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ARE NET ZERO APPRENTICESHIPS FIT FOR PURPOSE IN WALES?

A QUALITY REVIEW WITH APPRENTICES, PROVIDERS AND INDUSTRY EXPERTS

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Abstract

This study evaluates the effectiveness of Net Zero apprenticeships in Wales in addressing the skills required to support the Welsh Government's low-carbon transition. Using a mixed-methods approach, data was collected from 82 apprentices on light or dark green programmes via questionnaires, and from 5 employers and learning providers through semi-structured interviews.

Findings show high levels of satisfaction with resources, support, and knowledge development, with most apprentices reporting an improved understanding of green skills since the programme commenced. However, results also reveal variability in employer support and limited opportunities for practical application. A small number of participants identified gaps in legislative and technical knowledge, indicating that curricula may not fully address regulatory requirements.

The study concludes that while Net Zero apprenticeships are achieving positive outcomes in awareness and knowledge-building, greater industry engagement, more workplace-based learning, and improved integration of regulatory content are needed. Recommendations focus on enhancing employer–provider collaboration, expanding practical training, improvement of funding systems and promotion of continuous skills development to meet the evolving sector's needs.

Declaration and Statements

DECLARATION

This work has not previously been accepted in substance for any degree and is not being concurrently submitted in candidature for any degree.

Signed *Charlotte Reed* (candidate)

Date .....01.09.2025.....

STATEMENT 1

This work is the result of my own investigations, except where otherwise stated.

Other sources are acknowledged by footnotes giving explicit references.

A bibliography is appended.

Signed *Charlotte Reed* (candidate)

Date .....01.09.2025.....

STATEMENT 2

I hereby give consent for my work, if accepted, to be available for photocopying and for inter-library loan, and for the title and summary to be made available to outside organisations.

Signed *Charlotte Reed* (candidate)

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Chapter 1 – Introduction

1.1 Research Aim and Objectives

This dissertation investigates the impact of Net Zero apprenticeships in Wales, drawing on feedback from apprentices, work-based learning providers and industry experts. It evaluates both positive and negative outcomes and provides recommendations to support the sector's continued contribution toward achieving Net Zero targets. To achieve this aim, the project will have the following objectives:

- Outline key literature surrounding the provision of Net Zero Apprenticeships.
- Critically analyse data from questionnaire and interview responses.
- Compose analytical interpretation and application of results to the research question.
- Conclude with recommendations to inform future research of the subject area.

1.2 Theoretical Context

In response to rising concerns about climate change, an international treaty known as 'The Paris Agreement' was created at the 2015 United Nations Climate Change Conference to limit global warming to 1.5°C (United Nations Climate Change, 2020). According to the United Nations, industrial emissions "need to be reduced by 45% by 2030" and then reach as close to zero as possible by 2050, to ensure the planet remains habitable (United Nations, 2022).

As part of the Paris Agreement, all nations involved are required to report their progress towards Net Zero in a transparent manner and at regular intervals. This progress can be monitored through capping emissions across a five-year period, also known as a 'carbon budget' [CB] (Climate Change Committee, 2020), of which the Welsh Government has

reported great success, having reduced emissions by 27.8%, exceeding the guided reduction of 23% during CB1 (Senedd Research, 2024). With a progress report due in 2027, the increased uptake of green apprenticeships becomes pivotal in enabling Wales to maintain and exceed emissions targets.

The UK Government's Net Zero Strategy (2021) stated that reducing emissions to such a degree would require a complete overhaul of every sector of the economy, including creating a skilled 'green' workforce. This would require a review of post-16 training programmes such as apprenticeships to help individuals develop the skills needed to meet the demands of this green economy. Furthermore, as this particular power is devolved to the Welsh Government, they released their own publication stating their intent to prioritise Net Zero skills within the National Occupational Standards (NOS), undertake a complete review of vocational qualifications in Wales and reform as appropriate to increase the provision of Net Zero apprenticeships, or to change existing apprenticeships to include the delivery of Net Zero skills (Welsh Government, 2022a).

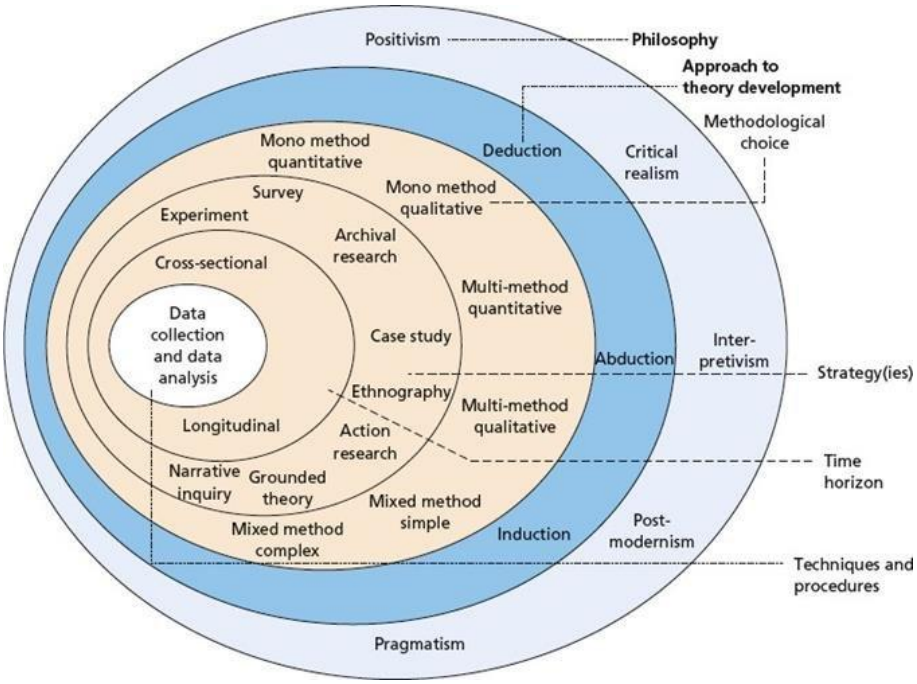
In their latest related publication, the Office for National Statistics (2021b) stated that approximately 247,400 people work in 'Low Carbon and Renewable Energy Economy' (LCREE) jobs in the UK, with the greatest turnover in the energy-efficient products, manufacturing and construction sectors. This is a 16.4% increase from the previous statistical bulletin, with a notable increase in general LCREE turnover of 30.8% (ibid). As well as reviewing current provision, Welsh Government have also partnered with several providers to develop new Environmental Management and Energy and Carbon Management apprenticeships, to enable businesses to "manage their own carbon footprints" (Welsh Government, 2023a).

Welsh Government have pledged to create at least 125,000 apprenticeship posts, including an increase in 'green' job opportunities during this tenure (Welsh Government, 2022b) . There are currently limited case studies on the actual impact of green apprenticeships, with the inception of energy management apprenticeships in Wales beginning in 2023 (Agored Cymru, 2023). The objective of this research is to investigate whether these new apprenticeships are fit for purpose and meeting the needs of employers in LCREE areas. It is essential to review this aspect to ensure that the work-based sector is effectively contributing toward the Government's Net Zero strategy and if not, how can this be improved? As these apprenticeships are relatively new, there is a limited amount of literature covering this topic, identifying a gap in this research area.

1.3 Summary of Research Methodology

According to Patil & Sinha (2016), "research is an intensive and purposeful search for knowledge and understanding of social and physical phenomena… a scientific and systematic search for valid information on a specific topic." Furthermore, research design provides us with a "framework for data collection and analysis", allowing the researcher to consider the approach they will take and where their priorities lie (Ghauri, et al., 2020). For example, the researcher would need to consider whether they will be collecting quantitative or qualitative data and if the data will be sourced from primary or secondary origins. Primary data is collected by the researcher, enabling them to directly map their findings to the specific area that is of interest of them, whereas secondary data is data that has already been collected by an external agency, such as the government (ibid).

To create a thorough research design, it is recommended that the approach is considered in parts, from the outer-most layer starting with philosophies that will be adopted in the research, through to strategies, techniques and procedures. This approach is known as the research 'onion' on account of the layers that are peeled back at each stage until you reach the centre and are ready to undertake the project, as pictured below:



Source: Saunders et al. 2023

Starting with philosophy, it could be appropriate to adopt the pragmatic approach, by "seeking knowledge through a variety of methods", as several techniques will be required to collect both quantitative and qualitative data, which will be combined to create an explanation for the phenomena (Elkjaer and Simpson, 2011, cited from Ghauri et al., 2020). As there is an identified gap in understanding for this subject, the pragmatic approach is ideal as suggested by Saunders et al. (2023), who state that a combination of methods allows for greater reliability and credibility. This is further supported by (Wasti, et al., 2022), who

suggest a mix of quantitative and qualitative techniques that includes the advantages of each methodology, thereby achieving a triangulated approach.

When considering the approach, a deductive approach starts with a theory or known premise that the research must then prove, whereas an inductive approach is where data is used to establish new knowledge, or to develop upon an existing theory (Ghauri, et al., 2020). Furthermore, abduction refers to the continuous development of a researcher's understanding as the research process unfolds, due to being presented with new data or ideas that may not have been previously considered (Van Maanen et al., 2007, cited in Ghauri et al., 2020). Whilst it is possible that new ideas may challenge the assumptions of the researcher as the research is conducted, time constraints are going to limit their ability to carry out further research if new assumptions arise and for that reason this research will be inductive, as any data collected will be used to explore the current effectiveness of Net Zero apprenticeships.

This study adopts a mixed-method approach, combining qualitative and quantitative data from employers and apprenticeship providers. The scope is intentionally limited due to time and logistical constraints, as the research is conducted by a single investigator. A more complex design could have included additional stakeholders such as apprentices, teaching staff, awarding bodies and government agencies (Schoonenboom & Johnson, 2017). Strategies will take the form of interviews with leading sector experts within South Wales and questionnaires that will contain qualitative and quantitative questions – some will be open-ended to allow for the perspectives of individuals to be taken into account, but many of the questions will be closed and will utilise a Likert scale, which allows them to be quantified (Ghauri, et al., 2020). It is also important to note that extensive research will be carried out

through a literature review, to inform inquiry, drawing upon sources such as statistical data from regulatory and governing bodies, apprenticeship providers and employers who greatly benefit from LCREE workforce investment. Furthermore, research will be cross-sectional as opposed to longitudinal, due to the aforementioned time constraints.

1.4 Summary of Sampling Framework

The research will be conducted through two parts: interviews with sector-leading experts and questionnaires that will contain qualitative and quantitative questions. The initial interviews will be used to gain perspectives on the current progress and effectiveness of the new green apprenticeships, but also as a means of gaining clarity in an area that has limited research at this time. The target response for interviewees is 5.

Questionnaires will be directed at apprentices as a means of gathering insight but will also contain open-ended questions to explore perspectives and context. The researcher will approach 10 apprenticeship providers and 10 large employers with apprentices based throughout Wales, aiming for a target response rate of 100 respondents.

The researcher will need reliable access to a smart device and internet connection, in order to carry out the interviews and questionnaires. Consent forms will be distributed to all participants, along with a debrief pack containing relevant contact details and a procedure to follow should the candidate wish to withdraw. For the purposes of background research, appropriate materials such as books, journals, reports and academic papers will also need to be accessed, although can be found using the University's Library Services.

1.5 Summary of Data Analysis Techniques

The quantitative data collected from the questionnaires will be entered into Microsoft Excel, with each row representing a respondent and each column corresponding to a variable. Likert-scale items will be numerically coded to facilitate statistical analysis. After cleaning the data by identifying and addressing missing values and inconsistencies, Excel's analysis toolkit will be used to generate descriptive statistics and images (e.g., percentages, pie charts and bar graphs) and perform inferential tests (such as the chi-square test). Visualisations may further aid interpretation across different demographics and will be presented in the findings. This will allow for a comprehensive analysis to support the research objectives effectively (Kumar, 2023).

The qualitative data from the open-ended questions of the questionnaire and the semi-structured interviews will be scrutinised through thematic analysis. This approach is a widely used method for identifying, analysing and interpreting patterns of meaning, or "themes" within qualitative data. Researchers can organise complex datasets and highlight recurring ideas or experiences relevant to the research question. Using Braun and Clarke's (2021a) updated six-phase framework, the process begins with familiarisation of the data, followed by generating initial codes, grouping codes into potential themes, reviewing and refining these themes, defining and naming them and finally producing a coherent and thorough analysis (Braun & Clarke, 2021b).

Chapter 2 – Literature Review

The pursuit of Net Zero emissions has become a global imperative, with nations worldwide committing to ambitious climate targets. Apprenticeships play a crucial role in developing a skilled workforce that can drive the transition to a sustainable and low-carbon economy. This review aims to explore the current state of Net Zero apprenticeships in Wales, examining existing research and literature that foster a workforce capable of addressing the challenges posed by climate change.

2.1 Climate Policy Landscape

Governments and organisations worldwide have recognised the importance of apprenticeships in achieving sustainability goals and reducing carbon emissions (Institute for Apprenticeships and Technical Education, 2023a). Policy frameworks and initiatives aimed at promoting apprenticeships in green industries have been implemented to incentivise employers, provide financial support for apprentices and align training programs with the needs of a low-carbon economy (Welsh Government, 2024a). As mentioned prior, in light of escalating concerns regarding climate change, the Paris Agreement was adopted at the 2015 United Nations Climate Change Conference to limit the increase in global average temperature (United Nations Framework Convention on Climate Change, 2020). As outlined by the United Nations (2022), achieving this target requires a 45% reduction in industrial greenhouse gas emissions by 2030, followed by a decline to Net Zero levels by 2050, in order to safeguard the planet's long-term habitability. In response, the UK Government proposed a systematic approach to achieving Net Zero, as such an undertaking requires "action by multiple parties across the public and private sectors, delivery at pace, and management of large uncertainties" (Department for Energy Security & Net Zero, 2022). One such approach

is the Emissions Trading Scheme, which caps the total emissions that sectors may produce over a specified period, with the cap decreasing over time. This enables organisations to plan accordingly, avoiding financial repercussions (Energy Advice Hub, 2024). As of 2023, the UK is struggling to meet its 2030 commitment. There has been success in the reduction of emissions in the electricity supply sector, however, all other sectors will need to "quadruple" their emissions reductions, with particular issues identified in agriculture and land use sectors (Climate Change Committee, 2023a). Furthermore, Delivorias (2023) states that many reductions have been due to external global factors that could not have been anticipated by Westminster, such as the conflict between Russia and Ukraine, which has led the UK to reduce its dependence on Russian fossil fuels. Another significant factor is that emissions were reduced considerably during the pandemic, where high-emitting sectors such as aviation effectively came to a standstill. For that reason, many figures are compared with pre-pandemic levels to obtain a more authentic measure. On a positive note, there is evident progress in reducing emissions today compared with pre-pandemic levels (Climate Change Committee, 2023a).

Wales was quick to act following the declaration of a climate emergency in 2019. The Welsh Government (2019) released 'Prosperity for all: a low carbon Wales'; a collection of policies that would enable them to "cut emissions… and support growth of the low carbon economy." However, it is stated that Welsh Government have varying degrees of control over policy areas affecting emissions, with some being "non-devolved and managed by UK Government." This means Wales is not in control of their own destiny regarding the decrease in emissions, which could create barriers to meeting their targets. In the report, they claim to have mitigated this by committing to placing positive pressure on Westminster, to ensure they recognise their impact on enabling Wales to achieve its targets. However, if Westminster is

not currently meeting its commitments, then positive pressure is insufficient and arguably represents a detached approach to the problem from the Welsh Government's perspective. Furthermore, the Climate Change Committee (2023) has reported that emission reduction in Wales is largely due to sectors directly controlled by the UK Government, rather than policy areas falling under the Welsh Government. The report repeatedly emphasises that Wales' current strategy is dependent mainly on reducing sectors under Westminster's jurisdiction, which is quite damning of their plans to date (Climate Change Committee, 2023b). However, it is identified that there have been some positive steps, for example, within the skills sector, such as the creation of an action plan with a focus on the increased provision of 'green' apprenticeships and job roles.

Welsh Government responded to the Committee's report, stating that they are on track to meet the statutory value of a 37% decrease by the second carbon cap at the end of 2025. Still, they also took on board many of their recommendations, centered around agriculture, land use, aviation, decarbonising homes and so on. Of the 77 points raised by the Climate Change Committee (2023), only two were rejected by the Welsh Government (2023), which reiterates that much of its ability to reduce emissions is governed by policy areas led by the UK Government. Until these are rectified at a national level, Wales is restricted in what it can deliver.

2.2 The Role of Apprenticeships in Achieving Net Zero

Apprenticeships have long been recognised as effective mechanisms for skills development and workforce training across diverse industries. By combining practical experience with theoretical knowledge, apprenticeships provide individuals with hands-on learning

opportunities that meet the demands of evolving industries (National Training Federation Wales, 2015). The management of apprenticeships is devolved to each country's government within the UK. Comparing the success of Welsh apprenticeships with England is challenging, as England reports annually on the UK Government website, while Wales reports by quarter on its site. Furthermore, it appears that the Welsh Government has not yet reported achievements for the academic year 2022/23, as no figure is present within the statistics (StatsWales, 2023). England reported 337,140 apprenticeship starts, 752,150 ongoing and 162,320 achieved in 22/23's figures (GOV.UK, 2023). Wales had 22,880 new starts in year 2022/23 (StatsWales, 2024) which may appear low, although Wales' current 3.105 million population is roughly 5.5% of England's 56.536 million (Office for National Statistics, 2021a). Comparatively, Wales' starts are approximately 6.8% of England's total starts, so there was some scope here for providers to obtain additional numbers, as according to Colegau Cymru (2023a) there has been an increase in demand for apprenticeships in Wales.

The UK Government's Net Zero Strategy (2021) acknowledged that achieving Net Zero would require a complete overhaul of every sector of the economy, including apprenticeships. This would require a review of training programmes to help individuals develop the skills needed to meet the demands of this green economy. The Welsh Government (2023a) released its publication, stating its intent to prioritise Net Zero skills within the National Occupational Standards (NOS), undertake a comprehensive review of vocational qualifications and reform them as appropriate to increase the provision of Net Zero apprenticeships or to modify existing apprenticeships to include the delivery of Net Zero skills. The Welsh Government (2022) pledged to create at least 125,000 apprenticeship posts, including an increase in 'green' job opportunities during their current term. Unfortunately, this pledge was reduced to 110,000 apprenticeship starts as of the 2024-25 draft budget (Welsh Government, 2023c),

with training providers anticipating a 24.5% cut in funding for the contract year (Colegau Cymru, 2023b). Nevertheless, the creation of green jobs or the review of existing roles to include green skills is still pivotal to their current plans.

A clear distinction must be made between roles that fully qualify as 'green' and those that simply incorporate sustainability elements. Apprenticeships are classified as light, mid, or dark green: light green roles include sustainability aspects, whereas dark green roles directly target carbon reduction (Institute for Apprenticeships and Technical Education, 2021). The Office for National Statistics (2021b) stated that approximately 247,400 people work in 'Low Carbon and Renewable Energy Economy' (LCREE) jobs in the UK, with the greatest turnover in the energy-efficient products, manufacturing and construction sectors. This represents a 16.4% increase from the previous statistical bulletin, accompanied by a notable 30.8% rise in general LCREE turnover. As well as reviewing current provision, Welsh Government have also partnered with several providers to develop new Environmental Management and Energy and Carbon Management apprenticeships, to enable businesses to "manage their own carbon footprints" (Welsh Government, 2023a). According to Chapman and Kiberd (2021), "20% of jobs in Wales have direct exposure to the shift to a green, zero-carbon economy," of which 150,000 would transition smoothly and 140,000 would need to be reskilled. They also state that the sectors most likely to be impacted would be construction, transport and manufacturing, which "account for 73% of the jobs in need of reskilling" (ibid).

There are limited case studies as to the actual impact of green apprenticeships currently, as neither England nor Wales has recorded the uptake of these qualifications. However, both have worked to create and reform roles that specifically impact the green economy. For example, over 200 apprenticeships have been reformed in England to better align with the

UK's Net Zero strategy, of which six have been recognised as significantly contributing toward carbon neutrality (Institute for Apprenticeships and Technical Education, 2023b). Similarly, in Wales, many work-based qualifications have gone through reformation, also with the inception of energy management apprenticeships in Wales happening earlier in 2023 (Agored Cymru, 2023). According to National Grid (2020), the energy sector will need to recruit 400,000 new jobs by 2050 to achieve Net Zero. This includes roles such as operation, generation, distribution and retail, as well as pivotal roles to the supply chain related to building, maintaining and upgrading of infrastructure. This is just one sector.

Despite the potential benefits, integrating apprenticeships into the Net Zero agenda presents several challenges. It is not abundantly clear what the direct contribution of apprenticeships is to achieving Net Zero, but they are pivotal in developing green skills and creating a greener workforce that will help achieve Net Zero. As of 2022, the Office for National Statistics (2024) has estimated that 48% of UK employees work in industries that account for less than 1% of total greenhouse gas emissions, compared with 14% of the UK's employees who work in high-emitting industries responsible for 62% of the country's total emissions. Therefore, priority for green reskilling should fall to these higher-emitting sectors, such as manufacturing (Wales Centre for Public Policy, 2023). For example, an increase in jobs related to battery manufacture and the installation of electric vehicle charging points will be required to support the increased use of electric vehicles (ibid). Welsh Government must also specifically define workplace requirements for low-carbon manufacture by 2024 and help these updates through policy, including the uptake or reskilling of workers within this industry (Climate Change Committee, 2023b).

Another issue that has repeatedly come to light is the financial implications of achieving Net Zero through funding apprenticeships, with the Welsh Government already rescinding its pledge to create 125,000 apprenticeships within this term (Welsh Government, 2023c). Therefore, it is possible that achieving Net Zero by 2030 will also be hindered by financial constraints. It has been suggested that larger organisations required to pay the apprenticeship levy consider funding training in small and medium enterprises [SMEs] within their supply chain to combat this shortfall (Wales Centre for Public Policy, 2023). Limited access to training opportunities, inadequate funding and mismatches between industry demands and educational opportunities can hinder the scalability and effectiveness of apprenticeship programs. The Centre for Economics and Business Research (2024) (Centre for Economics and Business Research, 2024) found that the loss of 10,000 apprenticeships in Wales amounts to a loss of approximately £84.1 million in Gross Value Added contributions in the short term and an overall loss of £406.8 million in the long term, unless intervention occurs. This is due to potential apprentices entering the workforce later or experiencing bouts of unemployment in the absence of funding; however, it is estimated that this long-term shortfall could be reduced to £296.5 million with targeted skills development for those affected by this delay, thereby still reaching their productivity capabilities (ibid).

While most research has focused on the UK, international models provide a helpful comparison. For example, Germany's dual vocational training system has been progressively adapted to include sustainability modules, ensuring that environmental competencies are integrated across multiple sectors (European Commission, 2024). Similarly, in Denmark, green skills have been embedded into national apprenticeship frameworks through partnerships with renewable energy companies, highlighting the value of strong employer–provider collaboration (OECD/Cedefop, 2024). Compared to these examples, Wales' progress appears

more tentative. While the Welsh Government has pledged to reform qualifications and expand provision, challenges persist around funding and industry engagement. This contrast suggests that Wales could benefit from adopting international best practice, particularly in embedding sustainability across all vocational pathways rather than creating isolated 'green' apprenticeships.

2.3 Industry Engagement, Collaboration, Initiatives and Funding

The transition to a Net Zero economy necessitates a paradigm shift across sectors, requiring innovative solutions and a highly skilled workforce. Apprenticeships play a crucial role in this transition by equipping individuals with the skills and knowledge needed to support renewable energy projects, develop sustainable infrastructure and implement eco-friendly practices across industries. According to Christenson (2024), the UK as a whole has identified the significant contribution of industry toward carbon neutrality, with total emissions in the UK measured at "487 million tonnes of carbon dioxide equivalent [MtCOe] in 2023", the largest increase being in the transport industry, also being one of the higher contributing sectors aside from consumer expenditure. In Wales, there was a projected 15 MtCOe in 2023, with the highest contributing industries being iron and steel at 38% and petroleum refining at 17% (Welsh Government, 2019).

Due to the sheer size, scope and range of industries that will need to adapt to meet industry targets, collaboration is necessary across Wales. The Swansea Bay City Deal [SBCD] is one such partnership, involving Carmarthenshire, Neath Port Talbot, Pembrokeshire and Swansea local authorities, who have invested £1.3bn in funding to projects across these areas, including the development of a greener economy (Swansea Bay City Region Deal, 2023). Another example,

Zero Carbon Hwb, is a collaboration between various organisations that advises best practice for social housing retrofit and new builds (Zero Carbon Hwb, 2024). This takes the form of 'Industry Action Advisory Groups' [IAGs] to discuss supply chain issues, technology and financial innovation and offer training. In addition, the Hwb will offer e-learning courses, skills and gap analysis for organisations, networking events, expert forums and an annual conference to related organisations (Hatton, 2024).

A lot of challenges face the construction sector, with 34% of the UK's annual carbon emissions coming from existing buildings (Bennett & Leiper, 2024); the question is whether it is more eco-friendly to build new or to 'retrofit' – "any improvement work on an existing building to improve its energy efficiency" (Centre for Sustainable Energy, 2024). It is estimated that 80% of buildings in the UK today will still be in use by 2050 and retrofitting is considered the ideal approach, as related carbon emissions are approximately halved in a 'deep retrofitted' building, as opposed to a new build (Bennett & Leiper, 2024). However, the average cost of retrofitting a home is £69,000, more than double the UK Government's estimate of £30,000 per home (Webb, 2023). In Wales, 10% of carbon emissions come from people's homes, with the added challenges of widespread fuel poverty and some of Europe's least energy-efficient housing to contend with and an estimated £14.75bn investment needed to fund retrofit up to 2030 (Future Generations Commissioner for Wales, 2021). One project supported by SBCD is Homes as Power Stations [HAPS], which serves to increase the uptake of greener technologies within homes and attempt to tackle fuel poverty. Working alongside the Welsh Government's Optimised Retrofit Programme, this could demonstrate advancement in the sector, although arguably providing funding for the adaptation of only 10,300 properties could be seen as more tentative steps than real action (Swansea Bay City Region Deal, 2024). In order to meet the scale of change required, Welsh Government will need to find a way to

plug funding gaps for renovation whilst converging this with “policy on skills and training as well as regulation, standards and supply chain” (Future Generations Commissioner for Wales, 2021). This is supported by the Centre for Economics and Business Research (2024), which found that funding shortfalls in apprenticeships could be mitigated through a convergence of innovative training opportunities that make up for a decrease in worker productivity due to missed opportunities from a lack of funding.

As stated, another major emitter of greenhouse gases within the UK, namely, Wales, is the iron and steel industry. Tata Steel UK [TSUK] recently made waves when they announced the closure of their blast furnaces in Port Talbot, “putting 3,000 jobs at risk” and casting major doubt amongst apprentices, local communities and work-based providers (Davies, 2024). This may seem a huge blow to the industry; however, the recent announcement of the development of two freeports in Wales, including in Port Talbot, may offer some relief. Focusing on low-carbon technology, wind power, hydrogen and marine technology, they aim to provide mass green energy alternatives and create approximately 29,000 jobs (Welsh Government, 2023b). At this time, local authorities are already looking to retrain those affected by TSUK’s closures (Price, 2024) and there are multiple routes to go about this. For example, the Shared Prosperity Fund [SPF] is a nationwide funding stream that allows local authorities to target funding to benefit communities. One such area is work-based training for companies and Colleges, enabling the reskilling of workers where needed (Department for Levelling Up, Housing & Communities, 2022). Some organisations such as NPTC Group of Colleges have created institutions specifically to provide Net Zero opportunities, such as their Net Zero academy. However, this is still in its early stages and is not yet delivery any ‘dark green’ apprenticeships as yet, with its website still in the beta stage of development (NPTC Group of Colleges, 2024).

To promote collaboration nationwide, the Institute for Apprenticeships and Technical Education (2022) is forming working groups, known as 'trailblazers', that have a say in the development of occupational standards and can be approached by organisations for advice and guidance on what is considered best practice within their sector. Currently, working groups exist across 11 routes, including some of the higher carbon-emitting sectors, although numbers for sales and procurement, transport and logistics and education seem low, implying their reach is limited within these areas currently. In Wales, a 'Net Zero 2035 Challenge Group' has been created to challenge the government "to go further and faster" and to find best practice from around the world that could be implemented within Wales. This seems to be a relatively new development, with their newsletter starting in October 2023 (Wales Net Zero 2035 Challenge Group, 2023). There seems to be a shift in pace, with more local authorities and organisations now engaging in efforts to upskills and build a green workforce.

With an emissions progress report due in 2027, the increased uptake of green apprenticeships becomes pivotal in enabling Wales to maintain and exceed emissions targets (Climate Change Committee, 2023b) (The Open University, 2024). Future research should focus on evaluating the impact of apprenticeship programs on sustainable development outcomes, identifying best practices for integrating apprenticeships into green industries and assessing the long-term sustainability of apprenticeship models in the context of evolving environmental priorities today. Notably, few studies capture apprentices' own experiences or examine how programmes align with workplace practice. These gaps justify the mixed-methods approach adopted in this dissertation, which is outlined in the following chapter.

Chapter 3 – Methodology

3.1 Aims and Objectives

This dissertation aims to investigate the current impact of Net Zero apprenticeships in Wales, according to feedback from apprentices, work-based learning providers and experts in the industry, by achieving the following objectives:

- Outline key literature surrounding the provision of Net Zero Apprenticeships.
- Critically analyse data from questionnaire and interview responses.
- Compose analytical interpretation and application of results to the research question.
- Conclude with recommendations to inform future research of the subject area.

3.2 Research Rationale

The rationale for this study is founded on existing literature that emphasises the role of apprenticeships in addressing Wales's Net Zero ambitions (Institute for Apprenticeships and Technical Education, 2023a; Welsh Government, 2023a). Evidence suggests that apprenticeships play a crucial role in addressing the skills gap in high-emitting sectors, including construction, transport and manufacturing (Chapman & Kiberd, 2021). However, the current provision is constrained by funding cuts (Colegau Cymru, 2023b) and limited tracking of Net Zero-specific outcomes.

The Welsh Government's policies, such as embedding Net Zero skills in National Occupational Standards and creating new environmental management pathways, reflect a commitment to developing a greener workforce (Welsh Government, 2023a). However, literature notes that these ambitions are challenged by devolved policy limitations (Climate Change Committee, 2023b) and a lack of clear evidence on their effectiveness. This study builds on these findings

by examining whether current Net Zero apprenticeships are delivering the skills and workforce capacity needed to meet Wales's climate targets, through feedback gained from apprentices, their employers and learning providers.

Conducting research enables the development of knowledge in a specific field or addresses a gap in the literature (Adu & Miles, 2024). This research examines the effectiveness of Net Zero apprenticeships in Wales, an area of growing importance given national and global sustainability targets, through a mixed-methods approach. Questionnaires with apprentices will gather insights into their experiences and opinions, while semi-structured interviews with employers and learning providers will explore the link between training, industry and policy needs. Combining these perspectives with existing statistical data will help to identify whether skills outcomes are a direct result of apprenticeship provision or shaped by wider factors such as funding or other sector challenges. According to the Learning and Work Institute (2024), research into apprenticeships is essential in ensuring high-quality standards and accessibility for all. This involves benchmarking against best practice (ibid) and this dissertation seeks to evaluate the current effectiveness of these apprenticeships.

3.3 Research Design

Research design serves as a structure that guides the researcher through the investigative process, enabling a feasible path from research questions to evidence and analysis (Saunders et al., 2023). It involves establishing suitable procedures to ensure the collection of relevant data and materials necessary to address the research question (Panke, 2018).

This research seeks to develop an understanding of the current effectiveness of Net Zero apprenticeships on the sector's ability to meet its carbon-neutral goals, drawing upon both

apprentice and employer perspectives. In choosing a suitable methodology, careful consideration is given to practical constraints, including time, data accessibility and the project's word count limitations (Kumar, 2019). Saunders, et al., (2023) considers the stages of research as "formulating and clarifying a topic, reviewing the literature, designing the research, collecting data, analysing data and writing up", however, the process is not necessarily linear and they also consider that research often results in re-visiting and refining past ideas as our knowledge and findings accumulate. Nevertheless, this dissertation will follow this structure and any refinements will be considered in the findings.

Action research is a practitioner-led approach that integrates problem-solving with systematic inquiry, utilising repeated cycles of planning, action, observation and reflection to enhance practice and generate new insights for development (Mertler, 2021). It enables researchers to identify challenges, implement interventions, evaluate the outcomes and then refine their practice in a professional context (ibid). In this research, the initial phase involves identifying skills gaps and delivery challenges within existing Net Zero apprenticeship provision, as indicated by the existing literature (Chapman & Kiberd, 2021) (Colegau Cymru, 2023b). Targeted interventions such as adapting training content or enhancing collaboration between employers and providers will be explored through a mixed-methods design. Questionnaires with apprentices will capture the learners' perspectives, while semi-structured interviews with employers and learning providers will provide insight into programme design, alignment with the needs of their industry and the effectiveness of delivery. The findings will inform reflection and potential refinements of practice, ensuring that the research not only evaluates current provision but also contributes to the ongoing development of apprenticeship models that support Wales's Net Zero and skills policy

objectives and also directly benefits those within the sector (Wood, et al., 2018).

3.4 Research Philosophy

Using the research onion model, this project applies a mixed-methods approach combining qualitative and quantitative data through questionnaires and interviews, supporting triangulation (Saunders, et al., 2023). This ensures robust interpretation and helps offset limitations of individual methods (ibid). The structured design allows for replication and generalisability (Biggam, 2021). Furthermore, Biggam (2021) considers that successful design considers both the 'what' and the 'why' questions, combined with thorough instructions that would allow other researchers to replicate the method if they wished to do so. In support of this, Tsui (2021) stated that applying the seven principles of responsible research design would lead to greater credibility and relevance. This includes a research topic's potential service to society, contributions of primary and secondary research, collaboration with experts, appropriate methodology, involvement of stakeholders, the impact on stakeholders and the dissemination of results to relevant parties (ibid).

Starting with the outermost 'layer', general ideologies consider the "beliefs and assumptions" about how this knowledge will be developed (Saunders, et al., 2023), as consciously or not researchers will make assumptions about the data they gather depending upon the view in which the research was taken, thereby influencing how this data is analysed (Burrell & Morgan, 2019). Before considering a philosophy, different theoretical assumptions should be explored considering the nature of the reality in which the research is undertaken (ontology), the assumptions about the knowledge to be gathered within the chosen field (epistemology) and also the impact of the values and ethics of the research (axiology), whether that be from

the researcher or the subjects (Saunders, et al., 2023). Combining these assumptions with various philosophical approaches, Clark (2021) outlined them as such:

	Positivism	Pragmatism	Interpretivism	Critical Theory	Deconstructivism
Ontology	Reality is objective and 'found'	Reality is layered and 'experiential'	Reality is subjective and constructed	Reality is subjective and constructed on the basis of issues and power	Reality is ultimately unknowable; attempts to understand subvert themselves
Epistemology	Truth is one	Truth is relative	Truth is many	Truth is many and constitutes a system of socio-political power	"Truths" are socially constructed systems of signs which contain the seeds of their own contradictions
Questions	What is true? What can we know?	What is useful? What is the best fit?	What is heuristic? What can we understand?	What is just? What can we do?	Is there a truth? What constitutes truth?
Methods	Quantitative	Mixed	Qualitative	Usually qualitative, but may include quantitative and mixed methods	Qualitative
Purpose	Knowing the world	Informing the world	Understanding the world	Changing the world	Critiquing the world

Source: (Clark, 2021)

When selecting an applicable philosophy, the researcher must consider the main objectives of research and which approach best meets their needs (Biggam, 2021). The Positivism philosophy considers the researcher to be external to the research being gathered, meaning results are objective and independent of the researcher's observations (ibid). Analysis of data would be quantitative and focuses on causality, so results can be measured or predicted (Rugg & Petre, 2007).

In contrast, interpretivist philosophy considers that reality can be time and context-dependent and research is gathered through qualitative means, such as surveying or interviewing subjects for their opinions (O'Donoghue, 2018). Although positivism emphasises objectivity, quantitative data still requires interpretation and is therefore not free from human influence (Biggam, 2021). Used in isolation, quantitative methods may also overlook contextual nuance, such as individual experiences, which qualitative approaches can capture

(Cant & Dvorak, 2023). However, interpretivist philosophy and qualitative methods also need to be treated with caution, as any approach is subject to human fallibility (Elliott & Resnik, 2014).

Therefore, the Pragmatic philosophy may be best utilised in this research. From this perspective, the researcher is still external to the study and so does not directly influence the data gathered, however, qualitative and quantitative data is converged and the researcher can take a view that best answers the research question (Ramanadhan, et al., 2021). In this instance, there is currently limited statistical data as to the quantitative impact of green apprenticeships on a business' ability to achieve Net Zero (Reay, 2023). Research will require the input of individuals with lived experience, including apprentices in the sector and experts of industry to provide a greater insight. Under the pragmatist philosophy, gathering both quantitative and qualitative data can inform future practice by investigating the connections between statistics, opinions and work experience (Simpson, 2018; Ramanadhan et al., 2021). Therefore, under the pragmatist philosophy, this research will collect data from subjects within the Net Zero sector using questionnaires and semi-structured interviews to evaluate the current effectiveness of green apprenticeships.

The next layer of the research onion considers whether the research project is designed to build or test existing theory, thereby how the results are interpreted. Saunders et al. (2023) identifies three types of reasoning: deductive, inductive and abductive. The main difference between the three being that inductive reasoning focuses on the development of understanding, deductive looks to test existing theory and abductive is forming a conclusion from information that is already known (Yin, 2018).

Research in Net Zero apprenticeships is new and according to Copi et al. (2019), inductive reasoning involves researching individual phenomena to inform generalised conclusions, in this instance, investigating the personal experiences of apprentices and experts in the field to analyse the impact of Net Zero apprenticeships critically. However, inductive reasoning is largely objective (ibid) and so Saunders et al. (2023) suggests that combining this with other methods, such as deductive, can improve the validity of research.

Using deductive reasoning, broad statements can be narrowed down to specific cases, however, this is dependent on the truth of the initial premises (Johnson-Laird, 2009). For example, apprenticeships go through rigorous quality checks to ensure they are fit for purpose; the same would hold true of Net Zero apprenticeships (Estyn, 2024) (Welsh Government, 2024a). To strengthen the validity of this research, inductive reasoning applied to primary research will be considered alongside deductive reasoning gained through thorough research into the Net Zero apprenticeship sector, an approach endorsed by Proudfoot (2022). Neither approach is effective alone, but together provide a greater context to the issue, “mutually enhancing one another” (ibid).

3.5 Data Collection

Primary data will be collected through anonymous online questionnaires and semi-structured interviews, applying the mixed-methods approach, which involves the implementation of two or more research strategies to enhance the reliability of qualitative research (Tashakkori & Teddlie, 2003). According to Hitchcock and Onwuegbuzie (cited from Proudfoot, 2022), “mixed analyses necessitate the mixing or combining of paradigmatic assumptions and stances”, which is demonstrated in the adoption of pragmatic philosophy and combined with

both inductive and deductive reasoning, to strengthen the results. According to Bartram (2019), questionnaires are effective tools for data collection, being cost-effective, time-efficient and standardised, which facilitates easier comparison and analysis of the data. Furthermore, when utilised online, they can offer a wider reach to a global audience, which can provide diverse data and reduce bias, as the researcher will have no direct influence on the participants (Willis, 2020). The purpose of this research is to provide a detailed and nuanced interpretation of the data gathered through the questionnaires and followed up in the interviews, thereby increasing validity and reliability (Finlay, 2021). According to Bartram (2019), researchers must also consider that questionnaires may not allow for in-depth exploration of complex issues, as they often rely on closed-ended or dichotomous questions. This is supported by Creswell and Creswell (2018), who state that participants are often restricted to predefined questions or may provide brief answers, limiting the richness of the data. Additionally, self-reported information can be influenced by social desirability bias or misunderstanding of questions, which may affect the accuracy and validity of the findings (Clark, et al., 2021). To overcome this, questionnaires can be used as a basis for further research and explored in more depth (ibid), in this instance, through further structured interviews.

Dunwoodie et al. (2022) consider that interviews are typically under-utilised within social research, ironically when this method can offer subjective interpretations of quantitative data, thereby increasing its reliability or offering scope for further research. In this instance, interviews will be utilised to further explore the data gathered in the online questionnaires. On that note, interviewers also have the advantage of flexibility, to adapt questions based on responses or to align with previously gathered data, to enable further exploration of a subject (Adu & Miles, 2024). They may also clarify questions on the spot, reducing the likelihood of

misunderstandings, increasing the relevance and accuracy of information (ibid). However, a disadvantage of semi-structured interviews is that the quality and depth of data can depend heavily on the interviewer's skill in effectively following up on responses, which may introduce interviewer bias (Gill, et al., 2008). They can also be time-consuming to conduct and analyse, which may limit the number of participants and affect the breadth of perspectives captured (Cohen, et al., 2018).

The timeframe used to collect data for this study will be cross-sectional, meaning data will be collected at a single point in time or over a short period (Ghauri, et al., 2020). Cross-sectional designs are commonly used in fields where researchers are interested in understanding the current state of a population or phenomenon (ibid). Through an online questionnaire and several structured interviews, this approach will allow the researcher to examine and analyse the impact of Net Zero apprenticeships on apprentices and employers, providing a snapshot of the situation at that moment (Saunders, et al., 2023).

According to Wang & Cheng (2020), as data collection occurs at one point in time, cross-sectional studies are generally more efficient compared to longitudinal studies, which require repeated observations and over a longer period. Furthermore, this approach enables descriptive research, identifying trends, prevalence, or associations within the data (ibid). However, it does not establish cause-and-effect relationships and it is difficult to measure the influence of variables, since data is collected concurrently (Institute for Work & Health, 2015). Nonetheless, to form a basis for future research, cross-sectional provides a good opportunity, enabling quick data collection that is cost effective and easier to interpret, to establish whether further research is necessary, perhaps to delve deeper into causality if research data

appears fruitful (Wang & Cheng, 2020).

3.6 Population and Sample

Selecting a suitable population sample is a crucial step in developing a methodology, as well-chosen samples typically yield more reliable results (Ahmed, 2024). Researchers must determine whether to survey the entire population or a representative sample (Kumar, 2019). This study focuses on apprentices enrolled in light or dark green apprenticeship programmes in Wales, along with employers and learning providers engaged in delivering or supporting these programmes. Apprenticeships outside these categories, or based outside Wales, were excluded to maintain alignment with the Welsh Government's green skills objectives.

A total of 100 apprentices were invited to complete a questionnaire on Microsoft Forms, with the link being distributed via employer and training providers' email systems. The sample was selected on a completely random and anonymous basis, where no demographic information was available to the researcher. The only inclusion criteria were learners' participation in a light or dark green apprenticeship. This approach ensured impartiality in selection and reduced potential sampling bias (Golzar, et al., 2022). The questionnaire combined closed and open-ended questions to capture apprentices' views on the relevance, quality and impact of their training, although no questions were marked as 'mandatory' aside from the declaration that learners were happy to take part. This approach was utilised to decrease respondent fatigue in participants, which may cause the quality of the data to decrease over time (Lavrakas, 2008).

To complement this, 5 employers and learning providers were purposively selected for semi-structured interviews. This number was chosen to secure a diversity of organisational

perspectives while allowing for in-depth discussion. Interviews explored the alignment of apprenticeship content with industry needs, challenges in delivering Net Zero skills and strategies to improve provision. Several questions were adapted from prior research undertaken during the literature review on green skills and apprenticeships to maintain comparability while being tailored to the Welsh policy context. Combining the anonymous apprentice questionnaires with targeted employer and provider interviews facilitated triangulation, offering a robust understanding of both the effectiveness and perceived value of Net Zero apprenticeship provision in Wales (Ahmed, 2024).

3.7 Data and Analysis

Quantitative data will be analysed using Excel, to help the researcher to identify, summarise and interpret statistical patterns (Cant & Dvorak, 2023). Qualitative interview data will undergo thematic analysis to identify meaningful patterns related to the impact of Net Zero apprenticeships. Themes are the descriptions of beliefs and practices that emerge from the data and relate directly to the research question (ibid) and will reflect experiences, perceptions and potential improvements (Braun & Clarke, 2021b). Furthermore, thematic analysis is valued for its accessibility and adaptability across research disciplines, allowing both inductive (data-driven) and deductive (theory-driven) analyses while ensuring transparency and rigour in interpreting qualitative findings (ibid). Triangulation of these methods will enhance reliability and contextual understanding, offering further insight into the topic (Saunders, et al., 2023).

3.8 Reliability and Viability

Valid research is research that is recognised as credible by the academic community through the application of robust, transparent and established research methods (Biggam, 2021). While all data collection and analysis methods have inherent strengths and limitations, researchers must carefully select and apply approaches that minimise bias and maximise the accuracy of findings (Cohen, et al., 2018). Ensuring that the chosen methodology is well aligned to the research topic and objectives is essential for producing results that are both reliable and valid (Gray, 2018). The questionnaire has been designed with clear, unambiguous wording and will be piloted informally before being released to participants, to minimise misinterpretation. Furthermore, quantitative findings will be cross-checked for consistency, while qualitative themes will be derived through a transparent coding process and supported by direct quotations. Triangulation across apprentices, employers and providers will strengthen credibility, ensuring that the results reflect multiple perspectives rather than a single source (Carter, et al., 2014).

Reliability is also addressed through replicable methodology and clear processes for data collection and analysis (Elliott & Resnik, 2014). The external validity and reliability of the research can be influenced by its generalisability, for example, it can be replicated again (Elliott & Resnik, 2014) (Gray, 2018). For this reason, the researcher is seeking a minimum of 100 responses to the digital questionnaire but acknowledges that further research of greater depth and scale will be of benefit. Net Zero is currently a significant topic across all sectors, so there is scope for research across different age ranges [population generalisability], different work-based sectors and countries in the UK [environmental generalisability] and across time as Net Zero approaches continue to develop [temporal generalisability] (Bermignham, 2020). Furthermore, the use of mixed methods enhances validity by supporting

cross-verification. Triangulation and transparency mitigate risks of researcher bias (Cant & Dvorak, 2023).

3.8.1 Limitations of the Research

There are a few limitations to consider when analysing the results. The research design adopts a mixed-methods approach, which is potentially time consuming and expensive (Biggam, 2021). To overcome the expense issue, subjects will be the sourced from the researcher's own network of contacts. Furthermore, triangulation ensures findings from one method can be validated or enriched by the results from another. This can enhance the reliability and validity of the research outcomes (Gill & Johnson, 2010). However, integrating and interpreting qualitative and quantitative data can be challenging, requiring researchers to find effective ways to synthesise their findings, which can be time-consuming (Biggam, 2021).

Questionnaires also present certain limitations, particularly when using closed, multiple-choice questions. Whilst they are easier for participants to complete, the inherent ambiguity of such questions often results in limited statistical insights (Dalati & Gómez, 2018). Furthermore, low response rates in questionnaires are a common challenge, often leading to biased results and reduced confidence in the findings, which restricts the ability to generalise the findings to a broader population (Roszkowski & Bean, 1990). To address this issue, questionnaires will not contain more than twenty questions, to reduce respondent fatigue (Ghauri, et al., 2020).

Regarding the interviews, despite their greater depth, they are also time-consuming; from scheduling, to conducting the interview, to transcription and analysis and are more costly due to travel and time spent (NCVO, 2023). Winwood (2019) also considers that the presence of

the interviewer can influence responses, introducing bias that may affect the integrity of the data, so they must be aware of their own biases, their body language and facial expressions when conducting the interview. With the above in mind, a structured approach will be utilised to improve consistency, objectivity, time-efficiency and to minimise bias from the interviewer (Rashidi, et al., 2014). Furthermore, the analysis of qualitative data is time-consuming and requires specific methodologies, such as thematic analysis, which is used to identify patterns from a transcript and determine their significance (Braun & Clarke, 2021a).

Another limitation is the absence of employer demographic breakdown, such as distinguishing between SMEs and large organisations. Smaller employers often face different funding and training challenges compared with larger firms, so this lack of differentiation may obscure important variations in the data (European Research Council, 2024). Due to the time and logistical constraints of the researcher, this may not be rectified this time around, but could be overcome through similar, replicable studies and will be considered in the recommendations for future research.

Response bias could have an impact, particularly as carbon neutrality is a culturally sensitive topic at this time, or if individuals are concerned about discussing trade secrets (Kalton & Schuman, 1982). To this end, the questionnaires will be anonymous and will not seek to identify any unique characteristics of participants, to encourage honest answers (Ong & Weiss, 2006). Researcher bias may also provide a challenge during analysis if these multiple methods are not managed carefully (Adu & Miles, 2024). According to Cant & Dvorak (2023), researchers need to be aware of their own biases and ensure that both data sets are analysed rigorously to avoid such bias.

3.9 Research Ethics

When undertaking research, the researcher must consider and address all pertinent ethical and credibility issues (Iltis & Mackay, 2024). A key ethical consideration is whether the research should proceed at all, even if it poses no harm to its subjects, as Shreffler & Huecker (2023) state you should consider what the area of research brings to the subject area and shouldn't be undertaken just because the researcher finds it interesting.

In interviews and questionnaires, privacy and informed consent are crucial ethical considerations (Adu & Miles, 2024). Informed consent means participants understand the purpose, scope and potential risks of participation, and agree to participate voluntarily (Rukwaru, 2015). Therefore, they must be clearly informed about the study, provide informed consent and are able to withdraw at any stage if they wish (ibid). Similarly, semi-structured interviews require researchers to maintain confidentiality and appropriately manage the interpersonal relationship between the interviewer and the interviewee, ensuring that participants are treated fairly and with dignity (British Educational Research Association, 2024). Participants must be fully informed about the research purpose and procedures and researchers must follow relevant data protection guidelines and protect the identity of the participant (ibid). Furthermore, all responses were anonymised and stored securely in password-protected files on the University's secure cloud server, to ensure confidentiality and to prevent accidental loss of data.

Chapter 4 – Data Analysis

4.1 Questionnaires

The purpose of the questionnaires was to gather apprentices' views on training quality, support and skill development, to assess the effectiveness of Net Zero apprenticeship provision. Results have been analysed and linked to the themes identified in the literature review and both quantitative (Likert-scale) and qualitative (open-text) data are analysed to gain further insight into apprentice perspectives. A total of 82 apprentices responded to the questionnaire, providing a strong dataset despite falling slightly short of the initially targeted 100.

4.1.1 Analysis of Full Data Set

Initially, apprentices were asked to identify the type of apprenticeship that they belonged to (Figure 1). Dark-green apprenticeships are solely about developing Net Zero skills and light-green contain some elements or concepts. Only two respondents were unable to identify what programme they belonged to and so the participation response was a 1:4 dark to light green ratio.

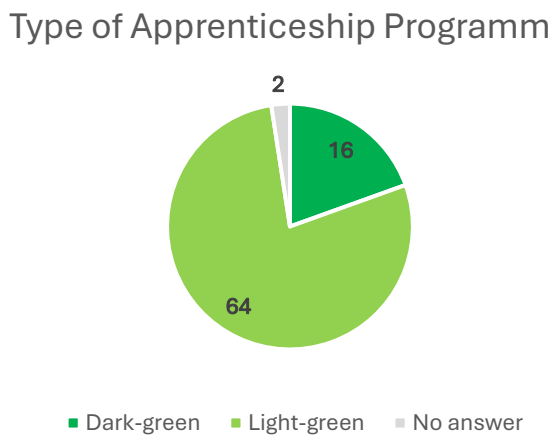


Figure 1

Regarding green skills, the participants were then asked if they: understood their role within the workplace (figure 2); receive appropriate support (figure 3); are provided with quality learning materials (figure 4); have access to resources and equipment (figure 5); are supported by their employer (figure 6) and are receiving practical experience (figure 7).

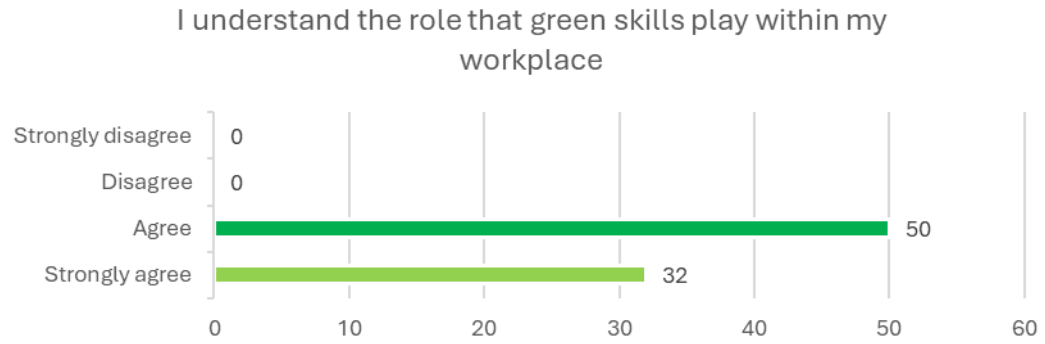


Figure 2

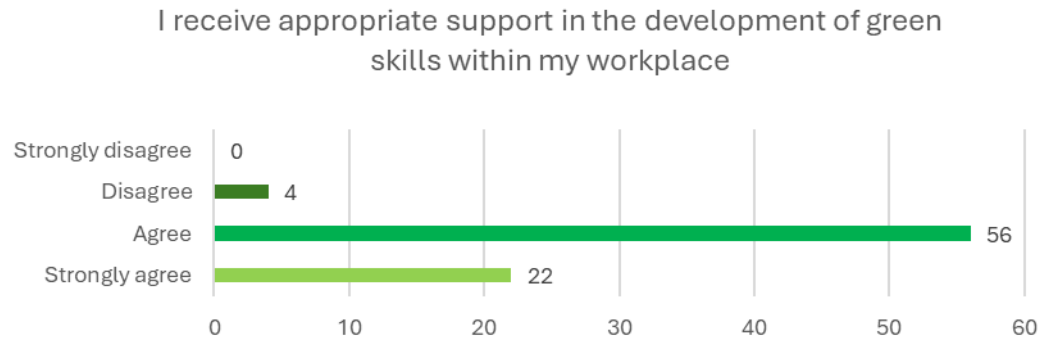


Figure 3

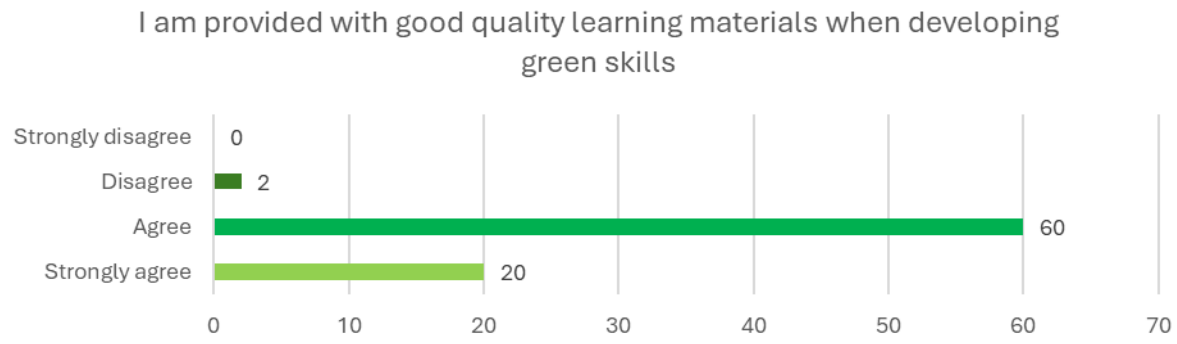


Figure 4

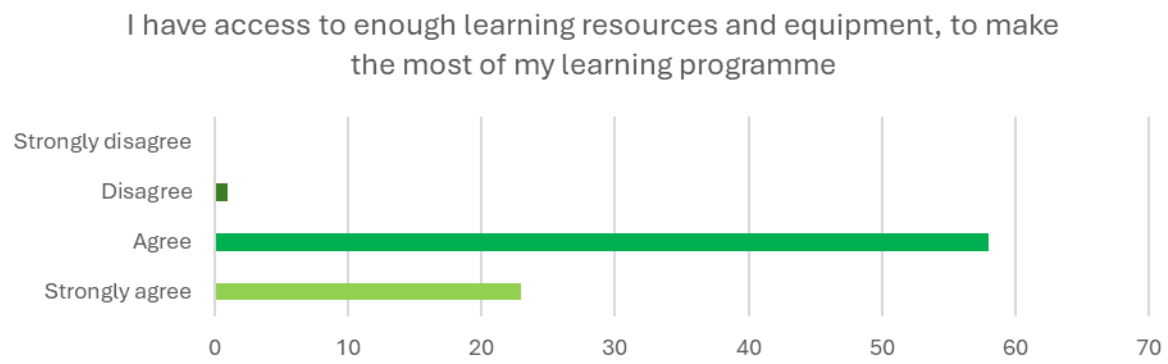


Figure 5

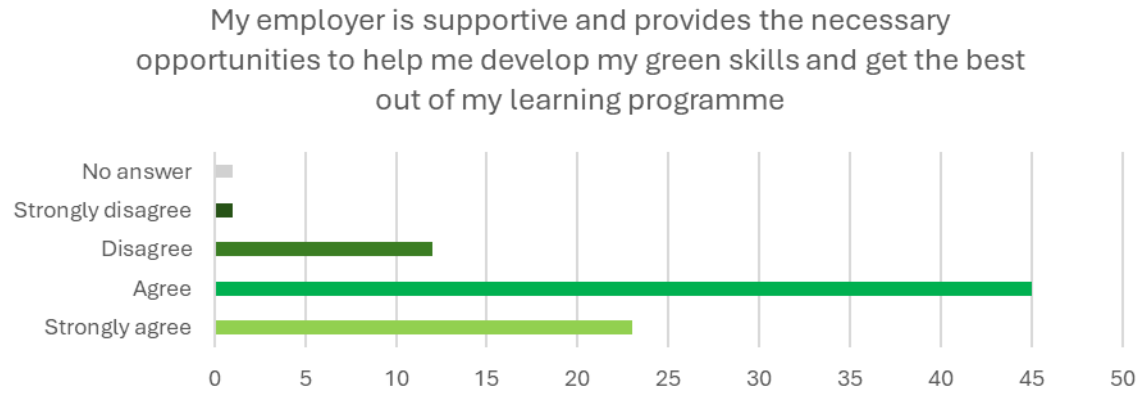


Figure 6

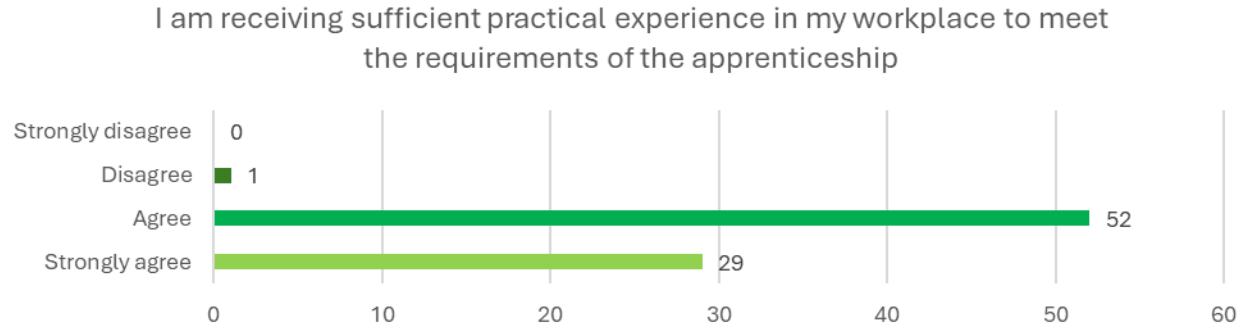


Figure 7

Quantitative data shows a strong awareness amongst apprentices, with 100% agreeing or strongly agreeing that they understand the role green skills play in their workplace. This aligns with Welsh Government objectives to embed Net Zero skills into vocational training (Welsh Government, 2023a) and confirms literature findings that apprenticeships can effectively raise sustainability awareness (Institute for Apprenticeships and Technical Education, 2023a).

Most respondents expressed satisfaction with resource provision, with 97.6% agreeing or strongly agreeing that they had access to good-quality learning materials and 98.7% reporting sufficient equipment. These results support Welsh Government claims of progress in providing resources for green skills training. However, employer support was less consistent: 84% of apprentices agreed or strongly agreed that their employer was supportive, while 16% expressed some level of disagreement. These findings align with the literature, which notes variability in industry engagement (Climate Change Committee, 2023b).

Following these questions, respondents were invited to offer further clarification of their answers, had they 'disagreed' or 'strongly disagreed' with any of the statements. Analysis of open-question responses emphasised a lack of practical opportunities to apply skills in the workplace, underscoring the literature's emphasis on workplace integration as a critical factor for effective training (Centre for Economics and Business Research, 2024). Also, those who felt that some element of support was lacking stated that there was no support from management, or they had to find their own way in developing green skills.

> 'My job is environmental manager, so currently hands-on all the time. I have had to resource a lot of materials myself, by on-the-job learning, no real help' [sic].

Respondents were then questioned as to whether their apprenticeship programme had impacted their understanding of green skills [figure 8] [figure 10] and their role in the wider community [figure 9] [figure 11].

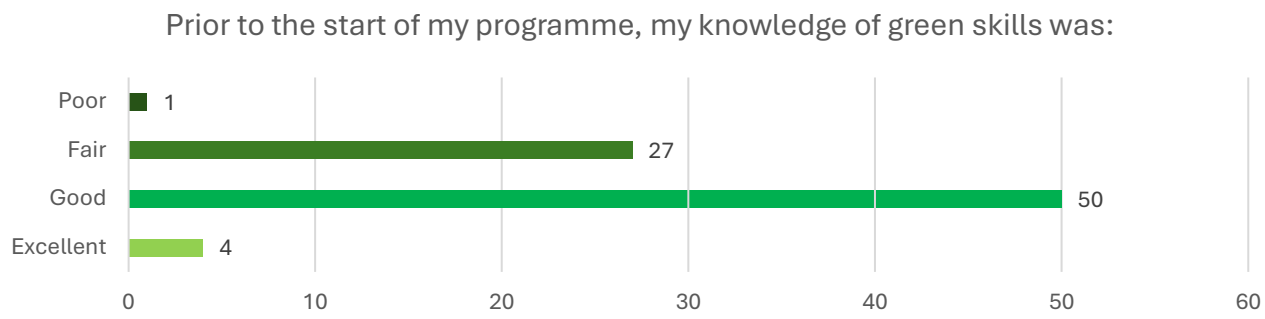


Figure 8

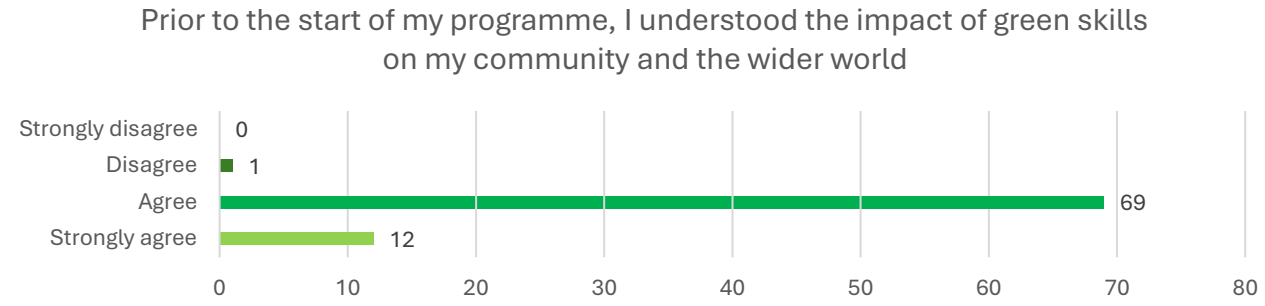


Figure 9

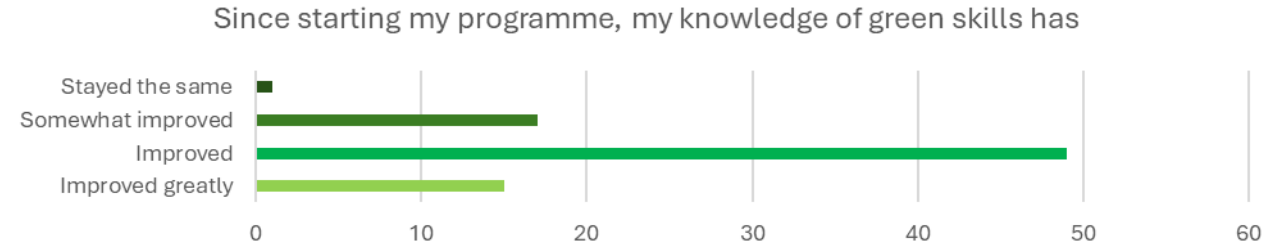


Figure 10

Figure 11

Almost all respondents (98.8%) reported an improved understanding of green skills' community impact, reflecting the findings of ONS (2021) that emphasises the economic and value of green jobs. Prior to starting the programme, most respondents rated their knowledge of green skills as 'Good' [50] or 'Fair' [27], with only 4 selecting Excellent. The vast majority

also ‘Agreed’ [69] that they understood the impact of green skills on the wider community, with only 1 respondent disagreeing. This suggests a baseline of awareness and that learners generally appreciated the broader importance of green skills before starting the programme.

To analyse further, a chi-square test was used to determine if there was a significant association between the ‘prior to starting’ and ‘since starting’ variables. According to Mann (2024), this test evaluates whether the distribution of categorical responses after the programme was independent of participants’ initial responses and is calculated using a chi-square table and the following formula:

$$\chi^2 = \sum \frac{(O-E)^2}{E}$$

Where:

- $\chi 2$ = Chi-square
- O = Observed frequency
- E = Expected frequency

The expected frequency for each cell is:

$$E = \frac{(\text{Row Total} \times \text{Column Total})}{\text{Grand Total}}$$

The degrees of freedom were calculated using the following formula:

$$(\text{number of rows} - 1)\ (\text{number of columns} - 1)$$

Categories were re-coded to ensure comparability [Figure 12] and analysed using a chi-square test of independence, with the workings shown via Excel in Appendix 1.

Knowledge prior to programme	Knowledge since starting
Fair = 1 Good = 2 Excellent = 3	Somewhat improved = 2 Improved = 2 Improved greatly = 3
Impact prior to programme	**Impact since starting**
Disagree = 1 Agree = 2	Disagree = 1 Agree = 2 Strongly agree = 3

Figure 12

Comparison of the knowledge questions gave a chi-value at $\chi^2 = 1.98$ and p value of = 0.37. Comparison of the impact questions gave a chi-value at $\chi^2 = 0.30$ and p value of = 0.86. Neither test reached significance ($p > .05$), indicating that improvements were consistent across different starting levels. In other words, participants began with moderate knowledge, but strong awareness of green skills and the programme successfully deepened both knowledge and understanding. Improvement was observed across all learners, regardless of their baseline.

Finally, respondents were asked if they understood the benefits of holding a green apprenticeship in their sector [figure 13], if their skills could be improved [figure 14], if they had any optional comments to explain how they could improve and what they hoped to achieve by developing their skills [figure 15].

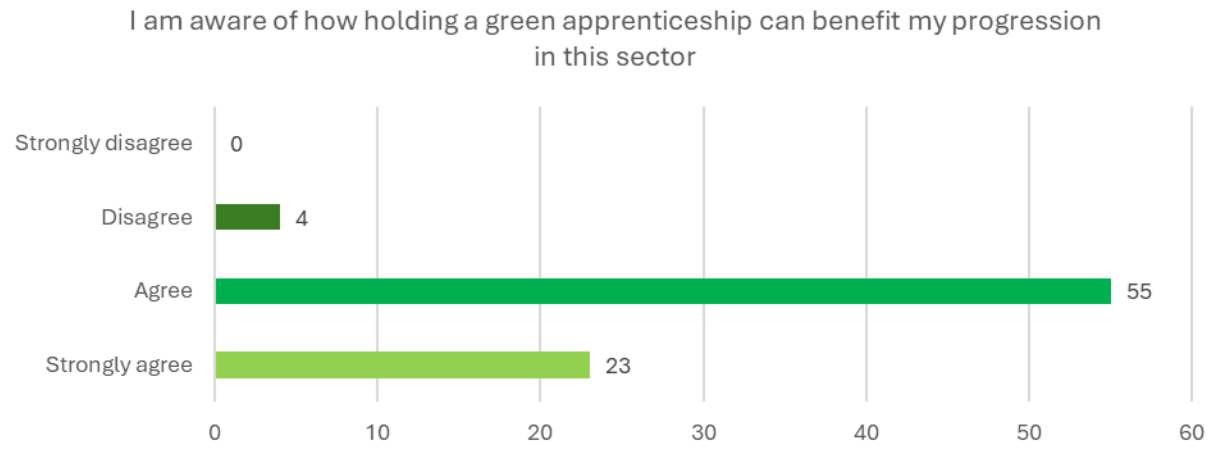


Figure 13

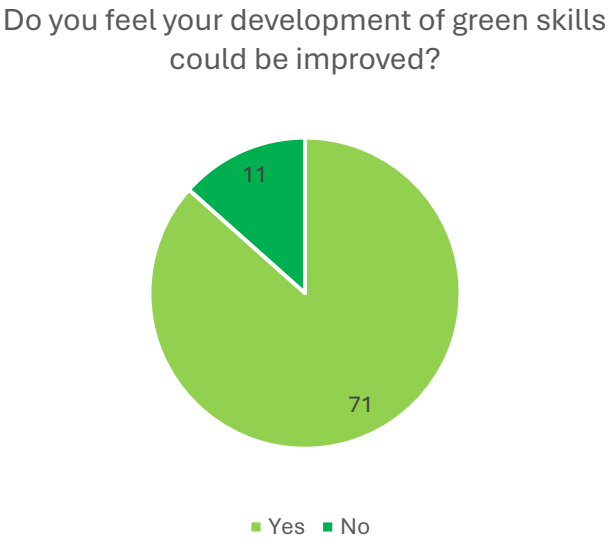


Figure 14

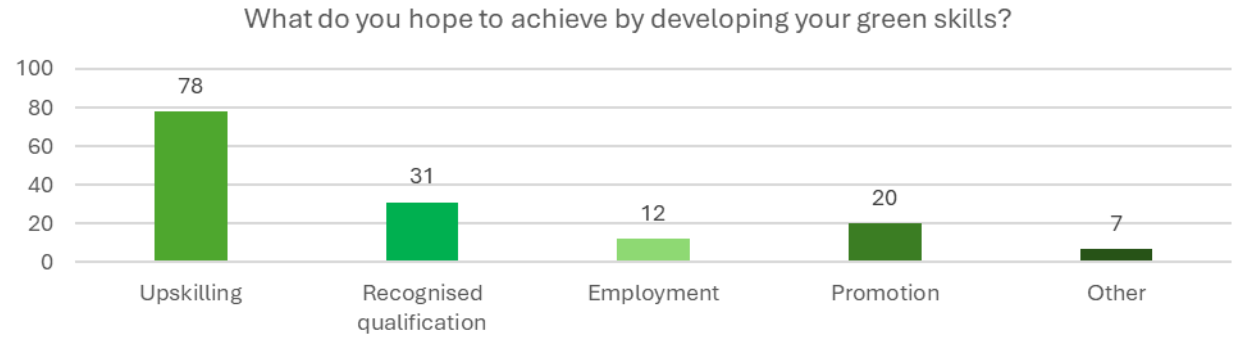


Figure 15

The responses to these questions suggest that apprentices recognise the career value of green apprenticeships, yet most feel their development of green skills could be improved.

This is supported by the literature, which identifies underfunding and varying provision as potential barriers to progress (Welsh Government, 2023a; Climate Change Committee, 2023b). While the Welsh Government positions apprenticeships as central to achieving Net Zero, the lived experiences of apprentices suggest some gaps in delivery. The strong emphasis on upskilling aligns with calls in the literature for reskilling in high-emitting sectors (Chapman & Kiberd, 2021). However, without sustained investment and clearer pathways, the potential of green apprenticeships to drive Wales' Net Zero transition remains under strain. Furthermore, analysis of the qualitative responses regarding how skills could be improved revealed a consistent theme of continuous learning in a sector that is evolving. Apprentices recognised the importance of continued development, noting that green skills require constant updating as regulations and practices change. This reflects Chapman and Kiberd's (2021) assertion that the green workforce must be adaptable to ongoing industry transitions.

> 'As [redacted] has made a transition to green initiatives, my knowledge and development requires constant improvement. So yes, my green skills can always be improved with updated knowledge and more sustainable approaches. Learning whilst you go, researching and adaptation are key. [sic]'

> 'Always more to learn! Currently covering Life Cycle Analysis and reviewing systems for circular design to improve efficiency. [sic]'

4.1.2 Analysis of Dark versus Light-Green Apprenticeships

While most apprentices in this study recognised the career value of a green apprenticeship, the majority also felt their development of green skills could be improved, suggesting that much current provision may lean towards light green roles. Further analysis was conducted

to explore whether the type of apprenticeship (light or dark green) was associated with perceptions of support.

Using chi-square analysis, a significant relationship was found between apprenticeship type and ratings of employer support ($\chi^2 = 35.66$, $p < 0.001$). Dark green apprenticeships had a higher proportion of 'Strongly Agree' responses and no disagreement, while all 'Disagree' and 'Strongly Disagree' responses came from light green apprenticeships. This supports the literature's finding that roles more directly linked to carbon-reduction goals benefit from stronger workplace support (Climate Change Committee, 2023b; Institute for Apprenticeships and Technical Education, 2021).

Similarly, a significant association was observed between apprenticeship type and ratings of support for developing green skills ($\chi^2 = 29.05$, $p < 0.001$). Again, dark green apprenticeships recorded more 'Strongly Agree' responses and no disagreement, whereas all 'Disagree' responses were from light green apprenticeships. These findings reflect the literature, identifying that sustainability-focused roles tend to integrate green skills more effectively into workplace activities (Institute for Apprenticeships and Technical Education, 2021).

4.1.3 Summary of Findings - Questionnaires

Overall, apprentices reported high levels of understanding of green skills, strong satisfaction with training resources and clear improvements in knowledge since starting their programmes. These findings support Welsh Government objectives to embed Net Zero skills into vocational training and reflect the literature's emphasis on the important role of apprenticeships in advancing sustainability goals. However, the results also highlight key areas for improvement. While resource provision is strong, some apprentices reported limited opportunities to apply their skills in the workplace and variable levels of employer

support, suggesting that training provision could be more standardised within the sector. These findings reinforce the literature's identification of the need for industry engagement, consistent sharing of best practice and ongoing upskilling as the Net Zero sector evolves.

4.2 Semi-structured Interviews

The purpose of the semi-structured interviews was to investigate stakeholder perspectives on green skills provision in Wales, with suitable questions arising from the research of corresponding literature. This approach enabled a consistent approach through a set of guiding questions, but with flexibility to allow participants to elaborate on issues based on their own experiences. This enabled the researcher to identify barriers and opportunities in implementing green skills from the perspective of work-based providers and employers (Kallio et al., 2016). Interviews were conducted via Teams with three work-based providers and two large employers. Once the interviews were scheduled, the questions were circulated in advance to enable preparation (Appendix 2). At the outset, the procedure was outlined, including recording, transcription, assurances of anonymity and the right of participants to withdraw. Transcriptions were subsequently verified for accuracy (Appendices 3–7) and then analysed using Braun and Clarke's (2021a) six-phase framework, using the following steps:

- Familiarisation with the data: the transcript is read multiple times to gain a thorough understanding of the content.
- Generate initial codes: significant data features are identified and colour-coded on the transcript.
- Identify themes: codes are grouped under related themes.

- Review themes: these are then refined to ensure each theme is distinct. Any overlapping areas are consolidated and themes are adapted.
- Define themes: themes are finalised and named, linked with specific quotes from the transcript.
- Report findings.

4.2.1 – Transcript A

Key points from this interview include the organisation's strong focus on sustainability, practical approaches to training and reporting of systemic issues in relation to green skills provision.

Initial codes	Themes
Integration of sustainability into training	Embedded Sustainability, Skills Development as a Sustainability Strategy, Disconnect Between Policy and Practice
Eight wastes and lean methodology	Embedded Sustainability, Skills Development as a Sustainability Strategy
Six Sigma for environmental impact	Embedded Sustainability. Skills Development as a Sustainability Strategy
Informal Net Zero strategies	Embedded Sustainability
Limited scope of green apprenticeships	Systemic and Institutional Barriers, Strategic Gap, Disconnect Between Policy and Practice
Barriers to qualification access	Systemic and Institutional Barriers, Strategic Gap, Disconnect Between Policy and Practice
Funding issues	Systemic and Institutional Barriers, Strategic Gap, Disconnect Between Policy and Practice

Reviewed themes	Definition	Key Quotes
Practical Integration of Sustainability in Training	Organisation's commitment to embedding green skills across all levels and subjects	“We undertake specific courses… circular economy, waste recycling…”
Challenges in Formalising Green Apprenticeship Pathways	Difficulties accessing accredited training. Limited availability from awarding bodies	“Only available from Agored… expensive process…”
Institutional Limitations and Lack of Support	Lack of funding, slow bureaucracy, and exclusion from decision-making processes.	“Funding tends to go to Colleges, but they're slow to react…”
Local Innovation and Commitment	Staff-led efforts to promote sustainability without formal structure or incentives.	“Staff are encouraged to car share… Net Zero Environmental Champion…”
Need for Strategic Alignment with Policy	Disconnect between policy ambition and implementation in practice.	“Qualifications in Engineering are probably no longer fit for purpose…”

The analysis highlights the steps taken by this organisation to embed sustainability across its operations and training. However, they have identified challenges including limited access to recognised green qualifications, lack of systemic support and outdated educational frameworks. These concerns mirror findings in the literature which have noted gaps between ambitious Net Zero targets and the slow pace of curriculum reform, alongside funding barriers that may restrict provision (Welsh Government, 2023a; Colegau Cymru, 2023b; Centre for Economics and Business Research, 2024). Echoing wider calls for collaboration among policymakers and the industry, the interviewee emphasises the need to align sustainability goals with practical training delivery, as identified in current literature (Climate Change Committee, 2023b; Wales Centre for Public Policy, 2023).

4.2.2 – Transcript B

Analysis identified recurring concepts and key concerns, such as this organisation's phased approach to sustainability, concerns over the use of 'Net Zero' terminology, the collaborative development of qualifications and an emphasis on community accountability and action.

Initial codes	Themes
'Start small' change approach	Practical and Inclusive Implementation of Green Skills, Communication Challenges around Net Zero, Community-Based Approaches
Misinterpretation of Net Zero	Communication Challenges around Net Zero
Community-led sustainable practices	Practical and Inclusive Implementation of Green Skills, Community-Based Approaches
Apprentices' need for access to carbon management data	Practical and Inclusive Implementation of Green Skills, Qualification Design
Organisational action plans	Practical and Inclusive Implementation of Green Skills, Community-Based Approaches, Qualification Design
Practical sustainability steps	Practical and Inclusive Implementation of Green Skills, Community-Based Approaches, Funding
Desire for qualifications at all levels, including entry	Practical and Inclusive Implementation of Green Skills, Communication Challenges around Net Zero, Community-Based Approaches, Qualification Design, Progression Gaps
Funding limitations and structural barriers	Communication Challenges around Net Zero, Qualification Design, Progression Gaps, Funding

Reviewed themes	Definition	Key Quotes
Inclusive and Practical Green Skills Implementation	Focus on small, achievable actions and accessible qualifications for diverse learners.	"Anybody can go, 'I'm going to go and take my kettle, that doesn't work, grab a coffee, have a chat.'"

Communication Challenges of “Net Zero”	Misinterpretation of terminology leading to discouragement or unrealistic expectations.	“Net Zero, sounding like zero… nil… people have that expectation that they need to eliminate everything.”
Community and Collaboration as Drivers	Emphasis on joint accountability, shared learning, and community change rather than top-down mandates.	“It's a community-based, bigger project… we all have to do our part together.”
Gaps in Qualification Progression and Accessibility	Recognition that current offerings don’t suit all roles, levels, or sectors.	“There are many who are interested that won’t… or perhaps they want more than Level 3.”
Structural and Financial Constraints	Limited funding, need for organisational accountability, and reliance on voluntary best practice sharing.	“Funding, always funding… there is only so much to go around.”

Interview B revealed a grounded and inclusive approach to sustainability education, centred on manageable changes, community engagement and clear learning pathways. However, challenges such as unclear messaging around Net Zero, funding limitations and qualification gaps reflect broader concerns in the literature about inconsistent communication, structural barriers and limited access to green skills provision (Welsh Government, 2023a; Colegau Cymru, 2023b). Again, emphasising the need for more accessible and collaborative frameworks, the interviewee highlighted the importance of entry-level modules and broader participation to increase progress toward carbon neutrality (Wales Centre for Public Policy, 2023; Climate Change Committee, 2023b).

4.2.3 – Transcript C

Initial observations from this interview include this organisation’s role in renewable technology projects, frustration over the absence of sector-specific apprenticeship

frameworks in Wales and criticism of funding structures and bureaucratic delays. There is also an emphasis on employer incentives and a proposed review of qualification design.

Initial codes	Themes
Indirect contribution to carbon neutrality targets	Employer Incentive, Industry Support Needs
Lack of relevant green skills frameworks in Wales	Structural and Bureaucratic Barriers, Skills Gap, Framework Deficiencies, Disconnect Between Policy and Practice, Industry Support Needs, Qualification Design
Slow institutional and policy response	Structural and Bureaucratic Barriers, Skills Gap, Disconnect Between Policy and Practice
Inefficient college funding structures and competition	Structural and Bureaucratic Barriers, Disconnect Between Policy and Practice, Employer Incentive, Industry Support Needs
Lack of financial support for employers	Structural and Bureaucratic Barriers, Employer Incentive, Industry Support Needs
Cross-border contracting issues	Structural and Bureaucratic Barriers, Skills Gap, Disconnect Between Policy and Practice, Industry Support Needs
Preference for Colleges	Structural and Bureaucratic Barriers, Skills Gap, Industry Support Needs
Lack of collaboration across training providers	Structural and Bureaucratic Barriers, Framework Deficiencies, Disconnect Between Policy and Practice, Industry Support Needs, Qualification Design

Reviewed themes	Definition	Key Quotes
Structural and Bureaucratic Barriers	Systemic issues in funding, procurement, and delivery that slow progress and create inefficiencies.	“The funding structure… means we’ve got Colleges competing against each other rather than working together.”
Skills Gap and Framework Deficiencies	Lack of relevant, sector-specific apprenticeship frameworks in Wales, limiting capacity for green skills growth.	“We haven’t got frameworks directly linked into the green skills sector… it’s available in England, but in Wales… no.”

Disconnect Between Policy and Practice	Disconnect between government/college 'Net Zero' branding and the actual skills/employment needs of the sector.	“The Net Zero School was listing courses like Health and Safety… selling it like it was Net Zero. I find it… lazy.”
Employer Incentives and Support Needs	Financial barriers for employers reduce apprenticeship uptake, particularly in SMEs.	“The financial support for employers is the only way that you're going to increase apprenticeship numbers in certain sectors.”
Qualification Design	Need for qualifications tailored to specific trades and technologies in renewable and low-carbon industries.	“Have a renewable qualification with PV battery, heat pump… everything in one qualification, because that’s what’s needed.”

The analysis of Interview C highlights gaps between policy ambition and the practical needs of Wales’s renewable energy and low-carbon sector. Although the organisation contributes to carbon reduction through renewable technology projects, progress is constrained by outdated frameworks, slow processes and inefficient funding structures, all of which are identified in the literature regarding a disconnect between policy and delivery and systemic barriers to green skills development (Welsh Government, 2023a; Colegau Cymru, 2023b). Interviewee C emphasised the importance of employer incentives, sector-specific training and more accountable funding to avoid superficial Net Zero initiatives.

4.2.4 – Transcript D

Key points identified from this interview include operational carbon reduction measures, the inclusion of sustainability in apprenticeships, gaps in advanced green skills provision, funding inequalities, tokenistic Net Zero engagement and a call for earlier engagement in green skills.

Initial codes	Themes
Informal Net Zero strategies	Practical Implementation of Green Skills
Green initiatives in engineering apprenticeships	Practical Implementation of Green Skills, Gaps in Provision, Lack of Standardisation, Funding, Broader and Earlier Green Skills Engagement
Limited 'dark green' apprenticeship availability	Gaps in Provision, Lack of Standardisation, Funding, Broader and Earlier Green Skills Engagement
Poor sharing of best practice	Practical Implementation of Green Skills, Gaps in Provision, Lack of Standardisation
Lack of official benchmarks or recognition	Lack of Standardisation
Tokenistic Net Zero initiatives	Practical Implementation of Green Skills, Superficial Engagement with Net Zero
Preference for Colleges	Funding, Broader and Earlier Green Skills Engagement
Entry-level green skills pathways	Practical Implementation of Green Skills, Gaps in Provision, Lack of Standardisation, Funding, Broader and Earlier Green Skills Engagement
Early engagement with schools and NEETs	Gaps in Provision, Funding, Broader and Earlier Green Skills Engagement

Reviewed themes	Definition	Key Quotes
Operational and Educational Integration of Green Skills	Embedding sustainability into both company operations and apprenticeship curriculum.	"The majority of our employees have either electric vehicles or hybrid vehicles… A lot of the apprenticeships we deliver are in line with green initiatives."
Gaps in Provision and Lack of Standardisation	Shortage of advanced ('dark green') apprenticeships and inconsistent quality across providers.	"These are limited at the moment… everyone is doing their own thing, so there's not a lot of sharing of best practice."
Funding Inequities and Recognition Gaps	Funding structures favour colleges, with limited incentives or acknowledgement for proactive providers.	"Funding is heavily favoured towards Colleges… missed opportunity for other providers to utilise these funding

		streams."
Superficial Engagement with Net Zero	Perception of tokenistic, non-substantive adoption of sustainability concepts.	"They had an 'Eco Code'… people signed it but it wasn't discussed. It's a tick box, it's frustrating."
Need for Broader and Earlier Green Skills Engagement	Expanding provision to include entry-level options and earlier engagement with school leavers and NEETs.	"It would be good to have more entry level options… engage people sooner… such as school children, school leavers, NEETs."

The analysis of Interview D shows how sustainability can be embedded both operationally and within apprenticeship provision. However, it highlights persistent gaps in advanced 'dark green' qualifications, slow curriculum reform and inequitable funding structures. These challenges mirror the literature, which notes systemic barriers in qualification design and the uneven distribution of funding that favours certain providers (Colegau Cymru, 2023b; Centre for Economics and Business Research, 2024). The interviewee criticised tokenistic Net Zero initiatives and emphasised the need for broader entry-level options and earlier engagement, reflecting wider evidence that flexible and inclusive training pathways are essential to building a Net Zero workforce (Welsh Government, 2023a; Wales Centre for Public Policy, 2023).

4.2.5 – Transcript E

Initial impressions from Interview E include this organisation's role in embedding sustainability in its training, frustration with slow and inconsistent sector engagement, policy and practice disconnects and barriers to accessibility for learners and employers.

Initial codes	Themes
Integration of sustainability within existing programmes	Practical Integration of Sustainability into Training, Variable Sector Engagement and Awareness, Industry Needs

Lack of consistent sector uptake of green skills training	Variable Sector Engagement and Awareness, Policy-Delivery Disconnect, Funding and Accessibility Barriers, Industry Needs
Disconnect between policy and practice	Practical Integration of Sustainability into Training, Variable Sector Engagement and Awareness, Policy-Delivery Disconnect, Industry Needs
Funding mechanisms creating barriers for smaller providers	Funding and Accessibility Barriers
Demand for flexible, modular training routes	Practical Integration of Sustainability into Training, Funding and Accessibility Barriers, Industry Needs
Employer awareness and motivation challenges	Variable Sector Engagement and Awareness, Policy-Delivery Disconnect, Industry Needs
Need for partnerships between providers and industry	Practical Integration of Sustainability into Training, Variable Sector Engagement and Awareness, Industry Needs
Early engagement with young people	Variable Sector Engagement and Awareness, Funding and Accessibility Barriers, Industry Needs

Reviewed themes	**Definition**	**Key Quotes**
Practical Integration of Sustainability into Training	Embedding green principles and practices within training content and organisational operations.	"We build sustainability into the courses we already deliver… it's part of the learning journey."
Variable Sector Engagement and Awareness	Uneven uptake of green skills training across industries, with some employers lacking awareness or motivation.	"Some employers are keen, but others just don't see it as relevant to them yet."
Policy-Delivery Disconnect	Misalignment between government sustainability goals and the operational delivery of training on the ground.	"The targets are there, but the delivery mechanisms aren't matching up to them."
Funding and Accessibility Barriers	Funding structures and eligibility criteria that disadvantage smaller	"We can't access the same funding streams as bigger

	providers or limit learner participation.	providers… it makes it harder to compete."
Need for Flexible and Targeted Training Routes	A call for modular, adaptable training that can address specific skill gaps and fit around employer needs.	"We need shorter, targeted courses that employers can actually release staff to attend."

The analysis of Interview E highlights efforts to embed sustainability within training while acknowledging barriers of uneven employer engagement, funding restrictions and a disconnect between policy targets and delivery. These findings reinforce concerns in the literature about limited accessibility, misalignment between government ambitions and provider capacity and the slow pace of systemic reform (Welsh Government, 2023a; Colegau Cymru, 2023b). Echoing broader calls for more responsive provision, the interviewee stressed the importance of flexible, modular training routes to address sector-specific skill gaps and enable wider participation (Climate Change Committee, 2023b; Wales Centre for Public Policy, 2023).

4.2.6 Summary of Findings – Semi-structured Interviews

The analysis of interviews A–E demonstrates that work-based learning providers in Wales are actively engaging with the sustainability agenda and embedding it across their organisational practices and programmes. Evidence of innovation was apparent in examples such as renewable technology projects, community-focused initiatives and the development of flexible, learner-centred pathways, all of which demonstrate the sector's capacity to contribute meaningfully to the Net Zero transition. These findings indicate a clear commitment among providers to advance the sustainability agenda, often in contexts characterised by resource constraints. Nevertheless, in line with the wider literature, the

study also identifies persistent structural challenges, including a disconnect between policy and practice, restrictive funding and gaps in qualifications that do not adequately reflect the sector's requirements. Whilst progress could be made to improve these areas, the findings also highlight a potential for collaboration, increase in modular training opportunities and stronger engagement between policymakers, employers and providers to deliver more meaningful outcomes. The apprentice questionnaires combined with the semi-structured interviews provide a more in-depth understanding of how Net Zero ambitions are realised at all levels, identifying potential reforms required to support Wales's low-carbon transition effectively.

Chapter 5 – Recommendations & Conclusions

This study aimed to assess the current effectiveness of Net Zero apprenticeships in Wales, focusing on their capacity to develop the skills necessary for supporting the Welsh Government's climate and economic objectives.

The findings demonstrate that apprenticeships are succeeding in several key areas. Apprentices reported a strong understanding of green skills, high satisfaction with training resources and significant knowledge gains since starting their programmes. These outcomes reflect the intentions of recent policy measures, such as integrating Net Zero competencies into the National Occupational Standards and enhancing access to high-quality learning materials (Welsh Government, 2022c). These findings also align with a recent report into the implementation of the Well-being of Future Generations (Wales) Act 2015, which requires public bodies to pursue long-term sustainability goals, address the current skills gap and strengthen apprenticeship provision (Future Generations Commissioner for Wales, 2022).

The research also identified notable challenges, such as employer engagement. Support was reported as inconsistent, with some apprentices reporting a lack of opportunities in the workplace to apply their skills. This issue aligns with concerns in the literature about variable industry engagement and the risk of a disconnect between training provision and workplace practice (OECD/Cedefop, 2024).

The findings confirm that Net Zero apprenticeships in Wales make a meaningful contribution to knowledge and the needs of the industry, however, several areas for improvement have been identified. Stronger industry collaboration, greater integration of practical learning and more comprehensive coverage of sector-specific and regulatory requirements are essential to maximising the effectiveness of Net Zero delivery.

5.1 Work-based Learning Providers

Work-based learning providers are at the frontline of delivering sustainability education and skills training. The results highlighted the proactive steps already being taken to embed sustainability into provision, but also revealed the challenges of outdated frameworks, limited qualifications and funding inequality. First, providers should seek to embed sustainability as a core theme across provision, ensuring that environmental awareness and green skills are not limited to 'dark green' apprenticeships, but integrated across all learning pathways. This reflects literature suggesting that sustainability must become a cross-cutting theme across the skills system (Welsh Government, 2023a).

Secondly, providers should increase opportunities for their staff, learners and the employers they support to access green skills. Through developing short courses, entry-level modules and micro-credentials, provision would enable wider participation and allow employers to

release staff for training more easily, addressing both demand and supply-side barriers (Colegau Cymru, 2023b). Flexible and modular pathways can particularly support the onboarding of entry-level employees, or those in small and medium-sized enterprises [SMEs] to access this training.

Finally, stronger collaboration with employers and awarding bodies is essential to ensure that provision reflects the needs of the sector. This should include further collaborative qualification design, sharing of best practice across providers and engaging younger learners, including those not currently in education or training, to sustain and build the future workforce pipeline (University and College Union, 2025). As providers build on their own knowledge of sustainability and equip their own staff in what constitutes best practice, they could cement this through the allocation of green mentors or champions, who could be the go-to contacts for staff and employers to enable smoother communication channels.

5.2 Employers

Employers are also pivotal to ensuring that sustainability training translates into practical workplace change. However, the findings highlighted uneven engagement across sectors, with some employers being proactive in supporting training and others being reluctant to view it as a priority (The Open University, 2024). To address this, employers should recognise green skills as a long-term investment in resilience and competitiveness, rather than as a compliance exercise. This requires active investment in workforce development, supporting employees to access green training and providing the necessary time and resources. This could involve projects such as actively integrating apprentices into sustainability practices, offering rotations across departments, to give apprentices a well-rounded experience (SUEZ,

2025) and appointing ‘green’ mentors as go to contacts for anything from the development of green skills to basic queries. Employers should also collaborate more closely with training providers to co-design practice qualifications that specifically meet their needs. This ensures that learning outcomes are aligned with workplace realities and help avoid the risk of training being perceived as abstract or disconnected (Climate Change Committee, 2023b). Finally, employers have a role in shaping workplace culture. By championing sustainability within their own operations, employers reinforce the value of training and create an environment in which green practices are embedded as standard (Future Generations Commissioner for Wales, 2023). This should not be a reflection of best practice, but rather an expectation when collaborating with other organisations within the industry.

5.3 Apprentices

Apprentices should also be considered an important stakeholder in this research and whilst they don’t have higher levels of influence, there are recommendations on how they can be supported and how they can make an impact on the direction of these qualifications. Apprentices must be empowered to take ownership of their professional development and one way in which they can do this is through the maintenance of their own portfolios and keeping a log of their CPD. This will enable apprentices to identify areas for further growth, which can also relate to green skills (Institute for Apprenticeships and Technical Education, 2023c). They can be encouraged to engage in peer-learning networks. If green mentors and champions are utilised within the workplace, or through the provider, this can be extended to apprentices. This provides further opportunities for networking and sharing of best practice in the green sector (ibid). Furthermore, apprentices must continue to be offered opportunities to develop their skills, which makes it more likely that they will continue to pursue lifelong learning beyond apprenticeship completion. This is supported by CQM (2024)

who state that apprenticeships offer the means and encouragement to pursue lifelong learning, at any age.

5.4 Welsh Government

The Welsh Government has set ambitious Net Zero targets, however, this study highlights the gap between policy ambition and the structures available to deliver them effectively. As such, government intervention is crucial to reforming funding, improving qualification development and collaboration across the sector. A central priority is the reform of funding to ensure equal access for all providers, including smaller work-based learning organisations, who often face barriers to the same funding streams as larger organisations. This seems to have started through provision of 'Flexible Skills Programme' [FSP] funding in recent weeks, although the impact is yet to be reviewed at this early stage (Senedd Research, 2025). Furthermore, ring-fenced funding could be introduced for 'dark green' apprenticeships to safeguard these from potential budget cuts. Eligibility criteria should also be simplified to widen participation and ensure that green skills training can be delivered at scale, enabling organisations to meet this demand.

Additionally, policy and delivery must be better aligned. While Net Zero targets are clear, the methods for implementing them in practice are often inconsistent. Welsh Government should therefore work to bridge the gap between policy and delivery, providing clearer guidance and additional resources to providers (Senedd Research, 2025). There is also a pressing need to accelerate qualification reform. Outdated frameworks slow the uptake of sector-relevant green skills training and greater collaboration with awarding bodies and industry experts is required to develop sector-specific qualifications in areas renewable technologies (Wales Centre for Public Policy, 2023). National standards will need to be periodically reviewed and

updated to reflect any regulatory developments, ensuring apprenticeships remain relevant in this evolving industry. This is a norm within qualification development, however, data from the interviews and questionnaires suggested that changes are happening rapidly, meaning that the standard qualification reviews may not be quick enough. Qualification reviews occur 'regularly' based on the sector in which they belong, but there is currently no fixed timeframe for review (Welsh Government, 2024b). Furthermore, providing a more precise definition of what constitutes 'light' and 'dark' green apprenticeships, along with establishing evaluation frameworks can ensure consistency across provision and also the ability to measure the impact effectively.

Finally, Welsh Government should take a stronger role in promoting collaboration and communication across the sector. This includes providing opportunities for dialogue between policymakers, employers and providers, ensuring that public communication on Net Zero and sustainability is consistent and accessible to all stakeholders. Consistent and sector-wide tracking of Net Zero apprenticeship outcomes, including both quantitative metrics and qualitative feedback could be used to inform policy adjustments and future funding allocations. There could be an introduction of further incentives for employer engagement, as the findings indicated a potential solution through redistribution of funding. This could take the form of redistribution of apprenticeship levy funding, or even tax relief for organisations that can evidence embedding green skills into workplace training and practice.

These recommendations require large-scale review and so should be prioritised into short, medium and long-term goals in order to clarify precedence, as in Figure 16.

5.5 Barriers

The research highlights several barriers to achieving these recommendations. The most pressing issue is of funding constraints, with providers warning of reduced capacity following government budget cuts (Welsh Government, 2023c). Additionally, variable employer commitment creates unequal opportunities for apprentices to apply their skills in practice (The Open University, 2024). Bureaucratic delays in qualification reform can further exacerbate these challenges.

Short-term [within 12 months]	**Medium-term [1 – 3 years]**	**Long-term [3-10 years]**
Introduce ring-fenced funding for green apprenticeships.	Reform curricula to better integrate regulatory and technical content.	Fully embed sustainability competencies into all vocational pathways, ensuring that green skills are not isolated to specialist roles.
Establish employer–provider advisory boards to improve collaboration.	Expand accessibility of programmes to SMEs and entry-level staff.	Develop international partnerships to benchmark Welsh provision against global best practice.
Encourage apprentices to add green skills to their CPD portfolios.	Develop frameworks for evaluating the contribution of apprenticeships to Net Zero outcomes.	Monitor longitudinal outcomes of apprenticeships, such as career progression and contributions to emissions reduction.

Figure 16

Despite these obstacles, there are also strong enablers. Apprentices themselves displayed high levels of enthusiasm for continuous learning in the results, which can be harnessed through structured CPD. Moreover, Wales could benefit from adapting international models, such as Germany's dual vocational training and Denmark's renewable energy partnerships (European Commission, 2024), to meet local needs. Finally, policy momentum is already

strong, with Welsh Government recognising the importance of green skills in its occupational standards review (Welsh Government, 2022c). Building upon these enablers will provide a pathway to overcoming these systemic barriers.

5.6 Recommendations for Future Research

Future research should build on these findings by conducting longitudinal studies that track apprentice outcomes over time, sector-specific case studies of high-emission industries such as construction or steel and a comparative analysis with other UK and Global nations. As Wales approaches its 2027 carbon budget review, such research will be crucial for informing whether apprenticeships can serve not only as a skills pipeline but also as a measurable driver of Net Zero policy outcomes, particularly if there is a focus on career progression and industry impact. This would consider whether green skills are gained and retained, adapted and also applied within the evolving sector.

Further studies should also seek to address any limitations of the research design. A potential source of bias in the study arises from the sample's composition. Several work-based learning providers suggested that policy and funding mechanisms favour colleges, yet no college representatives participated in the research. This means the findings may reflect provider perspectives more strongly, without the balance of insights from colleges. Future research should therefore include college voices to ensure a more comprehensive understanding of how sustainability and green skills are being delivered across the sector. The sample size was also relatively small, which may limit the extent to which the findings can be generalised and so replication of this study would benefit and demonstrate the reliability and validity of the results acquired, ensuring to approach employers and providers of all sizes. Furthermore,

candidates who responded may have done so due to their personal values in relation to green skills (self-selection bias), resulting in a non-probability sampling (Kaźmierczak, et al., 2023). This could be overcome through the use of random sampling and following up on any non-respondents (ibid).

Future research should also explore the integration of digital competencies into Net Zero apprenticeships, as was highlighted by one of the interview respondents in the construction industry [Appendix 7]. Tools such as carbon accounting software, lifecycle analysis systems and energy management algorithms are increasingly utilised in low-carbon sectors (OECD, 2024). Embedding these skills into frameworks would ensure apprenticeships remain relevant and learners are sufficiently equipped to meet updated industry standards. Digital upskilling is therefore a critical complement to the green transition (ibid).

Overall, these recommendations highlight the need for a more consistent and collaborative approach to green skills in Wales. Work-based providers must embed sustainability across all provision and develop flexible pathways for learners; employers must take ownership of workforce development and collaborate with providers; and Welsh Government must reform funding, accelerate qualification development and facilitate stronger partnerships between all parties. Only through coordinated action across these groups will Wales be able to close the skills gap and realise its Net Zero ambitions.

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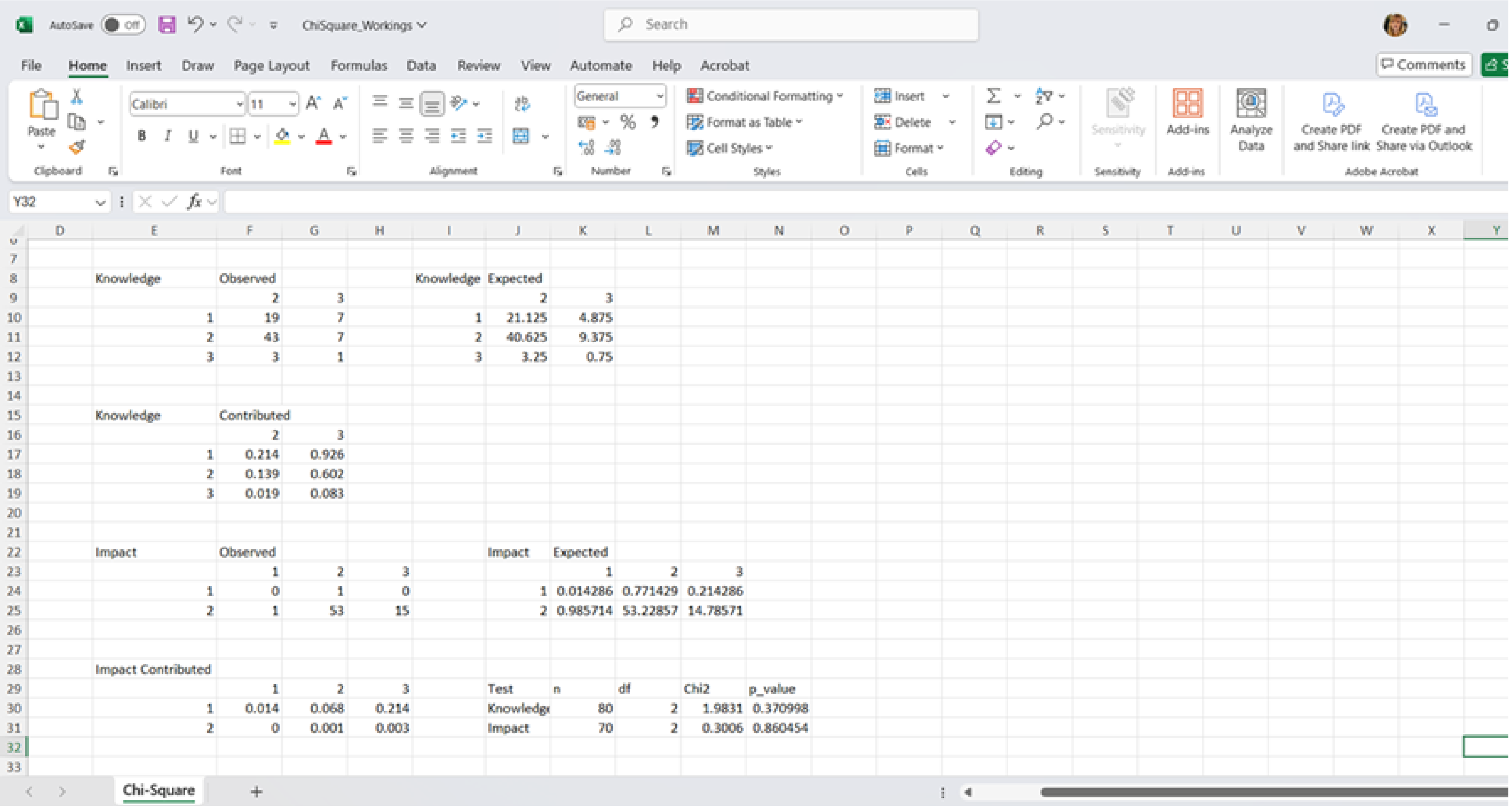
Appendices

Appendix 1 – Chi-Square in Excel



Row	E	F	G	H	I	J	K	L	M	N
8	Knowledge	Observed			Knowledge	Expected				
9		2	3			2	3			
10	1	19	7		1	21.125	4.875			
11	2	43	7		2	40.625	9.375			
12	3	3	1		3	3.25	0.75			
15	Knowledge	Contributed								
16		2	3							
17	1	0.214	0.926							
18	2	0.139	0.602							
19	3	0.019	0.083							
22	Impact	Observed				Impact	Expected			
23		1	2	3			1	2	3	
24	1	0	1	0		1	0.014286	0.771429	0.214286	
25	2	1	53	15		2	0.985714	53.22857	14.78571	
28	Impact Contributed									
29		1	2	3		Test	n	df	Chi2	p_value
30	1	0.014	0.068	0.214		Knowledge	80	2	1.9831	0.370998
31	2	0	0.001	0.003		Impact	70	2	0.3006	0.860454

Appendix 2 – Semi-structured Interview Questions

Could you describe how your organisation aligns with the carbon neutrality goals of Welsh Government? [Further prompt – how do you meet these goals day-to-day or practically within your organisation?]

What is your opinion on the current provision of green skills and apprenticeships?

Have you been involved in reviewing the provision and progress of green skills and apprenticeships? How so?

Have you faced any challenges regarding the current provision of green skills and apprenticeships?

In your opinion, could the provision of green skills and apprenticeships be improved? How so?

In your opinion, could Welsh Government's approach to carbon neutrality within your sector be improved. How so?

Any other comments?

Appendix 3 – Interview Transcript A

27 June 2025, 02:23pm

Interviewer started transcription

Interviewer 1:44
Thanks for coming to the interview. For the purposes of this study, I just need to let you know that I am recording and transcribing, but the recording itself won't be used. OK? The transcription… I'm going to go through afterwards and remove any mention of yourself as an individual, or your organisation, so that remains anonymous. Alright? So, the results are anonymised. And the reason I'm doing this is because I need to conduct a thematic analysis. And so I need the transcription to be used in my findings. Also, you can… if you ever change your mind… you can request to have your results taken out.

Interviewee A 1:45
OK, that's not a problem at all.

Interviewer 1:45
Is everything OK with you?

Interviewee A 1:45
Great. It's my pleasure. And I look forward to it.

Interviewer 1:45
OK. Brilliant. I'll start out by asking you the first question. Could you just describe to me how your organisation aligns with the carbon neutrality goals of Welsh Government?

Interviewee A 1:46
Well, we work very closely with employers throughout South Wales to develop the skills that their staff need to reduce waste and undertake sustainable practices throughout their organisations. All staff need training if Net Zero is to be achieved and this doesn't have to come from green training courses, but by building the training to every course, be it electronic engineering or performing manufacturing operations, which are just some of the courses we undertake. As part of apprenticeships, we undertake specific courses which deal with not just the circular economy, waste recycling, but all forms of waste, which can be split into 8 categories and can be adopted by service and manufacturing industries. These eight wastes are the foundation of a lean strategy to improvement for any organisation and require reduction of eight wastes, if you like. Which include transport… focused on the movement of products, inventory. This can be a waste if there's a lot of inventory in organisations. Motion, which is the movement of people rather than product, and is concerned with workplace layout ergonomics. Also, waiting where people are waiting for work because they're reliant on other departments. Over processing, which means making better quality than that that's paid for or required by the customer, which requires a lot more energy, as you can imagine. Overproduction. By overproducing the customer may never take the over product if you like,

and therefore you're using energy to create what would be waste eventually and would need scrapping and therefore that provides other problems for the environment. Defects for whenever you've got a defect in any process, be it manufacturing or in a service industry, it requires a lot of energy to reprocess those things or rework those things. In manufacturing particularly, there's the waste of energy to take it back to where it was – the base then - and then more energy to bring it back up to good product. Skills can be another waste when they're utilising staff, for example with when working on Net Zero, certain staff have got the necessary skills that they've developed already and have done a lot of research. If you're not going to utilise them then that's a waste. Problem-solving tools such as value stream mapping, which are things that we teach can aid in reducing all forms of waste.
In engineering, energy efficiency is at the forefront of current research. Apprentices learn many of the energy efficient means of using and purchasing equipment without even realising… for example, that, that, that they have used these energy efficient skills, if you like. For example, some plants would still use fixed speed motors which run at a greater speed than what is required… the output of what the motor is running... for example, if you think about a fan in a factory, if the motor is running flat out, then it might not require that level of energy usage to run a fan, and the only way to slow that fan then would be to reduce it by mechanical means, which means that you're using all the engine of the motor when it's not required. Whereas more modern variable speed motors would have the same output for the fan itself, but less energy can be used by reducing the speed. Many of our apprentices learn this very early on and they're aware of it without even thinking about what they doing to the environment.

Aside from work with external stakeholders, our own staff undertake green and light green training up to level 7. Our induction for new staff emphasises the need to improve and share green skills and ideas. Net Zero sustainability is integrated at an early stage for all new employees… well, in fact, right at induction. Focuses on being lean and… staff are due to undertake not only further environmental training, but Six Sigma Black Belt training, which focuses on reducing waste. And as we've spoke about earlier, with reducing waste that has a knock-on effect for the environment from 8 different forms. Many organisations have not yet understood the link between Six Sigma and energy reduction, but by improving efficiency in the organisation, energy usage is greatly reduced and we have tried to tell all of our clients this. We also conduct the usual green processes of circular economy at our organisation. Circular economy waste, minimising utility usage and staff are encouraged to car share wherever possible. Our Head of Operations has the role of Net Zero Environmental Champion built into their role. As we are a new organisation, we have still to set proper Net Zero targets and are currently working towards general informal goals rather than a fully approved strategy that includes sustainability data management systems. We're also amiss in that we don't track emissions across the supply chain, but we do operate a policy whereby we do what we say we're going to do and avoid any lip service activities, which often alienate staff, as much as anything else. We do have a buy in from all staff and everyone is committed towards making the organisation better and slowly transitioning then, to Net Zero.

Interviewer 1:56
Yeah. OK. So relatively small company at the moment. You'd probably be looking to implement those initiatives as the company grows then essentially…

Interviewee A 1:56
Yeah, that's definite. As I say, you've a Head of Work Based Learning who has been tasked with this and this… it'll be a slow process and as… as you say we do not have many staff at the moment, but it is now starting to be implemented into all inductions.

Interviewer 1:57
And so… great. Thanks for that. So, from that I got a lot of you know, your approach to delivery, what you do practically day-to-day and also how you encourage your apprentices then… to adopt those green skills. So, there's a lot that you're offering. What is your opinion on the current provision of skills and apprenticeships in general, would you say?

Interviewee A 1:57
Well, we've come across some good online courses, for example, with [local area] University and Colleges in our area, which are finally starting to look at it. But this is mainly in the area I'd say of construction and retrofitting, which is an area that has had a great deal of emphasis, I would say, in [local area] actually, which is how… which is where we are from. From our point of view, aside from the Uni courses mentioned just now by myself, there has been very little drive in Engineering apart from the very good EAL Level 2 Sustainability Award. There appears to be a lot of lip service and most courses apply green training in an ad hoc, incidental manner.

Interviewer 1:59
So basically, we would need more options then you would say.

Interviewee A 1:59
Yeah, definitely. Yeah.

Interviewer 2:00
OK. Have you been involved in reviewing the provision and progress of green skills and apprenticeships?

Interviewee A 2:00
No, we haven't. Not really. We've been involved in quite a bit of training in the areas, but we haven't been involved in actually doing anything about it… about the current provision.

Interviewer 2:01
Yeah. OK. Have you faced any challenges then regarding the current provision of green skills and apprenticeships?

Interviewee A 2:01
Quite a lot. The new Level 3… there is a Level 3 qualification which I haven't mentioned… I've mentioned the Level 2 EAL, but there's also another new Level 3 qualification for dark green learning but is only available from Agored. Therefore, for a small organisation like ourselves,

who, who already have awarding body recognition with EAL, City & Guilds and ILM, to also gain that from Agored is… is quite an expensive process really.

Interviewer 2:04
Yeah, yeah.

Interviewee A 2:04
As I mentioned, EAL have developed a Level 2 Award in Sustainability Engineering and that comprises of one unit being as it's only an award, but it covers the importance of sustainability and it does apply sustainable principles to engineering projects and the sustainability responsibilities of engineers, which is a very good start for anybody setting up to become an engineer. The course includes the definition of sustainability, which of course is not using up the planet's resources. It covers the atmosphere, the greenhouse effect, carbon emissions and air pollution.

Interviewer 2:07
Yeah.

Interviewee A 2:07
It also covers why CO2 matters to the climate change. It recognises carbon sources and carbon sinks and tests engineers, or prospective engineers, on what they feel carbon sources and carbon sinks are. Renewable energy. It trains in conducting energy audits, energy usage in manufacturing, sustainable buildings and social responsibility, so it covers quite a wide area. Although it is only an award… Problem for us, of course, is that we have to market it commercially with no available funding at present time. Funding tends to go to Colleges, but they're slow to react as a result of layers of bureaucracy, and we're hoping to apply for [funding] ourselves. As a subcontractor, we can only deliver funded training in areas agreed by our delivery partner. At the moment, this only involves engineering BIT. The BIT however is useful because when I was talking about the 8 wastes earlier, this is what BIT is involved in… Business Improvement Techniques then, if you like. So this will allow us to have to provide funding, training and implement waste saving, which we feel that we can have a have a good input into Net Zero into the employers, we work with then.

Interviewer 2:13
Yeah. Just to clarify then, the actual scope of dark green apprenticeships is quite narrow at the moment. There's only one real awarding body doing the Level 3, which is Agored. EAL is offering an award, but what you said is you could do something yourselves through BIT, just because it happens to be business improvement techniques. It's not specifically for green, but you as an organisation have decided we can look at sustainability as part of that…

Interviewee A 2:15
Yes, by integrating it into that and as I said, making employers realise that they… that Six Sigma business improvement techniques then all relate strongly to Net Zero. Because if you're reducing waste in any area, you're then… you've seen your carbon footprint reduce in the long run.

Interviewer 2:16
Yeah. OK, that's interesting again, because although you decided to do that, it just shows how narrow the scope is for apprenticeships right now. OK. OK. So, we've sort of touched upon it already but the next question is how do you think that the provision could be improved?

Interviewee A 2:17
Right. Many of the qualifications, particularly in Engineering… most particularly in engineering… I'm not sure about construction because we don't deal with that. But many of the qualifications in Engineering are probably no longer fit for purpose. Some courses look very similar, in fact to what they did 30 years ago, which hardly shows keeping up with technology, let alone sustainability practices, which were not at the level 30 years ago, certainly that they are today. I think that unless working groups draw on experts from all fields and… they have currently brought together so-called light green training… it will remain unfit for purpose. Apart from a few educational organisations like ourselves, may I say, that managed to integrate their own initiative or their own innovative ideas then into light-green training. I feel funding must be made available to less hierarchical training and educational establishments, that can work flexibly and develop strategies that integrate Net Zero efficiently then.

Interviewer 2:21
Yeah, OK. And then in a similar vein, I suppose, how do you feel Welsh government's approach to carbon neutrality could be improved?

Interviewee A 2:22
Well much of what I've spoken about already, particularly in the last question, would answer that, but other than that, I think they really need to sit down with experts in all fields of the courses that they're delivering currently to see what can be integrated into them and then also look at what they want to do for Net Zero and environmental sustainability courses.

Interviewer 2:23
Yeah. OK. Any other comments?

Interviewee A 2:23
No, no, all OK.

Interviewer 2:23
Thank you for your time.

Interviewer stopped transcription

Appendix 4 – Interview Transcript B

3 July 2025, 12:03pm

Interviewer started transcription

Interviewer 0:05
Thanks very much for helping me out. So basically, I'm just going to ask you a couple of questions. It's a semi-structured interview. So, if anything else comes up naturally through the discussion, you know if you wouldn't mind, I just… I'll be asking some questions on that, but essentially we're following the questions that I've, you know already sent to you.

Interviewee B 0:10
OK, no problem.

Interviewer 0:24
OK and oh yeah. And just to say as well, it's completely anonymous. So any reference to yourself or to the organisation is then removed from the final results as well. As we discussed, the meeting is recorded and transcribed for me to refer to later, as I am conducting a thematic analysis. But then… but then it is anonymised and the meeting recording is kept securely on the University's One Drive. OK.

Interviewee B 0:26
Yeah. No problem.

Interviewer 0:42
OK, perfect. So to start off then could you just describe to me how your organisation aligns with the carbon neutrality goals of Welsh government?

Interviewee B 0:52
OK. So in oh, it's…. Oh, I can't even remember this…. 2024, we managed to release a qualification. It was a Level 3 in Energy and Carbon Management. So, prior to that release, [organisation] and [organisation] and also a group of big employers in that industry worked together to develop that. Whilst we were developing that, we also then reflected on our own practice…

Interviewer 1:29
Hmm.

Interviewee B 1:29
In terms of how we can be more sustainable and obviously contribute to the action plan. So with that, we… we made contact with... I'm just trying to think of their actual name… I might have to get back to you on that, their actual name. But they are very big within Wales and they help manage senior leaders and managers to develop their own action plan…

Interviewer 1:57
Yeah.

Interviewee B 2:03
Ask me at the end because I can… I can look into that. So they developed an action plan with us… so they come in, they act like a consultant and advise. We developed an action plan right from senior leadership down to management level down to staff level on how we can contribute to that plan. So with that it is… we started off with simple things that we can do in order to change the offices. We have lights that switch off automatically, so we don't have to do things like that. We have offered car schemes… electric car schemes.

Interviewer 2:23
Yeah.

Interviewee B 2:39
We have… we try to encourage car sharing, remote-working where drive is not necessary. We have looked into… if anybody takes the Energy and Carbon Management qualification, we will plant a tree… for their success, so we can offset some of our carbon emissions. We also have somebody within the organisation that's dedicated to that role. So within that role, she completes the Green Dragon award within the organisation and she conducts surveys on how many miles we do so she can try and track that data to see if we're reducing things that we put in place. So it's… it's fairly, quite new, but we have a big action plan that we obviously need to follow and we're slowly making small changes.

Interviewer 3:22
Yeah.
Yeah, yeah. Is it the climate change committee?

Interviewee B 3:34
No. So, they were there on one of the talks we went to. I will. It's I'm sure it's called Cynnal Cymru?

Interviewer 3:39
Yes, I've heard of them! They… they support organisations to be more sustainable. I think they're a Charity.

Interviewee B 3:47
Have you heard of those? Have I said it right? OK.

Interviewer 3:48
Yeah. Yeah, there's… there's so many people involved, though. I get mixed up as well.

Interviewee B 3:54
There is, yeah. They run courses in terms of how they can support people. So they act as like a consultant. They can come into your organisation and give you ideas… because it's like anything, if you want to change you need to get the buy in of every person, every staff member. And if you start small, the changes are small and they don't realise that there's a huge disruption in the, you know, in the workforce. So they actually help companies, but they also carry out… I think there's probably quarterly meetings where they share best practice.

Interviewer 4:23
Yeah.

Interviewee B 4:32
And everybody comes onto the course and they just share best practice. So we've done a few of those and obviously, we were shouting about the Energy and Carbon Management course, but again it's all learning and it's also being accountable. So we're not saying we're fully green, that's not what we're saying. We're saying that we're making the small steps to make some changes to become better.

Interviewer 4:33
Yeah. OK. Brilliant. And obviously you helped out with the creation of this Carbon Management apprenticeship. What does that look like generally? Only because… you know, we've not delivered it ourselves. We've not looked at it. Do you support apprentices to make their own action plans and things like that or?

Interviewee B 5:01
Yeah. OK. Yeah. So it has to be to their organisation and it has to be that the apprentice can make those changes. So, it's fit for any organisation and where they can obviously have access to data… that you are able to measure if the changes are making an impact. They also need to be able to make changes…

Interviewer 5:12
Yeah.

Interviewee B 5:31
So it could be any organisation where they can gather data for us. I find it's more travel oriented at the moment, so any organisation where you've got staff that travel quite a lot, like ours. That's easy to monitor how much fuel emissions that are carried out on a monthly basis. So that apprentice would have to have some sort of access to that data and the power, so that they can start making those changes.

Interviewer 5:38
Yeah. OK. Perfect. Thank you. The next question then is, you know, what is your opinion on the current provision of green skills and apprenticeships?

Interviewee B 6:02
I think… I think the changes that everybody is making are small and I think that's got to be celebrated. I think a lot of people are trying to become green overnight and I don't think that would happen. It's not a sustainable way to work and I also think that achieving Net Zero… it's a community-based, bigger project, where we all have to do our part together rather than, you know, stamp somebody as fully green, because I'm sure that everybody can do a little bit more. So, when I say community, I think as soon as you have that awareness and not being worried that you're not fully green immediately… it's taking accountability of not just in your working environment, but then also in the wider world. So, at home and things like that. I think we should celebrate the small… the small changes that everybody is making rather than, you know, "we're not planting thousands of trees monthly."

Interviewer 6:58
Yeah, yeah. OK. Brilliant. Because when you talk about it, it sounds a lot bigger and it can put people off, can't it?

Interviewee B 7:03
Huge! It sounds huge. And it does put people off. And it's also when you work with the community and you find out little things that people are doing. Like, I didn't know there were so many eco cafes in [area]. I didn't know anything about it until obviously you get speaking about it. One of them, it's a free service and you come in and you get a coffee and you get your appliances fixed rather than going out and buying another one. Now, I thought was amazing and promoting the... circular method, rather than just throwing something away because it doesn't work. So again, it's just those little quick wins that can be spread and everybody then can say, well, I can do that.

Interviewer 7:29
Yeah.

Interviewee B 7:43
And reduce their measures to zero, because that's quite impossible. You need to start measuring and then obviously slowly make those changes to reduce them.

Interviewer 7:47
Yeah, yeah, I'll have to look into that cafe as well.

Interviewee B 7:56
I thought that was really, quite good. So because anybody can do that, anybody can go, "I'm going to go and take my kettle, that doesn't work, grab a coffee, have a chat." It's sustainable and showing it is easy to do. It's a nice experience.

Interviewer 7:59
Yeah, that's brilliant. This next question, we've touched upon this already… talking about the creation of the apprenticeship, but just in case you wanted to add anything else. Have you been involved in reviewing provision and progress of green skills and apprenticeships and how so?

Interviewee B 8:17
Yeah. So, that came into rotation in 2024. Prior to that, we were working really hard with employers… big employers too. Especially people who would… decarbonisation is a big part of what they do, so they had a lot of input and knowledge on that. We are now looking at higher and lower levels, because I think where we base this qualification, it was a Level 3, because learners or apprentices… they have to have access to that data. There are many who are interested that won't, or perhaps they are the specialise and would want more than the Level 3. Therefore, we think a lower one for knowledge, awareness and also then a higher one for strategic managers would fit. So we're just in talks with Agored where we can come together again and align where that apprenticeship fits.

Interviewer 9:17
Yeah.

Interviewee B 9:33
So there's progression as well, as there isn't at the moment.

Interviewer 9:34
Yeah. Interestingly, part of this research has also been sending out questionnaires to apprentices and people who work in the sector. And quite a few people have fed back that an Entry Level or smaller modules would be better as well. Either as an introduction, or as a form of upskilling.

Interviewee B 9:58
I think it would probably fit quite nicely within the industry. So having a lower level will give that stepping stone for that person to start making those changes and then they can obviously progress up. We've been quite successful in the apprenticeship so far, as we've managed to get direct claims. How we're delivering has been approved and we seem to have quite a lot of interest within local authorities, because I suppose they probably give those specific jobs to somebody within the council.

Interviewer 10:21
Yeah.

Interviewee B 10:37
For management, they just need to have access of running… of the company for access to

their data. But I think once it was launched, people recognised that role would suit this qualification and it has enticed people in, thinking, “OK, I'm not in that job role, but I can still make a little difference.”

Interviewer 11:06
Yeah. OK. Brilliant. So the next question then is, have you faced any challenges regarding the current provision of green skills and apprenticeships?

Interviewee B 11:17
I wouldn't necessarily say challenges. It's more of… because we were quite open and honest and realised it wasn't about being completely green. So, we didn't try and just turn into a green company overnight because that's not going to happen.

Interviewer 11:42
No, of course not. No, I suppose another way I could say it then is when you were creating the qualification or even now delivering it and… continuing to encourage people to use green skills, are there barriers to that delivery?

Interviewee B 11:53
Yeah, OK. I wouldn't say barriers then. I would probably say some challenges of understanding. So Net Zero, sounding like zero… nil. People have that expectation that they need to eliminate everything to achieve it.

Interviewer 12:26
Yes.

Interviewee B 12:36
What does that actually mean? That you… everybody's going to be nil, everybody's going to be zero carbon emissions? How is that achievable?

Interviewer 12:41
Which isn't going to happen, no.

Interviewee B 12:53
Big, big ambition. Unrealistic… that people will be like, “I can't be that.” So I suppose that's probably the biggest challenge that we have is education.

Interviewer 13:10
Yeah. OK. And then in your opinion, is there any way that the provision of green skills and apprenticeships could be improved?

Interviewee B 13:22
I think probably like we mentioned, having all entry levels so somebody can have a go at any level, any role within a working environment. We have qualifications that will fit anybody. When I was helping to write the qualification, I didn't know much myself at the beginning and I think… because I was from industry, it was easy for me to say, "I don't understand, can someone explain in a working scenario… what does that mean?" We all come from different backgrounds. For some it will be, I understand this because it's about their gas bill, or about their own water usage. Some will understand because it's this huge process in a manufacturing plant. I think the Entry Level could be something as easy as examining your gas bill, making small changes in the home.

Interviewer 13:43
Yeah. Having that perspective is really helpful… from writing the qualifications, be able to pick apart how a qualification is going to look. Because you're coming at it then from all angles and you have the perspectives of people from different sectors. OK. Brilliant. And then again, this is sort of similar, but again, if there are any other comments… in your opinion could Welsh Government approach to carbon neutrality be improved in any way?

Interviewee B 14:49
I think we need to get rid of Net Zero wording when talking about these initiatives.

Interviewer 14:53
Yeah.

Interviewee B 15:13
And I think also it… it should be marketed more towards community as well. Smaller qualifications or units that anyone can achieve. The people in industry are making the progress because they have to. Companies are taking accountability, so making qualifications more accessible. It needs to be more community-based rather than hitting people individually.

Interviewer 15:28
Yeah, I get that.

Interviewee B 15:31
Funding, always funding. There is only so much to go around, but carbon neutrality is everyone's future. Every sector, every person, so I think it needs that real priority in terms of funding. Also organisations need to get better at sharing those ideas. That's the sort of thing that will enable good practice to grow, not just put in a measure in place and hoping we're going to get there eventually.

Interviewer 15:54
Yeah. OK. Brilliant. And then lastly, any other comments or any questions or?

Interviewee B 16:05
No, I'm good. Think I have covered what I wanted to.

Interviewer 16:16
Yep. OK, no worries.

◉ **Interviewer** stopped transcription

Appendix 5 – Interview Transcript C

11 July 2025, 08:38am

Interviewer started transcription

Interviewer 0:04
Firstly, I want to thank you for taking part in this research. Just to let you know that I've put on recording and transcription, although only the transcription will be used and this is purely so that I can conduct a thematic analysis of the response. In order to analyse the data, the recording is just so I can ensure that the transcription is completely accurate.

Interviewee C 0:32
There we are. No problem.

Interviewer 0:39
Excellent. All right, so basically my research is looking into Net Zero… apprenticeships specifically. So the first question I want to ask you is how does your organisation align with the carbon neutrality goals of Welsh Government?

Interviewee C 1:06
Oh, that's a good starter!

Interviewer 1:10
(laughing overlaps audio)

Interviewee C 1:16
Yeah. OK. It doesn't align directly to the Welsh Government goals, but we're definitely a part of it… the bigger picture. We've got funding to install renewable technology, which will reduce energy usage in homes.

Interviewer 1:33
Yeah.

Interviewee C 1:43
We've got funding to support the manufacture of renewable technology, which will support low carbon manufacturing ideas. It's hard to put a figure on it though. Every project we do will… will contribute to the reduction in carbon.

Interviewer 1:52
Yeah.

Interviewee C 1:59
The reduction in utility costs, as well as the improvement in, you know, cleaner, greener, warmer homes. So we'll.. we don't know as yet, but by the time we get to our 10,300 home targets, we'll be able to have a rough idea of the actual impact. Like a statistical figure…

Interviewer 2:06
Yeah.

Interviewee C 2:15
Of how much carbon we've saved and how much utility costs we've saved as well. So, we do align to it, but not… we haven't got a direct target which links into it as such.

Interviewer 2:17
No, that's OK. It's just about what you do, you know, and things like that. Because what I found so far in my research is that no one really knows the actual impact in terms of a figure. You know, there are no measurements out there yet. So, what does that look like with you on a day-to-day basis? You know, do you work directly with apprentices or, what does that look like in [organisation]?

Interviewee C 2:51
For carbon reduction of homes, yeah. On a day-to-day we use [area] University, so we work with the School of Architecture. They monitor… at the moment… around 400 houses that we've installed. Daily they're tracking the reduction in carbon and utility usage on those properties, which have been improved. The day-to-day… how we track it in terms of apprenticeship contacts is we track how many apprentices are involved in our sites. There's currently not many involved in our sector. It's definitely a… there's a definite gap there. So we'll have the trades which are looking at lower carbon solutions… installing the fabric of the building… you know, external wall insulation, internal walls. And then we've got traditional trades like carpentry and electric and plumbing and heating. But we are struggling with apprenticeships for the sector because there's not many that fit what's needed in the growing sector that we're in. Most of our traders will have an apprentice or two and we liaise with them and with the training providers to track progress, but definitely a shortage. Yeah.

Interviewer 3:33
Yeah.

Interviewee C 3:49
So day-to-day… actually, more recently my conversations are around how can we change apprenticeship frameworks to match what's needed and how we can increase the amount of apprentices coming in. Funny enough, was in a meeting about this last week…

Interviewer 4:19
Yeah, yeah. OK. And I suppose this leads into this next question. Now, what is your opinion on the current provision of green skills and apprenticeships in your sector?

Interviewee C 4:27
I think it's talked about a lot as green skills, but no one really knows what green skills are and the frameworks within Welsh Government are behind England. We haven't got frameworks directly linked into the green skills sector, which is, for me, renewable technology, so we haven't got it. It's available in England, but in Wales… no.

Interviewer 4:46
Yeah. Yeah. OK. Have you been involved in the reviewing of that provision of green skills and apprenticeships?

Interviewee C 4:52
I've had conversation with the regional skills partnerships. They've tabled their concerns with Medr, who would obviously look into frameworks and how to develop those. The partnership has also had discussions with the Minister for Skills and Welsh Government. Nothing's changed yet, so I think it's the unknown really as well. This sector has grown quite a lot in the last three years and we've got more demand coming for it as well, in terms of installation as well as the maintenance on the back of it.

Interviewer 5:08
Yeah.

Interviewee C 5:11
And it's a little bit unknown of what to do and it's just taking too long to change. I think we've definitely tabled it with Medr and with Welsh Government so… here's hoping.

Interviewer 5:23
Yeah, yeah, OK. And we've already touched upon this, but just if you have anything else to say, have you faced any challenges regarding the current provision of green skills and apprenticeships?

Interviewee C 5:45
Yeah, lack of awareness as well as what I said. I think it's the skills to deliver as well. So, even if we did develop the qualifications, just getting the assessors and the right tutors in place to be able to deliver… the funding structure for Colleges as well, that's another challenge.

Interviewer 5:59
Yeah.

Interviewee C 6:03
They're [Colleges] only challenged to deliver what they can, rather than develop new frameworks in a sector that's growing… too slow to react. And then I think the funding structure also means we've got Colleges competing against each other rather than working together. So, as a region we could

have really good training resources and have really good quality training… one between the Colleges in the area, rather than having four really poor options in in four different Colleges in the region.

Interviewer 6:29
Yeah.

Interviewee C 6:33
So I guess challenges around funding, the structure, the workplace learning contract doesn't help with apprenticeships. It's not flexible enough and yeah, it takes too long to change anything.

Interviewer 7:26
Yeah. Yeah. Again, you've already answered this question really, but I just want to check if you want to say anything else. So how do you think the provision of green skills and apprenticeships could be improved?

Interviewee C 7:47
That's fine. Yeah. I think it needs its own focus and I think we need to split green skills up into different sectors and not just put it under one umbrella. At the moment they're looking at green skills for, you know, it could be retrofit assessor, which isn't anything to do with physical construction. You've got all the fabric of the building. You've got the trades involved, and then you've got the solar panel, battery and heat pump installations. It needs to be broken down I think. So take away the green skills and have you know, for example, low carbon heating engineer qualification. So they deal with all heat pumps.

Interviewer 7:59
Yeah.

Interviewee C 8:11
Or perhaps have all in one where you've got a renewable qualification with PV [photovoltaic] battery, heat pump… everything in one qualification, because that's what's needed. And I think that, yeah, it's too generic as green skills, it needs to be more specific in terms of what trade they're actually going to be doing in this growing sector.

Interviewer 8:39
Yeah. Yeah. And again touched upon this already, but you know, what do you think Welsh government could do to improve like carbon neutrality in your sector?

Interviewee C 8:47
I think they need to work with employers more. I think your biggest carbon footprint at the moment is contractors working cross-border. There's so many things. Procurement is one. So, the way Welsh

Government and the local authorities and social landlords procure allows a lot of contracts to be lost over the bridge.

Interviewer 8:52
OK.

Interviewee C 8:54
So we've got installers coming from Birmingham to do contracts in South Wales and then we've got our contractors in South Wales not able to get contracts. So they're doing work in Birmingham and there's… so many things that are wrong with the way it's set up. I'm just… let's focus then on getting the right qualifications available for this. With, you know… with almost like a five-year strategy to get the installer network better and trained up, but also then looking at our long-term maintenance schedules, which are coming in so that we're preparing proactively for demand, not reacting. The problem is a lot bigger than what I can put into words, sorry. So yeah, better… better frameworks, better qualifications, improve infrastructure for contractors…

Interviewer 9:20
Hmm.

Interviewee C 9:23
Better procurement and I think more support and realistic support, not just the tick box support but more support for the businesses in the area as well.

Interviewer 9:30
Yeah, yeah, OK. And then just any other comments?

Interviewee C 8:38
I think I've said a lot. Now I want to sort it all out. Yeah, because nothing changes.

Interviewer 8:42
[laughs]

Interviewee C 8:45
So yeah, the funding side for me is a big thing too, because the Colleges sort of control the money. They've got the FE money for the sector, they've got the workplace learning money for the sector and they've got no responsibility, say for a full-time learner.

Interviewer 8:57
How does that work?

Interviewee C 9:07
If you've got an electrical or construction learner, only 40% actually go into the sector, so the Colleges are only targeted on getting them through that qualification. They get this certificate and leave, that's their money, job done. There should be more on the College to take responsibility, to put them into work following that qual.

Interviewer 9:21
OK.

Interviewee C 9:23
So they should have more responsibility to engage with employers through their course, put them on placements through their course and set them up for an apprenticeship at the end. You know, the same with the workplace learning contract. If you take away work-based apprentices… the health and social care, the business admin, advice and guidance, if you take away all of those the apprenticeship has failed. This has been poor… poor I would say for the last five 5-6 years. And you know, if they're [the College] short on contract, they fill it up with, you know, members of staff on apprenticeships and everything else. So we need to get them to be… be more responsible for the money they have. More tightly monitored I think.

Interviewer 10:13
Yeah, yeah. Somebody I interviewed a couple of weeks ago said very similar. There are pockets of good practice all around Wales, but nobody's talking to one another, you know, no one's working together. Colleges, employers and so on.

Interviewee C 10:25
Yeah, I agree. That's what Medr is supposed to be doing. But whether it'll happen or not, I'm not… not sure, you know. There's doubts on it, but yeah, it needs to be brought together. And with the overall purpose of… giving people the right skills, but also support them to get into the right jobs.

Interviewer 10:31
Yeah.

Interviewee C 10:47
It's been like… after 12 years and nothing's really changed. So unless you get the ones with the financial reins… to be responsible for it and accountable for it as well… financially it's, you know, it's not going to change. There's so many opportunities there. It's just not taking it and… you know, we've got so many Colleges looking after work-based learning contracts. That's not efficient. That contract should be with private training providers with better skills able to move quicker and who are more relatable to the sectors they're in. Less control…

Interviewer 11:08
OK.

Interviewee C 11:23
For the Colleges, more for private training providers who specialise in sectors and can actually deliver on the skills employers need. What do you think?

Interviewer 11:39
(Laughs) For the purposes of the study I can't comment my own opinion, but we can have a chat about it if you want.

Interviewee C 11:42
Sorry!

Interviewer 12:01
No, no! It's all interesting and it's important to hear from employers and from the private and tertiary sectors because that's what I'm looking at… you know, what are the problems? What are people's experiences and what do they think?

Interviewee C 12:08
Yeah. OK. On a bit of a tangent I am but I've been in the sector now… I forget… a long time. Long enough to have experienced through the College, through private and through different local authorities. [Local College] have a… Net Zero School… they announced recently. It sounds good, but what is that? What does that even mean? You know, that could be… I think they should scrap all of that and just focus on sectors, not ticking boxes. The Net Zero School was listing courses like Health and Safety, but that's not a green course. It has green in it, but they were selling it like it was Net Zero. I find it… lazy. I find it just to be, you know, a tick box.

Interviewer 12:25
I can understand that.

Interviewee C 12:40
It's not helping our skills shortage or helping people come into the sector or, you know, supporting employers with their recruitment and their up-skilling strategies. It's basically making money on commercial training by calling it Net Zero.

Interviewer 12:46
Yeah.

Interviewee C 12:57
I find that's… that's an old Welsh Government and College philosophy and we need to move away from that and you know, get the specialist training companies involved instead. They manage the contracts better… there's better relationships with employers. Have you seen the most recent attainment rates? One of the biggest contract holders is around 70% and the smaller companies, the private companies, they're 85 plus all day long.

Interviewer 13:16
Yeah. Can I just ask. You're currently working with an organisation that works in the construction sector and you're… you're moving away from fossil fuels in homes. Using PV batteries, solar and so on… that is right? Is it?

Interviewee C 13:22
Yeah, pretty much got it.

Interviewer 13:23
If you don't mind me just asking, what is your previous experience in apprenticeships and with Colleges?

Interviewee C 13:30
No, no, absolutely! I have worked with Colleges… specifically, apprenticeships. Can I say? I'll just… I'll just say I was higher management then. Managing large contract value, working with Colleges, working with local authorities. Separate to that, I have previously worked with local authorities on other things. Still working with apprentices now, as you say, but in a different capacity. So, I feel I have a well-rounded view as I have looked at this from different sides.

Interviewer 13:34
Yeah, yeah. I didn't want it to come across like I was saying any different but I felt that context was important for the results, you know. You've worked in all of these areas.

Interviewee C 13:36
[Laughs] don't worry! I agree with that… I get frustrated because things don't seem to change. I'll say one more thing. I can… I can guarantee the tenders, the applications for the tender… the last round… I can guarantee there was favouritism in Colleges because that was a strategy… part of the strategy for Net Zero. They wanted… Welsh Government wanted to have the Colleges involved. Again, frustrating because there seems to be less accountability. Attainment numbers, referral numbers, numbers going into sector were down last year… the work-based learning contract was down. Yeah, everything's down. A million under spent for this financial year.

Interviewer 14:52
Yeah.

Interviewee C 14:57
One million, but they [work-based providers] were allowed… first time we've ever heard of this… that they're allowed to carry it into next year.

Interviewer 15:03
Yeah.

Interviewee C 15:04
Which I've… I've never heard of that before. Normally, you get claw back and Welsh Government take it back. So, I think that shows it's… it's an underspend right across the whole sector.

Interviewer 15:10
Yeah.

Interviewee C 15:21
The SMEs [small-medium enterprises], which traditionally take on aren't going to take a lot of apprentices I feel, because of funding issues. I did suggest something recently, at one of the skills meetings and I think I got… they frowned on me on it. What's the rate now for an engineer framework? Let's say about 14 grand for an apprentice. The training provider gets… you know that's quite a lot of money for a… for a Level 3 for one day a week in teaching, the rest in placement. So, you're looking at 28, maybe 30 days of teaching really, on average. I know you've got the assessment and the safeguarding part of it… but there's nothing for the employer. So, it's what I said is… if you if you want to prioritise sectors, then rather than just having a three grand employee incentive share, share out the, you know, the funding with the employer and get that working relationship with the employer and training provider even closer.

Interviewer 17:20
Huh. That's interesting. Yeah.

Interviewee C 17:37
I think that the financial support for employers is the only way that you're going to increase the apprenticeship numbers in certain sectors. So yeah, I got shot down for that.

Interviewer 17:41
Yeah.

Interviewee C 18:05
And you know, the employers got them on there… on site for four days a week. They have to pay them holiday pay, support them, supervise them. It's a big expense for some of the small employers with rising costs all of the time.

Interviewer 17:41
I hadn't thought of that!

Interviewee C 18:05

Yeah. Yeah. I think I'm done now. I've ranted at you long enough. Was that OK?

Interviewer 17:41

Really, not a problem! Really interesting to get your thoughts on this. Has given me a lot to think about, so I do thank you for your help with this.

Interviewee C 18:05

Great.

Interviewer stopped transcription

Appendix 6 – Interview Transcript D

14 July 2025, 11:14am

Interviewer started transcription

Interviewer 0:07

Firstly, I want to thank you for taking part in this research and just as a reminder, I've put on recording and transcription of this chat. I'll only be using the transcription, but need the audio to double-check it's correct. The reason I'm doing this is to conduct a thematic analysis of the… of the interview. So I can analyse the findings and compare more effectively.

Interviewee D 0:07

No problem. Thank you.

Interviewer 0:07

OK. So the first question is, could you describe how your organisation aligns with the carbon neutrality goals of Welsh Government?

Interviewee D 0:08

Right. I work for [company name] and we're a private training company that deliver apprenticeships. Primarily in engineering, although we have also delivered qualifications in management and health and social care. We're subcontracting through a larger organisation for the mainstream quals. At this time, we also deliver commercial training as well to organisations. In regards to carbon neutrality, there's smaller aspects of it and then the larger aspects. So, I'll start with the smaller aspects now as an organiser. We have a duty to try to limit our carbon emissions as much as we possibly can. Now there's ways that we can do this just in our day-to-day working. So in line with Welsh Government initiative and digital strategy we try to limit the amount of paper that we use, the printing that we do currently. Also, the majority of our employees have either electric vehicles or hybrid vehicles… to reduce emissions that way, because there's a lot of travel involved in in this role. We also utilise hybrid working approach so employees can choose to go into the office or work from home. Again, that reduces travel time, but also it can reduce the consumption of energy within the office space as well. That's sort of the smaller aspects of it now in terms of what we deliver. A lot of the apprenticeships that we deliver are in line with green initiatives, so a lot of the engineering, for example, utilise green skills in order to fulfil their roles. The engineering assessors will, you know, encourage green initiatives through teaching on both a general and specific scale. Now this is either through discussion, through the progress reviews. This can be, for example… another initiative of Welsh Government is to encourage soft skills within the workplace. This is, you know, things that are occurring within the world such as in the news, global citizenship and things like that, and part of that would include green initiatives. Where the opportunity arises or something big has happened within the news recently, this will be discussed with apprentices. We'll gain their comments on it as well. What they think of situations. But this encourages further thinking and then that would be specifically around green initiatives. We're trying to broaden apprentices' thinking around these

concepts and then practically the engineering companies themselves will also have their own green initiatives. When assessors go out to, you know, observe or to conduct knowledge questions or discussions and things like that, they will also deliver green units as well. So that's encouraged that way… trying to think if there's anything else really.

Interviewer 0:16
Honestly, take your time.

Interviewee D 0:16
I don't know much about the practical aspects of it. I know that it's occurring throughout… so within my role as Quality Lead, essentially you know, I've discussed these units with the assessors. They're very present within the engineering sector and I know that people within the engineering sector are taking strides to, you know, to reduce their carbon emissions all the time, not only because it's green, but also because of the cost saving as well and the waste management.

Interviewer 0:18
Yeah.

Interviewee D 0:18
Oh, that's something that I just thought of. One of the commercial programmes that we deliver, but this also comes under a lot of what the apprentices do as well is we teach Lean. Now, part of Lean is waste management and this can be through things such as motion or mobility. So, this can be things such as reducing travel time or reducing somebody having to move from place to place and make processes more lean and efficient. This can also come under carbon reduction as well, because less energy is expelled as a result of efficient working, logistics and processes. A lot of the apprentices will do BIT, or business improvement techniques, which would also come under Lean, so they're also, you know, looking at ways to become more efficient, which then naturally does reduce carbon production as well.

Interviewer 0:21
Yeah.

Interviewee D 0:21
I'd say that's pretty much it for the day-to-day and say for our role then essentially. We offer Level 2 apprenticeships specifically in Environmental Processes and then Levels 2 through 4 for Engineering in Manufacture, Electrical, Mechanical and those contain elements of green skills.

Interviewer 0:22
OK, So what is your opinion on the current provision of green skills and apprenticeships?

Interviewee D 0:23
Well, from conducting our own sort of investigation as an organisation and through talking with the assessors and talking as a team as well provision could certainly be improved. I know people are taking strides to improve things, but what I found is it tends to be in pockets… I mean smaller sections of people, or areas who are doing great things but then it's not standardised. So, there's a lot of people out there who are doing their best to have… come up with a carbon management plan. And are, you know, encouraging this throughout their organisations and through their apprenticeships and things like that. However, it seems like everybody is doing their own thing, so there's not a lot of sharing of best practice. The other thing that we've come across is that actually apprenticeships, or what we would refer to as dark green apprenticeships… so these are ones that are purely focused on the development of green skills. These are limited at the moment. I'm aware of two… at present. One through Agored and one through EAL. You know, I'll have to look into the other awarding bodies, but the point still stands that there are not many of these dark green apprenticeships available currently. And the depth as to which they're being utilised is also, in my opinion questionable as well.

Interviewer 0:26
OK.

Interviewee D 0:26
So, just as an example. Now, Engineering is one of the sectors where carbon emissions are huge. We're talking across manufacture, you know, construction and things like that. Electronics. They all have a large carbon emission level to deal with anyway. So, where we're seeing the strongest initiatives or the greatest impacts is within the Engineering sector. Now, you can also do a green apprenticeship if you're working in an office. Not to take away from these people, you know, but these are small wins. All right, so some of these apprenticeships, I don't know, it seems in my opinion, that they're being treated like a tick box exercise essentially. So anyone can do a green apprenticeship. But what does it actually mean for carbon reduction? Again, don't get me wrong, small wins if everybody is doing this across all organisations, across all sectors it's going to have a positive impact, but I do feel that at the moment the deep green or dark green, sorry, apprenticeships are limited at the moment. We need more specific apprenticeships say for electric battery installation and maintenance, or heat pump engineer. The awarding bodies aren't doing enough then to provide these options and Welsh Government should be pushing that. Now, in terms of what we would consider light green, I think everyone is doing their bit to an extent. You know, everyone is encouraging soft skills… that is an expectation from the Welsh Government to providers. Like I said, it naturally occurs throughout a framework or should be.

Interviewer 0:31
Yes.

Interviewee D 0:32
Engineering apprenticeships, even if they're not say, purely about development of green skills…

these are being encouraged, at least from our perspective. I've previously worked in a few Colleges and I didn't see it so much, so whether or not that's being covered across all providers… I wouldn't know, but certainly from our perspective, it is being, you know, encouraged. I would definitely say that we could be looking for more opportunity and it is certainly a priority as it impacts our entire future, no matter what sector you are in. So, more opportunities to provide these apprenticeships and you know, certainly there needs to be a review of how effective they are currently.

Interviewer 0:35
Brilliant. OK. The next question then is, have you been involved in reviewing the provision of and progress of green skills and apprenticeships?

Interviewee D 0:36
Me personally, no. It's something that we do discuss with organisations that we work with, with providers as well and the larger providers. So for example, the… [provider] that we're subcontracting with does have the ear of Welsh Government to an extent. So, you know the way we do it is vicariously through them. When we're pushing for green initiatives, we are discussing this with, you know, these bigger companies. Me, myself though I have not been, you know, involved in the revision of green skills and apprenticeships, unfortunately. Although we have pushed what we can offer to this provider and they have championed us, partly because we have that specialist knowledge, I… well, at least I hope so! No, we have. Our assessors are very experienced Engineers, from industry and one of them more recently from an employer we work with and he's brought that angle with him. You need to stay on top of current trends.

Interviewer 0:39
Absolutely! I agree. OK, great. Next question is, have you faced any challenges regarding the current provision of green skills and apprenticeships?

Interviewee D 0:39
Yeah. So, I previously mentioned the actual provision itself is… is lacking in my opinion. I think there is scope there to provide more opportunities for dark green apprenticeships, or you know, to regulate the provision of light green skills. I'm not sure how effective that's been, because as far as I'm aware there is no public research on it just yet. Now organisations might look be looking at it themselves, but like I said, there's these pockets of best practice that aren't being shared at the moment, so any organisation is only going to know how well they're doing, or those within their immediate networks. Essentially, you know, they could benchmark against other organisations, but again, that information right now is not readily available as far as I'm aware. And the other biggest challenge that we have now is… we're a little bit biased here, because we are a relatively small company and we do subcontract through the larger providers. However, I would say one of the biggest challenges is funding. So, what we find is some of the smaller providers, or like some of the private providers tend not to be… tend to miss out on funding, where perhaps Colleges are being favoured and you know… it's a shame really, because again, if that funding was more evenly distributed, or perhaps the Welsh Government could create an initiative where the companies that are pushing for green initiatives are rewarded, you know… It may seem cynical, but I feel that would

work as well, whether it's to do with carbon reduction, or whether it is to do with say pushing these green initiatives, making the effort, going the extra mile to provide this education and these opportunities for apprenticeships. I think that would be a really good way forward, but yeah, challenges are definitely funding. We get around this to an extent as we can apply for [local authority funding] with the emphasis being on bettering the community, particularly with [closure of local business]. But with limited frameworks, it's up to us to plug the gap ourselves and… a bit selfishly, maybe… we're not having that recognition. There is no recognition currently, there is no official benchmark. Just, this is the expectation of Welsh Government… vaguely. Go and do it! I'm trying to think of anything else…

Interviewer 0:45
No worries, take your time.

Interviewee D 0:45
Oh, I am aware of a programme with [local University] where they're offering… they're offering Level 4 modules around Net Zero, carbon reduction, circular economy… introduction to electric vehicles and things like that, so people can apply for that. And I was made aware of that through our partnerships. That's the only one I'm aware of at the moment that is freely available. So you know, it could only be a good thing to provide more of those opportunities, funded, but again, it would be nice to see those with the expertise, in the industry, other than Colleges… some funding being directed to like private training companies who, you know, can put the time towards something like that.

Interviewer 0:46
OK.

Interviewee D 0:47
I'm trying to think if there's anything else, there's so much to say, you know? I've got my notes but my brain needs a second.

Interviewer 0:47
[Laughs] Please don't worry! Anything is useful so we'll just go by when you feel ready to move on. There's no rush.

Interviewee D 0:48
Brain fog, dear me. Another thing I suppose… the… the current understanding out there of Net Zero and carbon reduction. I've personally felt a lot of companies again pay a bit of lip service to the concept, because it is a buzz word, it is gaining traction. So perhaps apprentices aren't getting the full exposure to this topic that perhaps they could be getting. Now, again, this can be encouraged through the assessor, but if it's not being… if it's not being fed to them through the company [employer] as well… if this is not a… usual practice that they utilise regularly, then that's a missed

opportunity for these skills. And again, that's something that I've personally observed through working with other companies and some… this sounds terrible, but some Colleges too. I promise I don't have it in for them, but I think they lack that motivation to include this concept.

Interviewer 0:51
Could you expand on that slightly, so what do you mean by that?

Interviewee D 0:51
[Laughs] Colleges are guaranteed work-based and FE funding every contract and it's the private companies that have to fight and justify their place on the… leader board, if you will. But coming from… having worked in Colleges for 10+ years you see a lot of lip service. I have… I'll give an example. There's one I used to work with and they had what they called an 'Eco Code', so when they engaged with apprentices or when they engaged with companies they would make them sign this Eco Code and it would state things like, you know, "we pledge to reduce our carbon emissions" or, "reduce our paper consumption." But I observed several people signing this form, they never read it and more often than not, managers and assessors wouldn't discuss it. It wasn't covered as part of the vetting, they just signed it, which is so… it's a tick box, it's frustrating. It's not genuine. It was just something they had to sign to get people on board, or to get programmes underway, you know, again, lip service to these concepts. Now, in industry, if we look at… a lot of the employers we work with are ISO [International Organisation for Standardisation] Certified, because they have to be. This includes processes, so Lean principles and waste management, carbon reduction goals and so on. These organisations will only work with other organisations who have that minimum ISO Certification, dependent on the standards of that industry. Now Colleges are meant to be providing a workforce for industry… I can tell you now, they are not looking this deeply, but perhaps they should be, because it is an expectation. So, I'm seeing a lot of that.

Interviewer 0:55
Yeah, OK.

Interviewee D 0:56
I'm seeing a lot to be fair, not to be completely doom and gloom… I am seeing things change, I am seeing perspectives change. Things are happening all the time and only hope that that trend continues, but you're not going to get real change, or real shift until it is backed up by policy, by infrastructure.

Interviewer 0:57
Yeah, of course. OK. We sort of touched upon this already, but in your opinion, could the provision of green skills and apprenticeships be improved and then how so?

Interviewee D 0:58
Yeah, it goes back to, I think, Awarding Bodies need to do more. They need to put more dark green apprenticeships out there, more opportunities. The ones that I'm aware of… I believe… are Level 2 and Level 3. It would be good to, and of course the [local University] initiative I talked about earlier, delivering a Level 4, delivering entry levels for workers who perhaps just need to upskill, or who are currently at a lower level, but it gets them thinking and prepares them for a higher apprenticeship. It would be good to have more entry level options, engage people sooner as well, so not just apprentices… you know, a lot of them can be people who are already in the workplace and have years of experience behind them… but also engaging with people who, well, then eventually come on to do their apprenticeship. So, such as school children, school leavers, NEETs and things like that, you know… more could be done to engage them earlier on.

Interviewer 1:02
Yeah.

Interviewee D 1:02
To start them thinking along these lines as well and to have a greater understanding of green initiatives. Again, the funding… you know, to target funding to reward like where people are showing initiative, or the terms and conditions of the grant stipulate innovation in carbon reduction, going the extra mile and to encourage companies to do better. Essentially, I think that could be a good thing as well. I think that it's… yeah, that's it in a nutshell.

Interviewer 1:03
Again, we've touched upon this, but in your opinion, could Welsh Government's approach to carbon neutrality be improved and how so?

Interviewee D 1:04
Again, I think it comes down to funding. Again, I'm going to sound a bit biased, but I think that funding is heavily favoured towards Colleges and maintaining a status quo. I think there is missed opportunity for other providers to utilise these funding streams… providers who are closely working with employers, who are going the extra mile and are not just focused on, "let's get this qualification", but also to stretch and challenge apprentices, to tailor their learning to their sector and to their employer. So, I would only encourage, you know, further access to things like that… in terms of green initiatives, anyway. I don't think there is a lot of accountability with the Colleges. They know they're going to be funded, so there's no motivation for improvement, you know…

Interviewer 1:06
OK

Interviewee D 1:06
They need a bit of a shove [laughs]. This is anonymous, isn't it?

Interviewer 1:07
[Laughs] yes, of course!

Interviewee D 1:07
Dear me.

Interviewer 1:07
Any other comments?

Interviewee D 1:08
You know, allowing people to develop courses, commercial training, things like that, that can help the progress of green skills. Better infrastructure, celebrate best practice. I think that's it.

Interviewer 0:07
Thank you for your time.

Interviewer stopped transcription

Appendix 7 – Interview Transcript E

17 July 2025, 03:17pm

Interviewer started transcription

Interviewer 0:04
Brilliant, okay. So again, thanks so much for giving me your time today. We've already discussed that the interview will be transcribed and recorded. So, if you wanted to start off, could you just give me a little bit of background about what it is that you do?

Interviewee E 0:16
Yeah. So my name is [redacted]. I'm the Head of Sustainability and Innovation with [organisation], which includes [sub-organisations]. We are part of a large housing association in Wales and we have about 24,000 homes that we manage. We also build around 7 to 800 new homes every year across that sort of geographical area. And that's really where my role is. It's to inform, direct forward, the low carbon specific justification of our new housing projects, some of it's very standardised and but then there's equally a very large number of projects which are completely unique, bespoke and therefore I work with internal teams as well.

Interviewer 0:52
Yeah.

Interviewee E 1:07
That would be… such as, project managers, but also architects, engineers, contractors, their apprentices and suppliers to help inform choices that we're making on these. The design of our new homes and places. So that's… that's my role. My background is as an architect, I qualified as an architect many years ago.

Interviewer 1:19
Yeah. OK.

Interviewee E 1:25
And… and I've been working in the my current role for 18 years, but obviously with a… initially having qualified as an architect.

Interviewer 1:36
Yeah. Oh, brilliant. Now, that's really interesting. To start off then, could you describe to me how your organisation aligns with the carbon neutrality goals of Welsh government?

Interviewee E 1:54
I mean... I'm going to make an assumption that, you know, the carbon neutrality goals of the Welsh Government are a commitment to be 0 carbon by 2050 in alignment with the Paris Agreement, which is the big, I suppose… the big picture.

Interviewer 2:06
Yeah.

Interviewee E 2:11
And using various policies and legislation across the whole of that area to drive forward that. So, for example, the Welsh Government has planning devolved to it and you know the town and country planning, policies, legislation and so on… is introduced and approved by the Welsh Government, as is the building regulations in Wales, which is a very useful instrument to reduce carbon. And I guess, you know, in the context of [organisation] as a house builder, we are very much aligned to the policies that you know… there's so many. For example, several years ago the Welsh Government brought in sustainable urban drainage, which seeks to improve the way that surface water… rainwater is managed on the new developments, to ensure that it has a lesser impact on the environment and on people's lives. You know, flash flooding can be, as you can see from the news, can be extremely dangerous.

Interviewer 3:13
Yeah.

Interviewee E 3:26
Dangerous events, both in terms of ruining people's lives and in some cases threatening people's lives, as well as threatening nature. The impact of new housing developments on the environment is reduced by implementing these procedures from Government. So this is all about slowing down the rate of surface water run off by holding water elsewhere on sites in the form of ponds and other water features, or using techniques like green roofs or green water gardens that absorb that moisture.

Interviewer 4:00
Yeah.

Interviewee E 4:02
We have about nine years of experience doing that. Another way and obviously the Welsh Government provides grants for house building which we… I don't want to sound like we're banging our own drum, but we take up more Government grants… than any other single organisation due our size.

Interviewer 4:31
Of course. Yeah.

Interviewee E 4:39
The Welsh Government's goals of carbon neutrality are also contained within the rules of that grant, so there's a document called WDQR 2021, which stands for Welsh Development Quality Requirements.

Interviewer 4:47
Right.

Interviewee E 4:56
Introduced in October 2021, which sets out what the government requires of developers receiving their grant monies. So this, on top of building regulations, on top of planning… it's an additional requirement and the terms that would come with a grant to build homes in Wales and of course, we then implement those. So, for example, all homes built using that grant for the last four years have had to be fossil fuel free. So, no gas, no oil, no coal, no LPG.

Interviewer 5:24
Oh right, yeah.

Interviewee E 5:28
To heat… to provide heating and hot water… it's all got to be fossil fuel free, so obviously we've been implementing heat pumps and solar panels and batteries and all sorts of other technologies to deliver our homes fossil-free.

Interviewer 5:35
Yeah.

Interviewee E 5:46
And in addition to that, all new homes must meet EPC, which is the Energy Performance Certificate that every new home has to have. Every single new home in the development will have to have its own unique EPC, and it must reach a minimum score of 92, which is the threshold to be given an ace… an A grading, if you like. So most members of the public understand that that a means very good, you know, but they may not understand that to get that you've got to go through like a modelling software in order to model the every unique house in terms of its position, orientation, the thickness of the walls, what the walls are made out of, the heating systems within the home and other… other considerations like solar panels and so on. So yeah. So yeah, in summary Welsh Government requires these things to be fossil fuel free to be EPC compliant and actually… it's even stipulated and an enhanced set of figures for the building fabrics or the walls, the roof, the floors, the windows and doors must achieve a higher energy efficiency rating than the standard building regulations. The reason I explained this is because we… that's how we now build our homes.

Interviewer 7:02
Yeah.

Interviewee E 7:16
And I've drafted… or not drafted, sorry… I've authored a strategy to explain how we're going to achieve the Welsh Government's carbon neutrality goals in many other ways as well. So, I call it the Decarbonisation Strategy for [organisation]'s New Hubs.

Interviewer 7:31
Yeah.

Interviewee E 7:33
A long title, isn't it? But it's a document which I review and rewrite every three years. So, we don't just sort of write something, put it on the shelf, so it's rewritten every three years. It contains an action plan of things that we need to do more of.

Interviewer 7:36
Yeah.

Interviewee E 7:50
So, in addition to the things that I've just mentioned to you, planning, building regulations and grant requirements, we have it within our own selves to improve things beyond that. This is all about sourcing locally our materials, making sure that we're looking for materials which have got low embodied carbon in them, trying to make choices around things like materials and the locality of the materials that we're using. Logistics, you know?

Interviewer 8:13
Yeah.

Interviewee E 8:22
Using local… locally sourced labour in increasing the amount of the construction process that's undertaken off site in factories. Umm, and you may ask why we do that? I think off site manufacturing, especially using local contractors… you're far more likely to build to the right standard than when you're building outdoors. Using dry components to a very exacting tolerance of performance, because the building's performance over the long term can be affected if you don't build it… if you don't build it to a very good air tightness and standardisation.

Interviewer 9:41
Yeah.

Interviewee E 9:41
Another Welsh Government initiative which has been brought in through the planning function is something called Net Gain for Biodiversity, so that was brought through in the last few years. It sort of mimics something that's been done in England, but it means that for every development that you build over and above, say, a single home, you must now demonstrate how you're going to improve the biodiversity value of that site.

Interviewer 10:05
Right.

Interviewee E 10:19
Compared to its original biodiversity value, so you could argue that a sort of a brownfield piece of land… it's quite easy to demonstrate that you've increased the biodiversity. If you not only build houses but plant lots of trees, or maybe put water pieces in.

Interviewer 10:22
OK. Yeah.

Interviewee E 10:37
It's less difficult to demonstrate how you're going to improve biodiversity, say, if you're building on a very tight city centre site where you're putting in a maybe high rise building, or conversely, if you're building on a greenfield site where you've got to demonstrate how are you going to improve the biodiversity of that site? You know, by introducing houses onto it. So, essentially it involves very accurately measuring what the existing biodiversity is, then putting a plan in place and demonstrating with the development how you're going to improve that biodiversity. So that's quite a challenge.

Interviewer 11:19
Yeah. That's interesting. I'd not heard of this initiative before.

Interviewee E 11:31
What else were we… hang on, let me re-read. Align and deliver the Welsh Government's carbon neutrality goals. Yeah, so, other things like reducing water consumption. It's a startling fact, actually… water consumption is very strongly linked with carbon emissions because for every litre of water that's brought to the tap, the amount of carbon emissions that are associated with that is quite startling. You know the purification of water, or the treatment of water and its conveyance to the tap can actually cost a lot of carbon emissions, therefore reducing water consumption in the home can not only save carbon emissions, but also save people on water bills, especially if the properties are being metered and so that's a big part of what we're trying to do now. Introducing water efficiency measures not only into new homes, but into homes that have already been built through retrofitting.

Interviewer 12:18
Yeah.

Interviewee E 12:34
Undetected leaks… things like toilets and other pipe work that needs fixing. Introducing water sanitation features can improve carbon neutrality as well. So yeah, I think you know and, it's a really important thing as well, is that we provide our tenants with really good information about using their homes because it's astonishing that when people… the vast majority of people, still live in homes with gas and heating. I think it's somewhere between 80 and 90% of existing builds.

Interviewer 12:59
Yeah.

Interviewee E 13:25
You know, there's an opportunity to reduce carbon emissions there, but if the person who's moved into the home isn't supported about how to use the home, then there's a bit of danger that they could end up using far more energy. And not only would it cost them more money, but will actually result in more carbon emissions. So, a very important part of what we do to deliver the Welsh carbon neutrality goal is providing tenants with information about how to use their homes efficiently.

Interviewer 13:49
Yeah.

Interviewee E 14:04
Through doing all of the things I've just mentioned, probably a whole lot more than that really. And other things you know… carbon emissions are not only emitted by the new builds, but [organisation]… they're a major employer. 3000 people I would say, you know, making car journeys, consuming electricity at various offices, buying paper and so on.

Interviewer 14:22
Yeah.

Interviewee E 14:37
You know, eating food at our offices, you name it. You know anything we do is being looked at. And so there's an overarching strategy and we do our annual carbon report and submit that to our board. But we also submit it to our partners. I'll give you one example. This morning, [local authority] asked us for our annual carbon report, so that they can see the amount of carbon we're emitting, because we are actually one of their... I think we're one of the largest spends, if that makes sense.

Interviewer 15:13
Yes.

Interviewee E 15:13
So, of all the money and services that [local authority] procure… what they pay us for and therefore, our carbon emissions are kind of their carbon emissions. We are accountable to them, you see?

Interviewer 15:18
Yeah.

Interviewee E 15:52
So, it's a bit of a long-winded question… um, answer for you, but because I know you're recording it, it'll be nicely summarised for you. I hope.

Interviewer 15:56
Yeah. No, that's brilliant, because a lot of my research so far around the sector has been quite, you know… a general look at carbon neutrality. I don't really have that in-depth sort of knowledge that you're able to provide. This is why I'm speaking to you… the sector is so vast, you know? So, a lot of what you're saying is really, really interesting to hear about. I'm learning a lot from this personally as well as for the research.

Interviewee E 16:15

Oh good. Let me know if I'm getting carried away.

Interviewer 16:18
Not at all. That's perfect, thanks. And now a big part of, you know, Welsh Government's pledge to Net Zero is the development of green skills and apprenticeships, because we need to be, you know, training people with the skill set to meet this demand. So, on that note, what is your opinion on the current provision of green skills and apprenticeships in your sector?

Interviewee E 16:29
I think it could be better is the overarching point I'm gonna make. It could be and has to be better. We've built, you know, hundreds of low-carbon homes over the last decade, and especially in more recent years we've built them using locally based contractors who have tradespeople, plumbers, carpenters, brick layers, roofers, plasterers, etcetera… that then obviously work either directly for them or are subcontracted. So, we have been able to build some seriously good low-carbon homes over the last decade and… but the amount of new homes that we now need to build goes way beyond the few 100 of homes that we've built already, using special grants and so on. We now need to be building, as I've mentioned to you already, 700 to 800 new homes a year all which have got to be, if you like, utilising green skills. So, therefore it's imperative that those green skills are developed within the Welsh workforce and to enable us to… because without those green skills, we are to not achieve the build rates that we want… that the government wants. You probably has got a build rate that we need to build. So, it is that classic kind of… it'll cost a lot more, you know. That time-cost-quality conundrum. You can have incredible quality very quickly, but it's going to cost you a hell of a lot.

[Wi-Fi outage – Interviewee opts to reset router]

Interviewer 26:28
Hello, there we go. Much better.

Interviewee E 26:41
It's having a funny week.

Interviewer 26:41
No problem! We were talking about the provision before the internet went down.

Interviewee E 26:42
That's right! So, we need everything in a way that we do need to deliver hundreds of low-carbon homes every year to a very good quality… and to do that, we would strongly prefer to be able to do that using the local supply chain. We put something like… £153,000,000 into the Welsh economy last year. Now that… I mean, clearly the cost of the materials and the cost of the heat pumps and batteries and windows and doors. Massive part of that. But a lot of that 153,000,000 is actually paying for people to provide their skills on building sites or in factories. Our part of that budget goes into the commissioning of architects to design things and engineers to implement, and landscape architects to design things for us.

Interviewer 27:53
Yeah.

Interviewee E 28:03
We will need and do need more. I know that local Colleges and even [organisation] now has got its own green… is developing its own Green Skills Academy. So, that's just a very new thing. We recognise it, we can't just be taking and taking and taking. We've got to, we've got to actually set up apprenticeships or academies to train people in the skills that they need, to support the work that we're doing. And it's not just people through… well, I went to an event last week where we spoke a bit about this. It's not just people, young people coming through schools and Colleges. There's an enormous number of people who are already in the job market who need to be re-skilled and so it's really important that we don't… that we look at the wider picture.

Interviewer 29:24
Yeah.

Interviewee E 29:35
If you don't appreciate… the story doesn't finish when we retrofitted or built the home. Because if you don't have the people with the right skills to service and maintain heat pumps and batteries and PV panels and all of the complexities that arise from those things… you're then also going to have problems, especially in winter, when people suddenly have a fault… and we need somebody to come out in 24 hours to fix someone's heating, or hot water. Well, in the days of gas central heating, there were legions of people who could do that. We've got to replace those now with people who can do, who can service and maintain heat pumps.

Interviewer 30:09
Yeah.

Interviewee E 30:25
And it's slightly different, but a lot of the people who are currently gas engineers can, with some training, be provided with the skills they need.

Interviewer 30:43
Yeah. Brilliant. Thank you. And as an extension to that, so obviously you've said that, you know, things do need to be improved, or you know, there definitely needs to be a drive to get those skills out there. Have you yourself ever been involved in reviewing that provision of green skills and apprenticeships? With Welsh Government directly?

Interviewee E 31:19
Reviewing the skills. Yeah, I suppose I have. I'm a member of a steering group in a consortium. It's called the [consortium name]. So, if you go online and find that website, you will see that it's a portal populated with training and case studies. Part of recent discussions was around looking at and conducting a review of skills. I guess I wasn't the person leading the review but I… but I contributed my thoughts to a big consultation that the Welsh Government conducted about 18 months ago into reviewing skills for zero carbon in Wales and hopefully the comments that I've made and my inputs have gone forward to formulate implemented plans, funding and target funding in the right way. So, I guess I have contributed in that way by sitting on the [consortium name].

Interviewer 32:06
Yeah.

Interviewee E 32:26
The purpose is to disseminate good practice and knowledge. Also, lessons learnt to a community of people within Wales, working on either retrofit of existing homes or the construction of new homes with a… with a focus on lowering carbon emissions so that the purpose of the group.

Interviewer 32:32
Yeah.

Interviewee E 32:45
Because I'm on the steering group of that… outside of my role within [organisation], I see that I'm also contributing to all of the different agendas like skills, supply chain, the financing…

Interviewer 32:55
Yeah.

Interviewee E 33:02
You know, improving specifications and so on. So I guess in that in that way I've been involved in the review, of which is continuous.

Interviewer 33:42
Yeah.

Interviewee E 33:53
We discussed recently… what came up is I will be introducing things in years to come around measuring the carbon emissions of materials and new homes. So, not measuring carbon emissions from using a home, which is, if you turn the light on, the heating on, but the carbon emissions of the actual upfront construction of the home, which is a little forgotten about but massive proportion of the carbon emissions. With the new drive it'll be, how can we reduce the carbon emissions in that? And again, there are skills involved. It's not just.

Interviewer 34:38
Yeah. Yeah, absolutely. And you've touched upon this already to a point, but if we can be really specific. What do you think are the challenges that are facing the provision of Net Zero skills at the moment?

Interviewee E 34:55
OK. Yeah. I think that there are pockets of best practice and we're not… we're too slow in recognising and rolling that out.

Interviewer 35:15
OK.

Interviewee E 35:16
So, I've seen there's an excellent example in [locality] actually. It's where I'm from, but I heard them speaking at a conference I went to last week, about the academy they've created in an old factory, which was going to shut down. They created an academy for the company's employees, but also for tenants in that area to learn green skills around manufacturing, servicing and maintenance of home… green homes. And this, I believe… they've managed to assemble funding and a collaboration across dozens of companies like [organisation]. I believe that if they can achieve and I also see that Colleges, Universities in [locality] stand to explore the same opportunities. Those opportunities also lie in [locality]… well, across Wales, you know.

Interviewer 35:59
Yeah.

Interviewee E 36:13
Anyway, that, I believe… they've established there a pocket of best practice, but we're not quick enough to recognise and actually emulate and deliver. Everyone's trying to reinvent their own wheel, so to speak. That was a big message I provided in my consultation response for the carbon report… and that was 18 months ago. But I still don't see an improvement in that regard. An excellent example of how you can really drive and embed green skills in an organisation and not just

let the Colleges do it. Although, you know, I think that's really important that Colleges are involved. What I find is they are not acting quickly enough, with the pressures they are having to deal with.

Interviewer 37:17
Yeah.

Interviewee E 37:23
And the challenges… if there isn't sufficient green skills, as already mentioned, you know, things will not be built either properly or on time. Incorrect, rushed installation will have a major knock-on to people in their homes.

Interviewer 37:32
Yeah.

Interviewee E 37:49
So, we mentioned there's certainly a lack of training and skills in either knowing how to install, or maintenance if a component has already been installed. How to check it. It seems to be something that's prevalent. There's not many people, or not in sufficient numbers, who understand what good practice looks like. So, we really need to be working with the other training providers, creating our own academies to ensure that those problems are addressed, you know, and if our contractors don't fully understand what's meant by carbon neutrality, they need to own that and we need to work with them.

Interviewer 39:19
Yeah.

Interviewee E 39:31
And bring additional support, because it's no good me writing a strategy and creating some figures and say we've got to do it this way and we're going to do it that way and then for that not to be fully understood by our contractor force, because they don't have those skills.

Interviewer 39:54
Yeah, yeah. And again, this next question you've touched upon this quite a lot already. So just check if there's anything else you want to add, you know. In your opinion, how could this provision be improved?

Interviewee E 40:15
Yeah. So, I mentioned that we need to emulate pockets of best practice and spread that throughout the whole of Wales. I also think that ultimately… specifically to construction, what we do is set out in a building contract. So, in our building contracts… if we have a £50 million contract with contractor A to deliver 400 homes, it says in that contract that they must provide the following green skills in order to do so. It'll be a three-year project and during that project they must identify programmes, capture it and record it and provide us with the evidence of the green skills that they've created. So,

let's say employee A is now trained in green skills that have come through the funding, through the contract and they've been working on. Employee A has been working on air tightness barriers for like 6 months, has now passed their test and has now got their certification. And that's how I would… how I think we should tackle this as well. If a project is not done in accordance of the contract then you have the ability to request… and not just request, I would say you are compelled to address the contractor. You know, there are penalty clauses if you don't deliver.

Interviewer 41:46
OK. Yeah.

Interviewee E 41:47
Now, your everyday contractor doesn't need the green skills that we need. What I mean is, our government contracts oblige us to fulfil the projects utilising these green initiatives, but that isn't the case for private contractors. But next year, when the Future Homes Standard comes in in Wales, as it will in England, Scotland and Northern Ireland, they are going to need the green skills. And so… we're going to be competing for the small pool of people with green skills, unless there is a significant uptake of that training.

Interviewer 42:22
Right. OK.

Interviewee E 42:24
This is why it's so important that we create our academies and you know, be ahead of the game on this.

Interviewer 42:29
Yeah.

Interviewee E 42:29
We can't… we can't be doing enough to make sure that we keep up with that demand. But yeah, I think creating, creating your own academies and programmes, putting it into your contracts, we're checking in with your contractors and supply chain.

Interviewer 42:45
Yeah.

Interviewee E 42:49
And I can see your final question, if you're happy with my penultimate answer, in the… could Welsh Government's approach to carbon neutrality within your sector be improved? How so? Well yes, I think the government's got the ability to provide more funding and ask us to achieve better. So, if the government says, "in order to get these grants now, you need to be committed to doing offsite manufacturing."

Interviewer 43:08
Yeah.

Interviewee E 43:12
And if you look at the offsite manufacturing… is often also called MMC, which stands for Modern Methods of Construction. So, if you Googled Welsh Government MMC strategy, you would suddenly come up with a document which was released in February 2020, which sets out the Welsh Government's strategy long term for rolling out or encouraging MMC in Wales. And as I've already mentioned, MMC can improve the quality of build. It encourages developers to build with lower carbon materials. So, for context… sorry… I'm going to assume… do you know about embodied carbon in materials?

Interviewer 43:27
Very, very little. I know that people are, you know, producing materials at a lower carbon sort of cost, but I not the specifics. Like the difference between wood and concrete?

Interviewee E 43:34
Yes, so, to give you some obvious reference points. To produce concrete, which is almost like an ubiquitous building material, there's the concrete that is required to build foundations and that type has an enormous carbon emissions associated with the production. So, cement is one of the most carbon-intensive materials that you can pick.

Interviewer 44:01
Yeah.

Interviewee E 44:04
So, gypsum, plasterboard, concrete… they are very carbon intense materials. You can actually count… again, if you Googled the carbon intensity of materials for building construction, you would suddenly get tables and they would say these are the carbon intense materials.

Interviewer 44:13
Right.

Interviewee E 44:17
Materials of less carbon intensity… of the lower end of the scale are timber, especially if harvested and grown locally.

Interviewer 44:22
Yeah. OK.

Interviewee E 44:22
Hemp, crete, natural fibre insulations like sheep's wool or cellulose fibre, wood fibre and materials

of that description. They are not very popular for building at the moment because they cost a lot more money and they result in much thicker walls. If I could boil it down to those two things… the reasons why they're not used. But, increasingly, I think the Welsh Government needs to reward developers for demonstrating the use of lower carbon materials, and there's something called an Environmental Product Declaration, or EPD. So if you look up EPD, it's already been adopted now across Europe in certain countries where there is legislation around counting the carbon in the build of your house. Denmark, France and the Netherlands have got this now, as a requirement.

Interviewer 44:51
That's interesting!

Interviewee E 44:51
And it's all measured in the CO2 per kilogrammes or CO2 equivalent per metre squared. So you can work out the overarching figure of the kilogrammes of CO2 equivalent per metre squared of your house and it's now possible to do that using software, such as LCA One Click.

Interviewer 45:23
Right.

Interviewee E 45:23
And I think this is what the Welsh Government should be encouraging. Changes are now through legislation and through encouragement and financial incentives.

Interviewer 45:27
Yeah.

Interviewee E 45:31
Because we if we don't do it and we don't start trialling it, we're not going to have the skills required to deliver when the time comes. And so, that was my very long-winded point. You need to be ahead of the game. The Welsh Government's got a leadership role. We've got a leadership role.

Interviewer 45:42
Yeah, yeah.

Interviewee E 45:42
Basically, the government's responsibility is to create some kind of policy framework to encourage and provide the funding for that. So that's my long-winded answer, sorry.

Interviewer 45:49
No, that's perfect. Thank you. That's a really good answer. So that's it essentially, unless you have any other comments or you know, any questions yourself?

Interviewee E 45:57
No, but [interviewer], I'm very keen to hear more about this. If you want to check in with me about confirming something, then please do so. You know, feel free to do that.

Interviewer 46:05
Yeah, thank you. That's much appreciated!

Interviewee E 46:10
Something I haven't mentioned actually that you might want to look at. I went on a 2-hour webinar recently and the topic of the webinar was, what are large engineering firms doing to lower their carbon footprint? They've got some seriously advanced ideas that they're implementing now to lower their carbon emissions. And it was around, you know, what type of concrete they're using and what type of plant and machinery they're using, so they're not moving away from diesel-generated plants to, you know, PV battery, not at this time. So, if you haven't approached them already, it'd be really useful for you to do so. Perhaps not for this, but if you are continuing your research, certainly!

Interviewer 46:45
OK. Forward me anything you think would be useful. Even just a contact or web link and I will look into that, definitely.

Interviewee E 46:51
Somewhere I've stored the slides of the presentations that I've seen and I can send them to you. And then, not only would you have the slides, but you might be able to then contact the people who authored those slides.

Interviewer 47:02
Yeah, yeah, that'd be perfect, if you could.

Interviewee E 47:07
Yeah, let me see if I can find those then. So yeah, there we are. That was my other comment. So yeah, like I said, keep in touch if you need to ask me any follow-on questions and most importantly, you know, wish you the best of luck with your research.

Interviewer 47:16
Thank you so much. Really appreciated! All the best.

Interviewer stopped transcription