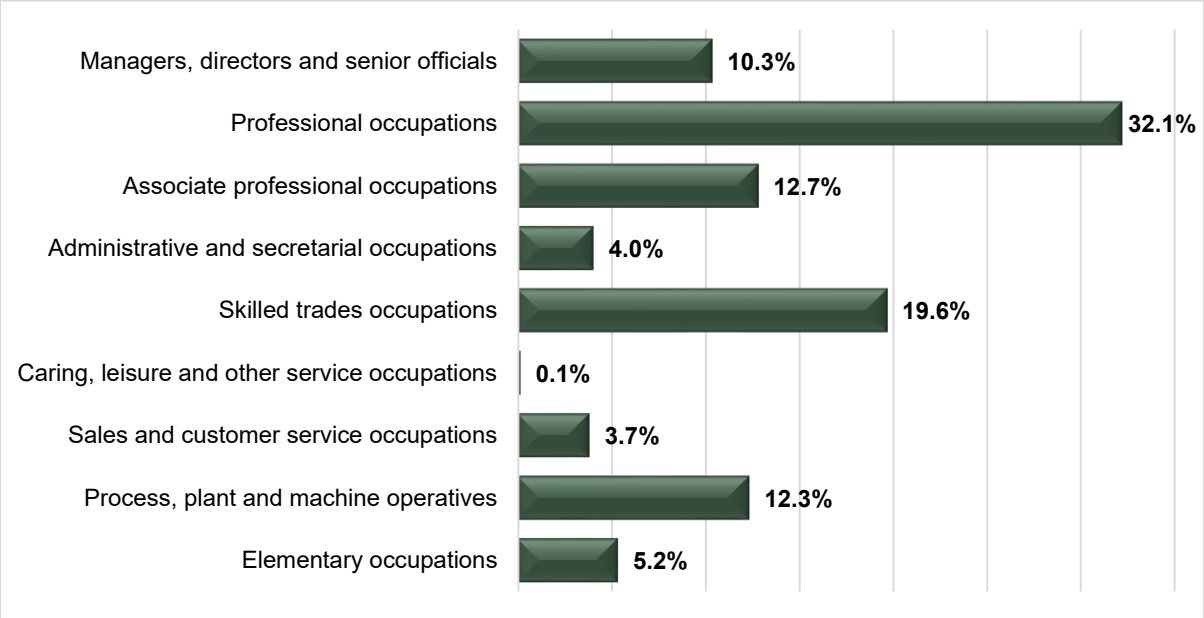



*Source: Labour Force Survey*

### 4.2. Occupational groups

Figure 4.3 shows the percentage share of green jobs in Scotland by Major Occupational Group (UK SOC2020). Professional occupations have the highest proportion of green jobs by occupational group (32.1%), followed by Skilled trades occupations (19.6%). Caring, leisure and other service occupations have the lowest proportion of green jobs (0.1% ).

**Figure 4.3: Green jobs in Scotland by SOC2020 Major Occupational Group**

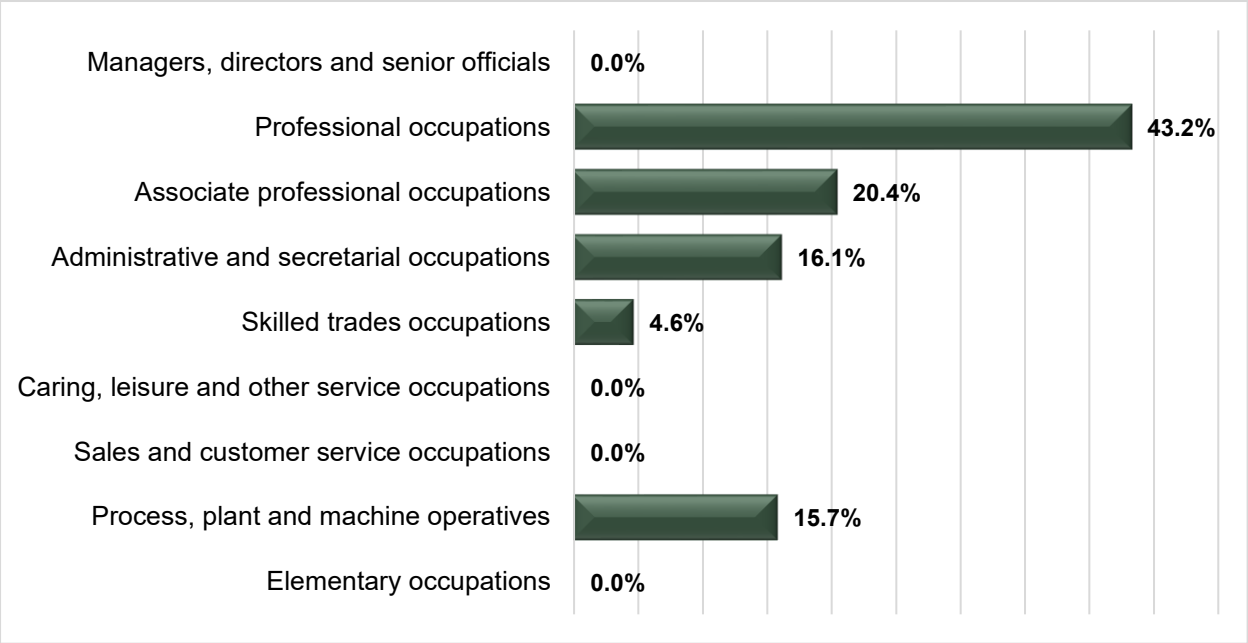



*Source: Labour Force Survey*

It is useful to examine in more detail variation by Major Occupational Group for each green job category, not least because each category of green job is qualitatively distinct.

Figure 4.4 shows the breakdown for New and Emerging green jobs. Professional occupations have the highest proportion of New and Emerging green jobs (43.2%) and Associate professional occupations have the second highest (20.4%). What is more, New and Emerging green jobs are concentrated exclusively in five of the nine UK Major Occupational Groups i.e. Professional occupations; Associate professional occupations; Administrative and secretarial occupations; Skilled trades occupations; and Process, plant and machine operatives.

**Figure 4.4: New and emerging green jobs in Scotland by SOC2020 Major Occupational Group**

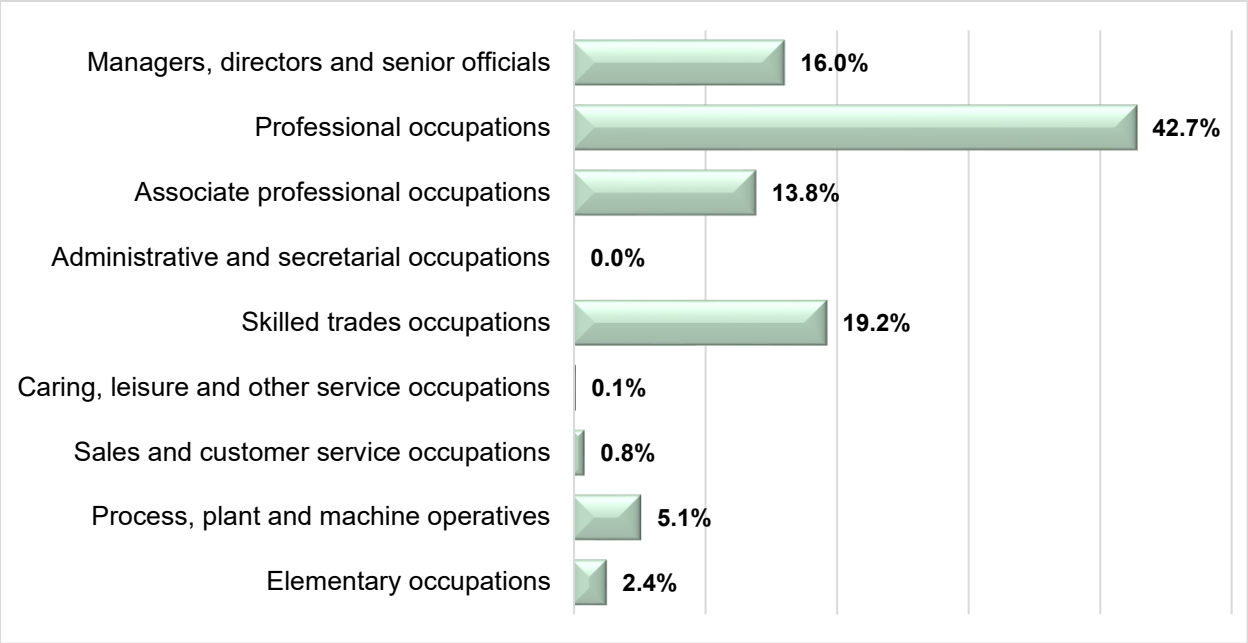



*Source: Labour Force Survey*

Figure 4.5 shows the breakdown for Enhanced Skills and Knowledge green jobs in Scotland. Professional occupations have the highest proportion of Enhanced Skills and Knowledge jobs (42.7%) and Skilled trades occupations have the second highest proportion of green jobs (19.2%). Most Enhanced Skills and Knowledge green jobs in Scotland (i.e. 97.1%) are located in four Major Occupational Groups i.e. Professional occupations; Managers, directors and senior officials occupations; Skilled trades occupation; and Associate professional occupations.

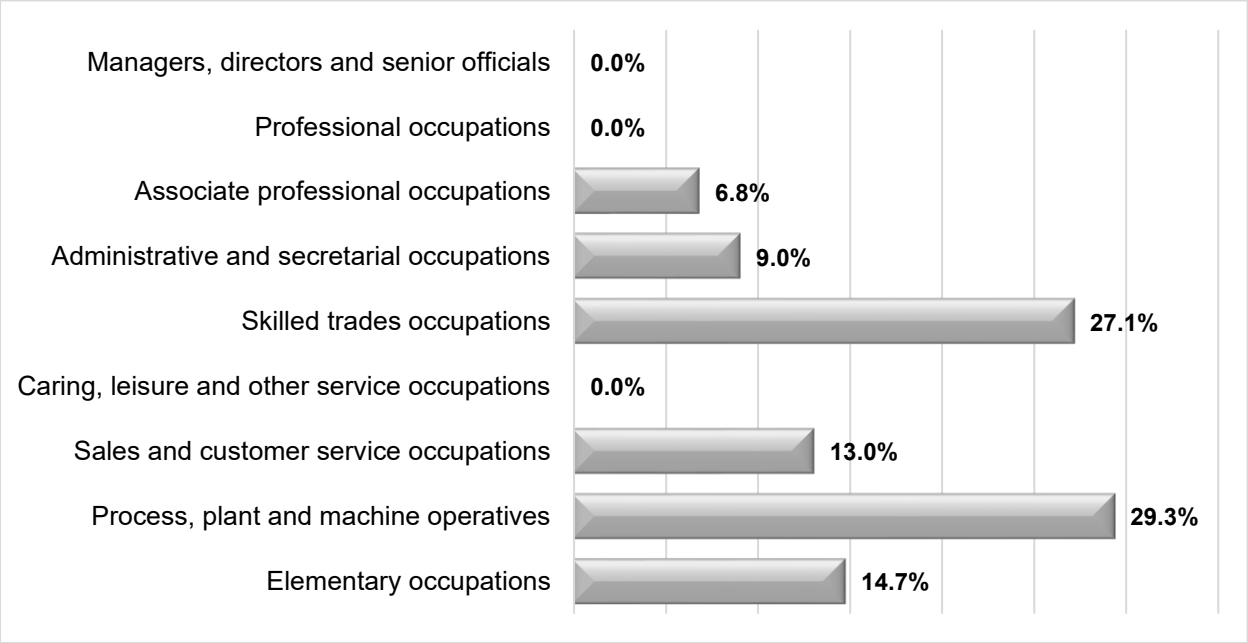
Figure 4.6 shows the breakdown for Increased Demand green jobs in Scotland. Together, Process, plant and machine operatives (29.3%) and Skilled trades occupations (27.1%) have more than half of the overall share of Increased Demand green jobs. Whilst Professional occupations feature prominently in New and Emerging and Enhanced Skills and Knowledge green jobs categories, they are notably absent in the Increased Demand catgory.

**Figure 4.5: Enhanced skills and knowledge green jobs in Scotland by SOC2020 Major Occupational Group**




*Source: Labour Force Survey*

**Figure 4.6: Increased demand green jobs in Scotland by SOC2020 Major Occupational Group**




*Source: Labour Force Survey*

It is useful to drill down to the SOC2020 4-digit level to consider the types of occupations that fall within each green job category. Table 4.1 provides examples of occupations within the

three green job categories at 4-digit level, and includes total employment figures for each occupation. The full list of occupations by green job category at this level might be usefully monitored as the transition to net zero progresses as a potential 'temperature check' of the dynamics and trends within the transition.

**Table 4.1: Examples of occupations in each green job category in Scotland in 2019 by SOC2020 4-Digit Level and total employment**

| New and Emerging | Enhanced Skills and Knowledge | Increased Demand |
|---|---|---|
| **2121:** Civil engineers (around n=9264)<br>**2129:** Engineering professionals n.e.c. (n=7584)<br>**2152:** Environment professionals (n=5220)<br>**3113:** Engineering technicians (n=9264)<br>**8133:** Energy plant operatives (n=918) | **1254:** Waste disposal and environmental services managers (n=1663)<br>**2112:** Biological scientists (n=2110)<br>**2151:** Conservation professionals (n=1680)<br>**2451:** Architects (n=2218)<br>**2483**: Environmental health professionals (n=678) | **4134:** Transport and distribution clerks and assistants (n=5783)<br>**5241:** Electricians and electrical fitters (n=25392)<br>**5316:** Carpenters and joiners (n=23453)<br>**8211:** Large goods vehicle drivers (n=25964)<br>**9112:** Forestry and related workers (n=996) |

*Source: LFS and IER*

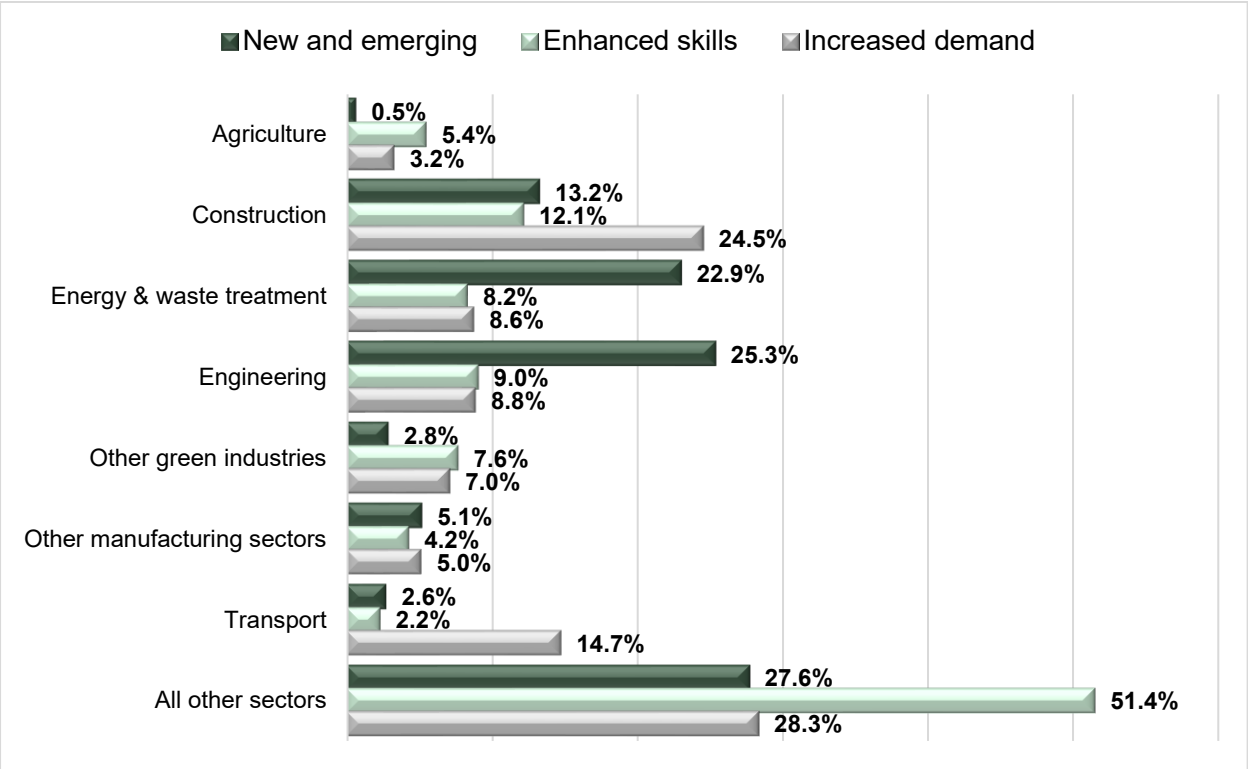
However, the SOC2020 4-digit level (i.e. the SOC2020 Unit Group) has limitations in terms of granularity. The Unit Group, '2121: Civil engineers' envelops a broad range of occupations, including, for example, mining engineers, oil and natural gas engineers, petroleum engineers, sustainability engineers, turbine engineers.[62] What is ideally needed to better inform and drive awareness and action to support reskilling and upskilling is data disaggregated at the 5-digit or even 6-digit level within the SOC. This level of granularity should also address data limitations in terms of estimating the number of green jobs in Scotland i.e. the reported figure of 9,264 jobs in the Unit Group '2121: Civil engineers' is clearly an over-estimate.

[62] See SOC2020 Coding Index https://www.ons.gov.uk/methodology/classificationsandstandards/standardoccupationalclassificationsoc/soc2020/soc2020volume2codingrulesandconventions

### 4.3. Green jobs by sector

Figure 4.7 shows green jobs in Scotland by green job category and sector. The vast majority of New and Emerging green jobs in Scotland are located within CESAP sectors (72.4%). This finding underlines that policy emphasis on CESAP sectors as growth sectors for purist green jobs is therefore useful.

**Figure 4.7: Green jobs in Scotland by green job category and sector**



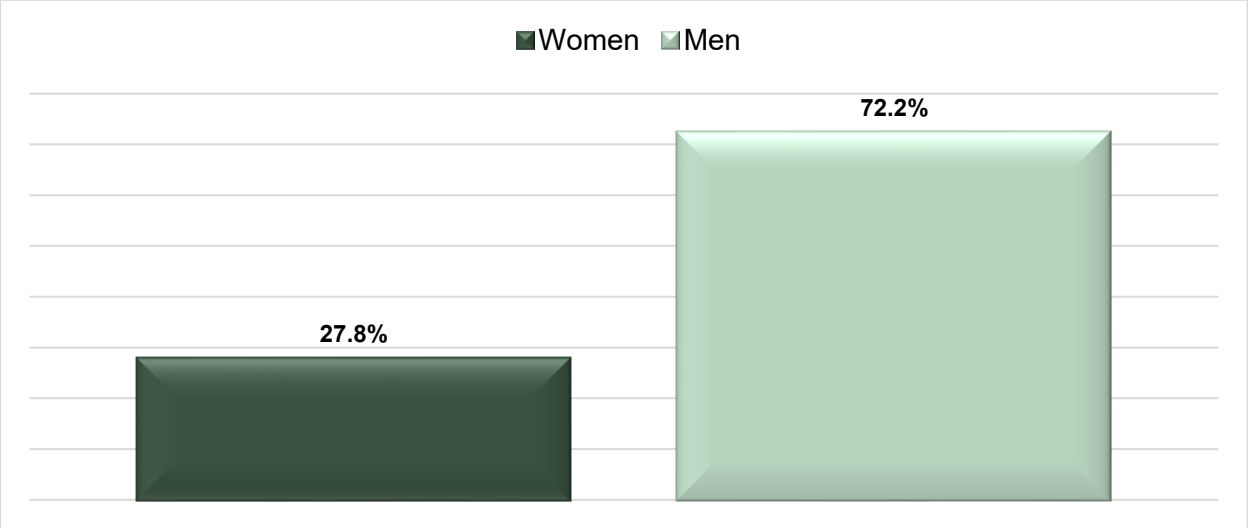

*Source: Labour Force Survey*

Understanding the broader impact of greening on jobs requires a shift from a 'purist' to a more 'inclusive' focus i.e. there is a need to understand the impact of greening on jobs, skills and knowledge across all sectors. As Figure 4.8 also shows, just over half of all Enhanced Skills and Knowledge green jobs in Scotland are located in 'all other sectors'. At the same time, the vast majority of Increased Demand green jobs are in CESAP sectors, with just under a quarter (24.5%) in Construction, which further emphasises that a more inclusive focus can also help better capture change within 'green' sectors.

### 4.4. Equalities (gender and age)

Delivering a just transition to net zero requires a clear focus on issues of equality. Whilst LFS data at the country level for Scotland does not enable analysis of the full range of potential areas of inequality, it is possible to make some key gender and age-related comparisons. Women, for example, are markedly under-represented in green jobs in Scotland (see Figure 4.8). Green jobs are therefore jobs that are disproportionately undertaken by men (i.e. 27.8% women vs 72.2% men).

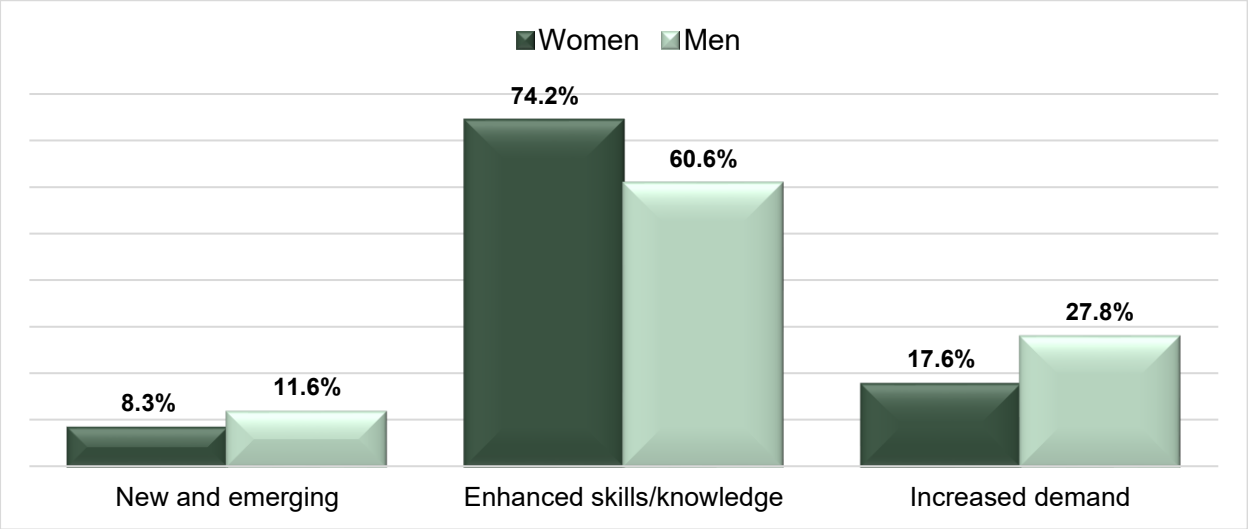
**Figure 4.8: Green jobs in Scotland by gender**




*Source: Labour Force Survey*

Although there are clearly far fewer women than men working in green jobs, it is useful to look at differences in the relative distribution of women and men by green job category (see Figure 4.9). Of the women working in green jobs, around three quarters are in Enhanced Skills and Knowledge jobs (74.2% vs 60.6% men). It is interesting that it is in New and Emerging jobs that the relative concentration of women and men has the narrowest gender gap (i.e. 8.3% women vs 11.6% men) despite the fact that engineering occupations tend to dominate in this green job category.

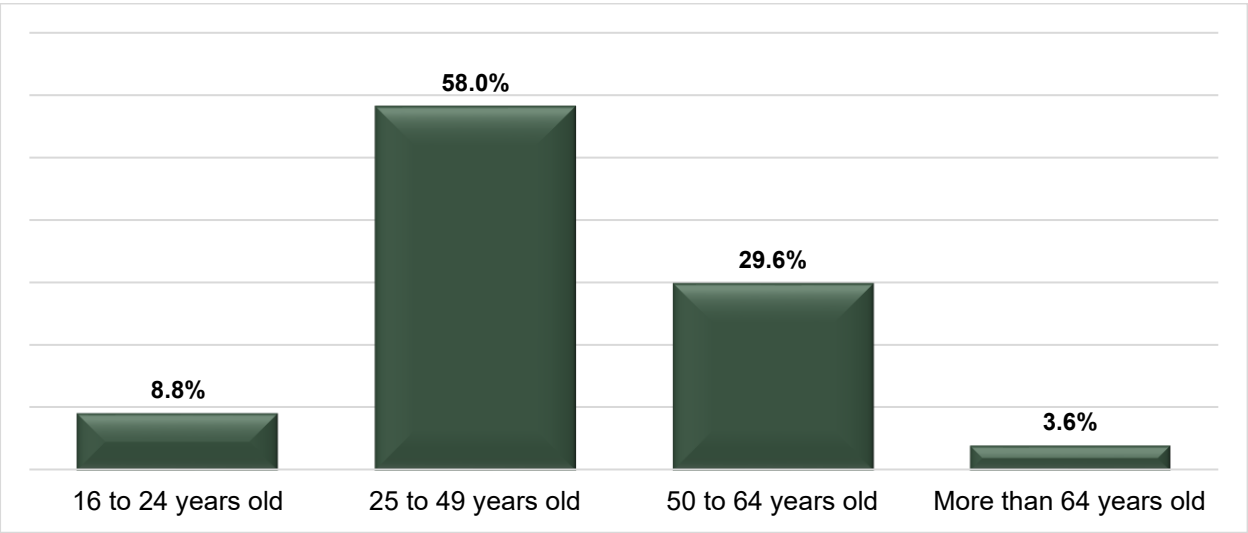
**Figure 4.9: Relative distribution of women and men in Scotland by green job category**




*Source: Labour Force Survey*

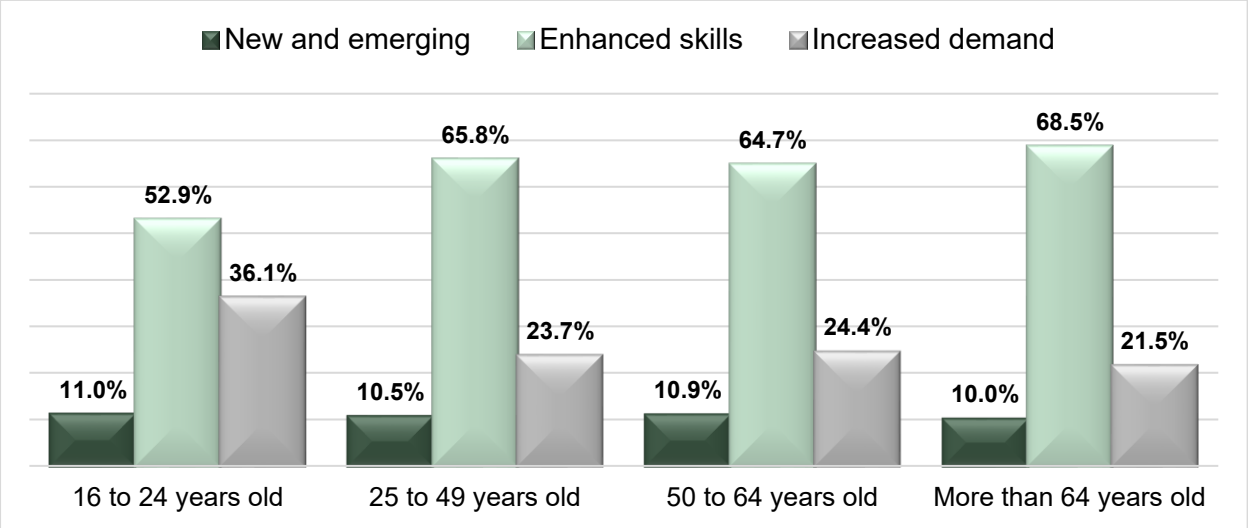
There is variation in green jobs by age. Figure 4.10 shows that green jobs in Scotland are most concentrated in the so-called 'prime age' group of 25-49 years (58%) and least concentrated in the 64+ years group (3.6%). Figure 4.11 highlights, however, that the relative distribution by green job category within age groups is not dissimilar – other than in the younger 16-24 age group where there is a higher proportion of Increased Demand jobs and lower proportion of Enhanced Skills and Knowledge jobs. Notably, the proportion of green jobs that are in the New and Emerging category is around 10% within all age groups in Scotland.

**Figure 4.10: Green jobs in Scotland by age group**




*Source: Labour Force Survey*

**Figure 4.11: Relative distribution by green job category in Scotland within age groups**



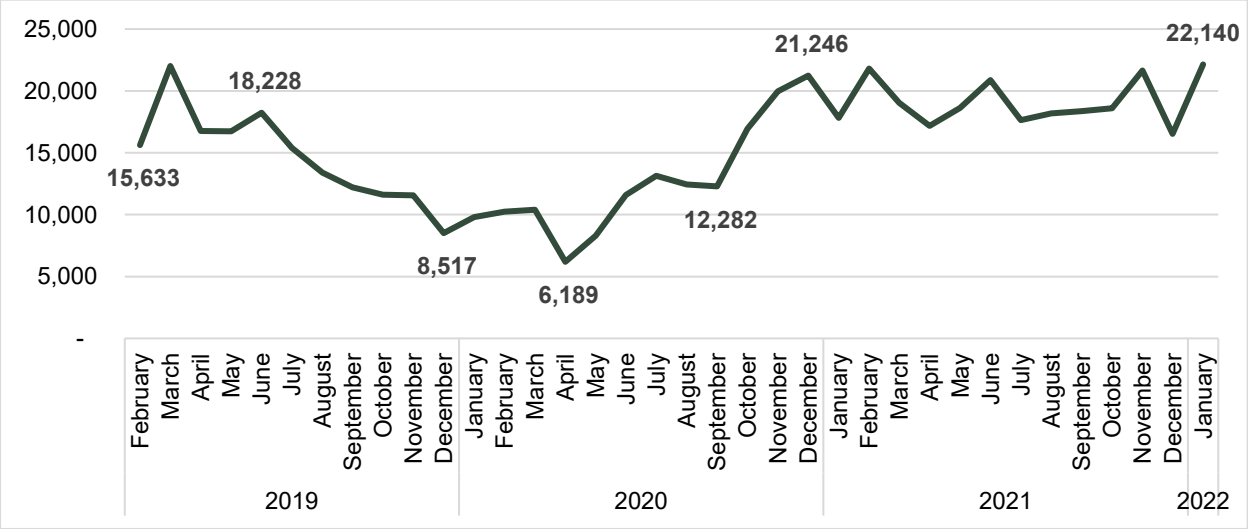

*Source: Labour Force Survey*

# 5. Changes in Demand

Given that green jobs are an unfolding development within the labour market, analysis of web-scraped job vacancy data provides a picture of dynamics of change in 'real time'. Job vacancy data can usefully capture changes in jobs as signalled by the demands from employers. In doing so, its use can help better identify and anticipate trends – and thus inform evidence-based action.[63] Using this second source of data, this section presents findings on employer demand for green jobs, represented by the three categories covering purist green jobs and those jobs that are greening.

Job vacancy data over the period 2019 to 2022 signals a post-COVID-19 labour market recovery in Scotland. Figure 5.1 highlights that from a period low of 6,189 vacancies in April 2020, there were 22,140 job vacancies in Scotland in January 2022.

**Figure 5.1 Job vacancy numbers in Scotland, February 2019 to January 2022**




*Source: IER*

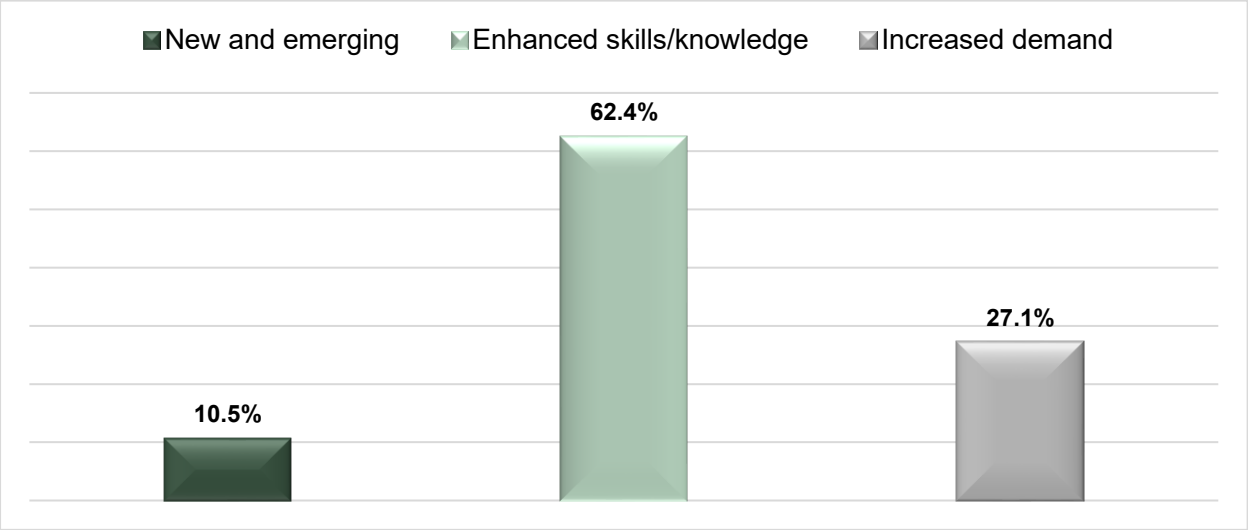
### 5.1. Green jobs

Analysis of vacancy data (see Figure 5.2) reveals that green job vacancies as a proportion of all job vacancies in Scotland is consistent with LFS data on green jobs as a proportion of total employment.

[63] It is important to note that any source of information has limitations or biases. Vacancy data might not properly cover those jobs recruited by word of mouth or in rural areas with relatively low internet use (Cardenas Rubio and Warhurst, 2022).

Vacancy data also mirrors LFS data in terms of variation in the relative proportion of jobs by green job category. However, there are some subtle differences. Vacancy data points to a slight decrease in the proportion of Enhanced Skills and Knowledge jobs and slight increase in the proportion of Increased Demand jobs (see Figures 4.2 and 5.2).

**Figure 5.2: Proportion of Green job vacancies in Scotland by green category, February 2019 to January 2022**




*Source: IER*

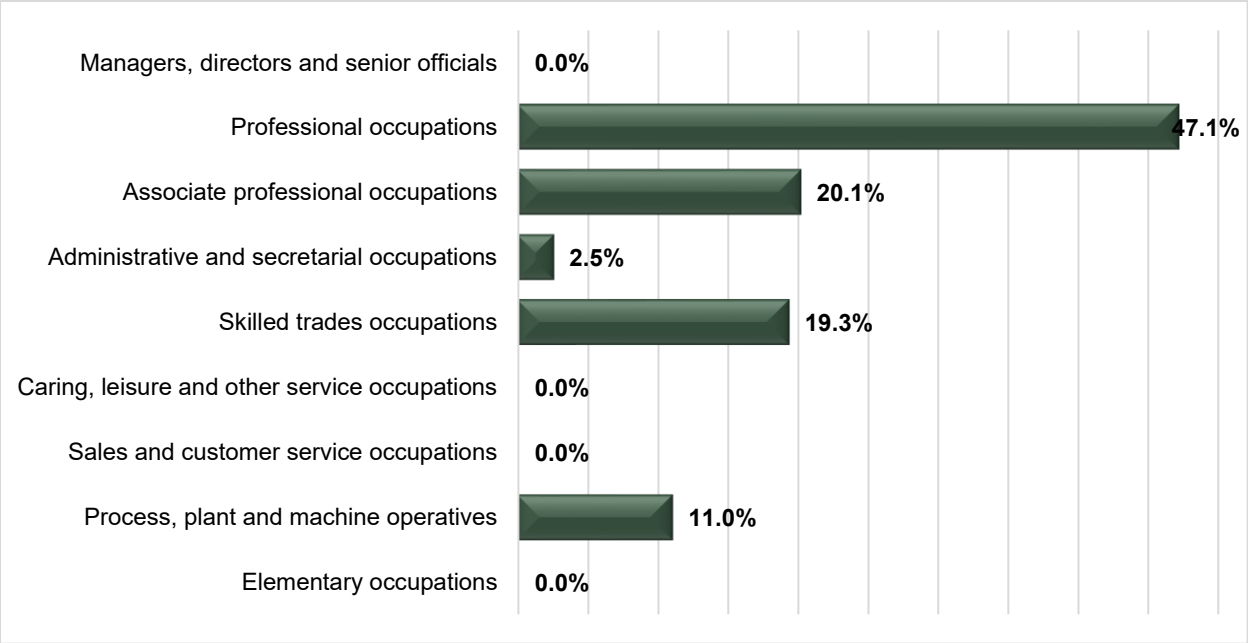
However, it is important to bear in mind that the overall number of job vacancies increased over the period (see Figure 5.1) and therefore, in terms of actual vacancy numbers, there was an increase in job vacancy numbers in all three green job categories.

### 5.2. Occupational groups

Figure 5.3 shows the breakdown of New and Emerging green job vacancies in Scotland by Major Occupational Group (UK SOC2020). The vast majority (97.5%) of vacancies for New and Emerging jobs are concentrated in four occupational groups: Professional occupations (47.1%); Associate professional occupations (20.1%); Skilled trades occupations (19.3%); and Process, plant and machine operatives (11%).

Examining New and Emerging green job vacancies at SOC2020 4-digit level provides information about the types of jobs most in demand e.g. ‘2127: Engineering project managers and project engineers’, ‘2129: Engineering professionals n.e.c’, ‘2121: Civil engineers’, ‘3119: Science, engineering and production technicians n.e.c.’ and ‘5249: Electrical and electronic trades n.e.c.’.

**Figure 5.3: New and emerging green job vacancies in Scotland by SOC2020 Major Occupational Group, February 2019 to January 2022**

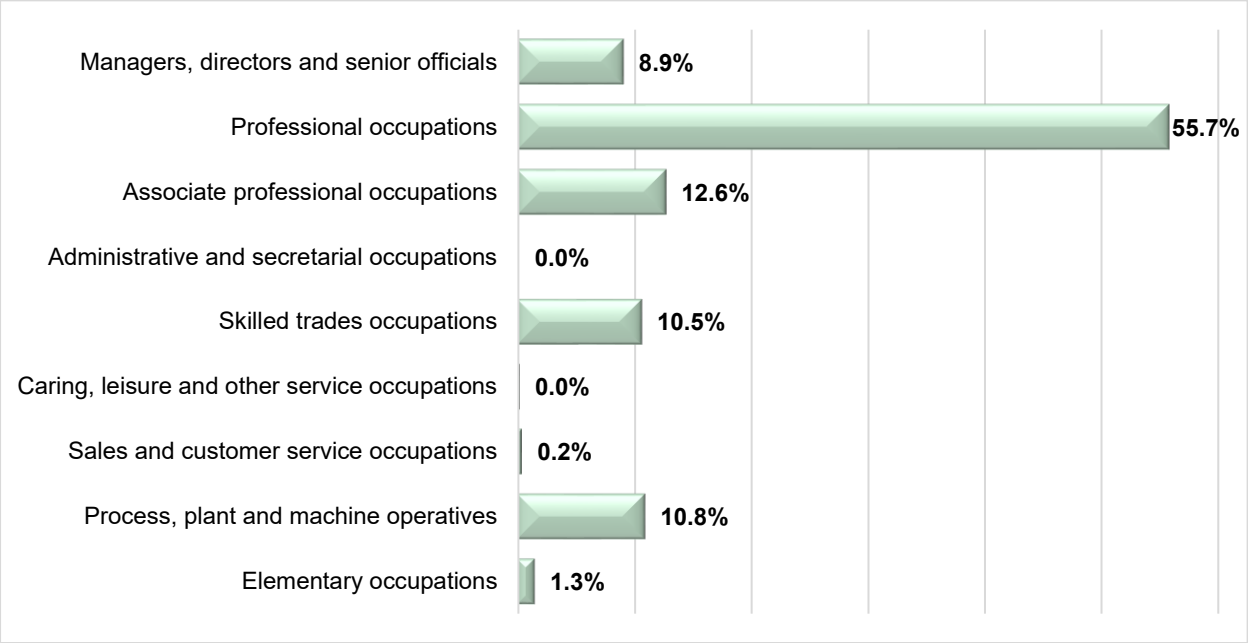



*Source: IER*

Figure 5.4 shows the breakdown of Enhanced Skills and Knowledge green job vacancies in Scotland by Major Occupational Group. Professional occupations account for over half (55.7%) of all Enhanced Skills and Knowledge job vacancies.

Once again, drilling down to the SOC2020 4-digit level helps identify some of the Enhanced Skills and Knowledge green jobs most in demand e.g. '1150: Managers and directors in retail and wholesale', '2134: Programmers and software development professionals', '2412: Solicitors and lawyers', '2421: Chartered and certified accountants', and '2422: Finance and investment analysts and advisers'.

**Figure 5.4: Enhanced skills and knowledge green jobs in Scotland by SOC2020 Major Occupational Group, February 2019 to January 2022**

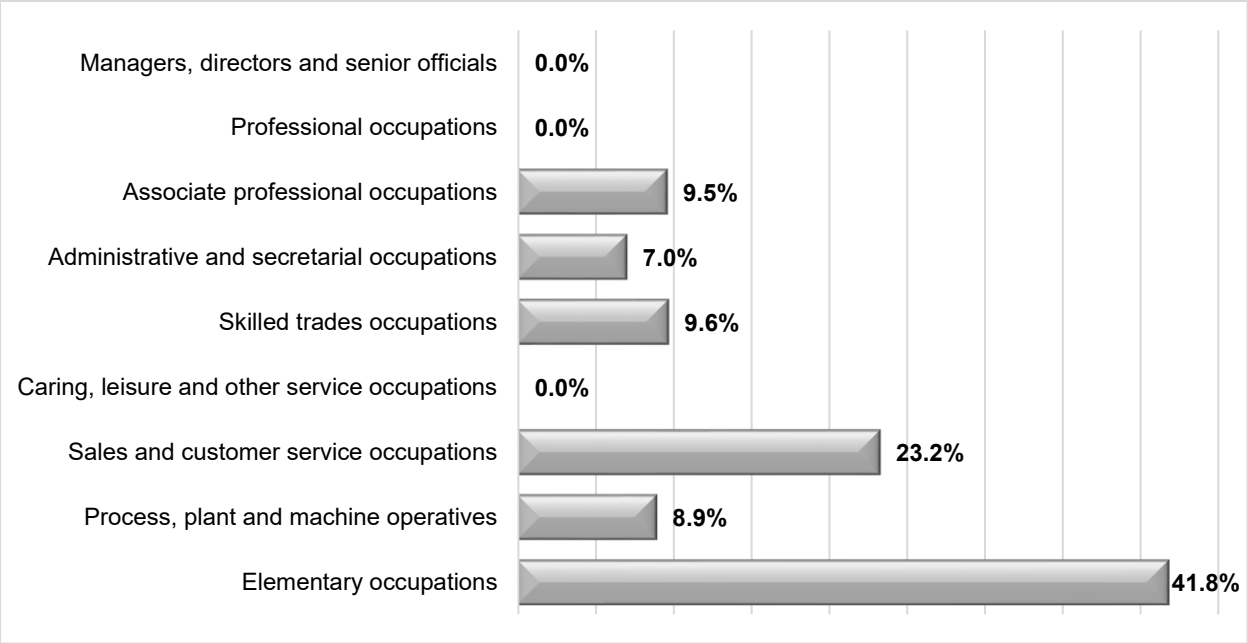



*Source: IER*

Figure 5.5 shows the breakdown of Increased Demand green job vacancies Scotland by Major Occupational Group. Elementary occupations have the highest proportion of Increased Demand job vacancies (41.8%), followed by Sales and customer service occupations (23.2%).

Data at the SOC2020 4-digit level reveals some of the Increased Demand green jobs most in demand e.g. ‘3132: IT user support technicians’, ‘4131: Records clerks and assistants’, ‘5316: Carpenters and joiners’, ‘7219: Customer service occupations n.e.c.’ and ‘9252: Warehouse operatives’.

**Figure 5.5: Increased demand green jobs by SOC2020 Major Occupational Group in Scotland, February 2019 to January 2022**




*Source: IER*

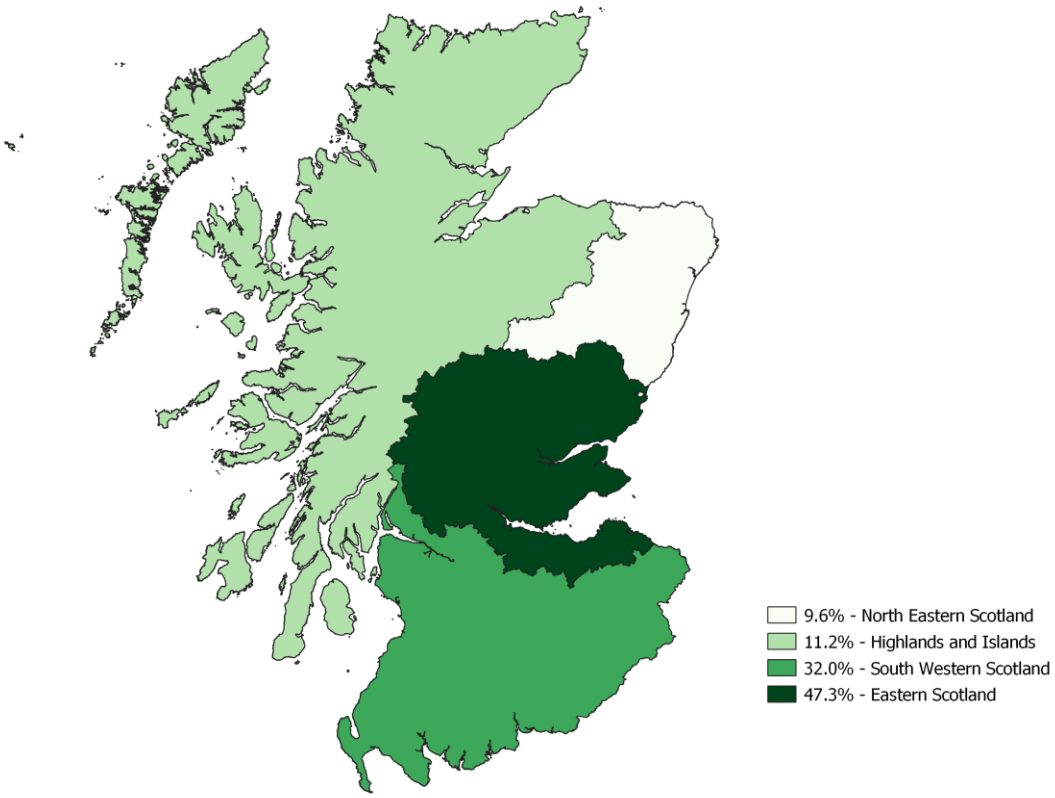
### 5.3. Regional variation

The Business Register and Employment Survey (BRES) helps highlight that there is regional variation in total employment in Scotland i.e. South Western Scotland (43.5%), Eastern Scotland (36.7%), North Eastern Scotland (10.7%) and Highlands and Islands (9.1%).[64] This variation generally mirrors in the proportion of all green job vacancies by region[65]. For example, Figure 5.6 shows that most of the green vacancies are in South western Scotland and Eastern Scotland. Under half of all green job vacancies (47.3%) are in Eastern Scotland and around one third (32%) in South Western Scotland.

[64] Figure based on 2020 data. See https://www.nomisweb.co.uk/query/construct/summary.asp?mode=construct&version=0&dataset=189

[65] The analysis of regions in Scotland is based on the Nomenclature of Units for Territorial Statistics (NUTS). As with SOC and SIC, NUTS is a hierarchical classification, in this case of administrative areas across Europe. Scotland is at the NUTS 1 level. NUTS 2 areas in Scotland are Eastern Scotland, Highlands and Islands, North Eastern Scotland and South Western Scotland. These areas correspond to a combination of council areas, local enterprise companies (LECs) and parts thereof. Details of these areas are available at: https://www.ons.gov.uk/methodology/geography/ukgeographies/eurostat.

**Figure 5.6 Proportion of all green job vacancies by Scottish NUTS2 region, February 2019 to January 2022[66]**




*Source: IER*

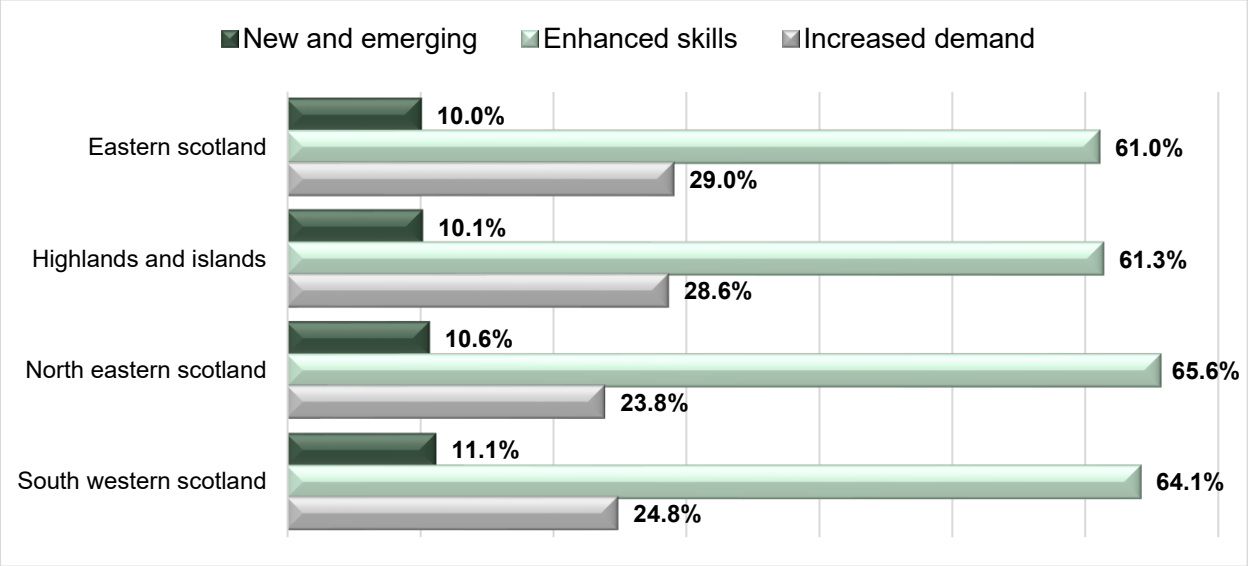
As measured by the total number of job vacancies, demand for New and Emerging green jobs is highest in Eastern Scotland and South Western Scotland. By some margin there is less demand for these jobs in the Highlands and Islands and North Eastern Scotland. Demand for Enhanced Skills and Knowledge green jobs is again much greater in Eastern Scotland and South Western Scotland and much lower in the Highlands and Islands and North Eastern Scotland. Demand for Increased Demand green jobs is highest in Eastern Scotland and much lower in the Highlands and Islands and North Eastern Scotland, with with demand in South West Scotland sitting in the middle.

However, Figure 5.7 helps illustrate that the relative split by green job category within each region is broadly similar. Around 10% of green jobs within each region are New and Emerging green jobs, albeit marginally greater in South Western Scotland (11.1%). Highlands and

[66] It is important to note that observations in the vacancy database are concentrated in specific cities such as Edinburgh, Glasgow, Aberdeen, Dundee and Inverness. Consequently, the map might be reflective of cities in the region.

Islands and North Eastern Scotland also have a slightly higher relative proportion of Increased Demand green jobs. Therefore, it is important to bear in mind that although there may be far fewer job vacancies in less populous regions, all regions seem to be exhibiting similar patterns in terms of the proportion of jobs within each green

**Figure 5.7: Green job vacancies within Scottish regions by green job category, February 2019 to January 2022**

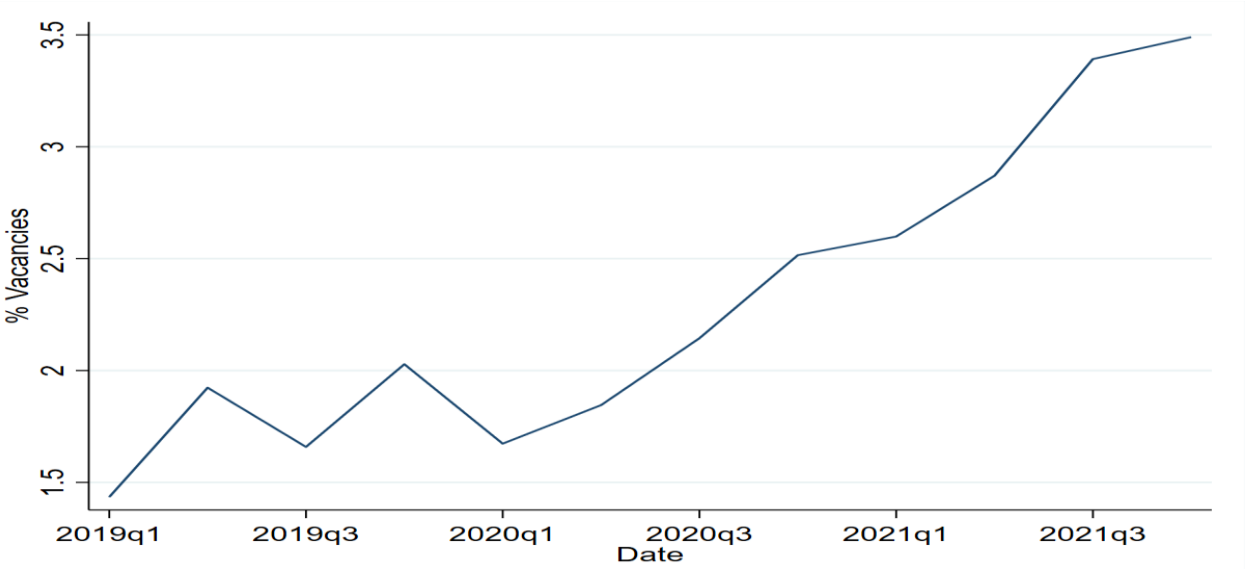



*Source: IER*

### 5.4. Green skills and knowledge

Analysis of job vacancy data using key 'green words' (e.g. 'geothermal', 'zero carbon', 'emissions') point to a sharp increase in job descriptions that included these key words from the start of 2020 (see Figure 5.8). The number of key green words used in job descriptions was greatest for New and Emerging jobs, followed by Enhanced Skills and Knowledge jobs, then Increased Demand jobs and, finally and unsurprisingly, non-green jobs.

**Figure 5.8: Key green words mentioned in job descriptions in Scotland, February 2019 to January 2022**




*Source: IER*

This analysis supported the mapping of 'green specific skills' labels to each of the three green job categories, and related tables were produced. Further work is required here with key stakeholders to 'road test' and refine these green skills labels. Data were also mapped to the classification of European Skills, Competences, Qualifications and Occupations (ESCO);[67] 'skills' tables were produced for each green job category, and include sector-specific skills, cross-sector skills and transversal skills. Both mapping exercises and related tables can inform the development of a green skills taxonomy that is best tailored to the Scottish context and aligned to existing activities and developments (e.g. meta-skills toolkit/framework, My World of Work).

Analysis of vacancy data provided validation evidence that the final list of green occupations at SOC2020 4-digit level agreed through the expert review process was robust. The decision, for example, to include '2412: Solicitors and lawyers' in the Enhanced Skills and Knowledge jobs category reflects a clear trend in increased knowledge requirements (e.g. environmental procurement, regulatory compliance, net zero investment, environmental litigation). Moreover, the analysis of vacancy data confirms that a 'greening' of jobs is an ongoing process in Scotland. Examples of non-green jobs showing signs of greening notably include '3534: Financial accounts managers' and '3582: Health and safety managers and officers'.

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

Analysis of vacancy data also uncovered new job titles that do not even feature in the recently completed SOC2020, such as a 'net zero engineer'. Understanding developments in relation to these New and Emerging jobs will be key in order to better anticipate and support reskilling and upskilling. Box 5.1 provides a summary of a job description in a vacancy posting for a net zero engineer. The impact of green economy activities and technologies has quite clearly generated the need for this unique work and worker requirements – albeit 'born' from an existing occupation.

### Box 5.1: 'Net Zero Engineer' summary job description

**Job Title:** Net Zero Engineer

**Role:** To support the project portfolio across the UK and worldwide, assisting clients towards achieving net zero emissions

**Knowledge, Skills and Experience:**

- Candidates should have an appreciation of the wider energy system and how this is changing and adapting as we move to decarbonization
- Ability to use industry standard energy modelling software such as energy pro or equivalent
- Ability to coordinate technical specialists and manage cost schedule and risk
- Technical modelling skills
- First rate communication skills
- Experience of advising clients in the delivery of net zero strategies including the preparation of business cases and economic models, and subsequently managing stakeholders through delivery and execution
- Experience of developing net zero route maps, renewable energy technologies, electricity heat networks (built environment energy efficiency would be highly beneficial)
- Excellent track record in managing health safety environmental and quality risks on behalf of clients
- Knowledge of the design and application of a range of technologies including heat pumps biomass solar and wind and their integration in both utility scale and decentralised power networks

**Qualifications/Certification:**

- Chartered engineer CEng or near chartered in mechanical electrical, civil chemical process, building services or related disciplines
- Design experience up to RIBA stage 2, 3 or beyond would be beneficial

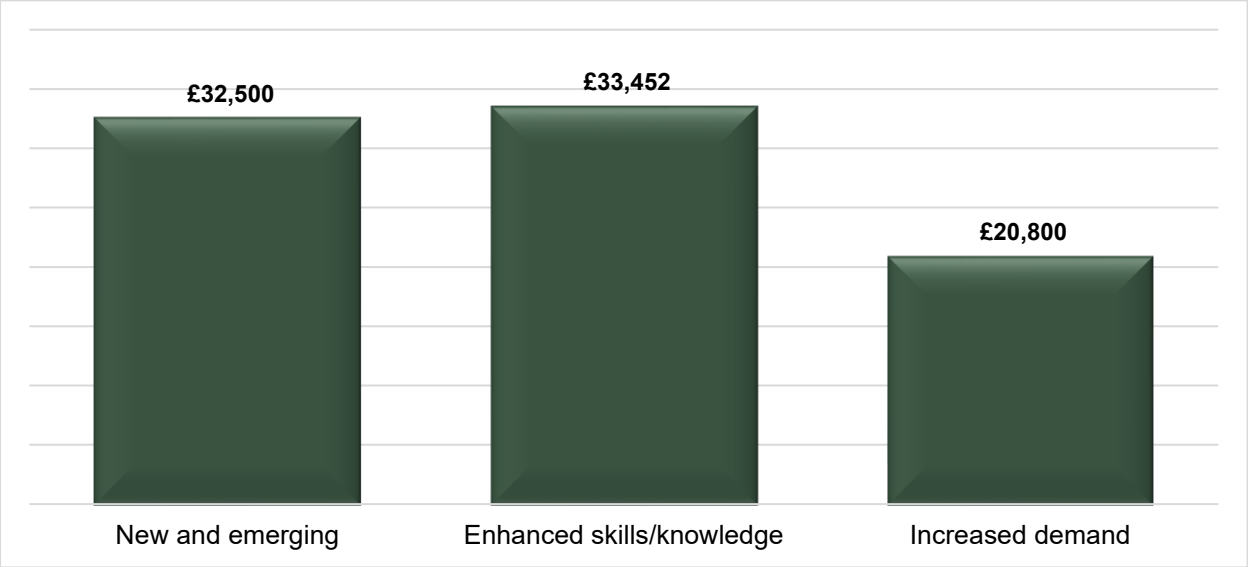
What this employer is looking for is a candidate who is a chartered engineer, ideally with relevant design experience. Knowledge, skills and experience requirements include job-specific, occupation-specific, sector-specific and transversal elements. This summary job description highlights that many New and Emerging jobs do not necessarily require lengthy

training but the transition into these jobs for some (e.g. chartered engineers) can potentially be supported with 'top-up' training/support to 'plug' key knowledge and skills gaps.

### 5.5. Pay

Analysis of the vacancy data reveals that median advertised wages are higher in green jobs than in non-green jobs in Scotland (£29,673 vs £23,837) (see Figure 5.9). Median wages are highest in Enhanced Skills and Knowledge jobs and lowest in Increased Demand jobs.

**Figure 5.9: Green job vacancies in Scotland by category and median wages**

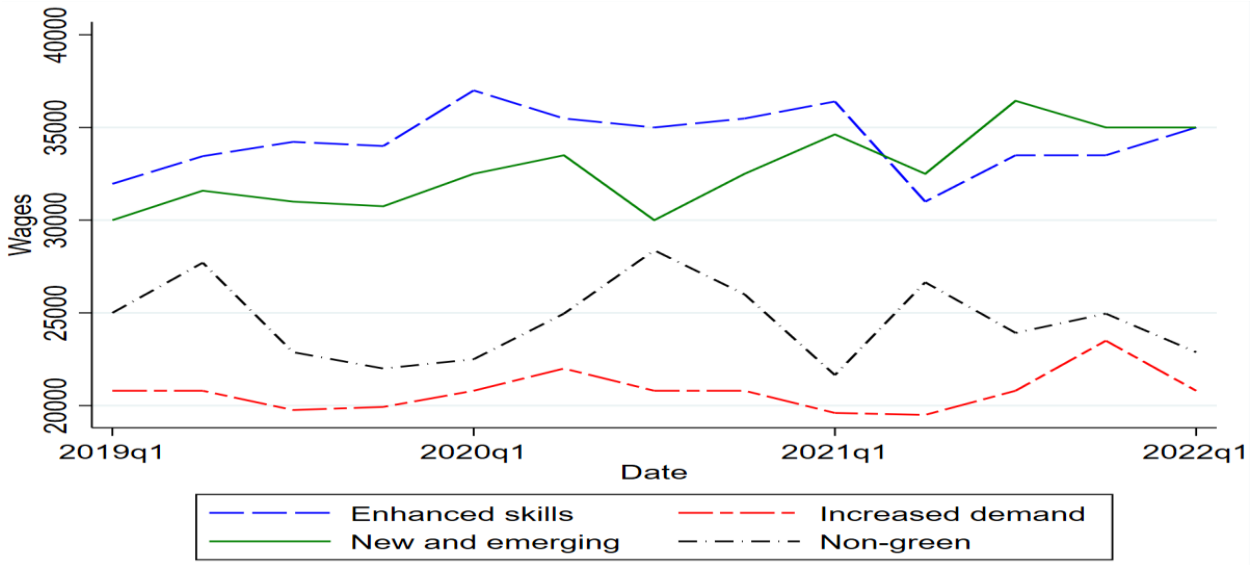



*Source: IER*

Wage trends over the period 2019 to 2022 (see Figure 5.10) point to contrasting pay trajectories for New and Emerging jobs and Enhanced Skills and Knowledge jobs (an upwards trend) vs Increased Demand jobs and non-green jobs (a downwards trend). Closer monitoring of vacancy data and mapping green jobs to other wage data sources[68] to analyse and understand longer term trends is needed.

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

**Figure 5.10: Green median wages in Scotland over time, February 2019 to January 2022**




*Source: IER*

These findings suggest that vacancy data, in contrast to LFS data, has much potential to generate, to varying degrees, rich data in relation to terms and conditions of employment beyond the usual narrow focus on pay – and thus offer important insights into whether green jobs are delivering Fair Work.

# 6. Conclusions and recommendations

Scotland, as with many other countries globally, is keen to respond positively to the climate emergency and develop a sustainable economy and society. As part of its transition to a net zero carbon future, developing green jobs and skills needed for those jobs is seen as critical. To date, however, there has been a lack of consensus amongst researchers and policymakers internationally about what constitutes a green job. The lack of definition hampers policy development and evaluation.

In estimating the extent and demand for green jobs in Scotland, this research has sought to address this problem. Reviewing international debates about and definitions of green jobs, it offers a new and inclusive GreenSOC based on an adapted three category classification of green occupations that draws on a broad definition that recognises a range of occupations in which new green jobs can emerge and existing jobs can change through greening (see Box 6.1). It then applies these categories to LFS data and data scraped from job vacancy websites.

**Box 6.1: The three-category Scottish GreenSOC**

New and emerging green jobs
Existing jobs with enhanced green skills and knowledge
Existing jobs that have increased demand due to the transition to net zero

This GreenSOC offers a significant new support tool for Scottish policy development and policy evaluation in the transition to a net zero economy. Drawn from a body of existing research and adapted to Scottish circumstances, it offers a robust means to monitor and assess the development of green jobs in Scotland.

Using this inclusive GreenSOC, the analysis using the LFS finds that there are just over 100,000 New and Emerging green jobs in Scotland, a figure which increases significantly when the numbers of Enhanced Skills and Knowledge and Increased Demand green jobs are included. However, given data limitations, the number of green jobs in Scotland it is likely to be an over-estimate. Better future data that could be disaggregated to a greater level of detail within occupations (see below).

In terms of the extent of green jobs in Scotland, of the three categories of green jobs, the highest proportion are in the Enhanced Skills and Knowledge category, suggesting that there

are strong qualitative changes happening to existing jobs in Scotland, despite the overall proportion of green jobs in the Scottish labour market remaining static. The extent of this category of green job is clearly seen in the CESAP sectors. Despite the impressive extent of purist type green jobs in the CESAP sectors, most of these sectors have experienced some decline in the number of green jobs generally. Nevertheless, almost half of all New and Emerging jobs in Scotland are in the engineering and energy & waste management CESAP sectors. Using SOC2020, it is professional occupations that are more prevalent amongst green jobs in Scotland, followed by skilled trades. In terms of contributing to Fair Work female workers are significantly under-represented in Scotland's green jobs. Green jobs in Scotland are mostly concentrated in the 25-49 age group.

Based on the web-scraped job vacancy data, the analysis was able to identify changes to demand since the start of 2019. Overall, this data shows that there has been a post-COVID-19 labour market recovery in Scotland. Within this recovery, green job vacancies as a proportion of all job vacancies in Scotland align closely with the LFS data, at just under 40% of all job vacancies. Job vacancy data also shows that green jobs demand overall is heavily skewed towards professional occupations. Likewise, regionally, most green job vacancies are in Eastern Scotland, though New and Emerging job demand is relatively similar across all regions. It is also the case that indicators of green jobs have increased in job adverts through word use in those adverts, and this indicator also validates the decision to include some occupations in the GreenSOC on the basis of having enhanced knowledge, not just enhanced skills, demand. It also shows that there are qualitative changes occurring to jobs in Scotland driven by green activities and technologies – that is, there is indeed a greening of some existing jobs. Finally, the vacancy data reveals that pay is higher for green jobs than non-green jobs in Scotland. On this marker of job quality alone, green jobs are better jobs.

The good news therefore for Scotland is that the current number of green jobs is significant, even appreciating the data limitations. Moreover there has been a sharp rise in job vacancies using green words and vacancy data also shows an on-going greening of jobs in Scotland. This data reveals that there are increases in demand for all three categories of green jobs and, as well as new green jobs emerging, existing jobs are greening. New and Emerging job demand is also occurring across all regions of Scotland, suggesting a geographically widespread transition. These jobs dominate green job growth in the CESAP sectors and are also better jobs if pay is the marker of job quality. The surprising news is the weakening job demand in CESAP sectors, and the existence of non-green jobs in these sectors. Indeed, even using the inclusive definition of green jobs, there also remains a large number of non-green jobs in Scotland. Policy has to focus on these jobs, perhaps seeking to identify how they

can be encouraged to start greening. Moreover if a just transition is to be realised, more needs to be done to address the under-representation of female workers in green jobs. Similarly, more needs to be done to encourage young workers into green jobs, as well as the oldest workers as the workforce generally ages and working lives extend.

Challenges remain, however, in developing a comprehensive GreenSOC for Scotland and thereby better estimating the extent of green jobs. We noted the problem of understanding what businesses do in terms of green and non-green economic activity because of a lack of sensitivity in the SIC. A similar problem exists with SOC. SOC2020 4-digit level is blunt in terms of providing detailed information on the exact tasks, skills and knowledge of any occupation. This problem exists for a number of the occupations within our classification. To be able to distinguish between green and non-green economic activity for the Mechanical Engineers, for example, that we discussed above in the findings section, would require the SOC to drill down to the 5- or 6-digit level. Unfortunately, the SOC does not currently offer this possibility, though the Institute for Employment Research has been commissioned to undertake pilots at the 6-digit level. In the meantime, any green jobs estimate for Scotland should be regarded as the upper celling figure that would likely be revised down with more detailed information for individual occupations.

Similarly, and for the same reason – the bluntness of information about occupations at the 4-digit level, the three categories of green jobs may be artificially neat. In practice there may be overlaps between some categories, for example between Mechanical Engineers who are New and Emerging *and* Enhanced Skills and Knowledge jobs. Better information provided at the 5- or 6-digit level would enable identification of any specialisation versus relatively minor task adaptions within an occupation in relation to green economic activity. Being able to better allocate occupations and segments of occupations to the three categories of green jobs in the future would enable better understanding of the dynamics and trends of each category of green jobs.

Nevertheless, the research undertaken for this report has demonstrated proof of concept for the new GreenSOC. A number of recommendations about it as well as how it might be extended to other areas of skills and employment policy in Scotland arise:

***1 The new GreenSoc should be considered as the methodology for estimating green jobs in Scotland***

The GreenSOC is derived from an existing methodology that has international recognition amongst policymakers and is sensitive to academic debates about the problems in defining

green jobs. It offers an academically rigorous, policy-useful methodology. Maintaining the three suggested adaptations, there should be periodic updates of the analysis using this methodology in order to identify trends and developments over time in the extent and demand for green jobs in Scotland. It would be preferable if future use of this methodology is able to incorporate 5- or 6-digit level SOC information in future updates.[69]

***2 Analysis of green jobs and skills should incorporate web-scraped job vacancy data***

Neither SOC nor the well-resourced O*NET are able to quickly capture changes to all occupations. The ambitious policy push for a net zero economy means that the labour market is currently dynamic when it comes to the demand for green jobs. As the example of the 'net zero engineer' illustrates, the job vacancy data scraping identified new jobs (or at least new titles) that are not currently coded in the UK's SOC2020. In this respect, this data scraping really does help in terms of both anticipating changes in 'real time' and help better anticipate education and training needs. Whilst constraints in its use still exist, having web-scraped job vacancy data usefully helps identify and monitor demand for green jobs and skills in Scotland. It will be helpful therefore to undertake regular exercises in scraping web-based job vacancy data in Scotland.

***3 Develop and maintain a Scotland-focused green skills taxonomy drawing on repeat web-based job postings data scraping***

Having a Scotland-focused green skills taxonomy helps understand what skills are needed both in work and the labour market, and so what adaptions might be needed within the Scottish education and training system to meet those needs. Data scraping web-based job vacancy data provides an evidence base of the skills needed as well as changing skills needs within green jobs in Scotland, both achieved and ascribed. Importantly, this data reveals the skills demanded by employers for workers to access jobs, and so can be an important tool of labour market information and career guidance. Developing and then maintaining this green skills taxonomy would thus benefit from regular job vacancy data scraping exercises to monitor employer skills demands.

69 https://www.ons.gov.uk/methodology/classificationsandstandards/standardoccupationalclassificationsoc/standardoccupationalclassificationsocextensionproject

### *4 Map the green skills of the GreenSOC onto existing skills frameworks/maps developed for use in the Scottish context*

What is regarded as a soft skill has mushroomed and there are attempts internationally to make sense of these skills based on a 'single language'.[70] In Scotland efforts in this respect are focused on future skill needs and what SDS term 'meta-skills.[71] In light of the ongoing work around skills mapping and the development of the meta-skills framework and MyWorldofWork skills map etc., it will be necessary to map the skills of the GreenSOC on to these frameworks/maps. The aim would be to inform delivery of these skills within the education and training system in Scotland to further support the jobs needed in the transition to a net zero economy.

### *5 Apply the GreenSOC to analyses of regions and industries within Scotland*

Given Scotland's coordinated approach to addressing current and future skills needs at a regional level (e.g. Regional Outcome Agreement areas, Regional Skills Assessments, Regional Enterprise areas), it would be helpful if future analysis drilled down into each NUTS 2 level region. Such analysis would enable comparison of urban and rural areas within each regions for example. Applying the GreenSOC at this level would feed into and complement existing regional evidence sources including labour market information. Similarly, it will also be important to apply the GreenSOC to key sectors (e.g. key growth sectors, CESAP sectors) to ensure workforce development considerations are aligned to areas of economic growth. Evidence from the US suggests that a regional/sector skills focus is a fruitful way to build better skill ecosystems.[72]

### *6 Explore the GreenSOC in relation to Fair Work in Scotland*

Fair Work is now firmly embedded in Scottish policy aspirations, with the Scottish Government aiming for Scotland to become a Fair Work Nation. Fair Work is defined as effective voice, opportunity, security, fulfilment and respect. The 'Fair Work first' default position encourages a Real Living Wage, investment in skills and training, the end of zero-hours contracts, a closing of the gender pay gap and more workforce engagement. Our analysis examined the pay of green jobs and access to these jobs on the basis on gender and age. This analysis should be extended, where possible, to all five Fair Work pillars. Doing so would provide a more

[70] WEF (2020).

[71] https://www.skillsdevelopmentscotland.co.uk/media/44684/skills-40_a-skills-model.pdf

[72] Buchanan et al. (2017).

comprehensive understanding of the quality of green jobs in Scotland and help align the policy imperative to create a fairer, greener future for all in Scotland.

### *7 Encourage the greening of jobs in all sectors*

Purist green jobs in the industries covered by the CESAP sectors will have an important role to play in furthering a net zero economy in Scotland. However, most if not all jobs should contribute to the transition to a net zero economy. Already in Scotland a significant proportion of jobs in non-green industries – though outwith the CESAP sectors, are greening. This development shows that it is possible for non-green jobs to change. Encouraging more of this change is also important. Given that it is incremental changes to these jobs' skills and knowledge, one way of encouraging this greening will be through training that delivers up-skilling and re-skilling enabled by new micro-credentials[73], and which might also support the drive to a more inclusive net zero economy by drawing in workers in all other sectors.

[73] See, for example, Karanovic et al. (2022).

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