

CESAP Pathfinder

A Dynamic Skills Response to Supporting the Transition to Net Zero



Work Package 1: An Evidence Based Approach to
Supporting the Transition to Net Zero

November 2023

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The CESAP Work Package 1 Pathfinder has a suite of reports to share the insights, intelligence and lessons learned. These can be found [here](#).

This Pathfinder Report provides a comprehensive overview of the full range of activity that constituted the Pathfinder and the opportunities identified for further action.

It is supplemented by:

- Executive Summary – a short summation of the CESAP Pathfinder report and the opportunities identified for further action.
- Preces Reports (Investment, Demand and Provision) – succinct, accessible documents which provide the background to the work, summarise the main findings and identify key lessons learnt.
- Mapping of Green Investments – further detail on identified investments in Scotland to support the transition to net zero.
- Supplementary Demand Evidence – additional technical data from activity to estimate demand.
- Supplementary Provision Evidence – additional technical data

Executive Summary

1. Having a nation with the right skills will be fundamental to achieving the Scottish Government's ambitious target of becoming a net zero emitter by 2045. To support this, the skills system and labour market will need to be more agile and dynamic than ever before.
2. The Climate Emergency Skills Action Plan (CESAP) published in 2020¹ outlined the need for action to ensure that current and future skills investment in support of net zero is strongly evidence based. The CESAP Pathfinder is a direct response to this and has been led by Skills Development Scotland (SDS), in collaboration with the Scottish Funding Council (SFC) and forms part of the Shared Outcomes Framework².
3. The CESAP Pathfinder comprises two complimentary work packages: Work package 1: An Evidence Based Approach to Supporting the Transition to Net Zero and Work package 2: Decarbonisation of Domestic and Commercial Heating Pilots in two regions of Scotland. This report focuses on work package 1.
4. A key aim of the CESAP Pathfinder (Work package 1) was to establish a shared view of the breadth and quality of skills evidence in relation to the transition to net zero. This has been achieved through:
 - Understanding current and planned economic investment supporting the transition to net zero.
 - Assessing the breadth and quality of information on the demand for skills from the transition to net zero.
- Mapping existing skills provision across apprenticeships, further education, higher education, upskilling and reskilling relevant to the transition to net zero.
- Understanding current levels of skills investment in relation to the transition to net zero.
5. The findings from the CESAP Pathfinder advances the evidence base to identify current and future skills demand, establishes a baseline of green skills provision and identifies opportunities for action needed across the skills system to respond to the transition to net zero.
6. This report summarises the series of comprehensive research projects undertaken as part of the Pathfinder Work Package 1. Throughout this work, it has been critical to engage with relevant stakeholders. This has included consultations (21 organisations) and working with experts on the relative research, testing and validation of the approach and findings with stakeholders, including the subgroups of the CESAP Implementation Steering Group (ISG), sector experts, and colleagues at SFC and within SDS.
7. This work has been a significant undertaking over a 16 month period. Our engagement with stakeholders has identified a number of other ways in which Scotland's education and skills system is supporting the transition to net zero, including:
 - The development and deployment of research, innovation and new technologies to support the transition to net zero.
 - Action by institutions and organisations to reduce their carbon emissions (through, for example, travel reduction, estates investment, or switching to lower carbon intensive forms of heating).

¹ Skills Development Scotland (2020). Climate Emergency Skills Action Plan.

² Scottish Government (2022). [Skills: Shared Outcomes Framework](#)

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8. While these are important contributions, they are not within the scope of this research. Similarly, while we are aware of significant work to update apprenticeship, college and university curriculum, we have not been able to access information on this in a systematic way, so these efforts have not been considered as part of this work.
9. The focus of the Pathfinder activity has been on the five areas of economic opportunity identified in the CESAP. These sectors make a significant contribution to the net zero transition and are where there is also the greatest potential for skills implications and jobs growth arising from the transition. These broadly were:
 - **Agriculture (including Forestry and Fishing)**
 - **Construction**
 - **Energy and waste treatment**
 - **Manufacturing (including Engineering)**
 - **Transport**

Key Findings

10. Identifying known investment, understanding demand for skills and quantifying levels of current skills provision are all critical components of effective skills planning. By understanding these key components, we can determine and assess gaps and identify opportunities to address them, to ensure the skills system can effectively support the transition to net zero.

³ Gross Domestic Product. Scottish Government GDP Quarterly National Accounts, Scotland 2022 Quarter 2 (April to June), November 2022. Including oil and gas extraction in Scottish waters, Scotland's GDP in 2021 is estimated to be £179.9 billion in total.

⁴ Gross Value Added, see supplementary Demand Evidence Report for further details.

What do we know about green investment?

11. Investment will be a catalyst for the transition to net zero and lead to job creation. As a result, a core part of the Pathfinder was to map green investments across Scotland. A thorough process identified investments, importantly capturing the likelihood of investment materialising and the timeframe over which it was expected to take place. Key messages include:
 - Green investments (with known scale) total just under £90bn and are happening now or due to take place over the next 2-3 years. This is a significant level of investment and over the duration of the planned expenditure (up to 10 years) would be around 5% of Scotland's GDP³ annually over the period and just under a fifth of annual GVA⁴ from Scotland's CESAP sectors.
 - Energy Transition accounts for more than 65% of all known green investments at around £58.5bn. The largest component of this is investment in large-scale offshore wind farms (62% of identified Energy investment).
 - Of the total expected green investment, approximately £48bn (53%) is already going ahead or has a high likelihood of proceeding in the next 2-3 years.
 - The levels of known investment with a high likelihood of progressing are greatest in the Highlands and Islands, Edinburgh City Region, Aberdeen City and Shire, Tay Cities and Glasgow City Region.
 - There are also distinct geographical concentrations of known sectoral investment that is proceeding or likely to proceed by region, with Energy transition mostly concentrated in the north of Scotland and the east coast. Construction investment is concentrated in the Central Belt, while Transport investment is distributed across Scotland.

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12. This knowledge of investments can be used as a basis for prioritising evidence gaps and informing skills planning. It can also provide the basis for piloting specific sectoral skills interventions in regions where there is clear evidence of emerging activity.
13. There is investment that is known and investment highly likely to proceed across every region in Scotland that will require agility and responsiveness from the skills system over the next 3 years.
14. Crucially, what is presented is a snapshot of a point in time. It will be important to maintain the integrity and completeness of the insight going forward – and to communicate and share that evidence with partners in the skills system.

What do we know about the demand for green skills?

Green Jobs in Scotland

15. The Green Jobs in Scotland⁵ research, commissioned as part of the Pathfinder, advanced understanding of the types of green occupations in CESAP sectors, and across the whole economy. The report classified green occupations into one of three groupings:
 - New and Emerging occupations – where there is a need for unique work and worker requirements, which results in the generation of new occupations.
 - Enhanced Skills and Knowledge occupations – where the essential purposes of the occupation remain the same but

tasks, skills, knowledge, and external elements, such as credentials, have been altered.

- Increased Demand occupations – where the work context may change but the tasks do not.
16. The research estimated that more than one-quarter (25.7%) of all jobs in Scotland were in the Enhanced Skills and Knowledge category, one in ten (9.9%) were Increased Demand, and 4.3% were New and Emerging. This means that for every one job in New and Emerging, there are two jobs in existing occupations that we will need more of, but six jobs that already exist that need new skills to adapt to the implications of the transition to net zero. This highlights the critical role of upskilling in meeting the transition to net zero.

Demand in CESAP sectors

17. Looking across the CESAP sectors, in 2022 there were 690,900 people employed, accounting for 26.5% of Scottish employment. Construction accounted for the largest share of CESAP sector employment.
18. Not everyone who works in a CESAP sector is in a green job – but most are. Based on Oxford Economics employment estimates, for every ten people working in the CESAP sectors in 2022, seven worked in a green occupation and three worked in a non-green occupation.
19. Employment in the CESAP sectors is spread across Scotland. It is greatest in and around Scotland's cities and although lower in volume, green occupations accounted for an above-average share of employment in rural areas (33% compared to 27% across Scotland).

⁵ Cardenas Rubio, J., et al. (2022). [Green Jobs in Scotland: An inclusive approach to definition, measurement and analysis.](#)

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20. In the mid-term (2022-2025), demand arising from the need to replace workers far exceeds demand arising from growth. This is consistent with all sectors of the economy. Overall, 77,000 people are expected to be required to meet demand across the CESAP sectors from 2022 to 2025. The current level of employment, and outlook varies by CESAP sector.

Energy and Waste Treatment

21. The Energy and Waste Treatment sector is expected to face significant demand for new skills over the short to medium term. This will be driven by four primary factors:

- More than 12,000 people will be needed to fill jobs emerging because of replacement demand as existing skilled workers retire from the workforce.
- A significant reskilling requirement to support the transition of workers from high carbon intensive to low carbon intensive forms of energy production.
- Growth in the demand for new skills as new and emerging technologies such as Hydrogen production and Carbon Capture and Storage come to fruition.
- A significant requirement to upgrade grid and transmission infrastructure to accommodate new technologies.

22. The demand evidence highlights that many of the skills that are likely to be required in relation to energy and waste transmission are already in short supply – and that there is likely to be strong competition for these skill sets from other sectors.

Construction

23. The Construction sector in Scotland plays a key role in heat

decarbonisation, and as work ramps up to support this process, the sector is expected to face significant demand for new workers and new skills. The main factors driving this demand are:

- A requirement for substantial upskilling and reskilling to support the current workforce to acquire suitable skills for retrofitting and installing net zero heating systems.
- A substantial expansion and replacement demand is forecasted in the sector, with a total requirement of 21,700 people to meet demand in the sector up to 2025.
- An ageing workforce and reduced availability of migrant labour which is expected to contribute to high replacement demand and labour shortages.
- Shortages in key trades required for the decarbonisation of heat, including plumbers, electricians and retrofit coordinators.

24. The evidence highlights that there are challenges around upskilling and reskilling within the Construction sector, particularly due to financial barriers, availability of training and labour shortages. Notwithstanding the challenges, it is important to ensure upskilling and reskilling opportunities are readily available to employers to support the amount of training required in the heat decarbonisation space.

Transport

25. The Transport sector is expected to be subject to significant demand for changing and new skills as the sector adapts to the transition to net zero. The primary factors driving this are:

- Demand for skills to support the expansion of ULEV infrastructure.
- A significant requirement for training (for new starts and re-skilling existing workers) on the maintenance and repair of ULEVs.

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- Wider training requirements (for both new starts and re-skilling) around ULEVs relating to core and para Transport occupations. It is estimated that 65,000 people will need to undertake training to support the uptake of electric/hybrid vehicles.
 - Considerable total requirement – amounting to 24,900 people up to 2025, which includes replacement demand as the ageing workforce retires.
26. The expansion of ULEV infrastructure is vital in supporting the sector's transition to net zero. Primarily this reflects the need for more charging points to support the uptake of electric vehicles. It also includes wider infrastructure to support the decarbonisation of HDVs (e.g., hydrogen refuelling infrastructure) and trains (e.g., the electrification of lines).

Manufacturing (including Engineering)

27. The Manufacturing sector is currently heavily reliant on fossil fuels, and there will be major changes required in the sector to reduce emissions and meet Scotland's net zero targets. This will result in significant demand for skills and labour, which will be particularly driven by the following factors:
- An ageing workforce and reduction of migrant labour contribute to a replacement demand for 6,900 people in the sector up to 2025.
 - Shortages of workers trained in key trades required to support decarbonisation in the Manufacturing sector, including welders, fabricators, and engineers.
 - Significant upskilling and reskilling is required to allow

workers in the sector to adapt to new ways of working to support the decarbonisation of Manufacturing.

28. To support decarbonisation in the Manufacturing sector, there is an increasing demand for higher-level skills within the workforce. This is particularly due to the introduction of new technologies that require design, analytical and technical skills, as well as management skills. These skills will support the Manufacturing sector adapt to new ways of working that will reduce the sector's carbon emissions.

Agriculture (including Forestry and Fishing)

29. The Agriculture sector is of key importance to the transition to net zero. The sector is expected to face significant demand for new skills as it adapts to agricultural practice in a low carbon environment. The primary factors driving this are:
- A considerable replacement demand as the ageing workforce retires. This is the key driver of the 11,500 total requirement over the period to 2025.
 - Adoption of new digital technologies to support more efficient and sustainable agriculture.
 - Growing skills demand from peatland restoration. This is a new and growing sector, which is already leading to unmet skills demand. Estimates suggest there could be a need to fill 1,500 jobs in the period to 2030.
30. This is set against a challenging backdrop as labour availability has been affected by Brexit. The availability of housing and public transport in rural areas combined with challenges around sector attractiveness have also created difficulties in the Agriculture skills pipeline. However, the transition to net zero offers the opportunity for more technical/highly skilled occupations in areas such as peatland restoration, chemical management, soil testing and other occupations related to the greater adoption of digital technologies.

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What have we learned about the provision of green skills?

31. Understanding the scope, level and volume of 'green' provision is crucial for effective skills planning. The post-16 skills system has an important role in achieving the transition to net zero, by ensuring that new entrants who leave education and enter the labour market, and those within work who need to upskill or retrain, have the skills needed. Skills alone will not realise the economic opportunities presented by the transition to net zero, but they are an essential component part.
32. Looking across the data on provision, there is evidence that training and learning to support the transition is already taking place:
 - 27% (32,300) of college enrolments are in courses that are aligned to CESAP sectors.
 - Around 16% of graduates from Scottish universities were working in a CESAP sector 15 months after graduation.
 - Around 29% (7,400) of Modern Apprentices (MA) starts and 38% (400) of Graduate Apprentice (GA) starts were in sectors aligned to CESAP.
33. Retaining talent and skills in Scotland will be important to achieving the transition. There is some evidence of leakage from this pipeline of potential skills supply, however:
 - Of the university graduates going into a CESAP sector as their first destination, around 40% of these do so in a job that is outside of Scotland.

- Data on destinations for college enrolments at the detailed sectoral level – and therefore the extent to which people are entering CESAP sectors or going on to use qualifications and skills gained in CESAP sectors – is not available. This is an important data gap which should be filled.

34. Around 90% of GAs and MAs aligned to CESAP sectors were still working in the sector 15 months after completing their qualification.
35. Much of the university and college data used for this analysis will include elements of upskilling and reskilling. However, extracting this from the data has proved difficult. This is a significant gap in our knowledge, particularly given the importance of upskilling as a driver of skills demand.

Gap analysis

36. A key aim of the CESAP Pathfinder was to assess the strength and quality of the existing evidence base to support the transition to net zero and identify ways in which it could be strengthened. From the analysis that has been undertaken, we have been able to identify strategic evidence and underlying data gaps and offer a view on how these might be addressed. We are also able to identify evidence-based opportunities to respond to the transition to net zero. These nine opportunities are detailed below.

Investment

37. Whilst there are significant uncertainties about the timing and critical path to investments in some sub sectors, evidence on known and certain investments is strong at the level of CESAP sectors, allowing disaggregation by region and, in some cases, specific economic opportunities. The level of known investment is considerable – and should be of sufficient scale to signal the need to invest in anticipation of skill needs.

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1. To take advantage of upcoming economic opportunities in ScotWind, Hydrogen, CCUS and Green Freeports, developing an understanding of the investment aligned to these opportunities should be an early priority. This should look to provide up to date detail on known investments within Scotland, specific locations, and the nature and timeframes for investment. This will provide a stronger basis for subsequent skills demand assessment and a strong signal of potential future skills demand to skills providers.

Demand

38. The evidence on the volumes of people who might be needed across some CESAP sectors is less consistent and clear than we might have anticipated at the start of the Pathfinder. This is in part down to some uncertainties on investment timelines but also reflects a fragmented approach to the forecasting of skills requirements. However, competition for key skillsets across sectors and the expected retirements allied with the persistence of skills shortages suggests strong likelihood of people and skills availability acting as a barrier to achieving Scotland's net zero ambitions.
39. We have also identified evidence gaps in relation to the specific skills requirements that will be associated with different elements of the transition to net zero. These gaps are best filled by direct engagement with employers and those undertaking work in these sectors.

2. Further develop specific demand analysis across CESAP sectors, focusing on known opportunities and including direct insight from employers and industry. This analysis should also look to identify skills in demand across sectors and inform skills planning on a national and regional basis.

3. Undertake further engagement with relevant stakeholders and partners to assess and validate findings from this pathfinder work and explore ways to address data gaps collectively and strengthen the evidence base.

Provision

40. The demand evidence highlights the critical role that upskilling will play in supporting existing workers to contribute to the transition to net zero. The availability of evidence on discrete upskilling activity – and the extent to which existing provision is supporting upskilling is a key weakness – which should be addressed.
41. In addition, whilst there is evidence of alignment of existing provision to support the transition to net zero, leakage from this pipeline of potential skills supply is evident. A key data gap exists on the destination of college leavers in relation to CESAP sectors.

4. As a priority, establish a mechanism to better disaggregate the extent to which existing provision is supporting reskilling and upskilling to support the transition to net zero.

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5. For colleges, gather data on destination following completion. This approach should be in line with the Graduate Outcomes survey measures and the Real Time Apprentice Insights (RTAI) survey. A crucial part of this would be capturing where completers are working (by sector) and whether they are within Scotland.

6. Create a consistent evidence base on provision which takes account of starts, withdrawals, completers and final outcomes on a common basis across colleges, universities and apprenticeships. Work towards implementing a robust and annualised monitoring framework to ensure post-school provision is moving in the right direction to meet net zero needs.

To support this, it may be helpful to start with a pilot of a small number of green occupations critical to net zero with a standard set of measurements across the apprenticeship family, colleges and universities. The CESAP Pathfinder Work Package 2 (decarbonisation of domestic and commercial heating) could explore how best to achieve this.

42. It is important to consider what we can learn from elsewhere in terms of what good looks like in a dynamic skills response to support the transition to net zero. This would enable learning on how other countries are working towards net zero and climate resilience, with a specific focus on skills.

7. Identify any international best practice efforts to identify the evidence on investment, demand and provision of skills to support the transition to net zero, and embed any lessons in Scottish practice.

Gap Analysis

43. In relation to green skills needs in the CESAP sectors, the evidence points to the need for more workers in key occupations and for a substantial volume of upskilling for those already employed in these occupations. This reflects the anticipated higher levels of employment growth in the CESAP sectors – growth which will be essential if net zero is to be achieved.

8. Following the testing and validation of the Pathfinder findings (number 3 above) with partners and stakeholders, establish clear mechanisms to increase the volume of skills in those areas that have been identified as potential critical blocks in delivering the transition to net zero.

44. A significant amount of work has been undertaken as part of this research in what is a complex area and had not been attempted previously in a consistent way across CESAP sectors. Partnership involvement has been important throughout, and to successfully address the gaps and capitalise on the opportunities identified, collaborative working will be critical across partner agencies, with the involvement of wider stakeholders.

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45. This will enhance the lessons already learned and assist with the development of future research and an implementation plan, including agreeing priority areas of focus to support both immediate and emerging opportunities. The CESAP update, due to be published later in 2023, presents an opportunity to agree priority action areas with partners.

9. Agree implementation priorities across 1) Keeping data on investment intentions up to date and disseminating to partners 2) Filling strategic data gaps in provision 3) establish clear mechanisms to increase the volume of skills in those areas that have been identified as potential critical blocks 4) identifying priority areas to take forward further detailed demand assessment work and co-design of skills interventions (such as the one underway in Decarbonisation of Heat in Buildings).

1. Introduction

- 1.1 The Scottish Government has established a clear policy framework for Scotland’s approach to achieving net zero and greater climate resilience⁶. Given the nature and scale of the climate emergency, the framework is ambitious in its goals and targets. Having a nation with the right skills will be vital to achieving the target of becoming a net zero carbon emitter by 2045, and to support this, the skills system and labour market will need to be more agile and dynamic than ever before. This will also help create adaptive and resilient workers who will prosper in the current and future labour market. Underpinning this is a need for robust, respected and appropriate evidence on skills demand and supply.
- 1.2 The Climate Emergency Skills Action Plan (CESAP) outlines the need for coordinated action to ensure that current and future skills investment, in support of net zero, is strongly evidence-based⁷. This report of the CESAP Pathfinder advances the evidence base to identify current and future skills demand, establishes a baseline of green skills provision and identifies opportunities for action needed by the skills system to respond to the transition to net zero.

Policy context

- 1.3 The CESAP contributes to several Scottish Government policies that underpin Scotland’s approach to achieving net zero by 2045:
- In 2021, the Scottish Government prepared its response⁸ to a report by the Just Transition Commission: *A National Mission for a Fairer, greener Scotland*⁹. In the response, skills, training and education that help to secure good, high value jobs in green sectors are seen as essential to ensuring a Just Transition. There is also a strong focus on job security for all those transitioning out of high carbon sectors where reskilling has a critical role.
 - The 2021 *Heat in Building Strategy: Achieving Net Zero Emissions in Scotland’s Buildings*¹⁰ outlines the significant economic opportunity of transforming buildings. The heat transition has the potential to create new jobs, with estimates suggesting 16,400 jobs could be created by 2030 because of investment in this area¹¹. Arising from the strategy was the *Heat in Buildings Workforce Assessment Project*¹², 2022, which found a sizeable challenge for skills development and diversity of talent.
 - The Scottish Government’s *National Strategy for Economic Transformation (2022)*¹³ (NSET) set out ambitions for Scotland to become Fairer, Wealthier and Greener over the next ten years, with people at the heart of a wellbeing economy.

⁶ Scottish Government (2020). [Securing a green recovery on a path to net zero: climate change plan 2018–2032 - update.](#)

⁷ Skills Development Scotland (2020). [Climate Emergency Skills Action Plan.](#)

⁸ Scottish Government (2021). [Just Transition - A Fairer, Greener Scotland: Scottish Government response.](#)

⁹ Just Transition Commission (2021). [Just Transition Commission: A National Mission for a fairer, greener Scotland.](#)

¹⁰ Scottish Government (2021). [Heat in Buildings Strategy: Achieving Net Zero Emissions in Scotland’s Buildings.](#)

¹¹ Cambridge Econometrics (2021). [The Economic Impact of Decarbonising Heating to 2030 in Scotland.](#)

¹² ClimateXChange (2022). [Clean Heat and Energy Efficiency Workforce Assessment.](#)

¹³ Scottish Government (2022). [Scotland’s National Strategy for Economic Transformation.](#)

1. Introduction

- The Scottish Government's *NSET Delivery Plan*¹⁴ published in 2022 emphasises creating a more flexible and responsive skills system. It notes that around 2.1m workers will need to be upskilled by 2030, and over 400,000 retrained across all sectors.
- The Scottish Government's *Draft Energy Strategy and Just Transition Plan*¹⁵ published in January 2023 renews the commitments to reducing overall carbon emissions by 75% by 2030 and 90% by 2045. To achieve these targets, there will need to be a substantial increase in the capacity of renewables, as well as decarbonising energy for heat, transport and industry. To help meet the 2030 target, a consolidated and significant response from Scotland's post-school skills system is required.
- Emerging *Just Transition Plans* for Construction and the Built Environment¹⁶, Transport¹⁷ and Land Use and Agriculture¹⁸ will seek to complement the ambitions and actions of existing government plans and strategies, identify prevailing sector inequalities, and redress these. They will also provide targeted action and outline the critical steps to delivering a fair transition for each sector.

¹⁴ Scottish Government (2022). [Scotland's National Strategy for Economic Transformation - Delivery Plans October 2022.](#)

¹⁵ Scottish Government (2023). [Draft Energy Strategy and Just Transition Plan.](#)

¹⁶ Scottish Government (2023). [Just transition for the Built Environment and Construction sector: a discussion paper.](#)

¹⁷ Scottish Government (2023). [Just transition for the transport sector: a discussion paper.](#)

¹⁸ Scottish Government (2023). [Just transition in land use and agriculture: a discussion paper.](#)

¹⁹ Scottish Government (2022). [ScotWind Announcement.](#)

1.4 As the policy context advances over the coming years, there will be several opportunities to be realised as we move towards a net zero economy. Significant opportunities are expected to arise from ScotWind¹⁹, the hydrogen programme, and Scotland's Green Freeports²⁰. The CESAP Pathfinder and the action that occurs as a result will help Scotland to make the most of these opportunities.

Aims of the CESAP pathfinder

1.5 The CESAP Pathfinder was established as part of the Shared Outcomes Framework²¹. This is the mechanism for Skills Development Scotland (SDS), the Scottish Funding Council (SFC) and the Scottish Government to work together on collaborative projects that contribute to the overarching skills outcomes set out in the NSET and the missions of the Future Skills Action Plan²². The CESAP Pathfinder comprises two complimentary work packages: Work package 1: An Evidence Based Approach to Supporting the Transition to Net Zero and Work package 2: Decarbonisation of Domestic and Commercial Heating Pilots in two regions of Scotland²³. This report focuses on Work package 1.

²⁰ Scottish Government (2023). [Green Freeports.](#)

²¹ Scottish Government (2022). [Skills: shared outcomes framework.](#)

²² Scottish Government (2021). [Future Skills Action Plan.](#)

²³ Workpackage 2 builds on the evidence learnings from Workpackage 1 by testing an approach focussed on the decarbonisation of domestic and commercial heating, one of the early investment programmes being delivered as part of the Scottish Government Climate Change Plan. It concentrates on two pilot areas - Glasgow City Region and the Shetland Islands.

1. Introduction

1.6 A key aim of the CESAP Work package 1²⁴ was to establish a shared view of the breadth and quality of skills evidence in relation to the transition to net zero. This was achieved through:

- **Understanding current and planned economic investment** supporting the transition to net zero.
- **Assessing the breadth and quality of information on the demand for skills** from the transition to net zero.
- **Mapping existing skills provision** across apprenticeships, further education, higher education, upskilling and reskilling relevant to the transition to net zero.
- **Understanding current levels of skills investment** in relation to the transition to net zero.

1.7 This has allowed views to be offered and opportunities to be identified in several areas, including:

- Where there may be emerging gaps between the demand for skills because of the transition to net zero and current skills provision.
- How the existing evidence base could be strengthened.
- The alignment of current evidence against NSET policy priorities.

²⁴ Work Package 2 builds on the learnings from Workpackage 1 by testing an approach focussed on the decarbonisation of domestic and commercial heating, one of the early investment programmes being delivered as part of the Scottish Government Climate Change Plan. It concentrates on two pilot areas - Glasgow City Region and the Shetland Islands.

²⁵ As part of the Green Jobs in Scotland research, the University of Warwick and Strathclyde defined the key CESAP sectors using SIC codes based on the areas outlined in the CESAP as being affected the most by the transition to net zero. The sectors used for the gap analysis have been taken as a best-fit to these CESAP sectors using a SIC1 definition due to data availability.

1.8 The CESAP identified five areas of economic opportunity which would make a significant contribution to the net zero transition, and where there was potential for jobs growth and skills implications. These broadly were:

- **Agriculture** (including Forestry and Fishing).
- **Construction**
- **Energy and Waste Treatment.**
- **Manufacturing** (including Engineering).
- **Transport.**²⁵

These are the CESAP sectors which have been the focus of the Pathfinder activity.

1.9 This work has been a significant undertaking over a 16 month period. Our engagement with stakeholders has identified a number of other ways in which Scotland's education and skills system is supporting the transition to net zero, including:

- The development and deployment of research, innovation and new technologies to meet support the transition to net zero.
- Action by institutions and organisations to reduce their carbon emissions (through, for example, travel reduction, estates investment, or switching to lower carbon intensive forms of heating).

1.10 While these are important contributions, they are not within the scope of this research. Similarly, while we are aware of significant work to update apprenticeship, college and university curriculum, we have not been able to access information on this in a systematic way, so these efforts have not been considered as part of this work.

1. Introduction

The approach

1.11 This report summarises a series of comprehensive research projects led by SDS, in collaboration with SFC and the Scottish Government, to report overall on the CESAP Pathfinder, Work Package 1 activity. It is structured around three components of intelligence that are needed to underpin effective skills planning:

Figure 1.1: Components of intelligence needed for effective skills planning



1.12 Early research conducted as part of the CESAP Pathfinder activity included the Green Jobs in Scotland report²⁶, completed by the Warwick Institute for Employment Research, University of Warwick and the University of Strathclyde. This research was vital to establishing the building blocks for assessing demand, provision, and the gap between them by, for the first time, developing an inclusive approach to the definition, measurement and analysis of green jobs in Scotland. A comprehensive, mixed-method approach was taken, with members of the CESAP Implementation Steering Group contributing, as well as other industry and subject matter experts. This work culminated in creating a

‘GreenSOC’ (occupational categorisation) and a baseline of green occupations in Scotland; importantly, it provided a definition for green occupations that facilitated the next steps of the CESAP Pathfinder.

- 1.13 Investment will be a catalyst for the transition to net zero and lead to job creation. As a result, a core part of the Pathfinder was to map green investments across Scotland. Optimat developed a thorough process to identify and classify green investment in Scotland, including the likelihood of the investment materialising and over what timeframe. This work provided a new source of known planned green investment across CESAP sectors in Scotland.
- 1.14 An extensive demand assessment was undertaken that engaged stakeholders and industry. It identified occupations within the CESAP sectors where skills gaps²⁷ were already an issue, as well as potential future constraints as the transition to net zero accelerates over the coming decade. This broad approach (including current and forecast data from Oxford Economics, vacancy data and a wider literature review) provides a picture of current and future demand for green skills within each key CESAP sector.
- 1.15 SDS and SFC subject matter experts used their existing knowledge and expertise to map and analyse CESAP related college, university, apprenticeship, upskilling and reskilling provision to the industries and occupations identified in the Green Jobs in Scotland research²⁸. Particularly in the case of graduates and apprentices, provision mapping was correlated to the CESAP sectors and green occupations individuals worked in, for the first time moving beyond a subjective view on ‘green courses’ aligning to ‘green roles’. The research culminated in significant information and learning on the scale of learners in education and training in courses aligned to green occupations and CESAP industries across Scotland.

²⁶ Cardenas Rubio, J., et al. (2022). [Green Jobs in Scotland: An inclusive approach to definition, measurement and analysis.](#)

²⁷ Identified gap from demand evidence and provision mapping.

²⁸ As 26.

1. Introduction

- 1.16 Finally, Cambridge Policy Consultants (CPC) were commissioned to undertake a gap analysis to provide an external and expert view. To do this, CPC conducted extensive research, analysis and consultations with over 40 stakeholders from 21 relevant organisations, culminating in a number of opportunities, based on the findings to help shape a future research plan for improving the evidence base and gap analysis over time.
- 1.17 At each stage, it has been critical to engage with relevant stakeholders. This includes consultations with experts, testing and validation of the approach and findings with stakeholders, including the subgroups of the CESAP Implementation Steering Group (ISG), sector experts, and colleagues at the SFC and within SDS. A complete list of those consulted can be found in Appendix 1. Whilst a great deal of learning has taken place across the Pathfinder, further dissemination and engagement are essential to build on the work already undertaken. This report contributes to that aim.

2. Current and planned investment supporting the transition to net zero

Introduction

- 2.1 Understanding the scale and timing of green investments is critical to understanding the intensity of green skills demand. SDS commissioned an extensive mapping of green investments across Scotland to understand current and planned investments that could drive the need for green jobs²⁹. This provided insights into the composition and likelihood of green investment.
- 2.2 The research focused on more significant investments of £0.5m or above that are likely to create demand for green skills at scale. Investments were categorised depending on their likelihood to go ahead into the following groupings:
- 1 - Already proceeding
 - 2 - High likelihood
 - 3 - Medium likelihood
 - 4 - Significant uncertainties
- 2.3 The categorisation of investments was based on several factors, including whether the project was a high-level intention or had a firm business case developed, and the presence of significant dependencies such as a realistic chance of obtaining investment funding within the two-to-three-year timescale and obtaining planning and consents.

²⁹ Optimat SDS (2022) Mapping of Green Investments across Scotland. All data within this section is based on this research.

³⁰ Gross Domestic Product. Scottish Government GDP Quarterly National Accounts, Scotland 2022 Quarter 2 (April to June), November 2022. Including oil and gas extraction in Scottish waters, Scotland's GDP in 2021 is estimated to be £179.9 billion in total.

³¹ Gross Value Added, see supplementary Demand Evidence Report for further details.

³² Optimat mapped the investments to sectors based on desk research and consultations. The sector mapping is based on the same priority areas outlined in the CESAP, however the names used are slightly different from the rest of the report.

2.4 It is important to note that investment mapping captures a point in time, and any subsequent announcements in investment (confirmed or planned) will not be captured in the findings presented here. Further details on the method can be found in the full report.

What do we know about green investment?

2.5 Green investments (with known scale) total just under £90bn and are happening now or due to take place over the next 2-3 years. This is a significant level of investment and over the duration of the planned expenditure (up to 10 years) would be around 5% of Scotland's GDP³⁰ annually over the period. It is also just under a fifth of annual GVA³¹ from Scotland's CESAP sectors.

Table 2.1 - Investment value (£M) by CESAP sector³²

Sector	Total (£M)	% of known green investment
Energy Transition	58,468	65%
Transport	15,354	17%
Construction	14,414	16%
Agriculture Land Use	486	1%
Manufacturing	181	<1%
Other	966	1%
Total	89,869	100%

Source: Optimat SDS Mapping of Green Investments across Scotland

2.6 Energy transition has the highest levels of known investment, with £58.5bn identified (65% of all known green investment). The largest component of this is investment in renewable electricity generation from large-scale offshore wind farms, with this activity accounting for 62% of identified Energy transition investment.

2. Current and planned investment supporting the transition to net zero

- 2.7 ScotWind is the first offshore wind auction of Crown Estate Scotland in the past ten years. Developers have signalled investment on average of £1.4bn in the Scottish supply chain across the ScotWind projects.
- 2.8 In addition, the 2023 ClimateXChange report³³ on *Mapping the current and forecasted hydrogen skills landscape* has highlighted that hydrogen has the potential to be a significant contributor to decarbonising energy supply. At the time of writing, levels of known investment are however not quantified to meet the hydrogen production capacity ambitions in the Scottish Hydrogen Action Plan³⁴. The upstream Hydrogen Economy is anticipated to have an estimated turnover of c£7.6bn by 2030 and c£22.9bn by 2035.
- 2.9 Transport is another significant area of known green investment, valued at £15.4bn. This includes £400m for an expansion project at the port of Aberdeen to improve infrastructure to support energy transition, £117m for the reinstatement of Levenmouth Rail Link and £63m for the Barrhead Corridor Electrification which will support passenger and freight services and will be used as a key diversionary route for cross-border services.
- 2.10 Construction accounts for a sizeable proportion of the total green investment, accounting for £14.4bn (or 16% of all investment). This includes £409m as part of the Glasgow City Council investment plan to create 6,500 new affordable homes from 2022/23 to 2026/27. 'Tackling fuel poverty, energy efficiency and climate

change' is one of six strategic priorities of the investment plan. In addition, a £300m investment is already underway to support the development and rollout of zero-emission heat networks across Scotland.

- 2.11 Green investments relating to Agriculture and Land Use are valued at £0.5bn, 67% of which is happening now. This includes £100m of investment already underway for a facility for sustainable cattle feed and £107m for the Clyde Climate Forest. There is also a £120m investment Scotland-wide for new forest planting.
- 2.12 Manufacturing investments are valued at £0.181bn, with £103m of this - nearly 57% - already proceeding. This includes £25m for a Tay Cities Region Deal Biomedical Cluster, encompassing an Innovation Hub for new companies to grow and development of a Medical Technologies environment to demonstrate new medical devices. There is also an £18m investment underway to scale up thermal energy storage solutions that support the shift to low carbon heat in the UK and overseas.
- 2.13 Green investments classified as "Other" are valued at £1bn and include a total of £210m investment already underway on Wastefield Energy Centre in Fife - a project to design, build, operate and maintain a new Energy-from-Waste (EfW) facility in Fife. There is £70m for a similar EfW project in Perth and £34m as part of the Stirling and Clackmannanshire City Region Deal for Scotland's International Environment Centre (SIEC) to create an innovation community in the Forth Valley.

³³ ClimateXChange (2023). Mapping the current and forecasted hydrogen skills landscape.

³⁴ Scottish Government (2022). Hydrogen action plan.

2. Current and planned investment supporting the transition to net zero

What do we know about the certainty of green investment?

2.14 The scale of investment – and the likelihood of investment - provide important signals to skills delivery partners on whether they need to amend or upscale provision in anticipation of skills needs. Table 2.2 below details investment totals by CESAP sector and the likelihood of proceeding.

2.15 Of the total expected green investment, approximately £48bn (53%) is already going ahead or has a high likelihood of proceeding in the next 2-3 years. However, substantial uncertainty surrounds a sizable proportion of investments - £42.1bn of the identified spend is associated with either a medium likelihood of proceeding or having significant uncertainties.

2.16 The data shows that:

- Energy accounts for more than 65% of all known green investment at around £58.5bn. Projects already proceeding account for around 16.7% (£9.7bn) of known energy investment, and a further 55.4% (£32bn) of investment is identified as having a high likelihood of progressing. A further 16.1% (£9.4bn) is classified as having a medium likelihood of progressing. Only 11.9% of investment (£6.9bn) is classified as having significant uncertainties.
- Transport accounts for around 10% of all known green investment at around £15.4bn. Just over 10% of this investment is underway – and this sector has the highest proportion of unknown investment (89.2%) classified as having significant uncertainties.
- Construction accounts for 16% of all known green investment – and is significant in scale at £14.4bn. However, only £2bn (14.8% of the total) is already proceeding, and around £800m (5.6%) is classified as having a high certainty of proceeding. Around 71% (£10bn) is classified as having a medium likelihood of proceeding, and approximately 9% (£1.2bn) has significant uncertainties.

Table 2.2 – Green investment totals (£M) by CESAP sector and the likelihood of proceeding in the next 2-3 years.

Sector	1 = Already proceeding		2 = High likelihood		3 = Medium likelihood		4 = Significant uncertainties		Total
Energy Transition	9,737	16.7%	32,363	55.4%	9,418	16.1%	6,949	11.9%	11.9%
Transport	1,584	10.3%	70	0.5%	0	0.0%	13,701	89.2%	89.2%
Construction	2,139	14.8%	808	5.6%	10,202	70.8%	1,265	8.8%	8.8%
Agriculture Land Use	326	67.1%	160	32.9%	0	0.0%	0	0.0%	0.0%
Manufacturing	103	56.9%	26	14.4%	51	28.2%	2	1.1%	1.1%
Other	345	35.7%	67	6.9%	155	16.0%	399	41.3%	41.3%
Total	14,234	15.8%	33,495	37.3%	19,826	22.1%	22,315	24.8%	89,870

Source: Optimat SDS Mapping of Green Investments across Scotland

2. Current and planned investment supporting the transition to net zero

- Agriculture and Land Use accounts for around 1% (£486m) of all known green investment. Of this, however, 67.1% of investment is already underway, and the remaining 32.9% (£160m) is highly likely to progress.
- Manufacturing accounts for less than 1% of all known green investment at around £181m. Of this, 56.9% (£103m) is already proceeding, and a further 14.4% (£26m) is highly likely to proceed. Only 1.1% of known investment has significant uncertainties.

Where is green investment likely to take place regionally?

2.17 Table 2.3 below highlights the split of known green investment by region.

Table 2.3: Green investment (£M) and % share by region³⁵

Region	Total	%
Aberdeen City and Shire	5,252	5.8%
Ayrshire	1,282	1.4%
Edinburgh City Region	8,126	9.0%
Forth Valley	2,247	2.5%
Glasgow City Region	30,425	33.6%
Highlands and Islands	8,969	9.9%
Tay Cities	4,588	5.1%
South of Scotland	513	0.6%
Scotland-wide	460	0.5%
Offshore – not allocated to LA	28,786	31.8%
Total	90,649	100.0%

2.18 Investment levels vary substantially across the different regions. The highest levels of investment are in Glasgow City Region, accounting for £30.4bn. This is over three times the level of investment compared to the second highest in Highlands and Islands or third highest in Edinburgh City Region.

2.19 There is also a significant level of investment classed as 'offshore' (£28.8bn). This relates mainly to large wind generation projects where the supply chain strategies are not sufficiently developed (or at least available in the public domain) to identify the local authority areas where Scottish supply chain spend will take place. The 17 ScotWind lease projects are a good example of investments in this category.

2.20 Lower levels of investment are found in the South of Scotland, Ayrshire and Forth Valley Regions, albeit still significant.

2.21 In addition to the total value of investments, it is also important to consider investments according to their likelihood of proceeding.

³⁵ Scottish Borders Council is included in two regions (Edinburgh City Region and South of Scotland). Fife is included in Edinburgh City Region and North East Fife is included in Tay Cities. Totals of regional data will exceed actual totals due to some double counting.

◀ Source: Optimat SDS Mapping of Green Investments across Scotland

2. Current and planned investment supporting the transition to net zero

Green investment in regions by certainty

- 2.22 Table 2.4 to the right concentrates only on regional green investments already proceeding or where there is a high likelihood of proceeding in the next 2-3 years.
- 2.23 Despite Glasgow City Region having the highest value of overall regional green investment (Table 2.3), only 9% of this total (£2.7bn) is assessed to be already proceeding or have a high likelihood of proceeding.
- 2.24 Looking at the likelihood of investments proceeding by investment value, the Highlands and Islands Region (£5.4bn) and Edinburgh City region (£5.2bn) are the leading regions for known green investment proceeding or highly likely to proceed. In the Highlands and Islands, this is due to significant offshore supply chain investment being apportioned to the Moray Council area with £2.6bn associated with the Moray West Offshore Wind Farm.
- 2.25 In the Edinburgh City Region, the £5.2bn investment is attributed to a number of projects, including £2bn for the Neart na Gaoithe Offshore Wind Farm and £2bn for the Inch Cape Offshore Wind Farm.
- 2.26 In Aberdeen City and Shire, around £3.9bn of known investment is classified as happening or highly likely to proceed, dominated by the Energy transition sector. Similarly, there is around £3bn of proceeding or likely to proceed investment in the Tay Cities Region.

Table 2.4 Green investment totals (£M) and % already proceeding and with a high likelihood of proceeding in the next 2-3 years, by region (including 'Offshore' and 'Scotland wide' investments)³⁶

Region	1 = Already proceeding	2 = High likelihood	Total (£M) and %
Aberdeen City and Shire	1,661	2,280	3,941
	31.6%	43.4%	75.0%
Ayrshire	208	730	938
	16.2%	57.0%	73.2%
Edinburgh City Region	4,816	413	5,229
	59.3%	5.1%	64.3%
Forth Valley	722	41	763
	32.1%	1.8%	33.9%
Glasgow City Region	2,082	588	2,670
	6.8%	1.9%	8.7%
Highlands and Islands	2,011	3,409	5,420
	22.4%	38.0%	60.4%
Tay Cities	2,831	174	3,005
	61.7%	3.8%	65.5%
South of Scotland	99	269	368
	19.2%	52.4%	71.6%
Scotland-wide	325	135	460
	70.7%	29.3%	100%
Offshore - not assigned to LA	3	25,513	25,516
	<0.1%	88.6%	88.6%
Total	14,757	33,552	48,309

Source: Optimat, SDS Mapping of Green Investments across Scotland

³⁶ Scottish Borders Council is included in two regions (Edinburgh City Region and South of Scotland). Fife is included in Edinburgh City Region and North East Fife is included in Tay Cities. Totals of regional data will exceed actual totals due to some double counting.

2. Current and planned investment supporting the transition to net zero

2.27 Even across relatively small regions, by population, the levels of known investment that is proceeding or likely to proceed are significant at £938m in Ayrshire, £763m in Forth Valley and £368m in the South of Scotland.

2.28 Looking at known sector investment by geography:

- The most significant Energy investment is happening in the Highlands and Islands, Tay Cities and Aberdeen City and Shire Regions. This relates to investments in Offshore Wind as previously described but also includes £2.2bn for a carbon capture power facility on the Aberdeenshire Coast, £360m for a net zero technology centre established as part of the Aberdeen City Region Deal and £89.7m for an energy transition zone comprising several centres of excellence and business support initiatives to establish the North East of Scotland as a global leader in the energy transition to net zero and a net exporter of products, services, technologies and skills.
- Transport investment spans across the country, and includes electric charging infrastructure, and low carbon aviation, marine, rail and road fleet. This includes investment of £500m for the Bus Partnership Fund which aims to deliver targeted bus priority measures on local and trunk roads and intends to reduce the negative impacts of congestion on bus services and address the decline in bus patronage. There is also £150m earmarked for Active Travel to make walking, wheeling, and cycling the natural choice for shorter everyday journeys.
- Known Construction investment is situated mainly in the Glasgow City Region. This includes £115m for a Glasgow City Council Avenues Programme to transform 21 key streets and adjacent areas to improve the external environment, £113m for redeveloping the Glasgow City Council Clyde Waterfront and West End Innovation Quarter, and £83.6m for a project improving active travel routes, all of which are part of the Glasgow City Region Deal. There is also significant investment in the Edinburgh City Region, including £128m for a City of Edinburgh Council Affordable Homes Retrofit programme and £38.3m for the Midlothian Council Social Housing Quality Standards and Energy Efficiency Standard for Social Housing programme.
- Known Investment in Agriculture and Land Use is mainly located in the Glasgow City, Edinburgh City and Tay Cities Regions and they are focussed on the adoption of low carbon farming technologies and practices and forest planting. Projects include £107m for the Clyde Climate Forest, over £90m for projects in the Edinburgh City Region for the development of vertical farming and a state-of-the-art innovation facility for the food and drink sector. There is also a total of £62m investment for projects at the James Hutton Institute in Invergowrie - an International Barley Hub and an Advanced Plan Growth Centre, both part of the Tay Cities Region Deal. Forestry investment will also be important in the South of Scotland and the Highlands and Islands – though many of these projects may be under the £0.5m threshold used by Optimat.

2. Current and planned investment supporting the transition to net zero

- Manufacturing investment is concentrated in the Edinburgh City Region. This includes £17.3m for the development of a facility to process by-products from the whisky and other sectors and convert this into high-value renewable chemicals, sustainable biofuel, and other commercially and environmentally valuable commodities. There is also a £15.3m investment planned for a heat pump factory to meet increasing UK and European demand for low carbon heat pumps. Funds will be used to increase productivity and efficiency and research and development capabilities.

2.29 Since the mapping exercise was conducted, key announcements include the two Green Freeports³⁷ in the Firth of Forth and Inverness and Cromarty Firth, attracting up to £10.8bn investment and creating an estimated 75,000 jobs. These present considerable opportunities for the Scottish economy and job creation – as well as contributing to meeting NSET and net zero objectives³⁸.

³⁷ UK Government (2023). Joint cooperation to deliver two new Green Freeports in Firth of Forth and Inverness and Cromarty Firth.

³⁸ Two Scottish Investment Zones were recently announced in June 2023 - Glasgow City Region and the North East - supported by up to £80 million. [Scottish Government Investment Zone Announcement](#). This investment is not included in the above data, however the Investment Zones will align with the National Strategy for Economic Transformation and support innovation in sectors such as net zero, digital and life sciences.

2. Current and planned investment supporting the transition to net zero

Conclusion

2.30 The Optimat study, whilst capturing a point in time, has provided a good understanding of the scale and the likelihood of investment in support of the transition to net zero. This analysis highlights significant uncertainties with some investments and its anticipated sectoral focus – and is subject to change as investment intentions and barriers to development are removed. Maintaining a clear picture of investment scale and likelihood should remain a key priority going forward.

2.31 Focussing on those investments where there is greatest certainty – a number of lessons emerge:

- The levels of known investment with a high likelihood of progressing is greatest in the Highlands and Islands, Edinburgh City Region, Aberdeen City and Shire, Tay Cities and Glasgow City Region
- There are distinct geographical concentrations of known sectoral investment that is proceeding or likely to proceed by region, with Energy transition mostly concentrated in the north of Scotland and the east coast; known Construction investment concentrated in the Central belt while Transport investment is distributed around Scotland.
- Even in relatively smaller regions such as Ayrshire, Forth Valley and the South of Scotland the scale of known investment that is likely to proceed is of significant scale and is likely to drive demand for new jobs and skills as it progresses.

2.32 These lessons in terms of known investment could be used as a basis for prioritising filling evidence gaps and further skills planning pilot activity. It could also provide the basis for piloting specific sectoral skills interventions in regions where there is clear evidence of emerging activity.

2.33 At the same time there is sufficient known and highly likely to proceed investment across every region in Scotland that will require agility and responsiveness from the skills system over the next 3 years.

2.34 Finally – and importantly – the data presented here is very much a snapshot of a point in time. The volume of known investment will change as projects proceed through planning, attract funding and the policy drivers average and adapt. It will be very important to maintain the integrity of and completeness of the data set going forward – and to communicate and share that evidence with partners in the skills system.

3. What do we know about the demand for green skills?

3.1 Introduction

3.1.1 The Organisation for Economic Cooperation and Development (OECD) has identified international best practice approaches to the assessment of labour market and skills demand³⁹. The best approaches use blended methods and deploy a mix of information and strands of activity. The CESAP Pathfinder has adopted this approach drawing on the extensive work underpinning the demand assessment, including:

- *Green Jobs in Scotland (2022)* report, University of Warwick, and University of Strathclyde.
- Oxford Economics' Economic and Labour Market Forecasting Model.
- Detailed job postings data from Burning Glass.
- A comprehensive literature review of existing demand evidence.
- Over 40 industry and stakeholder consultations to identify demand insights from 21 organisations with a presence in relevant industries or fields.

3.1.2 This approach enables a consistent method that creates a picture of current and future demand for green skills within each key CESAP sector. Integrated approaches like this have been found to be more likely to provide robust information and insights and help to ensure that methodological limitations of a single method are overcome.⁴⁰

3.1.3 Much of the analysis in this section draws on the green occupation definition published in the *Green Jobs in Scotland* report, developed on behalf of SDS by the Universities of Warwick and Strathclyde⁴¹. This inclusive definition, built up using Standard Occupational Codes (SOCs), captures the significant impact the transition to net zero will have on a broad range of jobs. The authors make it clear that, due to current data limitations, it will provide an over-estimate of the green skills required by the Scottish economy. For that reason, it is appropriate for the demand assessment to focus on CESAP sectors.

3.1.4 The *Green Jobs in Scotland* report mapped the CESAP priority areas to sectors of the economy using Standard Industrial Classification (SIC) codes and categorised CESAP sectors as:

- Agriculture (including Forestry and Fishing).
- Construction.
- Energy and Waste Treatment.
- Manufacturing (including Engineering).
- Transport.

3.1.5 The CESAP sectors and green occupations defined by the *Green Jobs in Scotland* report form the basis of the employment estimates presented in this section from the Oxford Economics forecast model. The pragmatic approach provides a consistent basis across sectors but is likely to still over-estimate current and future employment levels as the model alone cannot provide the necessary level of detail. That is why the broader approach adopted here, where we also draw on literature and consultation evidence to identify demand across each CESAP sector is critical.

³⁹ This can be reviewed in the OECD library - [here](#).

⁴⁰ As 39.

⁴¹ Cardenas Rubio, J., et al. (2022). [Green Jobs in Scotland: An inclusive approach to definition, measurement and analysis](#).

3. What do we know about the demand for green skills?

Green jobs in Scotland

3.1.6 The Green Jobs in Scotland research, commissioned as part of the Pathfinder, advanced understanding of the types of green occupations in CESAP sectors, and across the whole economy. The report classified green occupations into one of three groupings:

- New and Emerging occupations – where there is a need for unique work and worker requirements, which results in the generation of new occupations.
- Enhanced Skills and Knowledge occupations – where the essential purposes of the occupation remain the same but tasks, skills, knowledge, and external elements, such as credentials, have been altered.
- Increased Demand occupations – where the work context may change but the tasks do not.

3.1.7 The research estimated that more than one-quarter (25.7%) of all jobs in Scotland were in the Enhanced Skills and Knowledge category, one in ten (9.9%) were Increased Demand and 4.3% were New and Emerging. This means that for every one job in New and Emerging, there are two jobs in existing occupations that we will need more of, and six jobs that already exist that need new skills to adapt to the implications of the transition to net zero.

3.1.8 The research also explored the occupation and workforce characteristics of green occupations. In summary:

- Professional occupations account for the highest proportion of green occupations at just under one third (31.1%) followed by skilled trades (19.6%).
- Women are markedly under-represented in green occupations - 25.7% of jobs in green occupations are held by women compared to 72.2% for men.
- Jobs in green occupations are most concentrated in the 25-49 years old age group (58.0%).

3.1.9 The Green Jobs in Scotland report focussed on assessing green occupations across the Scottish economy using a systematic and comprehensive approach. When we apply the definitions created to the CESAP sectors and use these in the Oxford Economics model, it greatly enhances our understanding of green occupations in green sectors and enables greater insight into the future direction of travel in the labour market to support the transition to net zero.

3. What do we know about the demand for green skills?

3.2 Demand in CESAP sectors

Current levels of employment in CESAP sectors

- 3.2.1 In 2022, there were 690,900 people employed across the five CESAP sectors accounting for 26.5% of Scottish employment.
- 3.2.2 Construction accounted for the largest share of CESAP sector employment, with 214,400 people in employment. Manufacturing was the next largest (181,600 people) followed by Energy and Waste Treatment (157,800 people). It is important to note that the renewable energy industry does not have a SIC code for statistical reporting purposes and as such is not fully included in the figures presented here.
- 3.2.3 Transport and Agriculture were smaller, each with fewer than 100,000 people in employment in 2022 (See Table 3.1).

Table 3.1: Total employment in CESAP sectors, 2022

Sector	Total employment 2022	% Scotland's employment
Construction	214,400	8.2%
Manufacturing (including Engineering)	181,600	7.0%
Energy and Waste Treatment	157,800	6.1%
Transport	98,000	3.8%
Agriculture (including Forestry and Fishing)	39,100	1.5%
CESAP Total	690,900	26.5%

Source: SDS, Oxford Economics

3.2.4 Not everyone who works in a CESAP sector is in a green job – but most are. Based on Oxford Economics employment estimates, for every ten people working in the CESAP sectors in 2022, seven worked in a green occupation and three worked in a non-green occupation.

3.2.5 Employment in the CESAP sectors is spread across Scotland. It is greatest in and around Scotland's cities and although lower in volume, CESAP sectors accounted for an above average share of employment in rural areas (32.7% compared to 26.5% across Scotland).

Future demand for green skills

- 3.2.6 The scale and timing of investment in activities and infrastructure that drives the transition to net zero will be a central driver of potential jobs growth. Based on policy and investment-neutral forecasts, employment in the CESAP sectors, without intervention, is forecast to stay broadly the same in the mid-term – rising slightly from 690,900 in 2022 to 691,700 in 2025 (0.1% increase).
- 3.2.7 Construction is the CESAP sector expected to have the greatest growth, notwithstanding any additional demand from new investments. Based on the forecast model, the workforce is expected to grow by 3,200 people by 2025. Strong growth in the already large skilled construction and building trades occupation is forecast and underpins this growth.
- 3.2.8 Agriculture and Transport are also expected to grow in the mid-term, with each having an additional 1,200 people employed in the sector by 2025.

3. What do we know about the demand for green skills?

3.2.9 Manufacturing is forecast to have a smaller workforce in 2025 than it had in 2022, declining by 4,300 people. The largest factor contributing to this is the adoption of new technologies which is expected to reduce the number of workers required whilst at the same time increasing productivity and output.

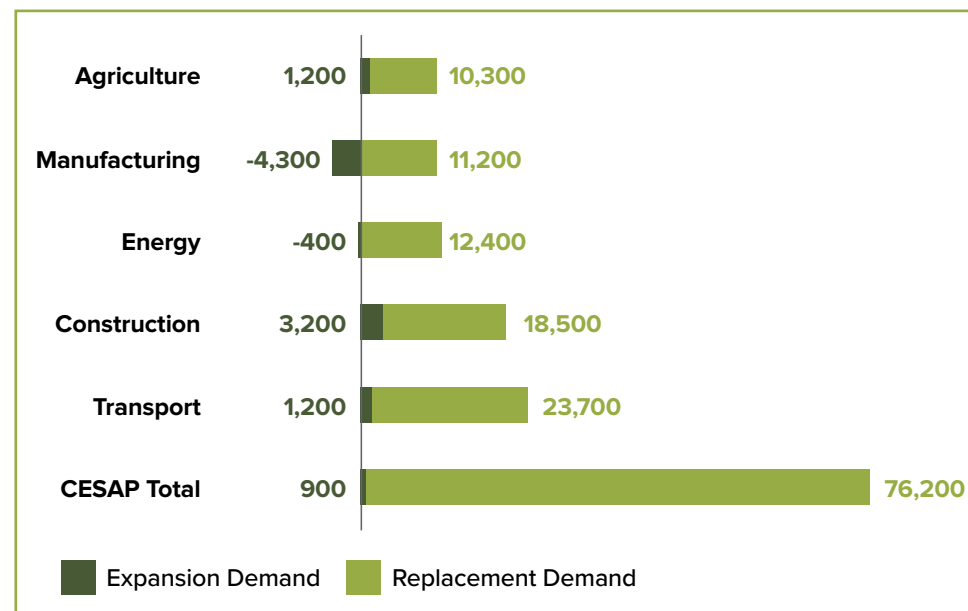
3.2.10 The Energy and Waste Treatment sector workforce is expected to stay broadly the same in the mid-term, with a slight contraction of 400 people by 2025. However, investment levels outlined in the previous chapter, have the potential to change this – growing employment and further increasing the economic contribution of the sector to Scotland significantly.

3.2.11 To effectively plan for skills, demand needs to be considered in the round – this means consideration of the total requirement, which is overall growth or contraction in the workforce plus the need to replace workers who retire or leave their role for another reason.

Total requirement

3.2.12 In the mid-term (2022-2025), demand arising from the need to replace workers far exceeds demand arising from growth. This is consistent across all sectors of the economy. Overall, 77,000 people are expected to be required to meet demand across the CESAP sectors from 2022 to 2025 (See Figure 3.1)⁴². This is equal to almost one-quarter, 23%, of Scotland’s total demand. Beyond the mid-term and over the longer term (2025-2032), a further 151,600 people at various skill levels are forecast to be needed.

Figure 3.1: Total requirement in CESAP sectors, Scotland, mid-term (people) (2022 – 2025)



Source: SDS, Oxford Economics

3.2.13 For future demand, uncertainty associated with investments and projects whilst still in development creates a broad range of possible employment estimates – these estimates are those beyond the investment and policy-neutral Oxford Economics forecasts. As project plans mature, and investments are agreed, more precise employment estimates are possible which refine the indicative figures. This is a consideration for the sectoral insights on future demand and highlights a significant challenge when planning for future skills needs.

3.2.14 The current level of employment, and outlook varies by CESAP sector. The remainder of this section looks at the demand insights for each sector to ensure the specific requirements of each are articulated to support effective skills planning.

⁴² Figures may not sum due to rounding.

3. What do we know about the demand for green skills?

3.3 Energy and Waste Treatment

3.3.1 Energy production is critical to all sectors of the economy. Historically the Energy sector has been dominated by Oil and Gas and has been a significant contributor of carbon emissions. However, the decarbonisation of energy production has drastically reduced carbon dioxide emissions at a time when energy usage has been increasing.

3.3.2 The Energy and Waste Treatment sector has a large workforce. As a result of the transition to net zero, the workforce is expected to go through a transformation and have considerable future growth. Hydrogen and Offshore Wind are highly likely to be significant drivers of future skills demand.

Current employment

3.3.3 In Scotland, 157,800 people worked in the Energy and Waste Treatment⁴³ sector in 2022, accounting for 6.1% of total employment in Scotland⁴⁴. There was evidence that the nature of these jobs, and as a result, the skills required, were changing. Almost one-quarter (22.9%) of employment in CESAP sectors was within the Energy and Waste Treatment sector.

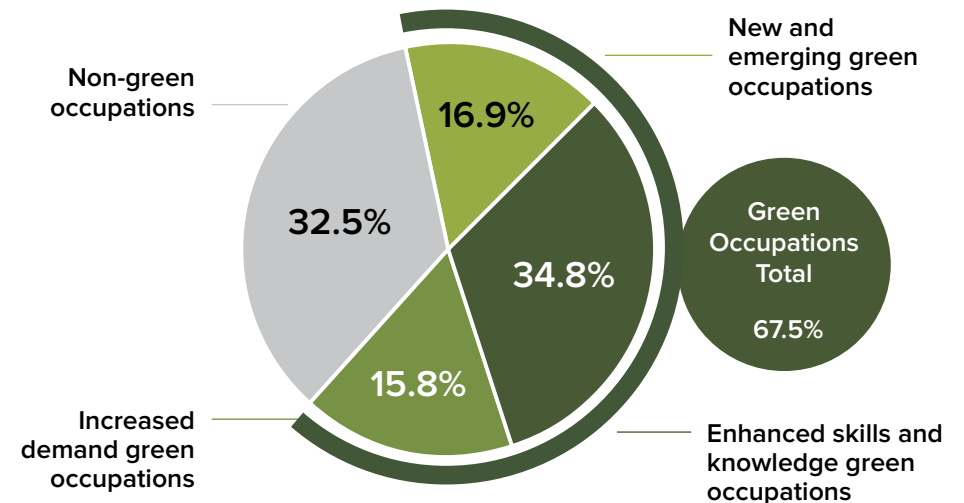
⁴³ CESAP sector definition from Green Jobs in Scotland research.

⁴⁴ The renewable energy industry does not have a SIC code for statistical reporting purposes and as such is not fully included in the figures presented here.

3.3.4 Most of the Energy and Waste Treatment sector workforce were working in green occupations in 2022, with 106,500 (67.5%) people in a green occupation (see Figure 3.2), and of these people, most were in roles that required Enhanced Skills and Knowledge because of the transition to net zero:

- 26,600 people (25.0% of people employed in green occupations in the sector) were in New and Emerging Occupations.
- 55,000 people (51.6%) were in occupations requiring Enhanced Skills and Knowledge.
- 24,900 (23.4%) were categorised as Increased Demand occupations.

Figure 3.2: Energy and Waste Treatment sector employment 2022, percentage of people employed in the sector by type of occupation



Source: SDS, Oxford Economics

3. What do we know about the demand for green skills?

3.3.5 Employment in the Energy and Waste Treatment sector was concentrated in Aberdeen City and Shire – well over a quarter (31.4%) of the sector’s workforce was located here in 2022. This makes the sector an important source of jobs for the regional labour market, accounting for twice as many jobs here than the Scottish average.

3.3.6 The large, predominantly urban areas of Edinburgh and the Lothians and the Glasgow Region together accounted for more than a quarter (28.0%) of Energy and Waste Treatment sector employment.

Vacancies

3.3.7 The sector was one of the most active CESAP sectors in terms of recruitment activity in 2022. There were more than 12,300 job postings in the sector in 2022, accounting for almost one in four job postings in CESAP sectors. More than half of these opportunities, 7,100, were in green roles (see Table 3.2).

3.3.8 Most of the job postings were in the Glasgow Region (29%), Edinburgh, East and Midlothian (21%) and Aberdeen City and Shire (18.5%), together accounting for 68% of all the Energy and Waste Treatment job postings in Scotland – and consistent with where employment in the sector was greatest.

Table 3.2: Green job postings in Energy and Waste Treatment, 2022

Occupation	Job Postings	% Total job postings in Energy and Waste Treatment
Engineering professionals n.e.c.	420	5.9%
Programmers and software development professionals	350	5.0%
Civil engineers	270	3.7%
IT business analysts, architects, and systems designers	260	3.7%
Engineering technicians	250	3.5%
Marketing and sales directors	250	3.5%
Management consultants and business analysts	220	3.1%
Customer service occupations n.e.c.	190	2.7%
Chartered and certified accountants	180	2.6%
Mechanical engineers	170	2.4%
All green occupations	7,100	57.7%

Source: Burning Glass

3. What do we know about the demand for green skills?

Current gaps and shortages

- 3.3.9 Evidence in current gaps and shortages was derived from the literature review and stakeholder and industry consultations. A number of consultees raised concerns about current and projected shortages in professional roles, including consenters, planners, and project managers. They highlighted that the 17 potential ScotWind projects all require environmental impact assessments, planning consents and other formal planning activities. The Royal Town Planning Institute (RTPI)⁴⁵ has already identified significant challenges in the supply of planning skills. These roles require degree level qualifications with a long lead time involved, and persistent shortages could significantly delay the start dates for major developments.
- 3.3.10 Major renewable projects all have significant requirements for project management skills. These roles are in demand across all sectors of the economy, and skills are highly transferrable. This creates a competitive market that is broader than Energy and Waste Treatment alone.
- 3.3.11 Labour shortages are prevalent in the current offshore Oil and Gas sector. Offshore Wind will hope to recruit labour released from Oil and Gas as the Offshore Wind sector gains momentum and Oil and Gas declines. However, the electrification of Oil and Gas platforms by introducing wind turbines through Innovation and Targeted Oil and Gas (INTOG), as well as

other decarbonising measures, has the potential to slow the availability of the Oil and Gas workforce, making it harder for Offshore Wind to source skilled workers from the sector.

- 3.3.12 Consultees also raised issues around skills transferability between Oil and Gas and Offshore Wind. A major exercise is underway, led by OPITO⁴⁶, to consider in detail the skills and health and safety requirements for the two sectors, identify the training gaps that need to be covered for an Oil and Gas worker moving over to Offshore Wind, and specify the skill development and certification required. A UK-wide 'passport' is the intended end product, and the study is expected to report by the third quarter of 2023⁴⁷. This development supports the Just Transition, and the growth of a green Energy sector for Scotland's future.
- 3.3.13 To generate a better understanding of employment and skill needs, the Scottish Offshore Wind Energy Council (SOWEC) has adopted the Skills Intelligence Model, developed by the National Skills Academy for Rail. This builds up a picture of current and future skill needs by talking to key businesses in the sector. The SOWEC Skills Group has established a Fabrication and Welding Training Network involving groups of colleges, so the skills system is ready to respond rapidly as these traditional shipbuilding skills are in short supply.

⁴⁵ Royal Town Planning Institute (2022). [Future Planners Project Report.](#)

⁴⁶ OPITO is the global, not-for-profit, skills body for the energy industry.

⁴⁷ OPITO (2022). [OPITO | News for Industry Standards for Safety, Skills and Competence.](#)

3. What do we know about the demand for green skills?

Where will demand for green skills come from in the future?

- 3.3.14 Looking to the future, as Oil and Gas production is expected to slow, growth in Offshore Wind, Hydrogen, Carbon Capture, Utilisation and Storage (CCUS), Wave and Tidal and other low-emission and carbon reduction developments are expected to create demand for skilled workers.
- 3.3.15 Investment and policy-neutral forecasts suggest that the size of the Energy and Waste Treatment workforce will stay broadly the same size in the mid-term – however, it is anticipated that it will undergo a continued transition towards a greener workforce. Over the longer-term (to 2032), green occupations are forecast to increase the share of the sector’s workforce that they account for.
- 3.3.16 Due to movements within the labour market, and based on Oxford Economics forecasts, there could be a total requirement for 12,000 people to meet employment demand in the Energy and Waste Treatment⁴⁸ sector up to 2025. Green occupations account for 8,400 of the total requirement (69.6%), and non-green occupations account for a smaller share (3,700 people, 30.4%). However, insights from planned projects and investment that are likely to proceed, and are essential to achieving net zero ambitions, indicate that actual demand could far exceed this.

⁴⁸ The renewable energy industry does not have a SIC code for statistical reporting purposes and as such is not fully included in the figures presented here.

⁴⁹ Opergy (2023) Offshore Energy People and Skills Intelligence Report – Scotland

⁵⁰ Full Time Equivalent

⁵¹ Scottish Government (2023). [Draft Energy Strategy and Just Transition Plan](#); Transition Economics (2022). [The ScotWind Lease Round: Analysis of ownership and potential job creation](#).

⁵² North Sea Transition Deal (2022). People and Skills Strategy.

ScotWind and offshore energy developments

- 3.3.17 Significant growth in activity connected to Offshore Energy, which includes ScotWind, is expected. The Opergy Group forecast that direct and indirect employment in Offshore Energy could rise by 21,000 alone between 2022 and 2030, with floating Offshore Wind being a sizeable driver of this⁴⁹. By 2030, 98,000 people could be working in Offshore Energy jobs across Scotland.
- 3.3.18 The Scottish Trades Union Congress (STUC) and Scottish Government expect ScotWind to be a significant source of job creation – Full-Time Equivalent (FTE)⁵⁰ creation from ScotWind could be as high as 13,000-14,500 based on their estimates⁵¹.
- 3.3.19 The North Sea Transition Deal forecasts that the Offshore Energy sectors could, over the longer term, support more than 211,200 jobs by 2030 and up to 350,000 jobs by 2050 across the UK⁵².
- 3.3.20 As major Offshore Wind developments come onstream, there will be substantial demand for welders and fabricators and in the consultations, estimates of between 5,000 and 6,000 were suggested. There will be strong demand for these skills from the Shipbuilding and Engineering sectors where there have been longstanding challenges in the availability of welding skills.

3. What do we know about the demand for green skills?

3.3.21 Floating Offshore Wind will also drive need for additional skillsets, around cable installation and concrete substations. In the move from fixed to floating wind platforms, a lot of the works will be carried out in deep-water harbours. Insight from the consultations revealed that some modelling had been carried out and indicated that the transition from fixed to floating wind could increase the blue-collar proportion of the workforce from 45% to 70%.

3.3.22 Analysis of the literature and consultations show it is difficult to tie down a definitive position in relation to green jobs and skills in the Offshore Wind sector as this will be dependent on the number of projects which move into the implementation phase and the extent to which the necessary manufacturing supply chain is in Scotland.

3.3.23 However, in their recent Scottish Offshore Skills Intelligence Report, Opergy estimated the requirements for the Offshore Energy workforce covering a range of occupations where demand would rise or fall in Scotland as a result of developments⁵³. Employment estimates are given for all sources of Offshore Energy already mentioned above, plus Wave and Tidal and continued Oil and Gas production:

- Total numbers employed in offshore Energy sector are expected to rise by 21,000 to 98,000 by 2030.
- Construction General Operatives are expected to have the greatest growth over the period – with the creation of almost 9,000 additional jobs.
- Almost 6,000 jobs are also expected to be created in the Mechanical job family, which includes Mechanical Technicians, Supervisors, Mechanics and manual Mechanical operatives.

Hydrogen and CCUS

3.3.24 A report by ClimateXChange⁵⁴ made several important findings about the upstream hydrogen value chain and its potential contribution to the Scottish economy. The report forecasts that many new jobs will be created in Scotland as the sector grows – direct annual employment is expected to be, on average, 6,614 FTEs over the 2025-2030 period and an average of 18,535 FTEs in 2030-2035.

3.3.25 In addition, as the skills to enable the Hydrogen Economy are considered to be similar to the skills required in other process industries, it is expected that the Hydrogen Economy will increase demand for the existing skilled workforce. It is expected that there will be a high demand across the Energy sector and other related sectors for science, technology, engineering, mathematics, and digital and data science skills. As a significant proportion of these skills will be at college and graduate levels, talent shortage is a key issue for the Hydrogen Economy⁵⁵.

⁵³ Opergy (2023) Offshore Energy People and Skills Intelligence Hub– Scotland

⁵⁴ ClimateXChange (2023). [Mapping the current and forecasted hydrogen skills landscape.](#)

⁵⁵ As 54.

3. What do we know about the demand for green skills?

3.3.26 Currently, there is a limited understanding of the detailed skill needs associated with hydrogen and CCUS, in meeting energy needs and moving towards net zero. There is significant uncertainty around timescales of investment, although Scottish Government's Hydrogen Programme is working to better articulate a critical path and investment pipeline that will drive the sub-sector's growth.

3.3.27 The ClimateXChange highlighted the difficulty in clearly articulating skills needs and gaps at this stage given the relatively immature nature of hydrogen in comparison to other forms of energy production. It recommends a focus on identifying skills gaps within the workforce in order that skills providers and policymakers can develop appropriate strategies to address these gaps and support Scotland's Hydrogen Economy ambitions.

Grid and power transmission

3.3.28 Evidence from consultations highlighted that there will be significant power grid requirements from the transition to net zero. This includes expansion and upgrading of the electrical power grid as transmission technology moves from AC to DC. To achieve this, expansion of the workforce will be required primarily in occupations such as civil engineering, plant maintenance and some construction trades such as electricians.

3.3.29 There will be requirements for reskilling, most significantly for electricians, who will upgrade the connections between the grid and individual homes and buildings. In addition, the introduction of heat pumps and Ultra Low Emission Vehicles (ULEV) connections in homes and buildings and the consequential potential for electricity to flow back to substations also presents upskilling challenges for the workforce.

Competition for resources

3.3.30 A clear challenge is the competition for the same skill sets and people across a number of roles – both within the Energy sector and across CESAP sectors. The major power companies across the UK face challenges if a number of substantial projects come on stream at the same time. For example, if the expansion and enhancement of the grid becomes in direct competition with the construction of new nuclear plants (in the UK) or other major infrastructure projects, there will be significant skill shortage issues in Construction and Civil Engineering across a range of craft, technical and professional occupations.

3. What do we know about the demand for green skills?

Energy and Waste Treatment- summary of demand evidence

3.3.31 The Energy and Waste Treatment sector is expected to face significant demand for new skills over the short to medium term. This will be driven by four primary factors:

- More than 12,000 jobs emerging through replacement demand as existing skilled workers retire from the workforce.
- A significant reskilling requirement to support the transition of workers from high carbon intensive to low carbon intensive forms of energy production.
- Growth in the demand for new skills as new and emerging technologies such as hydrogen production and Carbon Capture and Storage come to fruition.
- A significant requirement to upgrade grid and transmission infrastructure to accommodate new technologies.

3.3.32 The demand evidence also highlights that many of the skills that are likely to be required in relation to energy and waste transmission are already in short supply – and that there is likely to be strong competition for these skill sets from other sectors. From the perspective of the potential learner or training provider there would seem to be strong evidence of future demand from the sector – many of which are in skilled and well-paid roles.

3.3.33 The demand evidence has highlighted some uncertainties and these, in the main, relate to two areas:

- Uncertainty in relation to the timing of investment that will drive the adoption of new technologies – and in some cases competition between technologies.
- Uncertainty on the specific job roles and skills requirements that will be associated with some of these new technologies.

3.3.34 While it will be important that these gaps are addressed going forward, the existence of these gaps should not detract from the fact that there is significant demand for skills that can both be qualified and broadly understood.

3.4 Construction

3.4.1 Construction is a central and complex sector when it comes to the transition to net zero. The approach to skills needs to cover all stages of the lifecycle of infrastructure. There will be a need to take retrospective action such as retrofitting buildings and infrastructure, as well as proactively promoting the adoption of green technologies and practices in new buildings.

3.4.2 In Scotland, heat decarbonisation is a priority focus for the Construction sector and is a critical component of the transition to net zero. The scale of the transition to low carbon heat in Scotland offers huge economic opportunities as well as the potential to significantly contribute to meeting targets. Currently, 52% of Scotland's energy demand comes from heat (approx. 82,895 GWh per year), with heat the single largest source of our CO2 emissions at 41%. Natural gas currently heats 79% of houses and around 50% of businesses⁵⁷.

3.4.3 Demand for workers across a range of Construction occupations is already high, and future demand will arise not just from the transition to net zero, but from structural challenges of an ageing workforce, perception of the industry and reduced migrant labour.

3. What do we know about the demand for green skills?

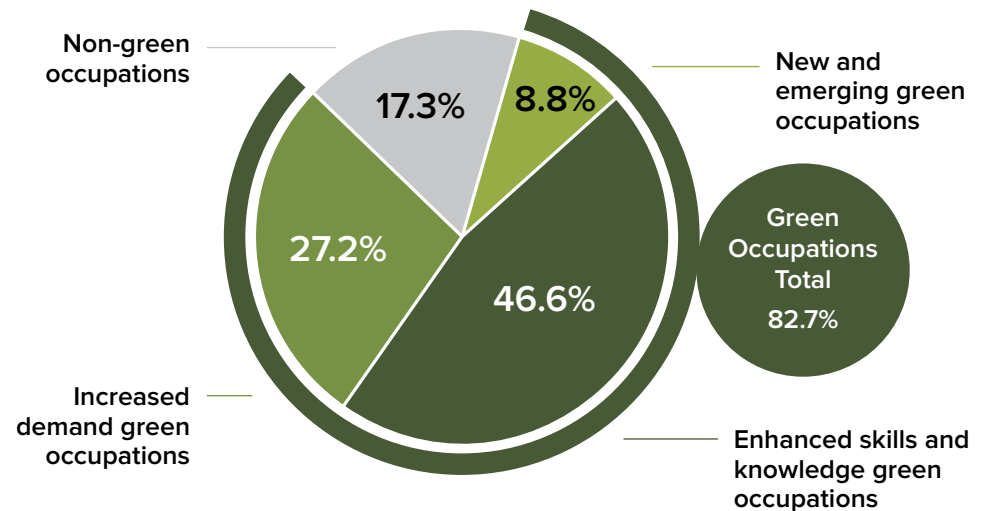
Current employment

3.4.5 In Scotland, 214,400 people worked in the Construction sector in 2022, accounting for 8.2% of total employment in Scotland. It was the CESAP sector with the largest workforce that year – accounting for approximately one third (31.0%) of the CESAP workforce. In Construction, the transition to net zero is increasing demand for existing occupations and also leading to the creation of new roles.

3.4.6 Most of the Construction sector workforce were working in green occupations in 2022 – it had one of the highest ratios of green occupations to non-green occupations of the CESAP sectors with 177,300 (82.7%) people in a green occupation (see Figure 3.3). Of those in green occupations, most were in roles that required Enhanced Skills and Knowledge because of the transition to net zero:

- 18,900 people (10.7% of people employed in green occupations in the sector) were in New and Emerging occupations.
- 99,900 people (56.4% of people employed in green occupations in the sector) were in occupations requiring Enhanced Skills and Knowledge.
- 58,400 (32.9% of people employed in green occupations in the sector) were categorised as Increased Demand occupations.

Figure 3.3: Construction sector employment 2022, percentage of people employed in the sector by type of occupation



Source: SDS, Oxford Economics

3.4.7 Almost one fifth (17.5%) of the Construction workforce were in the Glasgow Region in 2022. In addition, a further 50% of Scotland’s Construction workforce was based in Lanarkshire, Aberdeen City and Shire, Edinburgh, East and Midlothian and the Highlands and Islands.

3.4.8 West Lothian (60% higher) and Lanarkshire (50% higher) had the greatest concentrations – where the Construction sector accounted for an above average share of regional employment.

3. What do we know about the demand for green skills?

Vacancies

3.4.9 The sector was actively recruiting in 2022. Overall, one in every five (20%) of job postings for opportunities in CESAP sectors were for roles in the Construction sector. The sector sought to fill these 10,200 openings across a range of roles – and 69.8% (7,200 job postings) were opportunities in green occupations (see Table 3.3). The largest number of advertised occupations were in plumbing heating and ventilation engineer trades – and at 1,620 was three times greater than the next largest occupation (carpenters and joiners).

3.4.10 The majority of these job postings were in the Glasgow Region (28.1%), Aberdeen City and Shire (17.9%) and Edinburgh, East and Midlothian (16.5%), together accounting for 63% of all the Construction job postings in Scotland and aligned with where employment concentrations were greatest.

Current gaps and shortages

3.4.11 The Construction sector has an ageing workforce, with 38.5% of the Scottish construction workforce in 2021 aged 50+.⁵⁸ It is anticipated that as many as 50,000 workers could leave the sector in the next 10 years due to retirement.⁵⁹ This contributes to a high replacement demand in the sector and provides a challenge for ensuring the sector maintains the necessary skills to meet net zero targets.

⁵⁸ Office for National Statistics (2022). Annual Population Survey. [Accessed via Nomis, 2022].

⁵⁹ Fair Work Convention (2022). [Building Fair Work into the Construction Industry – Fair Work Convention Construction Inquiry Report 2022](#).

Table 3.3: Green job postings in Construction, 2022

Occupation	Job Postings	% Total job postings in Construction
Plumbers and heating and ventilating engineers	1,630	15.9%
Carpenters and joiners	520	5.0%
Quantity surveyors	420	4.1%
Engineering technicians	240	2.4%
Customer service occupations n.e.c.	210	2.1%
Civil engineers	190	1.8%
Elementary construction occupations	180	1.8%
Engineering professionals n.e.c.	160	1.6%
Programmers and software development professionals	110	1.1%
Production managers and directors in construction	100	1.0%
All green occupations	7,200	69.8%

Source: Burning Glass

3. What do we know about the demand for green skills?

- 3.4.12 The sector also faces significant current recruitment challenges in relation to qualified workers. This is largely due to the complex supply chains with a high level of sub-contracting which can be a major disincentive for some organisations to support new talent and upskill the existing workforce. For many of the traditional trade roles, and roles predominantly site-based, there is often limited access to part-time and flexible working arrangements making the sector comparatively less inclusive and can be a significant barrier to entry. In addition, some workers in the sector have more limited opportunities to undertake ongoing training. The sector also consists predominantly of men and has low representation from minority groups.⁶⁰
- 3.4.13 Construction has also benefitted in the past from the availability of workers from the European Union (EU). Sector leadership groups highlighted in the consultations the importance of attracting new and diverse talent into the sector in order to support a just transition and ensure the workforce has the skills to meet net zero targets.
- 3.4.14 The Construction sector will play a key role in decarbonising homes and buildings in Scotland. In order to do this, the emerging role of retrofit coordinator will be vital in ensuring insulation, heating and ventilation are appropriately installed. Consultees signalled there was a shortage of retrofit coordinators and insufficient people with the skills to carry out this role.

- 3.4.15 As well as retrofit, there is currently a high demand for electricians and plumbing and heating engineers, which will also be important in decarbonising Scotland's homes and buildings. Consultations raised the need to grow the number of apprentices working in these key trades in order to meet net zero targets.
- 3.4.16 Consultations also highlighted a shortage of site and project management skills within the Construction sector. This will need to be addressed in order to support the acceleration of work required to meet net zero targets.
- 3.4.17 There is a demand for the Construction sector to grow in size, and also a need to upskill and reskill the existing workforce in order to adapt to new ways of working, for instance the process of installing heat pumps rather than gas boilers. There is currently a concern that colleges do not have the capacity to supply an increased volume of training to support this, particularly due to a need to upskill existing college lecturers and recruit more lecturers.

Where will demand for green skills come from in the future?

- 3.4.18 Looking to the future, there are structural barriers and challenges that may contribute to continued skills shortages, but attracting and retaining talent in the sector will be important if net zero ambitions are to be met.
- 3.4.19 Investment and policy-neutral forecasts suggest that the Construction sector will grow in the mid-term – it is expected to have the largest workforce expansion of the CESAP sectors, and excluding sectors that are forecast to contract, the growth in the Construction sector workforce is greater than the other CESAP sectors combined. Over the longer-term (to 2032) green occupations are forecast to account for a marginally greater share of the sector's workforce.

⁶⁰ Scottish Government (2023). Just Transition – [Built Environment and Construction](#).

3. What do we know about the demand for green skills?

3.4.20 Due to movements within the labour market, and based on Oxford Economics forecasts, there could be a total requirement for 21,700 people to meet employment demand in the Construction sector up to 2025. Green occupations account for 18,100 of the total requirement (83.3%), and non-green occupations account for a much smaller share (3,600 people, 16.7%). However, actual demand could far exceed this due to the scale of some of the opportunities that are present.

Energy efficiency and retrofitting

3.4.21 A key part of the work required to meet Scotland's net zero heating targets is to increase the energy efficiency of homes and buildings, with the Scottish Government aiming to decarbonise heating in 75% of homes and buildings by 2030. This involves retrofitting buildings to ensure they are appropriately insulated and reducing the need for heat. The work required to do this is expected to grow over the next few years, which will create a demand for more workers in the Construction sector, as well as a vast amount of upskilling existing workers within the sector.

3.4.22 Currently around 3,000 homes per year are being retrofitted. By 2025, this will need to rise to 124,000 systems installed between 2021 and 2026 and reach a peak of 200,000 by the late 2020s.⁶¹ The Construction Industry Training Board (CITB) have estimated that an additional 22,500 FTE workers will be needed by 2028⁶². There is concern that there will be

major skills shortages as the retrofit process begins to build momentum and more workers are required.

3.4.23 As noted above, there is already a shortage of retrofit coordinators, which will play a key role in this process. There also appears to be some uncertainty around the qualifications and certifications required to carry out this role, which creates further barriers to growing the workforce.

3.4.24 Upskilling and reskilling the existing workforce will be a major factor in ensuring the workforce has the skills to retrofit buildings. However, there are some challenges in reskilling, including financial barriers. The Construction sector is dominated by SMEs and microbusinesses, who often do not have the finances or capacity to support employees to undertake training. This presents additional challenges to ensure upskilling and reskilling is readily available and cost effective for employers.

Heat pumps and heat networks

3.4.25 A key part of improving the energy efficiency of homes and buildings in Scotland will be the installation and maintenance of new net zero heating systems such as heat pumps and heat networks. This will generate an increased demand for workers in the Construction sector, as well as a demand for upskilling and reskilling.

3.4.26 Electricians and plumbing and heating engineers will play a key role in this process. As noted previously, these roles are currently in high demand and there will need to be a significant increase in the number of people undertaking apprenticeships in these key trades.

3.4.27 In relation to installing and maintaining net zero heating systems, some consultees raised issues over the content of the existing apprenticeship framework for plumbing and heating engineers and whether it adequately provides the necessary skills. This presents a potential skills gap and is currently being addressed by SDS through the development of a new framework for 2023/24.

⁶¹ Scottish Government (2022). [Towards an Industry for Green Heat: heat in buildings supply chains delivery plan.](#)

⁶² CITB (2021). [Building Skills for Net Zero in Scotland.](#)

3. What do we know about the demand for green skills?

3.4.28 Currently, the demand for heat pumps and heat networks is relatively low, however it is already causing the current workforce to be stretched. There is concern that, as the government's net zero heating targets become closer, the demand for these products will rise at a rate that will require a huge growth in the workforce.

3.4.29 There is a worry that, as the effort to install net zero heating systems accelerates, installation will be carried out by installers who do not have the required skills. The process of installing a heat pump is technical and requires different skills to those of installing a gas boiler. If installed incorrectly, there is a risk that a huge amount of time and money is wasted.

3.4.30 As well as heat pumps, there is expected to be a rise in the development of heat networks. This would involve an increased demand for civil engineering and engineering construction trades, as well as plumbing roles.

Decarbonising the supply chain

3.4.31 To complete the energy efficiency work mentioned above, the Construction sector will rely heavily on an efficient supply chain, and one that operates sustainably.

3.4.32 It is expected that there will be a significant growth in the decarbonisation of building processes and the materials used. This will require increased demand for manufacturing skills, traditional trades such as electricians and plumbers, as well as the development of more specialised areas.

3.4.33 The retrofitting effort will require substantial demand for insulation materials, and there will therefore be a requirement for skills to supply these materials. The Scottish National Investment Bank has already invested in IndiNature, a company making natural fibre insulation to help scale up production⁶³. There is more to be done to ensure growth in this area continues, which will require upskilling and a growth in workforce.

Construction - summary of demand evidence

3.4.34 The Construction sector in Scotland plays a key role in heat decarbonisation, and as work ramps up to support this process the sector is expected to face significant demand for new workers and new skills. The main factors driving this demand are:

- A requirement for substantial upskilling and reskilling to support the current workforce to acquire suitable skills for retrofitting and installing net zero heating systems.
- A substantial expansion and replacement demand forecasted in the sector, with a total requirement of 21,700 people to meet demand in the sector up to 2025.
- An ageing workforce and reduced availability of migrant labour, which is expected to contribute to high replacement demand and labour shortages within the sector.
- Shortages in key trades required for the decarbonisation of heat, including plumbers, electricians and retrofit coordinators.

3.4.35 The Construction sector faces recruitment difficulties and struggles to attract women and people from minority groups. These issues will need to be addressed to help grow the overall size of the workforce, address current labour shortages, and ensure the sector can support a just transition to net zero.

⁶³ The Scottish National Investment Bank (2021). [IndiNature](#).

3. What do we know about the demand for green skills?

3.4.36 The evidence highlights that there are challenges around upskilling and reskilling within the Construction sector, particularly due to financial barriers, availability of training and labour shortages. Notwithstanding the challenges, it is important to ensure upskilling and reskilling opportunities are readily available to employers to support the amount of training required in the heat decarbonisation space.

3.5 Transport

3.5.1 The Transport sector in Scotland is also currently undergoing a significant transition with respect to net zero, with the sector being the largest emitting sector for greenhouse gases nationwide- accounting for 24% of all emissions in Scotland in 2020.⁶⁴

3.5.2 The net zero transition in Transport is reliant on an increase in the use of more sustainable transport methods, ranging from:

- behavioural changes - in the form of increased uptake in public transport over personal car usage for short-range journeys
- infrastructural changes - such as more pedestrian and cycle-friendly access in towns and cities
- technological changes - such as an increase in the use of ULEVs across both public transport and private transport options.

3.5.3 These changes have implications regarding the availability of skilled labour to meet the increase in demand for more sustainable transport.

Current employment

3.5.4 In Scotland, 98,000 people worked in the Transport⁶⁴ sector in 2022, accounting for 3.8% of total employment in Scotland. There is evidence that the transition to net zero is increasing demand for existing occupations in the Transport sector – 14.7% of people in Increased Demand occupations worked in the Transport sector. Construction was the only CESAP sector to account for more.

3.5.5 The Transport sector had close to a 50:50 split in the workforce between green and non-green occupations in 2022. This differs from the other CESAP sectors that already had a higher proportion of the workforce in green occupations. In the Transport sector, 50,700 (51.7%) people were in a green occupation (see Figure 3.4), and of those people, most were in occupations with Increased Demand because of the transition to net zero:

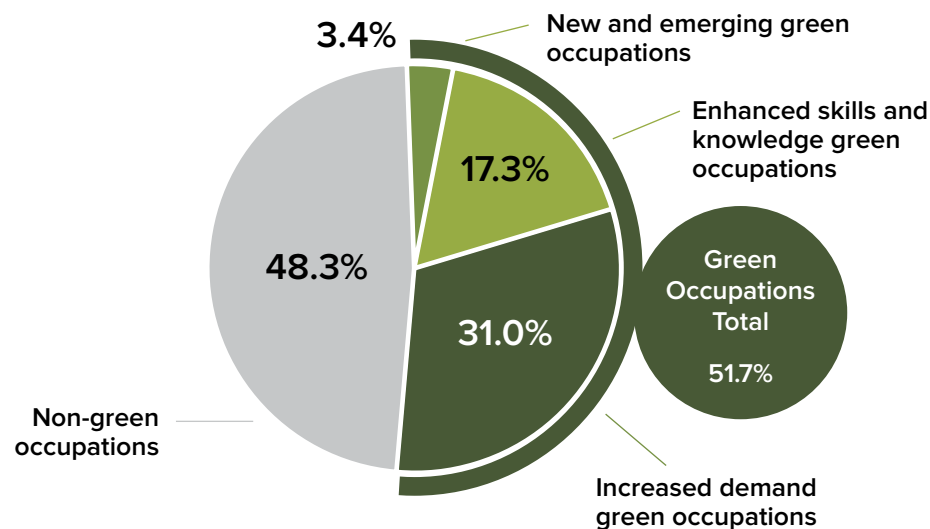
- 3,300 people (6.5% of people employed in green occupations in the sector) were in new and emerging occupations.
- 17,000 people (33.5%) were in occupations requiring Enhanced Skills and Knowledge.
- 30,400 (59.9%) were categorised as Increased Demand occupations.

⁶⁴ Scottish Government (2022). [Scottish Greenhouse Gas Statistics 2020](#)

⁶⁵ CESAP sector definition from Green Jobs in Scotland research.

3. What do we know about the demand for green skills?

Figure 3.4: Transport sector employment 2022, percentage of people employed in the sector by type of occupation



Source: SDS, Oxford Economics

- 3.5.6 Lanarkshire and the Glasgow Region combined accounted for more than one quarter (27.4%) of the Transport sector workforce. Edinburgh, East and Midlothian and Aberdeen City and Shire, further accounted for almost one quarter (23.1%) of the Transport workforce across Scotland.
- 3.5.7 In West Lothian, the Transport sector accounted for almost twice the number of jobs compared to the Scottish average. Across the rest of Scotland, the percentage of employment in the sector was broadly in line with the Scottish average.

Vacancies

- 3.5.8 The sector was recruiting in 2022, and it was one of the most active. Almost one quarter (24.1%) of job postings for opportunities in CESAP sectors were for jobs in the Transport sector. The sector sought to fill these 12,300 job openings across a range of roles – and almost three in every four (74.2%, 9,200 job postings) were opportunities in green occupations (see Table 3.4).
- 3.5.9 Large goods vehicle drivers accounted for more than a third of all job postings in the Transport sector in 2022, with postings for van drivers and fork-lift truck drivers accounting for a further quarter of all job postings in the sector.

Table 3.4 Green job postings in Transport, 2022.

Occupation	Job Postings	% Total job postings in Transport
Large goods vehicle drivers	3,080	33.6%
Van drivers	1,210	13.3%
Fork-lift truck drivers	1,070	11.7%
Bus and coach drivers	650	7.1%
Elementary storage occupations	380	4.2%
Customer service occupations n.e.c.	300	3.2%
Engineering technicians	180	1.9%
Programmers and software development professionals	120	1.3%
Transport and distribution clerks and assistants	110	1.2%
Engineering professionals n.e.c.	80	0.9%
All green occupations	9,200	74.2%

Source: Burning Glass

3. What do we know about the demand for green skills?

3.5.10 Many of the job postings were in the Glasgow Region (24.8%), Edinburgh, East and Midlothian (16.0%) and Aberdeen City and Shire (11.4%), together accounting for 52% of all the Transport job postings in Scotland, and consistent with where employment in the sector is greatest.

Current gaps and shortages

3.5.11 Like many sectors, Transport faces challenges around an ageing workforce. Across the UK nearly three in ten workers in the rail sector are aged over 50, and it is estimated that around 15,000 workers in the industry could be due to retire by 2025.⁶⁶ As fewer young people are coming into the sector this is leading to skills shortages, which is further exacerbated by Brexit having affected access to EU labour.

3.5.12 A lack of diversity in the sector has also been highlighted as impacting on the skills pipeline. Fewer than one in four (23%) people working in the Transport and Storage sector are women, and this is even lower in some sub-sectors.⁶⁷ For example, just 16% of workers in the Rail industry are female.⁶⁸

3.5.13 The Transport sector is the largest emitting sector in Scotland and therefore has a key role to play in the transition to net zero. Core elements include improving access and

infrastructure for public transport to help reduce car journeys, improving uptake of electric vehicles, decarbonising public transport and heavy vehicles and the implementation of Low Emission Zones (LEZs).⁶⁹ More specific gaps and shortages are starting to emerge around increasing demand for ULEVs.

3.5.14 This significant shift in the Transport sector is creating considerable skills demands, and there are skills shortages in some areas. This includes a shortage of electricians to develop charging infrastructure for electric vehicles. Consultees highlighted this as a particular concern for rural areas in the South of Scotland and Highlands and Islands. This is a key issue with the phasing out of new petrol and diesel cars by 2035.

3.5.15 A further skills challenge is a lack of staff trained to repair and maintain ULEVs. Analysis has underlined this gap as a study undertaken for SDS found that whilst three quarters of garages envisage that maintaining ULEVs will need to be part of their business offer, less than one third (31%) have the skills to service electric and hybrid vehicles. The most common reasons for garages not offering hybrid/electric repair and maintenance services were lack of demand (77%) and not having qualified staff (70%).⁷⁰

Where will demand for green skills come from in the future?

3.5.16 Looking to the future, as more people drive ULEVs, new petrol and diesel cars and vans are phased out by 2035, and the Scottish transport system is redesigned, the skills requirements of the sector will continue to evolve.⁷¹

⁶⁶ City and Guilds and National Rail Academy (2020). [Back on Track: Gearing up to meet the increased demand for talent in the rail industry.](#)

⁶⁷ Scottish Government (2023). [Just Transition: Transport](#); ONS (August 2023). [Emp 13: Employment by Industry.](#)

⁶⁸ City and Guilds and National Rail Academy (2020). [Back on Track: Gearing up to meet the increased demand for talent in the rail industry.](#)

⁶⁹ Scottish Government (2023). [Just Transition: Transport.](#)

⁷⁰ Optimat (2020). [Ultra-Low Emission Vehicle Skills Baseline Study. Report for Transport Scotland and Skills Development Scotland.](#)

3. What do we know about the demand for green skills?

- 3.5.17 Investment and policy-neutral forecasts suggest that the Transport sector workforce will expand in the mid-term – and it is anticipated that it will undergo a continued transition towards a greener workforce. Over the longer-term (to 2032) green occupations are forecast to increase the share of the sector’s workforce that they account for, within this Enhanced Skills and Knowledge occupations increase their proportionate share the most, which reflects changes in the nature of job roles within the sector.
- 3.5.18 Due to movements within the labour market, and based on Oxford Economics forecasts, there could be a total requirement for 24,900 people to meet employment demand in the Transport sector up to 2025. Green occupations account for 13,100 of the total requirement (52.4%), and non-green occupations account for a smaller share (11,800 people, 47.6%).

ULEV repair and maintenance

- 3.5.19 As mentioned previously, the availability of repair and maintenance professionals for ULEVs has already been noted as a potential barrier to ownership. Fewer than 10% of vehicle maintenance and repair staff have a recognised qualification/ accreditation to enable them to work safely on electric/hybrid vehicles.⁷²

3.5.20 It is estimated that 15,000 repair and maintenance staff will need upskilled or trained as new entrants to support the uptake of electric/hybrid vehicles in Scotland.⁷³

3.5.21 In terms of upskilling, the landscape at present includes a range of qualifications and accreditations aligned with National Occupational Standards. Training is delivered through a combination of manufacturers, colleges, and private training providers. Barriers to training include a perceived lack of demand meaning that training offers limited commercial return, a lack of training budget and a lack of awareness around training required and where this can be accessed.⁷⁴ These challenges will need to be overcome if a sustainable skills pipeline is to be achieved.

ULEV charging infrastructure

3.5.22 There is a significant skills requirement in the development of wider ULEV infrastructure. As mentioned above, consultees highlighted challenges in obtaining enough electricians to install, maintain and repair charging infrastructure for ULEVs.

3.5.23 Scotland has the most comprehensive public charging network in the UK outside of London, but to support the uptake of electric vehicles required this will need to be extended significantly, and at pace.⁷⁵ It is estimated that the public charging network will need to double over the next decade. This work will require qualified electricians who will need upskilling to deliver this particular task. Consultees highlighted this as a challenge, particularly in rural areas, although specific estimates of numbers needed were not provided.

⁷² Optimat (2020). [Ultra-Low Emission Vehicle Skills Baseline Study, Report for Transport Scotland and Skills Development Scotland.](#)

⁷³ As 72.

⁷⁴ As 72.

⁷⁵ Scottish Government (2023). [Just Transition: Transport.](#)

3. What do we know about the demand for green skills?

3.5.24 Challenges to growing the skills pipeline in this area include ensuring that charge point owners are aware that repair and maintenance staff need to be qualified electricians with additional training specific to safely working with charging points; and accessibility/availability of skills, particularly where manufacturers require that only workers with their specific ‘manufacturer approved’ training can work on charging points due to warranty conditions.⁷⁶

Heavy Duty Vehicles (HDVs) and rail decarbonisation

3.5.25 As well as cars, the decarbonisation of Heavy-Duty Vehicles (HDVs) and the rail system is also a priority. Decarbonisation of HDVs includes battery electric and hydrogen methods, with hydrogen also being an option for fuelling boats. It is estimated that between 34,400 and 38,200 employees across the HDV landscape will require some level of skills development relating to low carbon HDVs by 2026, and between 41,000 and 53,200 by 2032. This includes employees across the HDV landscape, such as manufacturers; charging/refuelling infrastructure; vehicles sales, inspection, and repair staff; as well as owners and operators.⁷⁷

3.5.26 Skills challenges highlighted in the HDV landscape include potential shortages in manufactures/system integrators at engineer and technician level; challenges with the content of Modern Apprenticeships (MAs) as electric vehicle modules are not yet mandatory; and that there are few training providers for hybrid/electric HDVs.⁷⁸

3.5.27 There is also a lack of specific content on installation and maintenance of hydrogen refuelling infrastructure; and a lack of upskilling courses outside of those available from manufacturers on safe and competent working on high pressure gas systems/hydrogen fuel cell systems within HDVs.

3.5.28 Looking specifically at vehicle repair and maintenance, a survey of HDV garages in Scotland found that just over one third (34%) currently provide services for battery electric/hybrid HDVs, with 15% of HDV technicians having recognised qualifications for working on electric/hybrid HDVs. The main barrier to skills development in repair/maintenance of electric/hybrid HDVs was a perceived lack of demand to justify investment. This was reported by 83% of garages not offering electric/hybrid HDV repair and maintenance.⁷⁹

3.5.29 The rail sector is already largely decarbonised as over three quarters (76%) of Scotland’s passenger rail services are zero emissions electric trains, with the remainder to be decarbonised by 2035. Rail freight already provides a far more sustainable mode of transport than lorries, and electric traction can reduce emissions further. Rail decarbonisation will create further demand for engineering skills to electrify lines, whilst development of alternative traction methods will create skills demand to support the supply of rolling stock and advanced technologies.⁸⁰

⁷⁶ Optimat (2020). [Ultra-Low Emission Vehicle Skills Baseline Study. Report for Transport Scotland and Skills Development Scotland.](#)

⁷⁷ Optimat (2021). [Skills for low carbon Heavy Duty Vehicles: Report for Transport Scotland.](#)

⁷⁸ As 77.

⁷⁹ As 77.

⁸⁰ Scottish Government (2023). [Just Transition: Transport.](#)

3. What do we know about the demand for green skills?

Wider infrastructure

3.5.30 As highlighted in the HDVs section, the decarbonisation of transport creates a number of requirements across the landscape, and this includes para occupations that may not be directly related to the manufacture, operation or maintenance of vehicles. For example, it is estimated that 65,000 people could need to undertake some level of training (either upskilling or from scratch) to support the uptake of hybrid/electric vehicles. A wide range of occupations are affected, including 20,500 vehicle sales staff, 22,000 emergency services personnel (who will require training in how to deal with accidents involving electric/hybrid vehicles) and 7,800 other staff in the automotive retail sector (such as roadside assistance and recovery personnel).⁸¹

3.5.31 Outside of ULEVs, one of the key pledges from the Scottish Government has been to reduce car kilometres by 20% by 2030. Achieving more active travel and use of public transport has been underlined as the preferred method for achieving net zero, rather than focusing solely on the adoption of ULEVs.⁸²

3.5.32 This has the potential to create wider skills demand relating to the planning and provision of public transport, which could affect occupations such as rail and bus drivers. Achieving greater use of public transport and active travel, such as cycling and walking, may also mean greater demand in areas relating to the planning and logistics of public transport routes/delivery and implementation of routes and layouts to encourage active travel.⁸³

Transport – summary of demand evidence

3.5.33 The Transport sector is expected to be subject to significant demand for changing and new skills as the sector adapts to the transition to net zero. The primary factors driving this are:

- Demand for skills to support the expansion of ULEV infrastructure.
- A significant requirement for training (for new starts and re-skilling existing workers) on the maintenance and repair of ULEVs.
- Wider training requirements (for both new starts and re-skilling) around ULEVs relating to core and para Transport occupations. It is estimated that 65,000 people will need to undertake training to support the uptake of electric/hybrid vehicles.
- Considerable total requirement – amounting to 24,900 people up to 2025, which includes replacement demand as the ageing workforce retires.

⁸¹ Optimat (2020). [Ultra-Low Emission Vehicle Skills Baseline Study. Report for Transport Scotland and Skills Development Scotland.](#)

⁸² Transport Scotland (2022). [A Network fit for the Future: Draft Vision for Scotland's Public Electric Vehicle Charging Network.](#)

⁸³ Transport Scotland (2022). [Reducing car use for a healthier, fairer and greener Scotland.](#)

3. What do we know about the demand for green skills?

- 3.5.34 The expansion of ULEV infrastructure is vital in supporting the sector's transition to net zero. Primarily this reflects the need for more charging points to support the uptake of electric vehicles. It also includes wider infrastructure to support the decarbonisation of HDVs (e.g., hydrogen refuelling infrastructure) and trains (e.g., the electrification of lines). This underlines the need for occupations such as electricians, which are already in high demand, in the Transport industry, but also across other CESAP sectors. Consultees have reported that there are already shortages of electricians available to install and maintain charging points, particularly in the Highlands and Islands and South of Scotland.
- 3.5.35 Vehicle maintenance and repair is a key area of demand, affecting cars and HDVs. There is already some suggestion of shortages in this area, causing concern that the lack of available maintenance and repair technicians is making ULEVs less desirable. The demand evidence also highlights the broad nature of skills requirements, with the 65,000 training requirement for ULEVs including occupations such as vehicle sales and emergency services staff.
- 3.5.36 Outside of ULEVs there is less certainty regarding skills requirements, but policy focused on the reduction of car usage may lead to growth in demand for occupations relating to the delivery and planning of public transport and active travel.

3.6 Manufacturing (including Engineering)

- 3.6.1 Manufacturing is one of the largest contributing sectors of total UK greenhouse gas emissions and is currently heavily reliant on fossil fuels. It will need to adapt to meet net zero targets by using less energy-intensive materials, exploring renewables and recycled materials, as well as technological advancements in processes. Exploring these changes requires the workforce to adapt and upskill in these areas.
- 3.6.2 The transition to net zero presents significant opportunities for the Manufacturing sector, which encompasses Engineering. Renewable technologies, in particular, have extensive supply chains that require the manufacture of components and parts. There are also emerging markets like CCUS and hydrogen that offer significant business opportunities for Manufacturing and will greatly contribute to the transition to net zero.
- 3.6.3 The Manufacturing workforce is highly skilled, and equipping the workforce with the skills to adapt to sustainable methods of production is underway but not complete – there are also concerns about the number of skilled workers to undertake the work needed in the time available to meet targets. As one of the largest employing CESAP sectors, it offers a sizeable opportunity to enhance green skills within a large segment of the Scottish workforce.

3. What do we know about the demand for green skills?

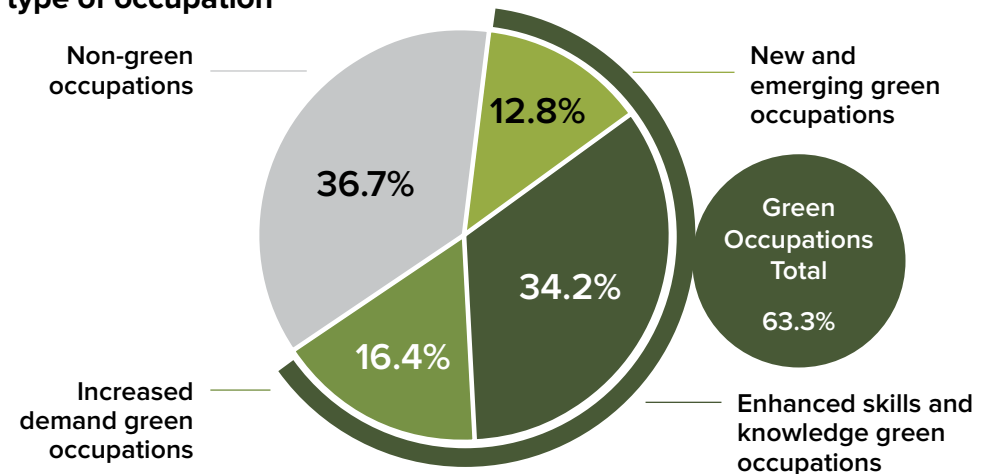
Current employment

3.6.4 In Scotland, 181,600 people worked in the Manufacturing⁸⁴ sector in 2022, accounting for 7.0% of total employment in Scotland. The transition to net zero is leading to the creation of new occupations in the Manufacturing sector – indicating that new markets and opportunities are beginning to come to fruition and that the sector continues to be at the forefront of the transition.

3.6.5 Most of the Manufacturing workforce were working in green occupations in 2022, with 115,000 (63.3%) people in a green occupation (see Figure 3.5), and of these people, approximately half were in roles that required Enhanced Skills and Knowledge because of the transition to net zero:

- 23,200 people (20.1% of people employed in green occupations in the sector) were in New and Emerging occupations.
- 62,100 people (54.0% of people employed in green occupations in the sector) were in occupations requiring Enhanced Skills and Knowledge.
- 29,700 (25.8% of people employed in green occupations in the sector) were categorised as Increased Demand occupations.

Figure 3.5: Manufacturing (including Engineering) sector employment 2022, percentage of people employed in the sector by type of occupation



Source: SDS, Oxford Economics

3.6.6 More than 10% (14.0%) of the Manufacturing workforce were located in Aberdeen City and Shire in 2022. This, combined with the high levels of employment in the Glasgow Region, Edinburgh, East and Midlothian and Lanarkshire, accounted for almost half (48.4%) of the Manufacturing workforce across Scotland.

3.6.7 Although the number of workers was lower, the Manufacturing sector was an important source of jobs in many regional economies – including rural areas. In West Lothian, employment in Manufacturing was 50% higher than the Scottish average, and across rural Scotland employment was 30% higher.

Vacancies

3.6.8 The sector was recruiting in 2022, and it was the most active CESAP sector. More than one-quarter (29.2%) of job postings for opportunities in CESAP sectors were for jobs in the Manufacturing or Engineering sub-sectors.

⁸⁴ CESAP sector definition from Green Jobs in Scotland research, Manufacturing includes Engineering.

3. What do we know about the demand for green skills?

Table 3.5: Green job postings in Manufacturing (including Engineering), 2022

Occupation	Job Postings	% Total job postings in Manufacturing (including Engineering)
Programmers and software development professionals	470	5.7%
Science, engineering and production technicians n.e.c.	370	4.6%
Engineering technicians	340	4.2%
Marketing and sales directors	310	3.7%
Engineering professionals n.e.c.	270	3.3%
Elementary storage occupations	230	2.8%
Customer service occupations n.e.c.	230	2.8%
IT business analysts, architects and systems designers	210	2.6%
Biological scientists and biochemists	210	2.6%
Mechanical engineers	200	2.4%
All green occupations	8,200	54.6%

Source: Burning Glass

The sector sought people to fill these 15,000 job openings across a range of roles – more than half (54.6%, 8,200 postings) were opportunities in green occupations (see Table 3.5).

3.6.9 Green job postings in Manufacturing were broad, with no one occupation or role dominating job postings. The highest number

of job postings were found in programmers and software developers; science engineering and production technicians; and engineering technicians.

3.6.10 The majority of the job postings were in the Glasgow Region (25.2%), Edinburgh, East and Midlothian (20.6%) Aberdeen City and Shire (10.1%), and the West Region (10.1%), together accounting for 66% of all the Manufacturing and Engineering job postings in Scotland, and consistent with where employment in the sector is greatest.

Current gaps and shortages

3.6.11 Labour shortages are already acute in the Manufacturing sector. According to those consulted Brexit has resulted in the loss of EU labour which the sector previously relied upon, and a high proportion of the sector’s workforce is aged 50+. This contributes towards a high replacement demand forecast for the sector and affects the ability of the sector to support the work required to meet net zero targets.

3.6.12 Consultations suggested a particular high demand for welders and fabricators within the Manufacturing industry, and a shortage of people trained in these trades. Welding is not a popular apprenticeship and there is a view that industry standards for some welding apprenticeships are set too high relative to industry needs. This creates a shortage of people trained to undertake this work, which affects the ability of the Manufacturing sector to grow and support the net zero transition. Work is ongoing to try to improve the training provision for welders.

3.6.13 Engineers play a key role in supporting the Manufacturing sector, and there is a view from the consultations of a general shortage of engineers at all levels and across disciplines. It is crucial that this is addressed to support the Manufacturing sector as well as other CESAP sectors that rely on engineering.

3. What do we know about the demand for green skills?

- 3.6.14 In addition, there is a perceived lack of engineering apprentices at craft and technician levels, creating another gap. These numbers will need to rise substantially to ensure the sector has the correct skills base for a net zero transition.
- 3.6.15 There is currently a rising demand for intermediate and higher-level skills in the sector, associated with the increase in energy efficiency and low carbon processes. Regulatory requirements to support net zero targets and market competition are together driving investment in new technologies which is increasing demand for higher level skills in the sector. This includes planning and assessing skills as well as strategic leadership and management skills.
- 3.6.16 Supply chain disruption is major issue within the Manufacturing sector, affecting the ability of manufacturers to finish products. This has been an issue since the COVID-19 pandemic, with around 69% of Scottish firms saying they are still facing supply chain issues.⁸⁵ This issue will need to be addressed to ensure the sector is able to meet demands for a net zero transition.

Where will demand for green skills come from in the future?

- 3.6.17 Looking to the future, the sector is expected to make a significant contribution to achieving the transition to net zero, but current and emerging skills shortages pose a risk to maximising the opportunities that are present. Future demand in the sector will have a strong dependency on investments

in Energy, as well as wider Manufacturing and Engineering advancements in artificial intelligence and robotics.

- 3.6.18 Investment and policy-neutral forecasts suggest that the Manufacturing workforce will contract in the mid-term – however, it is anticipated that it will undergo a continued transition towards green jobs and skills. Over the longer-term (to 2032) green occupations are forecast to increase the share of the sector’s workforce that they account for.
- 3.6.19 Due to movements within the labour market, and based on Oxford Economics forecasts, there could be a total requirement for 6,900 people to meet employment demand in the Manufacturing sector up to 2025. Green occupations account for 4,700 of the total requirement (68.5%), and non-green occupations account for a smaller share (2,200 people, 31.5%). However, actual demand could be higher as investments are confirmed and projects, like ScotWind and hydrogen production and distribution come to fruition.

Sustainable manufacturing practices

- 3.6.20A major driver of skills demand in the Manufacturing sector comes from the efforts to decarbonise the sector and adopt sustainable manufacturing practices. This is already impacting the demand for labour in the sector and is expected to require upskilling and reskilling of the existing workforce.
- 3.6.21 Currently only 62% of UK manufacturing organisations believe their workforce is equipped with the skills needed to manufacture goods and products in a more sustainable way.⁸⁶ Research by Lloyds Bank also estimates that around 22% of UK businesses do not have the necessary skills to adopt more sustainable modes of manufacturing.⁸⁷ Applying these proportions to manufacturing activity in Scotland translates to between 40,000 and 68,000 workers without adequate skills to manufacture sustainably.⁸⁸

⁸⁵ Barclays (2022). [Chain Reaction: How UK Manufacturers are Adapting to Supply Chain Issues](#).

⁸⁶ Make UK (2022). [Green Skills Guiding Principles](#).

⁸⁷ Lloyds Bank (2021). [UK Manufacturing: From Now to Net Zero](#).

⁸⁸ Office for National Statistics (2022). Business Register and Employment Survey.

3. What do we know about the demand for green skills?

This points to the need for substantial upskilling to ensure the Manufacturing sector is operating in a way that contributes towards meeting net zero targets.

- 3.6.22 Consultations suggested the requirement to decarbonise the Manufacturing sector will also result in a growing demand for engineers trained up to doctoral level. These skills will be required to generate innovative solutions to drive down the sector's emissions and to adopt waste reduction. There is already a major problem in retaining graduate level engineers in Scotland, with industry consultees reporting that around 50% of these graduates go on to work in other sectors. Scotland also loses graduate engineers to other parts of the UK and beyond. This therefore presents a challenge in ensuring the Manufacturing sector has enough graduate-level engineers to support decarbonisation efforts.
- 3.6.23 A further aspect of sustainable manufacturing is remanufacturing which involves dismantling products and restoring or replacing components to original design specifications. This process will require additional skills with more emphasis on dismantling, testing and analytical and fitting skills. There will therefore be a higher demand for these skills in the sector as it increases remanufacturing practices.
- 3.6.24 Decarbonising Manufacturing will also require the continuous development of professional and technically trained staff to ensure the sector is up to date with technological developments and working productively. This will require additional management and business planning skills.

Automation and technological advancements

- 3.6.25 An important aspect of decarbonising the Manufacturing sector is the introduction of new technologies and automation. This is already driving a demand for new skills, and this demand is expected to continue to grow in the future.
- 3.6.26 Greater investment is needed in engineering skills to support artificial intelligence and robotics. These skills will be crucial in the process required to reduce carbon in manufacturing processes and significantly reduce waste.
- 3.6.27 The adoption of data driven and digital processes to reduce carbon emissions in Manufacturing will further drive a demand for intermediate and higher-level skills in the sector. Engineers will need to possess design, analytical and technical skills in order to support the adoption of new technologies, and there will also be a requirement for greater levels of resilience and adaptability. It will be important that there are enough people trained to this level in Manufacturing in order to support the digital transformation in the sector.
- 3.6.28 The recently introduced MA in Engineering and Digital Manufacturing aims to develop competence in the use of emerging technologies to support apprentices to adapt to new ways of working. This should develop skills in roles that are currently in high demand such as technicians and engineers, whilst incorporating the latest digital and technological advances into learning and practice.

3. What do we know about the demand for green skills?

Manufacturing to support ScotWind and offshore energy

3.6.29 The Manufacturing sector is a key component of the supply chain for the Offshore Wind sector. As efforts increase to drive forward Offshore Wind projects, such as through ScotWind, there will be an increase in demand for skills from the Manufacturing sector.

Manufacturing (including Engineering) - summary of demand evidence

3.6.30 The Manufacturing sector is currently heavily reliant on fossil fuels, and there will be major changes required in the sector in order to reduce emissions and meet Scotland's net zero targets. This will result in significant demand for skills and labour, which will be particularly driven by the following factors:

- An ageing workforce and reduction of migrant labour contribute to a replacement demand for 6,900 people in the sector up to 2025.
- Shortages of workers trained in key trades required to support decarbonisation in the Manufacturing sector, including welders, fabricators, and engineers.
- Significant upskilling and reskilling is required to allow workers in the sector to adapt to new ways of working to support the decarbonisation of Manufacturing.

3.6.31 To support decarbonisation in the Manufacturing sector, there is an increasing demand for higher-level skills within the workforce. This is particularly due to the introduction of new technologies that require design, analytical and technical skills, as well as management skills. These skills will support the Manufacturing sector adapt to new ways of working that will reduce the sector's carbon emissions.

3.6.32 The Manufacturing sector underpins the supply chains in other key CESAP sectors, such as Energy and Waste Treatment and Construction. It is, therefore, important that the skills shortages facing the sector are addressed in order to maximise the contribution the sector can make to achieving the transition to net zero in Scotland.

3.7 Agriculture (including Forestry and Fishing)

3.7.1 The Agricultural sector in Scotland has a significant role to play in the transition to net zero with significant portions of Scotland's landscape being used for agriculture, forestry, and farming.

3.7.2 The sector, more than most, has already been directly impacted by the changing climate – extreme weather in 2017 and 2018 inflicted damaging economic loss across the entirety of the Agriculture sector to the value of an estimated £161m.⁸⁹ There are significant future risks, but also some opportunities if the sector adapts, such as “longer growing seasons; greater variety and yields of some crops; novel crops, previously uneconomic in Scotland; increased area for arable and doubling of grassland production in some parts of Scotland; and overall the potential for increases in agricultural production”.⁹⁰

⁸⁹ WWF (2019). [The Economic Impact of Extreme Weather on Scottish Agriculture.](#)

⁹⁰ SAC Consulting (2023). [Climate Change Adaptation for Agriculture: Is your farm ready?](#)

3. What do we know about the demand for green skills?

- 3.7.3 The Agriculture sector is a significant contributor of greenhouse gasses. However, these contributions have been falling in recent years, and are projected to continue to fall. Contributing to this outlook is the potential of digitalisation in the sector that could make Agriculture more efficient, sustainable and competitive.⁹¹
- 3.7.4 Agriculture is typically a key economic sector in rural communities, providing employment opportunities and valued income streams in places where there is less job diversity. Compared to other CESAP sectors, Agriculture has the smallest workforce however, the sector's workforce will be key to the transition to net zero.

Current employment

- 3.7.5 In Scotland, 39,100 people worked in the Agriculture⁹² sector in 2022, accounting for 1.5% of total employment in Scotland. The workforce has not yet undergone substantive change because of the transition to net zero, and where change has taken place, it has predominantly been to enhance skills in a workforce where there is already an above-average intensity of green skills.⁹³
- 3.7.6 Most of the Agriculture workforce were working in green occupations in 2022, with 32,400 (82.8%) people in a green occupation (see Figure 3.6, next page), and of these people, most were in roles that required Enhanced Skills and Knowledge because of the transition to net zero:

- 100 people (0.3% of people employed in green occupations in the sector) were in New and Emerging occupations.
- 25,200 people (77.6% of people employed in green occupations in the sector) were in occupations requiring Enhanced Skills and Knowledge; and
- 7,100 (22.1% of people employed in green occupations in the sector) were categorised as Increased Demand occupations.

- 3.7.7 Employment in the Agriculture sector was concentrated in rural areas. The Highlands and Islands accounted for almost one-quarter (23.7%) of the sector's workforce in 2022. This concentration made the sector an important source of jobs for the regional labour market, accounting for almost three times as many jobs here than the Scottish average.
- 3.7.8 The sector accounted for an above average share of employment in other rural areas too. In Dumfries and Galloway, employment in Agriculture was more than four times the Scottish average, it was also well above the Scottish average in the Scottish Borders (almost four times higher) and Tayside (almost three times higher).

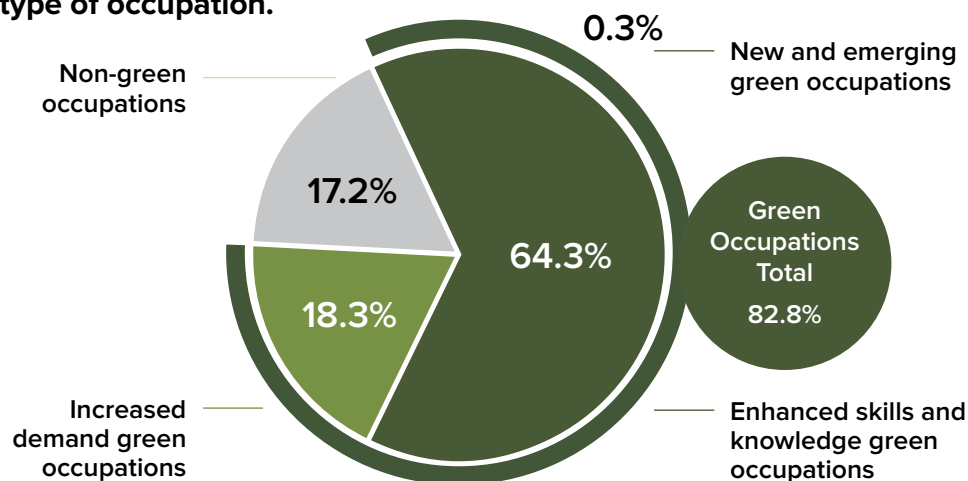
⁹¹ European Commission (2023). [The Digitalisation of the European Agricultural Sector](#).

⁹² CESAP sector definition from Green Jobs in Scotland research

⁹³ LinkedIn (2023). [Global Green Skills Report 2023](#).

3. What do we know about the demand for green skills?

Figure 3.6: Agriculture (including Forestry and Fishing) sector employment 2022, percentage of people employed in the sector by type of occupation.



Source: SDS, Oxford Economics

Vacancies

3.7.9 Due to the hiring practices of the sector where different job advertising platforms are used, and non-domestic job advertising is routine, recruitment activity was likely to be more than what the low level of online job postings in 2022 would suggest. There were 1,300 Agricultural job postings, which was 2.6% of opportunities advertised online in CESAP sectors. The job postings suggest that the intensity of green skills in the sector could grow further – more than two-thirds (66.9%, 900 postings) were opportunities in green occupations (see Table 3.6).

3.7.10 The majority of the job postings were in Edinburgh, East and Midlothian (25.8%), the Glasgow Region (19.7%) and the Highlands and Islands (11.1%), together accounting for 57% of all the Agriculture job postings in Scotland.

Table 3.6: Green job postings in Agriculture (including Forestry and Fishing), 2022

Occupation	Job Postings	% Total job postings in Agriculture (including Forestry and Fishing)
Gardeners and landscape gardeners	260	20.1%
Farm workers	80	6.0%
Elementary construction occupations	30	2.5%
Engineering technicians	30	2.1%
Construction and building trades n.e.c.	30	2.0%
Large goods vehicle drivers	20	1.7%
Managers and proprietors in agriculture and horticulture	20	1.7%
Van drivers	20	1.7%
Architects	20	1.5%
Production managers and directors in Construction	10	1.1%
All green occupations	900	66.9%

Source: Burning Glass

3. What do we know about the demand for green skills?

Current gaps and shortages

- 3.7.11 Agriculture faces a wider challenge to replace older workers as the sector struggles to attract and retain young people. In June 2021 only 10% of the workforce were under 41⁹⁴ with 45.1% over the age of 50 years; significantly higher than the average for all sectors in Scotland of 32.6%.⁹⁵ Females are also under-represented in this sector. Of all owner occupiers of working farms, 60% were male and 40% were female. Particularly women living in remote, rural Scotland have the lowest annual income compared to any other group in the sector.⁹⁶
- 3.7.12 The Agriculture sector is also characterised by many diverse small businesses. As a result, current labour shortages are widespread across the sector. In Forestry, many of the workers are self-employed contractors and these characteristics are generally associated with lower levels of skills investment and relatively low earnings. Current skills shortages are evident in the wider Food and Drink sector and include skills demand for engineers, food scientists/technologists and at an intermediate level for dairy farmers.
- 3.7.13 There are other issues restricting the supply of skilled labour. The sector struggles to attract talent due to perceived low wages and limited career prospects. Difficult working conditions are also a factor as many workers are exposed

to the elements all year round. In rural areas limited housing availability and public transport services have also impacted the talent pipeline. The sector has experienced additional labour shortages from a reduction in migrant labour following Brexit. These barriers and challenges must be addressed if the skills gap in the Agriculture sector is to be bridged in the future.

- 3.7.14 The Agriculture sector is having to respond to new demands and ways of working as part of the overall drive to decarbonise the sector. The sector therefore has a unique role to play in the transition to net zero, both through contributing to sustainable food production, and through developing new skills to work more sustainably and productively.
- 3.7.15 There will be a growing demand for people with relevant skills required for tree planting, and peatland restoration where there is a broader spectrum of skills required, including those with degrees in science and postgraduate qualifications. Forestry and peatland restoration are already beginning to compete with Agriculture for skilled labour, and it is anticipated the competition will grow stronger over time.

⁹⁴ Scottish Government (2021). [Results from the Scottish Agricultural Census: June 2021](#).

⁹⁵ ONS (2022). Annual Population Survey.

⁹⁶ Scottish Government (2019). [Exploring the Gender Pay Gap in Rural Scotland](#).

3. What do we know about the demand for green skills?

Where will demand for green skills come from in the future?

- 3.7.16 Looking to the future, the sector is expected to undergo a continued transformation, particularly through the use of digital technologies and growth in areas such as peatland restoration.
- 3.7.17 Investment and policy-neutral forecasts suggest that the Agriculture sector workforce will grow in the mid-term and undergo a continued transition towards greener occupations and skills. Over the longer-term (to 2032), green occupations are forecast to increase the share of the sector's workforce that they account for.
- 3.7.18 Due to movements within the labour market, and based on Oxford Economics forecasts, there could be a total requirement for 11,500 people to meet employment demand in the Agriculture sector up to 2025. This is largely driven by replacement demand which reflects the sector's ageing workforce. Green occupations account for 9,500 of the total requirement (82.8%), and non-green occupations account for a smaller share (2,000 people, 17.2%).
- 3.7.19 In Agriculture, skills transitions needed will include updated skills linked to agricultural practice in a low-carbon environment. There will be increasing demand for intermediate technical skills associated with soil testing, chemicals monitoring and business management. New areas of work will

include soil chemists, environment impact assessors, energy technicians, and IT technicians.

- 3.7.20 In Forestry, required skills transitions will include additional capacity to manage woodland stock and to commercialise wood production for timber and biomass energy. New work areas will include environment consultant, carbon assessor, transport operative, ground worker and peatland conservationist.

Peatland restoration

- 3.7.21 In February 2020, the Scottish Government announced a multi-national investment in peatland restoration of more than £230m up to the year 2030. This is an effective nature-based solution used to respond to the climate crisis and biodiversity loss.⁹⁷
- 3.7.22 Peatland restoration is a relatively new and growing sector, and some estimates suggest that there is a need to fill 1,500 jobs up to 2030.⁹⁸ As well as front line machine operators, there will be a need for specialist and technical jobs. These roles include hydrologists, satellite data analysts, surveyors, ornithologists, ecologists and project managers.⁹⁹
- 3.7.23 There is currently a shortage of people with skills in peatland restoration. To try combat this skills shortage, Scotland's Rural College (SRUC) have developed the Peatland Assessment and Restoration course in partnership with NatureScot, to provide an overview of peatland ecology and hydrology.¹⁰⁰ This is a good first step, however further intervention is required to meet the Scottish Government's targets.
- 3.7.24 In the short term there is an urgent need to upskill and develop the sector through the existing workforce and the development of new pathways for future entrants. In the medium to long term the market will have to respond to the need for industry capacity, skills and competencies.

⁹⁷ NatureScot. [Peatland ACTION Project](#).

⁹⁸ Skills Development Scotland. [Peatland skills - on the front line of climate action](#).

⁹⁹ NatureScot (2020). [Nature-based jobs and skills for net zero - an initial assessment](#)

¹⁰⁰ SRUC (2022). [Scotland's first peatland restoration course](#).

3. What do we know about the demand for green skills?

Technological advances and digital transformation

- 3.7.25 Reducing emissions in the Agriculture sector will require the adoption of new technological practices and digital technologies. The European Commission has indicated that technologies such as artificial intelligence, robotics, 5G, the Internet of Things, blockchain and supercomputing have the potential to make agriculture more efficient and sustainable.¹⁰¹
- 3.7.26 Some of the practices used in the Agriculture sector that require more technical and digital skills include soil and yield mapping, using GPS adapted machinery, chemical analysis, and emissions monitoring. To ensure the sector is contributing to the net zero transition it is likely that demand for these skills will grow, as well as demand for management skills to support the adoption of these processes.
- 3.7.27 Upskilling will be required in the Agriculture sector to adapt to the new technologies that will help make the sector more sustainable and productive. Farmers will be required to develop new skillsets including digital skills to work with these technologies.
- 3.7.28 To support this transformation, there is a need to improve pathways into Agriculture careers that effectively reflect future technical requirements in the sector.

Sector attractiveness

- 3.7.29 As noted, the sector has an ageing workforce, and this means there will be considerable demand for new workers to come into the industry to replace those that are retiring. In addition, the transition to net zero will create new skills demands in areas related to agricultural practice in a low carbon environment. This will include demand for intermediate technical skills such as soil testing, chemicals monitoring and business management and occupations including soil chemists, environment impact assessors, energy technicians, and IT technicians.¹⁰²
- 3.7.30 This skills demand may pose a challenge for the sector as it has suffered from negative perceptions and difficulties in attracting young people. A lack of affordable homes for young people in rural areas, as well as public transport availability, affordability and connectivity are key issues.¹⁰³
- 3.7.31 Surveys with young people in England and Scotland have underlined more sector specific challenges to attracting young people. These include poor public perception of the sector; career instability; lack of jobs/career support; and job requirements such as expectations for degrees and years of experience/volunteering required.¹⁰⁴
- 3.7.32 Respondents identified the greater availability of information and promotion of careers in the sector as the best ways to overcome these barriers.¹⁰⁵

¹⁰¹ European Commission (2023). [The Digitalisation of the European Agricultural Sector.](#)

¹⁰² Cambridge Policy Consultants (2021). [Climate Emergency Evidence Base for a Skills Action Plan.](#)

¹⁰³ Scottish Government (2023). [Just Transition: Land Use and Agriculture.](#)

¹⁰⁴ University of Exeter (2021). [Farm Labour in the UK: Assessing the Workforce the Industry Needs;](#) NatureScot (2022). [Youth Survey on NatureScot's Corporate Plan 2022-2026.](#)

¹⁰⁵ NatureScot (2022). [Youth Survey on NatureScot's Corporate Plan 2022-2026.](#)

3. What do we know about the demand for green skills?

Agriculture (including Forestry and Fishing) – summary of demand evidence

3.7.33 The Agriculture sector is important to the transition to net zero. The sector is expected to face significant demand for new skills as it adapts to agricultural practice in a low-carbon environment. The primary factors driving this are:

- A considerable replacement demand as the ageing workforce retires. This is the key driver of the 11,500 total requirement over the period to 2025.
- Adoption of new digital technologies to support more efficient and sustainable agriculture.
- Growing skills demand from peatland restoration. This is a new and growing sector, which is already leading to unmet skills demand. Estimates suggest there could be a need to fill 1,500 jobs in the period to 2030.

3.7.34 The transition to net zero is creating considerable changes and new skills requirements for the Agriculture sector as low carbon farming necessitates changes in land use and the adoption of new skills/technologies in areas such as soil testing and chemical management.

3.7.35 This is set against a challenging backdrop as the sector has an ageing workforce, and labour availability has been affected by Brexit. The availability of housing and public transport in rural areas combined with challenges around sector attractiveness have also created difficulties in the Agriculture skills pipeline.

3.7.36 However, the transition to net zero offers the opportunity of more technical/highly skilled occupations in areas such as peatland restoration, chemical management, soil testing and other occupations related to the greater adoption of digital technologies.

4. Provision of green skills

Introduction

- 4.1 Providing a clear and comprehensive understanding of the extent to which current skills provision is supporting the transition to net zero, is a critical element in the development of a dynamic skills response. The role of skills in supporting the transition to net zero should not be underestimated, a key message from the Skills and Net Zero Expert Advisory Group was that skills are a fundamental enabler of net zero. No policy aimed at realising net zero can succeed without having people in place with the right skills to deliver on it.¹⁰⁶
- 4.2 As part of the Pathfinder we have adopted an experimental approach to map provision to the pipeline of net zero skills.¹⁰⁷ This has involved advanced mapping by SDS and SFC of skills provision across each of the pathways where individuals could potentially acquire skills, through a range of pathways including via:
- College;
 - University;
 - Modern Apprenticeships (MAs);
 - Graduate Apprenticeships (GAs);
 - Foundation Apprenticeships (FAs); and
 - Upskilling/Reskilling.
- 4.3 Across all provision types (except for Upskilling/Reskilling) provision has been classified as “green” based on mapping to the green SIC and SOC codes identified in the *Green Jobs in Scotland* report and is the same approach taken in the demand analysis. The only variation in this section is that we examine provision for Manufacturing and Engineering separately to understand any underpinning differences. The method is outlined in further detail in the supplementary evidence paper on Provision.¹⁰⁸
- 4.4 In the case of graduates and apprentices, provision mapping was correlated between the subject or framework an individual had graduated in or started their apprenticeship in, and the CESAP sectors and green occupations individuals they were working in. This moves beyond a subjective view of ‘green courses’ aligning to potential ‘green roles’ and provides information on the specific sectors and occupations individuals are in within the economy.
- 4.5 The provision data has been analysed for college enrolments, university graduates 15 months after leaving their course and MA, GA and FAs starts.¹⁰⁹ Data was not readily available on a consistent basis across all provision types. For this reason, direct comparisons should not be made across the provision types.
- 4.6 To illustrate the provision in scope, Figure 4.1 outlines examples of provision which would be classed as within a CESAP sector but not a green occupation, within a green occupation but not a CESAP sector and within a CESAP sector and a green occupation.

¹⁰⁶ Climate Change Commission (2023), Skills and Net Zero. Available online at: <https://www.theccc.org.uk/publication/skills-and-net-zero-expert-advisory-group/>.

¹⁰⁷ Provision data is mapped using Green Jobs in Scotland SIC and SOC codes.

¹⁰⁸ CESAP Pathfinder Mapping provision.

¹⁰⁹ Data in this section has been rounded to the nearest hundred for college, university and MA data. Reflecting smaller figures it has been rounded to the nearest ten for GAs, FAs and upskilling/reskilling provision. All percentages have been calculated using unrounded data.

4. Provision of green skills

Figure 4.1: Examples of green provision and mapping to Green occupations and CESAP sectors

CESAP sector (not green occupation)	Green occupation (not CESAP sector)	CESAP sector (green occupation)
<ul style="list-style-type: none"> Graduate who goes on to work in HR for a Biotechnology company Chemistry college course MA working in an Administrative role for a Freight company GA working as an Office manager for a Transport company 	<ul style="list-style-type: none"> Graduate who goes on to work in a Biochemist role at a hospital Computer technology college course MA working in an Engineering role for a Food production company GA working in a Civil engineering role for a local authority 	<ul style="list-style-type: none"> Graduate who goes on to work as a Civil engineer for a Construction company Agricultural engineering/Farm machinery college course MA working in an IT operations role for a Transport company GA working in an Engineering role for a Pharmaceuticals manufacturing company

What have we learned about provision?

- 4.7 Understanding the scope, level and volume of ‘green’ provision is crucial for effective skills planning. Course data on its own does not provide a sense of the wider investment that colleges, universities and other training providers have made or are planning to make to support the transition to net zero. This will include, but not be restricted to, investment in new staff, new course developments and digital infrastructure.
- 4.8 Apprenticeships, Further Education and Higher Education already offer learning and training opportunities that are aligned to the climate emergency and CESAP sectors. The post-16 skills system has an important role in achieving the transition to net zero, by ensuring that new entrants who leave education and enter the labour market, and those within work

who need to upskill or retrain, have the skills needed. Skills alone will not realise the economic opportunities presented by the transition to net zero, but as already mentioned, they are an essential component part.

Colleges

- 4.9 Colleges in Scotland deliver a wide range of provision in subject areas that are fully or partly aligned to CESAP sectors and already contribute to the provision of the green skills required to support the transition to net zero. This section provides an overview of current provision at Scotland’s colleges that aligns to the CESAP sectors.

4. Provision of green skills

- 4.10 College enrolments provide the total number of students on a college course at a specific date. In 2020/21, 26.6% of college enrolments (32,300) were aligned to CESAP sectors.¹¹⁰
- 4.11 Across the CESAP sectors, most enrolments were aligned to the Engineering (44.7%) and Construction (36.4%) sectors, highlighting the strong contribution of colleges to these sectors overall (see Table 4.1).
- 4.12 Given the sizeable number of enrolments aligned to Engineering and Construction, of the subjects aligned to the CESAP sectors, the subject groups with the greatest number of college enrolments in 2020/21 were:
- Construction (general) (5,800 enrolments)
 - Electrical Engineering (3,500 enrolments)
 - Engineering/Technology (general) (3,400 enrolments)
 - Mechanical Engineering (2,300 enrolments)
 - Building/Construction Operations (2,000 enrolments)
- 4.13 College enrolments on CESAP related provision have fallen since 2017/18, by 5.1%, and the year-on-year change between 2019/20 and 2020/21 was a 1.9% contraction. However, as with all provision data, it is difficult to compare with certainty due to the impact of the pandemic on learner choice and institutions during that period.
- 4.14 Enrolments measure the number of learners on a course at a point in time. It is also important to consider the progression of college learners (indeed all individuals) throughout their study

Table 4.1: College enrolments at Scottish colleges aligned to CESAP sectors 2020/21

CESAP Sector	Number of enrolments aligned to CESAP sectors	% of college enrolments aligned to CESAP sectors
Engineering	14,400	44.7%
Construction	11,800	36.4%
Agriculture (including Forestry and Fishing)	2,100	6.5%
Energy and Waste Treatment	2,100	6.4%
Manufacturing	1,000	3.2%
Transport	900	2.8%
Total CESAP Sectors	32,300	100%

Source: SFC, SDS

and their destination on completion when mapping provision relevant to the transition to net zero.

- 4.15 Post-college, leavers can take many onward routes – further study and employment being two possibilities. Similarly, this continued path may remain aligned to CESAP sectors, or may not. It may also be in Scotland or may not. With enhanced data collection, greater certainty on post-study destination especially in relation to CESAP sectors, including geographical location may be possible, which would enhance the evidence. However, it is clear that colleges are contributing to growing Scotland’s talent base in skills aligned to the CESAP sectors.
- 4.16 Further information regarding the participation of Scotland’s colleges in training networks related to the transition to net zero is provided on the next page.

¹¹⁰ This figure is not based on all college enrolments, only those 160 hours plus in duration and SCQF levels 4 and above.

4. Provision of green skills

Source: Energy Skills Partnership Scotland.

	Advanced Manufacturing Training Network	Automotive Training Network	Fabrication and Welding Training Network	Hydrogen Training Network	Marine and Maritime Training Network	Wind Training Training Network	Energy Efficiency Training Network	Low Carbon Heat Training Network	Building Services Engineering Training Network	Construction Crafts Training Network	Construction Trade Training Network
Ayrshire College	✓	✓	✓			✓	✓		✓	✓	✓
Borders College	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
City of Glasgow College	✓		✓		✓		✓	✓	✓	✓	✓
Dumfries and Galloway College	✓	✓	✓			✓	✓	✓	✓	✓	✓
Dundee and Angus College	✓	✓	✓	✓		✓					
Edinburgh College	✓	✓	✓	✓			✓	✓	✓	✓	✓
Fife College	✓	✓	✓	✓		✓	✓	✓	✓	✓	✓
Forth Valley College	✓		✓	✓							
Glasgow Clyde College	✓	✓	✓				✓	✓	✓	✓	✓
Glasgow Kelvin College	✓	✓	✓				✓	✓	✓	✓	✓
NES College	✓	✓	✓	✓	✓	✓		✓			
New College Lanarkshire	✓	✓	✓				✓				
Orkney College UHI				✓	✓						
South Lanarkshire College							✓	✓	✓	✓	✓
UHI Argyle					✓	✓					
UHI Inverness	✓	✓	✓			✓	✓	✓	✓	✓	✓
UHI Moray	✓	✓	✓			✓		✓		✓	
UHI Outer Hebrides			✓	✓	✓						
UHI North Highland	✓		✓	✓		✓					
UHI Perth	✓	✓	✓				✓	✓	✓	✓	✓
UHI Shetland			✓		✓	✓	✓			✓	✓
UHI West Highland	✓				✓						
West College Scotland	✓	✓	✓				✓	✓	✓	✓	✓
West Lothian College	✓	✓	✓	✓			✓	✓	✓	✓	✓

4. Provision of green skills

Universities

- 4.17 There are three universities in the world’s top 200 and 19 autonomous higher education institutions in total in Scotland. Over 50% of Scottish 25-64-year-olds have a qualification gained through tertiary education, making Scotland one of the leading countries in Europe for higher education qualifications.¹¹¹ Like Scotland’s colleges, universities are already equipping graduates with the skills needed for green jobs and contributing to the growth of Scotland’s green talent pipeline.
- 4.18 The CESAP sectors were the employment destination of 15.8% of 2018/19 university graduates from Scottish institutions— 10.4% went into green occupations in CESAP sectors, and 5.4% went into non-green occupations in the CESAP sectors. More widely, approximately one third (33.9%) of 2018/19 university graduates went on to work in green occupations across the economy.
- 4.19 Energy and Waste Treatment and Engineering accounted for the largest proportion of 2018/19 university graduates working in CESAP sectors (see Table 4.2).
- 4.20 Graduates who entered employment in the CESAP sectors had varied subject backgrounds – reflecting the diverse roles, and green and non-green occupations within them. The most common subject backgrounds of 2018/19 graduates progressing to work in CESAP sectors were:¹¹³

Table 4.2: Estimated number of university graduates from Scottish institutions entering CESAP sectors 2018/19

CESAP Sector	Number of university graduates aligned to CESAP sectors ¹¹²	% of university graduates working in CESAP sectors
Energy and Waste Treatment	3,800	33.3%
Engineering	3,300	29.5%
Construction	2,000	17.8%
Manufacturing	1,400	12.7%
Transport	500	4.1%
Agriculture (including Forestry and Fishing)	300	2.6%
Total	11,300	100%

Source: SFC, HESA

- Engineering and Technology (2,900 graduates)
- Business and Administrative Studies (2,000 graduates)
- Social Studies (1,100 graduates)
- Architecture, Building and Planning (1,000 graduates)
- Physical Sciences (800 graduates)

¹¹¹ Scottish Government (2022). Building a New Scotland: A stronger economy with independence.

¹¹² Where numbers of graduates are referred to these have been estimated using proportions from the Graduate Outcomes survey and applying these to the total number of graduates. As this data is based on a survey, it may be subject to response bias. Numbers have been rounded to the nearest hundred, but percentages have been calculated on raw figures.

¹¹³ Please note that estimates for number of graduates by subject do not include Scottish Open University students as this could not be calculated due to the overall total and total number of graduates surveyed broken down by subject not being available for the Scottish Open university.

4. Provision of green skills

- 4.21 The top subject groups above can be split between those that had a high proportion of graduates entering CESAP industries - Engineering and Technology; Architecture, Building and Planning; and Physical Sciences¹¹⁴ - and those that don't have a particularly high proportion of graduates entering CESAP industries, but simply account for a large number of graduates - Business and Administrative Studies and Social Studies.
- 4.22 Overall, the number and proportion of graduates working in CESAP sectors and/or green occupations increased between the 2017/18 and 2018/19 cohorts. The estimated number of graduates working in CESAP sectors increased by 14.3%, whilst those working in green occupations increased by 11.9%.
- 4.23 Compared to 2017/18, there was an increase in Business and Administrative Studies graduates entering CESAP industries whilst those studying Architecture, Building and Planning graduates saw a decline in 2018/19.

What do we know about where graduates in CESAP sectors work?

- 4.24 While the progression from university to CESAP sectors is positive, a section of the talent pool is being lost, with around 40% of university graduates who are employed entering CESAP sectors beyond Scotland's boundaries. However, this is in line with all courses across Scotland and therefore not unique to CESAP sectors. It is also important to note that there will be graduates coming to work in Scotland from other countries who will enter CESAP sectors.

- 4.25 Of the graduates who were working in CESAP sectors in Scotland, nearly half (46.3%) were working in the cities of Glasgow (19.2%), Edinburgh (14.4%) or Aberdeen (12.8%).
- 4.26 Universities equip learners with higher-level qualifications and for many high-level green occupations, a degree level qualification is necessary for the role. The growth in university graduates entering employment in the CESAP sectors is positive and emphasises the potential these sectors present in creating employment opportunities.

Apprenticeships

- 4.27 Modern and graduate apprenticeships differ from other forms of provision as they place the individual in employment from day one. This means there is an immediate alignment of apprentices to CESAP sectors and green occupations from the beginning of their training. For some CESAP sectors, particularly Construction, apprenticeships are the preferred, and in some instances the only route for employers to recruit and train people to have the skills they need. As a result of this, and other factors, apprenticeships have a stronger alignment with CESAP sectors than other forms of provision.
- 4.28 More than one-quarter of MA starts in 2021/22 (29.3% or 7,400), and over one-third of GA starts in 2020 (37.6%, 440) were aligned to CESAP sectors.
- 4.29 A high proportion of MA starts (66.2%) are in the Construction sector, as are GA starts (34.6%). GAs have a considerably high proportion of starts in Engineering (28.0%) and Energy (17.8%) also (see Table 4.3).

¹¹⁴ Proportions of graduates entering CESAP industries were: Engineering and Technology (50.6%); Architecture, Building and Planning (50.4%); and Physical Sciences (27.1%), compared with 15.8% across all subjects.

4. Provision of green skills

Table 4.3 MA (2021/22) and GA (2020) starts in CESAP sectors, Scotland

CESAP Sector	Number of MA Starts (2021/22)	% of MA starts aligned to CESAP sectors	Number of GA Starts (2020)	% of GA starts aligned to CESAP sectors
Construction	4,900	66.2%	150	34.6%
Engineering	800	10.1%	120	28.0%
Manufacturing	700	9.1%	50	10.7%
Transport	500	6.9%	40	8.0%
Energy and Waste Treatment	400	5.0%	80	17.8%
Agriculture (including Forestry and Fishing)	200	2.7%	N/A	N/A
Total CESAP sectors	7,400	100%	440	100%

Source: SDS

GA data is not available for Agriculture due to disclosure reasons.

¹¹⁵ Proportions of graduates entering CESAP industries were: Engineering and Technology (50.6%); Architecture, Building and Planning (50.4%); and Physical Sciences (27.1%), compared with 15.8% across all subjects.

4.30 The frameworks with the most apprentices aligned to CESAP sectors were:

- **MA (2021/22)**
 - Construction: Building (1,200 MA starts)
 - Construction: Technical (900 MA starts)
 - Construction: Civil Engineering (800 MA starts)
 - Engineering (700 MA starts)
 - Freight Logistics (700 MA starts)
- **GA (2020)**
 - Engineering: Design and Manufacture (130 GA starts)
 - Business Management (120 GA starts)
 - Civil Engineering Level 10 (70 GA starts)
 - Construction and the Built Environment (60 GA starts)

4.31 There was a steady rise in the number of GAs aligned to CESAP sectors between 2018 and 2020 (+100, 29.1%). The number of MAs in CESAP sectors also increased significantly from 2020/21 to 2021/22 (+1,400, 22.7%) as the economy reopened following the pandemic.

4.32 There was strong retention of both MAs and GAs who trained in green occupations. Of MAs who trained in green occupations, 90% of leavers worked in the same sector as they trained in 15 months after completion.¹¹⁵ In addition, 79% of leavers also worked with the same employer that they completed their apprenticeship with. These figures show high retention of MAs working in green occupations. It is known that over 99% of MAs work in Scotland 15 months after completing their apprenticeship, suggesting these apprentices will likely all be working within Scotland and contributing to the green labour market.

4. Provision of green skills

- 4.33 Of GAs who trained in green occupations, 91% of leavers worked in the same sector as they trained in and 80% of leavers also worked with the same employer they completed their apprenticeship with 15 months later. Data shows that 100% of GAs work in Scotland 15 months after completing their apprenticeship, suggesting, that like MAs, these apprentices will all be working within Scotland and contributing to the transition to net zero.
- 4.34 As MAs and GAs place an individual in employment from day one of their training, where frameworks and pathways align to employer demand, they are a responsive form of provision. MAs are the most established form of apprenticeship, and they are essential to training the next generation of workers in skilled construction and engineering trades in particular. GAs are newer but have already established themselves as a valued form of skills provision – and both MAs and GAs are used for upskilling as well as training new recruits. A particular strength of apprenticeship provision is the high level of retention they have – meaning skills that support the transition to net zero are being retained in Scotland.

Foundation Apprenticeships (FAs)

- 4.35 FAs differ to MAs and GAs as they offer a blend of academic and work-based learning for young people in Scotland's secondary schools. They are aligned to key sectors currently facing skills shortages or where more jobs will be available in the future. FAs have been available since 2016.
- 4.36 In 2020, there were 790 FA starts in CESAP sectors. A large majority (81.3%) were aligned to the Construction sector (see Table 4.4).

Table 4.4: FA starts in CESAP sectors, 2020

CESAP Sector	Number of FAs aligned to CESAP sectors	% of FAs aligned to CESAP sectors
Construction	640	81.3%
Engineering	60	7.1%
Energy and Waste Treatment	40	5.3%
Manufacturing	20	2.9%
Transport	20	2.5%
Agriculture (including Forestry and Fishing)	10	0.9%
Total CESAP	790	100%

Source: SDS

- 4.37 FAs aligned to CESAP sectors come from a range of frameworks, reflecting that this definition is based on the industry FAs are undertaking their placement in rather than the occupation. The frameworks with the most FAs aligned to CESAP sectors in 2020 were:
- Construction Crafts (480 FA starts)
 - Civil Engineering (80 FA starts)
 - Engineering (50 FA starts)
 - Business Skills (40 FA starts)
 - Creative and Digital Media (40 FA starts)

4. Provision of green skills

4.38 Reflecting the development of the programme, the total number of FA starts increased by 175.9% over the period 2018 to 2020. The increase in starts in CESAP sectors has outstripped this, at 237.0%. In the main this has been driven by increases in the Construction sector, which has the largest number of FA starts each year and has shown a considerable (over eight-fold) increase in starts between 2018 and 2020. Two CESAP sectors – Manufacturing and Transport – have seen a decline in FA starts over the period, at 50.0% and 45.9% respectively.

4.39 FAs are helping to build the talent pipeline and knowledge base for the transition to net zero, and further learning aligned to green jobs and skills is available to young people on completion of their FA through colleges, universities and apprenticeships.

Upskilling and reskilling

4.40 Upskilling and reskilling will be a vital part of the skills response to the transition to net zero. As evidenced in the Demand section and noted previously, findings from the *Green Jobs in Scotland* report found that for every one job that is classified as New and Emerging, two jobs are in greater demand, but six jobs require Enhanced Skills. Such training can be delivered through specific initiatives, for example, the National Transition Training Fund (NTTF) and the Flexible Workforce Development Fund (FWDF), or through mainstream college, university and apprenticeship provision. Not all activity can be visible either, as employers may develop in-house training schemes of their own.

4.41 Much of the university and college data used for this analysis will include some element of upskilling and reskilling. However, extracting this from the data has proved difficult, and insights from institutions are not readily available. This study has however identified some publicly funded upskilling courses as detailed below.¹¹⁶

4.42 In 2020/21, there were:

- 350 enrolments on green skills university courses supported by the SFC Upskilling Fund, 6.0% of all enrolments supported by this fund. This includes courses such as PgDip Built Environment and Non-graduating Upskilling.
- 290 enrolments on Energy and sustainability upskilling courses, for example, 'An introduction to Climate Change and Carbon Literacy' and 'Solar Energy'.
- 560 enrolments in college upskilling courses aligned to green occupations and 550 in courses aligned to CESAP sectors. These courses are funded through the Young Person's Guarantee or the National Transition Training Fund.

4.43 Between November 2020 and August 2022, 2,020 learners took part in training related to green skills funded by the FWDF. This was approximately one-quarter (23.0%) of all learners supported by this fund.

¹¹⁶ It has not been within the scope of this study to analyse the upskilling and reskilling activity going on within industry and funded by private companies, which will be providing green skills training.

4. Provision of green skills

What has been learned about investment in green skills?

- 4.44 In addition to the provision mapping across colleges, universities and apprenticeships, the analysis sought to build up a picture of the level of additional Scottish Government investment in the skills system to support the transition to net zero. This offers another way of assessing the scale and focus of provision on green skills.
- 4.45 Whilst a range of programmes funded by the Scottish Government were identified as providing individuals with skills that will help them access and progress in jobs that will support the green economy, it was not possible to ascertain a comprehensive picture of investment. Similar to the challenges in clearly identifying reskilling and upskilling provision in universities and colleges, it was not possible to clearly identify investment made by the Scottish Government in green skills versus other skills, despite the knowledge that it is occurring.
- 4.46 It will be essential to fill this gap going forward as investment in green skills is a vital component of the overall skills effort needed to help accelerate effective progress on net zero over the next ten years.
- 4.47 This work highlighted the challenges in measuring and quantifying how much employers and the Scottish Government were investing for staff training in direct relation to green skills in Scotland. It will be important to consider how to strengthen the evidence on Scottish Government investment further as part of future research priorities.
- 4.48 Similarly, the research has highlighted the difficulty in assessing the investment from employers in green skills. This will be an important consideration in future assessments.

Summary of provision

- 4.49 Looking across the data on provision, there is evidence that existing provision is already aligned behind the needs of the transition to net zero:
- 26.6% (32,300) college enrolments are in courses that are aligned to CESAP sectors.
 - Around 15.8% of graduates from Scottish universities were working in a CESAP sector 15 months after graduation.
 - Around 29.3% (7,400) of MA starts and 37.6% (440) of GA starts were in sectors aligned to CESAP.
- 4.50 At the same time there is some evidence of leakage from this pipeline of potential skills supply:
- Data on destinations for college enrolments at the detailed sectoral level – and therefore the extent to which people are entering CESAP sectors or going on to use qualifications and skills gained in CESAP sectors – is not available. This is an important data gap which should be filled.
 - Of the university graduates going into a CESAP sector as their first destination, around 40% of these do so in a role or job that is outside of Scotland.
- 4.51 Around 90% of GAs and MAs aligned to CESAP sectors were still working in the sector 15 months after completing their qualification.
- 4.52 Evidence of discrete upskilling and reskilling activity – and specific investment in green upskilling - has largely been difficult to obtain. This is a significant gap in our knowledge, particularly given the importance of upskilling as a driver of skills demand.

5. Gap Analysis

Introduction

- 5.1 In the previous sections we set out a detailed review of the evidence on the three components required to inform effective skills planning to support the transition to net zero. In this final section of the report, we set out our assessment of:
- The strategic evidence (data) gaps identified to inform effective skills planning across the three key components of Investment, Demand and Provision
 - Where the evidence gathered points to gaps between current or future demand for skills, and provision to meet that demand.
- 5.2 This section draws on the gap analysis undertaken by Cambridge Policy Consultants, in reviewing the evidence gathered and consultation with stakeholders and industry. Nine evidence-based opportunities have been identified to respond to the transition to net zero and are detailed below.

Strategic evidence gaps

- 5.3 A key aim of the CESAP Pathfinder was to assess the strength and quality of the existing evidence base to support the transition to net zero and identify ways in which it could be strengthened. From the analysis that has been undertaken across the core components of planned investment, the demand for skills, and provision, we have been able to identify strategic evidence and underlying data gaps. We also offer a view on how these might be addressed going forward. The data gaps can be summarised as:

Investment

- 5.4 Evidence on known and certain investment is strong at the level of CESAP sectors – and allows disaggregation by region and in some cases specific economic opportunities. The level of known investment is significant – and should be of sufficient scale to signal the need to invest in anticipation of skill needs.
- 5.5 There are some significant uncertainties however about the timing and critical path to investment in some sub sectors, particularly in relation to hydrogen and Scotwind. Work is underway through the Hydrogen Programme and Scotwind Programme which should resolve some of these uncertainties going forward.
- 5.6 Going forward it will be important to keep track of the planned and certain investment across CESAP sectors – and importantly to communicate this to skills providers in a clear and accessible way that allows them to make plans to inform the shape for future provision.

1. To take advantage of upcoming economic opportunities in ScotWind, Hydrogen, CCUS and Green Freeports developing an understanding of the investment aligned to these opportunities should be an early priority. This should look to provide up to date detail on known investments within Scotland, specific locations, and the nature and timeframes for investment. This will provide a stronger basis for subsequent skills demand assessment and a strong signal of potential future skills demand to skills providers.

5. Gap Analysis

Demand

- 5.7 The evidence on the volumes of people who might be needed across some CESAP sectors is less consistent and less clear than we might have anticipated at the start of the Pathfinder. This is in part down to the uncertainties on investment timelines, but also reflects a fragmented approach to the forecasting of skills requirements. There are often competing and overlapping definitions of potential requirements from different agents in the skills system.
- 5.8 Nevertheless, a consistent message across the review of demand evidence has been the impact of replacement demand (or more pointedly expected retirements) from the workforce in many of the CESAP sectors. Allied with the persistence of skills shortages – and competition for key skillsets across sectors, suggests a strong likelihood of the people and skills availability acting as barrier to achieving Scotland’s net zero ambitions.
- 5.9 Fundamentally skills planning needs to be driven by high quality intelligence on employment demand, and this needs to be available at a detailed occupational level. The *Green Jobs in Scotland* report highlighted the use of SOC4 as a blunt measure in providing the details of the tasks, skills and knowledge of any occupation. Ideally information would be available at a more granular level (SOC5 or 6). Pilots are currently underway by the Institute of Employment Research at the University of Warwick to explore this further.
- 5.10 Finally, we have identified evidence gaps in relation to the specific skills requirements that will be associated with different elements of the transition to net zero. It will be important to address these going forward – as they can provide specific evidence on how specific qualifications need to be developed or adapted – and can inform the balance of future provision between traditional learning routes, apprenticeships and re-skilling and up-skilling. These gaps are best filled by direct engagement with employers and those undertaking work in these sectors.
- 5.11 All of this points to the need for a blended approach in identifying demand, incorporating both numerical modelling from standard data methods and the direct input from employers and industry on specific skills requirements – and challenges in sourcing these skills. It is vital that the approach also recognises the distinctive contributions that national, regional and sectoral actors can play in the demand assessment.
- 5.12 The work undertaken by Opergy in its Offshore Energy People and Skills Intelligence Report¹¹⁷ is a good example of where a blended approach to estimating demand has been taken. This approach draws on the expertise and data across the various sub sectors, economic modelling, engagement with the sector through regular surveys and consultation, known investment and policy direction to provide detailed data and insight on the combined future needs of the entire Offshore Energy sector in Scotland.
- 5.13 Within CESAP Pathfinder Work Package 2 (decarbonisation of domestic and commercial heat), there is an opportunity to explore a blended approach to identifying the detailed demand at the sub sectoral level and on a regional basis. This will draw on the numerical data and economic forecasts, but critically on the insight from industry, employers and national and regional partners to identify the detailed employment and skills requirements and provide a stronger basis on which to build a response.

¹¹⁷ Opergy (2023) Offshore Energy People and Skills Intelligence Report – Scotland

5. Gap Analysis

2. Further develop specific demand analysis across CESAP sectors, focusing on known opportunities and including direct insight from employers and industry. This analysis should also look to identify skills in demand across sectors and inform skills planning on a national and regional basis.

3. Undertake further engagement with relevant stakeholders and partners to assess and validate findings from this pathfinder work and explore ways to address data gaps collectively and strengthen the evidence base.

Provision

- 5.14 The demand evidence highlights the critical role that upskilling will play in supporting existing workers to contribute to the transition to net zero. The availability of evidence on discrete upskilling activity – and the extent to which existing provision is supporting upskilling is a key weakness – which should be addressed.
- 5.15 Currently there is no consistency in the provision measures across the three main provision types of college, universities and apprenticeships. It is not possible therefore to achieve a clear picture of the cumulative skills pipeline across post school provision in support of the transition to net zero.
- 5.16 Central to this is the lack of destination data for colleges. A critical gap is information on whether college leavers enter CESAP occupations or sectors after their course. Given the significant number of college enrolments mapped to CESAP sectors it is vital to understand the progression to the labour market by detailed sector and geographically in Scotland.

4. As a priority, establish a mechanism to better disaggregate the extent to which existing provision is supporting reskilling and upskilling to support the transition to net zero.

5. For colleges, gather data on destination following completion. This approach should be in line with the Graduate Outcomes survey measures and the Real Time Apprentice Insights (RTAI) survey. A crucial part of this would be capturing where completers are working (by sector) and whether they are within Scotland.

6. Create a consistent evidence base on provision which takes account of starts, withdrawals, completers and final outcomes on a common basis across colleges, universities and apprenticeships. Work towards implementing a robust and annualised monitoring framework to ensure post-school provision is moving in the right direction to meet net zero needs.

To support this, it may be helpful to start with a pilot of a small number of green occupations critical to net zero with a standard set of measurements across the apprenticeship family, colleges and universities. The CESAP Pathfinder Work Package 2 (decarbonisation of domestic and commercial heating) could explore how best to achieve this.

5. Gap Analysis

- 5.17 Additionally, it is important to consider what we can learn from elsewhere in terms of what good looks like in a dynamic skills response to support the transition to net zero. This would enable learning on how other countries are working towards net zero and climate resilience, with a specific focus on skills. A comparative analysis would therefore be useful for future learning. It would involve assessing how advanced countries have managed the skills supply pipeline to help them to sustain and accelerate their net zero efforts.

7. Identify any international best practice efforts to identify the evidence on investment, demand and provision of skills to support the transition to net zero, and embed any lessons in Scottish practice.

Gaps between provision and demand

- 5.18 The transition to net zero is happening now. There is labour market demand for people with the right skills, and there is evidence of some provision already being aligned to CESAP sectors and green occupations. However, it is not possible to determine the full scale of any mismatch due to the strategic evidence gaps noted above, particularly in relation to provision data.
- 5.19 Whilst a direct mapping between demand and provision has not been feasible for all CESAP sectors in detail, we have been able to identify potential gaps that present a risk to achieving Scotland's net zero ambitions.

- 5.20 Significant growth in activity around Offshore Wind is anticipated, with potentially very large demands placed on fabrication and welding. There are immediate issues around professional labour such as consenters and planners. The current and anticipated lack of these could significantly delay the implementation of major developments critical for the drive towards net zero.
- 5.21 The target to decarbonise heating in 75% of homes and buildings by 2030 has created widespread concerns given the slow start to date. There will be relatively high replacement demand for labour in key trades due to the age structure of the workforce which signals a need to look closely at current levels of people entering these occupations. Additionally, there are concerns about the supply of appropriately skilled and qualified people in key jobs at technical and professional levels, particularly for retrofit coordinators.
- 5.22 Some key occupations are the subject of significant demand increases across a number of the CESAP sectors, including electricians involved in decarbonising heat in homes and buildings, working on cabling for offshore wind, installing and maintaining charging points for ULEVs, updating the grid and upgrading electrical connections to homes and buildings. It will be important to ensure that there is a high degree of awareness of these cross-sectoral demands for the same skills when planning.

5. Gap Analysis

- 5.23 In relation to green skills needs in the CESAP sectors, the evidence points to the need for more workers in key occupations and for a substantial volume of upskilling for those already employed in these occupations. This reflects the anticipated higher levels of employment growth expected in the CESAP sectors – growth which will be essential if net zero is to be achieved.
- 5.24 Finally, the volumes of existing employees in CESAP sectors requiring upskilling is only set to accelerate as we move through the decade.

8. Following the testing and validation of the Pathfinder findings (number 3 above) with partners and stakeholders establish clear mechanisms to increase the volume of skills in those areas that have been identified as critical blocks in delivering the transition to net zero.

- 5.25 A significant amount of work has been undertaken as part of this research in what is a complex area and had not been attempted previously in a consistent way across CESAP sectors. Partnership involvement has been important throughout, and to successfully address the gaps and capitalise on the opportunities identified, collaborative working will be critical across partner agencies, with the involvement of wider stakeholders.
- 5.26 To successfully capitalise on the opportunities, a collaborative effort will be required across partner agencies with the involvement of wider stakeholders. This will enhance the lessons already learned and assist with the development of

future research and an implementation plan, including agreeing priority areas of focus to support both immediate and emerging opportunities. The CESAP update, due to be published later in 2023, presents an opportunity to agree priority action areas with partners.

9. Agree implementation priorities across 1) Keeping data on investment intentions up to date and disseminating to partners 2) Filling strategic data gaps in provision 3) establish clear mechanisms to increase the volume of skills in those areas that have been identified as potential critical blocks 4) identifying priority areas to take forward further detailed demand assessment work and co-design of skills interventions (such as the one underway in Decarbonisation of Heat in Buildings).

Lessons learned

- 5.27 The evidence gathered as part of the CESAP Pathfinder and the resultant gap analysis has provided significant learning to enhance the existing evidence base and analysis, to help make informed future decisions on skills planning.
- 5.28 Reviewing the existing evidence has identified current and prospective gaps between skills demand and supply and some priority areas of focus (now and in the future) for skills investment to support the transition to net zero in Scotland. The gaps have been identified both in specific occupations and sectors, and across sectors.
- 5.29 Importantly, there is a better understanding of the data currently available for skills planning for net zero (across demand, investment and provision) and the extent to which this data can be used (in terms of quality and quantity).

5. Gap Analysis

- 5.30 Critically, this research has highlighted what is not known – identifying the gaps in the existing data and the need for collection of new data. This is a key lesson as part of a Pathfinder as identifying what is not known in this complex area is vital to drive improvement.
- 5.31 We are very grateful to partners who contributed to this research as part of the many consultations and/or sessions where early findings were presented and discussed. We would particularly like to thank SFC colleagues for their continued involvement and particularly their expertise and input on exploring the approach to provision mapping and the resultant data to apply this. Sound partnership working will play a crucial role in filling data gaps and helping to assess and address how evidence is currently used to continuously improve the evidence base and realise the targets and ambitions of the transition to net zero.

APPENDIX 1 - List of Organisations Consulted

BEIS

BE-ST

CESAP Implementation Steering Group

CITB

Energy Skills Partnership

EU Skills

Glasgow City Region

Heat Decarbonisation Group

LANTRA

National Manufacturing Institute Scotland

Opergy

OPITO

Scottish Engineering

Scottish Funding Council

Scottish Futures Trust

Scottish Government

Scottish Renewables

Skills Development Scotland

South of Scotland Enterprise

Transport Scotland

Zero Waste Scotland