ENERGY & UTILITY SKILLS

Skills for a greener world

Investigating the skills required for a transition to an advanced zero emission, indigenous diverse energy secure and circular economy in Northern Ireland

June 2023

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1 Executive summary

1.1.1 This report has been prepared by Energy & Utility Skills in response to a commission from Northern Ireland's Department for the Economy (DfE).

1.1.2 This research provides the DfE, and its partners, with the intelligence needed to ensure that all organisations involved in the advanced zero emission, indigenous diverse energy secure and circular economy in Northern Ireland to play their part in delivering the required skilled workforce – and in a way that maximises the benefits to all sections of the Northern Ireland population.

1.1.3 The report covers eight relevant industries that are critical to the Northern Irish economy moving forward:

- Large-scale energy production
- Infrastructure
- Domestic low carbon technologies and energy efficiency
- Industrial processes
- Circular economy
- Transport
- Agriculture
- Fisheries

1.1.4 For each of these industries we have sought to answer the following questions:

1. What new skills will be required by new and existing workers to allow for a successful transition?
2. Is existing education, skills and training provision sufficient and relevant to allow for a successful transition for existing and new jobs?
3. What specific skills gaps are expected over the short, medium and longer term?
4. Which industries are likely to offer transferable skills to new growth industries?
5. How can government ensure the transition is a "just transition"?
6. What are other parts of the UK and Ireland doing to prepare their respective education, skills and training provision for a transition to a sustainable energy and circular economy?

   (And whether similar provision is in place in Northern Ireland and, where it is not, whether it would be appropriate)
7. How should the Northern Ireland government prepare in advance of the launch of any new energy schemes in the future to ensure it has the right skills to deliver?

What new skills will be required by new and existing workers to allow for a successful transition and what specific skills gaps are expected over the short, medium and longer term?

1.1.5 Across the green industries and circular economy there are a range of industry-specific and generic skills that are growing in demand and will be crucial to achieving the transition to a net zero economy in Northern Ireland.

1.1.6 Business skills such as project management, business and commercial, customer/stakeholder engagement, risk management and data analysis will not only be essential to the development of these industries, but they will also be demanded by a wider range of job roles than ever before. For example, operatives up to engineers are becoming increasingly customer facing as well as reliant on data to perform job roles that are widening in scope.

1.1.7 Digital skills are increasingly affecting almost every job role, including those in the field workforce. Whether it's new hardware or software, a range of generic/off-the-shelf provision as well as technology-specific courses will be required.

1.1.8 Multi-skilling is also an emerging trend and one that will be necessary to meet the future demands of the green economy. For example, if multiple technologies are being installed in one property (e.g. heat pumps, solar PV/thermal and electric vehicle charging points), it makes sense to multi-skill the installer workforce across the range of technologies (and accreditation systems will need to facilitate this in an efficient manner).

1.1.9 Specific skills have been identified in relation to each industry:

- **Large-scale energy production**: Particularly relating to offshore wind across all its project life cycle; (development of commercial battery storage should be monitored closely)
- **Infrastructure**: Relating to the planning, construction and operation of heat networks; hydrogen blending in the networks; existing skills in greater volume for network expansion and upgrading
- **Domestic low carbon technologies and energy efficiency**: Planning the implementation of various technologies in a "smart home"; installer skills across the full range of technologies; multi-skilling
- **Industrial processes**: Engineering and technician skills relating to the production, storage and transport of hydrogen and biofuels; (development of carbon capture, usage and storage should be monitored closely)

- **Circular economy**: Skills needed to gain value from various waste streams (e.g. biomass, anaerobic digestion, etc.); cross-industry skills/supply chain skills needed to minimise end of life waste through implementation of CE principles
- **Transport**: Repairing and maintaining electric and fuel cell vehicles
- **Agriculture**: Drivers; farm workers; food scientists/technologists; crop and livestock monitoring; Soil and water conservation
- **Fisheries**: Skills associated with the manufacture, servicing, repair and operation of hydrogen-fuelled vessels

1.1.10 Specialist skills that will be needed across many of these industries include those related to geosciences.

1.1.11 Geoscientific skills are essential for the energy transition as it is within geological formations that energy such as geothermal is found, and where the critical minerals essential for the development and construction of green energy technologies are extracted.

1.1.12 Geological formations are also the foundations for wind turbines, both onshore and offshore, and it is within these formations that geological storage can be used, including for gases such as air, carbon dioxide and hydrogen.

1.1.13 Geosciences also have play a central role in the mapping and valuation of our natural resources, including water and in preventing overuse of land and sea areas, all of which are vital for a successful transition.

1.1.14 Chemists, physicists, and product designers are also vital for the energy transition and the manufacturing of advanced technologies. This is necessary for processing critical raw materials, the production of new materials and to ensure longer product and material life cycles.

1.1.15 Finally, a deeper understanding of the effect that climate change could have on Northern Ireland's green infrastructure and other assets will increasingly be required. This will need to be disseminated to appropriate job roles as the scientific evidence comes through.

Is existing education, skills and training provision sufficient and relevant to allow for a successful transition for existing and new jobs?

1.1.16 Effective pathways to competency are need at all levels of the workforce – from entry level (level 2) through to higher skills levels; while the largest volume of skills demands will be at level 3-4.

1.1.17 Throughout this research, a number of themes have repeatedly been raised in relation to education and skill provision:

- **Entry-level opportunities**: Programmes such as Traineeships and the Skill Up programme offer a wide range entry level routes into selected industries and occupations and are crucial to ensuring that people of all capabilities and circumstances have the opportunity to enter meaningful employment.

  The reach of these programmes needs to be widened through targeted promotion and, potentially, incentives to ensure that the intended market is being reached. Furthermore, funding should be secured to allow these programmes to (i) continue and (ii) expand as required.

- **Apprenticeships**: Apprenticeships are very well regarded by industry. However, Sectoral Partnerships should be tasked with reviewing what is currently available both in terms of range (i.e. the available frameworks) and content (are they future-proof in terms of technology, data and digital advancements?). In relation to the circular economy, all framework content should be reviewed to ensure sustainability and the materials lifecycle is a central theme).

  Furthermore, consideration should be given as to the remit of Sectoral Partnerships in terms of influencing all education and skills provision relating to their industry (e.g. Skill Up, traineeships, further education and higher education).

- **Further education**: The six further education colleges are highly regarded by employers in the green industries, but there is a view that current provision has a bias towards introductory/awareness courses rather than delivering a technically competent workforce.

- **Higher education**: The two main universities in Northern Ireland deliver a range of courses that fit well with the green industries. However, the concern that graduates lack industry experience is often cited and more needs to be done to facilitate this during their studies. Furthermore, few graduates actually enter employment in the green industries – whether this is due to graduates choosing other industries or due to a lack of demand from employers needs further investigation.

1.1.18 There are currently no standalone geoscience degrees available at either undergraduate or postgraduate level in Northern Ireland, while the number of post-primary schools offering either A Level or GCSE courses is limited to one school only. Students that do go on to study geoscience at degree level have to travel outside of Northern Ireland to either GB or Ireland.

1.1.19 The number of graduates entering employment in the green industries and circular economy needs to increase substantially of the nearly 4,000 graduates that entered employment in 2020/21, just 115 did so within the industries covered by this research.

1.1.20 However, it is not clear whether this is due to a lack of supply or a lack of demand from employers. More work may be needed to understand this issue more clearly.

1.1.21 Given that the Northern Ireland Skills Barometer 2021 update reports that almost two-fifths (37%) of new workers in the period to 2030 will require level 6+ qualifications (i.e. undergraduate degree, masters, PhD) and that Northern Ireland will be short of nearly 3,000 level 4+ skilled people per year over the same period (with Engineering and Manufacturing Technologies being particularly in demand), the numbers enrolling on appropriate higher education courses needs to increase substantially.

1.1.22 While many employers, particularly the larger employers, do have good working relationships with education and skills providers, there is always room for more – whether it's through activities such as providing guest lecturers, work experience placements or practice interviews.

1.1.23 Furthermore, this engagement could extend out to organisations that work specifically with disadvantaged communities. Consideration should be given as to how to incentivise/promote the benefits of building "social value" within their communities.

1.1.24 As with tertiary education, course content in compulsory education should be reviewed in the context of the green industries and circular economy to ensure that they actually engender an interest in current and future careers in these industries. As those due to enter the workforce in 2030 are already in Year 6, this work cannot start enough.

1.1.25 Finally, in very few areas of the green economy is a skills revolution expected – it is more a case of evolution. Therefore, while new provision may be needed in some of the learning/training pathways (e.g. in areas associated with geoscience), the upskilling of the current workforce will be a major exercise that will not, generally, require new qualifications.

1.1.26 However, the possibilities for "micro-credentials" and skills passporting that recognise upskilling achievements and facilitate the transfer of these skills around the green (and wider energy) industries should be investigated (in conjunction with these industries across the rest of the UK).

Which industries are likely to offer transferable skills to new growth industries?

1.1.27 The industries which offer the greatest potential for the supply of skills into the green industries are:

- **Oil and gas**: This particularly applies to many aspects of the offshore wind industry and, potentially, tidal power generation

  However, as Northern Ireland does not have a historic legacy of offshore engineering, it is likely that this would require attracting and retaining these skills from other parts of the UK, Ireland and further afield

- **Advanced manufacturing and engineering**: National employment projections suggest that these industries could lose around 14,000 jobs between 2020 and 2035, presenting an opportunity to reskilling those at risk through a range of tailored conversion programmes

- **Fibre/telecoms**: Facilitating the transfer of skills between the utilities and fibre/telecoms could help alleviate skills shortages and reverse the trend of losing skills to that industry

1.1.28 Also, as mentioned previously, facilitating the movement of skills around the green industries should be a priority. For example, multi-skilling the installer workforce across domestic low carbon technologies, including heat pumps, solar PV and EV charging points.

How can government ensure the transition is a "just transition"?

1.1.29 A common theme during the employer discussions for this research was that the need for people (i.e. volume) was a more pressing concern than how to get the skills – without the people there are no skills!

1.1.30 Therefore, careers education advice, information and guidance (CEAIG) needs to be reviewed in the context of better articulating up-to-date learning and career pathways to those in schools, colleges, universities – and be generally available to all adults. The ultimate aim of this should be to ensure that all sections of the community, no matter what their academic abilities, are aware of and have access to meaningful employment in the green industries.

1.1.31 Therefore, targeted promotion of training and employment opportunities should put in place for:

- Females
- Long-term unemployed
- Those from specific disadvantaged and deprived communities
- Those who are retired
- Those with caring responsibilities
- With physical or learning disabilities
- Youth unemployed

1.1.32 Consideration should be given as to how participation in green training provision can be incentivised – from traineeships and other entry level initiatives, through to apprenticeships, further education and higher education.

1.1.33 Ways of promoting the opportunities available in the Northern Ireland green industries and circular economy to Northern Irish HE students in Ireland and Great Britain should be investigated – with the potential incentivisation to return to apply their newly-acquired skills in their home nation.

1.1.34 Finally, employers and stakeholders should consider how more can be done to create social value as a means of raising awareness of the various green industries and the role that they play in a sustainable, vibrant economy.

What are other parts of the UK and Ireland doing to prepare their respective education, skills and training provision for a transition to a sustainable energy and circular economy?

1.1.35 There are a wide range of activities being carried out across Great Britain that could be transferred over to Northern Ireland.

- Scotland has a strong history of developing offshore skills
- The Humber region is Europe's largest emitter of CO_2 and is working hard to decarbonise its industrial processes, including the production of green hydrogen
- The South West region is working hard to develop its floating offshore wind industry – building links with developers, operators and education and skills providers

1.1.36 On the training and qualification front, there is a more extensive range of apprenticeship frameworks/standards across Great Britain (although it is recognised that a lack of learner numbers in Northern Ireland might deter Awarding Bodies from funding some of the more niche frameworks/standards).

1.1.37 Similar in nature to the Skill Up programme, Skills Bootcamps offer free, flexible courses of up to 16 weeks followed by a job interview with an employer. There are currently nearly 200 different courses on offer, including some that support the green industries.

How should the Northern Ireland government prepare in advance of the launch of any new energy schemes in the future to ensure it has the right skills to deliver?

1.1.38 Starting at the beginning, clear learning and career pathways for critical roles within each of the green industries need to be developed and delivered from Year 6 upwards – through into adulthood.

1.1.39 Specifically, the Careers and Skills Portal for Northern Ireland that is being developed at the moment should have a clear focus on supporting the green industries and circular economy.

1.1.40 One of the major challenges in developing new pathways to competency to deliver new skills (for example, an apprenticeship framework) is that it can take a number of years to (i) develop the qualification and (ii) for learners to become competent through it.

1.1.41 As the pace of technological change in the green industries accelerates, it will be become more important to consider alternative routes to competence other than formal qualification structures. Innovative, more flexible pathways may need to be investigated on an industry-by-industry basis.

1.1.42 In those industries that are clear government priorities, both individuals and employers may need to be incentivised to invest in new skills before the market establishes itself.

1.1.43 Government should consult with industry as to how Apprenticeship Levy flexibilities could be achieved to ensure that employers are able to maximise the impact of the available funds. Part of this discussion could include the expansion of apprenticeships to people of all ages, thereby encouraging their use as a tool to upskill the existing workforce as well as people moving into the new green/ circular economy industries from other industries.

1.1.44 Government stakeholders and industry representative organisations should consider how collaboration with their counterparts in Scotland and Wales might provide economies of scale when seeking to address common issues.

1.1.45 Ensure that all appropriate accreditations/certifications from Great Britain, Europe and globally are built into the Northern Ireland system to ensure ready transfer of skills.

Concluding remarks

1.1.46 Based on the findings of this research, it appears the skills needed for energy transition are, generally, an upgrading/expansion of the skills required now. As new technologies are developed and deployed, the existing workforce will require appropriate upskilling – i.e. the skills of the workforce will evolve.

1.1.47 In responding to these evolving skills requirements, Northern Ireland's education and skills providers at all levels (which are highly regarded by employers) are expected to respond in a timely manner. However, this will require:

i. employer input into curricula development via an appropriate mechanism for identifying when/where new provision is needed or, more likely, existing provision needs to be brought up-to-date

ii. sufficient demand from employers and students to make new/expanded provision economically viable for the providers

1.1.48 Where a revolution is more likely to be required is in terms of:

- attracting the required number of people into the expanding workforce (the majority of which will require level 3-4 qualifications) in the face of strong competition from other sectors and from outside of Northern Ireland
- ensuring appropriate pathways are in place to allow access to these opportunities from all sections of the community and from all abilities – ensuring the transition to a green(er) workforce is just and accessible to all.

2 About this report

2.1 Introduction

2.1.1 This report has been prepared by Energy & Utility Skills in response to a commission from Northern Ireland's Department for the Economy[1] (DfE).

2.1.2 Energy & Utility Skills would like to place on record their appreciation of Angie Lower from Ask for Research for her valuable contribution to this report.

2.1.3 This research provides the DfE, and its partners, with the intelligence needed to ensure that all organisations involved in the advanced zero emission, indigenous diverse energy secure and circular economy in Northern Ireland to play their part in delivering the required skilled workforce – and in a way that maximises the benefits to all sections of the Northern Ireland population.

2.2 Research objectives

2.2.1 The objectives of this research are to:

1. Engage with the Green Energy Skills Industry Reference Group (GESIRG), relevant businesses, organisations and education/ training providers to understand the skills required by new and existing workers to allow for a successful transition to an advanced zero emission, indigenous diverse energy secure and circular economy in Northern Ireland over the short to medium (two-five years) and longer term.
2. Review and baseline the existing provision of education, skills and training provision available for existing and new jobs relevant to allow for a successful transition to an advanced zero emission, indigenous diverse energy secure and circular economy in Northern Ireland.
3. Set out the specific skills gaps (e.g. occupations, job titles, quantum) expected over the short to medium term and longer term for relevant industries identified during the Project Initiation Meeting.

[1] "Skills Required for a Transition to an Advanced Zero Emission, Indigenous Diverse Energy Secure and Circular Economy in Northern Ireland" topic within "A 10X economy: An open call for research proposals".

4. Set out what industries are likely to offer transferable skills to new growth industries as a result of transition to an advanced zero emission, indigenous diverse energy secure and circular economy in Northern Ireland.
5. Provide an assessment of how government can ensure the transition is a “just transition”.
6. Detail what other parts of the UK and Ireland are doing to prepare their respective education, skills and training provision for a transition to a sustainable energy and circular economy. Examine whether similar provision is in place in Northern Ireland and where it is not, whether it would be appropriate. This should give consideration to the size of Northern Ireland and where it is not deemed appropriate, comment on how Northern Ireland can create and maintain self-sufficiency with regards to ensuring it has the required skills.
7. Produce guidance on how the Northern Ireland government should prepare in advance of the launch of any new energy schemes established in the future to ensure it has the right skills to deliver (e.g. energy efficiency).
8. Provide a list of key recommendations for government and businesses, framed over the short to medium and longer term, to ensure that there are sufficient skills to successfully transition to a sustainable energy and circular economy.

2.2.2 In order to achieve the stated objectives, we drew upon:

- ✓ a comprehensive literature and data review
- ✓ interviews with subject matter experts from across Northern Ireland and other parts of the UK
- ✓ the extensive knowledge of the whole of the Energy & Utility Skills team

2.3 Industry coverage

2.3.1 The report covers eight relevant industries that are critical to the Northern Irish economy moving forward:

- Large-scale energy production
- Infrastructure
- Domestic low carbon technologies and energy efficiency
- Industrial processes
- Circular economy
- Transport
- Agriculture
- Fisheries

2.3.2 Within each of these, a number of technologies/fuels are considered – as shown in Figure 1.

2.3.3 However, increasingly the boundaries between traditionally separate industries are blurring. Therefore, some technologies cannot be solely placed within one industry alone.

2.3.4 In the table below, the “primary” industry indicates where a particular technology has been assigned for the purposes of this research. A “secondary” industry indicates that a technology will have an impact on the operations and workforce of an additional industry (e.g. onshore wind requires a grid connection, impacting on both the power generation and infrastructure workforces).

2.3.5 Generally, the industry/technology-specific skills that are considered relate to their installation, operation & maintenance. The manufacture or construction of sites/plants is outside the scope of this research.

2.3.6 In addition to these industries, the cross-cutting skills requirements for data, digital and specialist IT skills are also considered.

Figure 1: Mapping of green technologies and industries

Technology	Large-scale energy production	Infrastructure	Domestic low carbon technologies and energy efficiency	Industrial processes	Circular economy	Transport	Agriculture	Fisheries
Offshore wind	Primary	Secondary						
Onshore wind	Primary	Secondary						
Marine, wave and tidal	Primary	Secondary						
Electricity networks		Primary						
Gas networks		Primary						
Water supply and wastewater treatment		Primary			Secondary			
Heat networks		Primary						
Home insulation			Primary					
Heat pumps		Secondary	Primary					
Solar Photovoltaic and thermal		Secondary	Primary					
EV charging points		Secondary	Primary			Secondary		
Hydrogen-ready boilers			Primary					
Production of liquid fuels				Primary				
Carbon capture and storage				Primary	Secondary			
Production of hydrogen				Primary				

Technology	Large-scale energy production	Infrastructure	Domestic low carbon technologies and energy efficiency	Industrial processes	Circular economy	Transport	Agriculture	Fisheries
Biomass					Primary			
Anaerobic digestion					Primary			
Production of biogas/biomethane					Primary			
Waste management and recycling					Primary			
EV vehicle repair & maintenance						Primary		
Hydrogen fuel cells				Secondary		Primary		
Agriculture/Agri-tech							Primary	
Environmental protection		Secondary					Primary	Secondary
Fisheries and marine environment						Secondary		Primary

3 Employment in the green energy and circular economy

3.1 Employment by industry

3.1.1 Accurate and reliable estimates of employment within each of the green industries and circular economy in Northern Ireland are difficult to obtain.

3.1.2 By using a combination of the Northern Ireland Business Register and Employment Survey (2021) and Agricultural Workforce in the United Kingdom at 1 June (published by the Office for National Statistics), we estimate that 105,000 people are employed in the industries most closely aligned to those covered by this research (based on a "best fit" of Standard Industrial Classification codes into the eight industries – see Figure 2).

Figure 2: Workforce estimates by industry

Industry	Standard Industry Classification	People in employment
Large-scale energy production	35.11 Production of electricity	400
Infrastructure	35.12 Transmission of electricity 35.13 Distribution of electricity 35.14 Trade of electricity 35.22 Distribution of gaseous fuels through mains 35.23 Trade of gas through mains 36.00 Water collection, treatment and supply 37.00 Sewerage 42.2 Construction of utility projects 42.9 Construction of other civil engineering projects	10,000
Domestic low carbon technologies and energy efficiency	43.2 Electrical, plumbing and other construction installation activities 43.3 Building completion and finishing 43.9 Other specialised construction activities	18,800
Industrial processes	20.1 Manufacture of basic chemicals, fertilisers and nitrogen compounds, plastics and synthetic rubber in primary forms 20.2 Manufacture of pesticides and other agrochemical products 35.21 Manufacture of gas	200
Circular economy	38 Waste collection, treatment and disposal activities; materials recovery 39 Remediation activities and other waste management services	5,900
Transport	29.1 Manufacture of motor vehicles 49 Land transport and transport via pipelines 52 Warehousing and support activities for transportation	16,000

Industry	Standard Industry Classification	People in employment
Agriculture	01 Crop and animal production, hunting and related service activities 02 Forestry and logging 81.3 Landscape service activities	52,000
Fisheries and marine environment	03 Fishing and aquaculture	1,800
Total employment		**105,100**

Source: Northern Ireland Business Register and Employment Survey, 2021 and Agricultural Workforce in the United Kingdom at 1 June.

3.2 Employment by occupation

3.2.1 Looking at the workforce through the lens of occupation rather than industry provides a sense of the number of people undertaking similar roles in other industries and that may have a skillset that might easily be transferred into the green industries (if they are not already in those industries).

3.2.2 Almost 154,000 people are currently employed in occupations which are aligned to the eight green industries (irrespective of which industry they actually work in). This is nearly 50% higher than the 105,000 people employed in the industries detailed above.

3.2.3 Therefore, there is a potential labour pool of almost 50,000 people that could transfer into the green industries with relative ease.

Figure 3: Number of people employed in each Standard Occupational Classification (Northern Ireland)

Standard Occupational Classification	People in employment
1121 Production managers and directors in manufacturing	6,600
1122 Production managers and directors in construction	2,800
1123 Production managers and directors in mining and energy	*
1161 Managers and directors in transport and distribution	700
1162 Managers and directors in storage and warehousing	2,300
1211 Managers and proprietors in agriculture and horticulture	1,100
1213 Managers and proprietors in forestry, fishing and related services	*
1255 Waste disposal and environmental services managers	900

Standard Occupational Classification	People in employment
2111 Chemical scientists	600
2112 Biological scientists and biochemists	4,300
2113 Physical scientists	*
2119 Natural and social science professionals n.e.c.	1,500
2121 Civil engineers	3,200
2122 Mechanical engineers	1,000
2123 Electrical engineers	600
2124 Electronics engineers	600
2126 Design and development engineers	3,200
2127 Production and process engineers	1,200
2129 Engineering professionals n.e.c.	4,400
2133 IT specialist managers	2,400
2134 IT project and programme managers	1,300
2135 IT business analysts, architects and systems designers	7,600
2136 Programmers and software development professionals	8,800
2137 Web design and development professionals	1,000
2139 Information technology and telecommunications professionals n.e.c.	10,800
2141 Conservation professionals	*
2142 Environment professionals	1,000
2150 Research and development managers	500
2216 Veterinarians	1,300
2424 Business and financial project management professionals	6,500
2433 Quantity surveyors	1,700
2434 Chartered surveyors	*
2436 Construction project managers and related professionals	1,900

Standard Occupational Classification	People in employment
2461 Quality control and planning engineers	*
2462 Quality assurance and regulatory professionals	1,800
2463 Environmental health professionals	700
3111 Laboratory technicians	4,300
3112 Electrical and electronics technicians	700
3113 Engineering technicians	3,200
3114 Building and civil engineering technicians	*
3115 Quality assurance technicians	2,100
3116 Planning, process and production technicians	800
3119 Science, engineering and production technicians n.e.c.	900
3131 IT operations technicians	1,800
3531 Estimators, valuers and assessors	1,600
3550 Conservation and Environmental Associate Professionals	700
3563 Vocational and industrial trainers and instructors	4,100
3565 Inspectors of standards and regulations	1,600
5111 Farmers	12,600
5112 Horticultural trades	*
5113 Gardeners and landscape gardeners	1,600
5119 Agricultural and fishing trades n.e.c.	800
5215 Welding trades	3,100
5231 Vehicle technicians, mechanics and electricians	4,200
5241 Electricians and electrical fitters	7,100
5242 Telecommunications engineers	900
5245 IT engineers	*
5250 Skilled Metal, Electrical and Electronic Trades Supervisors	600
5314 Plumbers and heating and ventilating engineers	7,800

Standard Occupational Classification	People in employment
5319 Construction and building trades n.e.c.	3,100
8114 Chemical and related process operatives	900
8124 Energy plant operatives	700
8126 Water and sewerage plant operatives	700
8131 Assemblers (electrical and electronic products)	*
8141 Scaffolders, stagers and riggers	500
8221 Crane drivers	*
8223 Agricultural machinery drivers	*
9111 Farm workers	4,000
9112 Forestry workers	*
9119 Fishing and other elementary agriculture occupations n.e.c.	*
9232 Street cleaners	*
9235 Refuse and salvage occupations	1,000
Grand total	**153,700**

Source: Annual Population Survey, ONS, 2021.

3.2.4 The "green" workforce has a far higher proportion of the workforce in operational/technical roles than the Northern Ireland workforce as a whole – 78%, compared to 64%.

3.2.5 This is particularly driven by high proportions of the "green" workforce being in Skilled Trades (+18%) and Process, Plant And Machine Operatives (+6%) than the Northern Ireland workforce as a whole.

3.2.6 This underlines the importance of apprenticeships and other RQF level 2-3 provision in terms of meeting skills requirements.

3.2.7 Conversely, the green workforce employs a lower proportion of professionals. Although job roles at this level are crucial the development and day-to-day running of the green industries and circular economy, they tend to be in highly specialist areas.

Figure 4: Number of people employed in each Standard Occupational Classification

Standard Occupational Classification	% of "green" workforce	% of all in employment	Variance
1 'Managers, Directors And Senior Officials'	8%	10%	-2%
2 'Professional Occupations'	18%	25%	-7%
3 'Associate Professional And Technical Occupations'	13%	15%	-2%
4 'Administrative And Secretarial Occupations'	9%	11%	-2%
5 'Skilled Trades Occupations'	27%	9%	+18%
6 'Caring, Leisure And Other Service Occupations'	0%	8%	-8%
7 'Sales And Customer Service Occupations'	4%	7%	-3%
8 'Process, Plant And Machine Operatives'	12%	6%	+6%
9 'Elementary Occupations'	8%	9%	-1%
% in operational/technical roles	**78%**	**64%**	**14%**

Source: Annual Population Survey, Survey, 2021.

3.3 Projections of future employment

3.3.1 The Northern Ireland Skills Barometer 2021 update reports that total employment could increase from 902,000 in 2020 to 975,000 by 2030 in a high growth scenario – at an average of 0.8% per year.

3.3.2 Although the sectors used by the Skills Barometer do not align well with those under consideration in this report, it is possible to draw conclusions for some broad sectors:

- Agriculture employment is set to remain stable by 2030, growing at just 0.1% per year
- Employment in electricity & gas and water & waste management are forecast to growth by around 1.5% per year
- Construction is set to grow by 1.2% per year

3.3.3 The sectors that are forecast to grow the fastest are information & communication (3.1% per year) and professional & technical services (2.2% per year) – both of which will act as strong competition for the green industries and circular economy in terms of attracting and retaining STEM talent.

3.3.4 These estimates of future employment levels are supported by projections produced by NFER/ Warwick Institute for Employment Research/Cambridge Econometrics on behalf of the Department for Education in England and Wales.

3.3.5 Those projections report an increase in employment from 905,000 in 2020 to 986,000 in 2035.

3.3.6 Across the industry groups that broadly align with the green industries, the number of jobs is projected to increase by 15.2% - from 105,000 in 2020 to 121,000 in 2035.

Figure 5: Employment projections for green industries, 2020 to 2035 (000s)

Industry	2020	2025	2035	Average annual growth
Agriculture	35	35	36	0.01%
Electricity and gas	2	2	2	-0.1%
Water and sewerage	8	8	9	1.5%
Construction	60	66	74	1.5%
All industries	**105**	**111**	**121**	**1.0%**

Source: The Skills Imperative 2035: Occupational Outlook – Long-run employment prospects for the UK, NFER/ Warwick Institute for Employment Research/Cambridge Econometrics, 2023.

3.3.7 However, it should be noted that few interviewees within the industries that this research focusses upon did not expect current the current headcount to remain today's levels.

3.3.8 This reflects the nature of national employment projections and the extent to which they include any industrial or government strategies.

4 A just transition

4.1 Introduction

4.1.1 The term “Just Transition” is relatively new but is already firmly established in national and international policy relating to carbon emissions reduction and the green economy.

4.1.2 Originally introduced by trade unions in the context of social dialogue and workers’ rights, the term has rapidly gained traction around the world following the 2015 Paris Agreement and the 2021 UN Climate Change Conference of the Parties (COP26).

4.1.3 Various definitions exist but, generally, they all focus on working towards an inclusive economic and industrial transformation.

4.1.4 For example, the Institute for Human Rights and Business defines it as “focusing on the transition out of high-carbon activities and into the green economy, seeking to ensure harm to workers, communities, countries, and regions is avoided while maximising the benefits of climate action”[2].

4.1.5 Access to education and appropriate training and reskilling across society is seen as a key component of any “just transition”[3].

4.1.6 The principle of a “Just Transition” is particularly well embedded in Scottish policy, given the characteristics of its natural resource profile and economy.

4.1.7 While “skills, training and education that helps to secure good, high value jobs in green industries” is a key component, significant attention is also given to “job security for those that will play the biggest part in the transition”.

4.1.8 The social justice aspect is also prominent, in terms of “making sure the costs do not burden those least able to pay and the benefits (…) are felt regardless of where you live, who you are and what you do”[4].

4.1.9 The Scottish Government is consulting on its Draft Energy Strategy and Just Transition Plan until April 2023. This sets out an ambition that “by 2030, Scotland’s energy industry will have net positive employment in a range of zero carbon industries”, in addition to “increasing the number of community owned energy projects”.

[2] Just Transitions for All: Business, Human Rights, and Climate Action, Institute for Human Rights and Business, 2020.

[3] Just Transition of the Workforce, and the Creation of Decent Work and Quality Jobs – Technical Paper, UNFCC, April 2020.

[4] Just Transition – A Fairer, Greener Scotland, Scottish Government, 2021.

4.1.10 It envisions that, by 2030, “Scotland’s energy industries will provide fair work that (…) will create opportunities for local energy employment with a focus on supporting opportunities in vulnerable and deprived places and communities”[5].

4.1.11 The Welsh “Just Transition” policy focuses on skills as a “key enabler” of the shift to a net zero economy and society and its Net Zero Skills Action Plan states that “delivering a just transition will mean we leave no-one behind”.

4.1.12 According to the Plan, its “Just Transition Approach” aims to ensure that “individuals of all ages can receive a high-quality education, equipping learners with the required skills to secure jobs that provide fair work and where businesses and workers can thrive in a net zero economy”[6].

4.1.13 The consultation on “Just Transition to Net Zero Wales” has recently closed and, together with a planned ‘Just Transition Framework’ expected during 2023, it will inform the next Net Zero Wales Plan in 2026.

4.1.14 The UK Government convened a Green Jobs Taskforce in November 2020 to advise government, industry, and the skills industry on how to deliver the net zero transition from a workforce and skills perspective. Its remit included considering “how the UK can ensure green jobs are good jobs and open to all” and “how workers in high carbon-industries can be supported to transition to the new green economy”[7].

4.1.15 The Green Jobs Taskforce concluded its work with publication of its final report in July 2021[8], which fed into the UK Government’s Net Zero Strategy. Implementation of this is now being overseen by the Green Jobs Delivery Group.

[5] Scottish Government, “Draft Energy Strategy and Just Transition Plan” (January 2023).

[6] Welsh Government, “Stronger, Fairer, Greener Wales: Net Zero Skills Action Plan” (2023).

[7] More information can be found on the Green Jobs Taskforce website (external link opens in a new window).

[8] The Green Jobs Taskforce report is available from the gov.uk website (external link opens in a new window).

4.2 The Northern Irish Context

4.2.1 The Climate Change Act (Northern Ireland) 2022 (the Act) received Royal Assent on 6th June 2022 and provides Northern Ireland with its first ever climate change legislation.

4.2.2 The Act sets a statutory 2050 net zero greenhouse gas emissions reduction target for Northern Ireland (that must be achieved to comply with the legislation) and has a requirement for carbon budgets to be set in line with the 2050 net zero target.

4.2.3 The first three carbon budgets must be set before the end of December 2023. The Act sets requirements for the development and publication of climate action plans to set out how carbon budgets and the emissions reduction targets will be achieved. The climate action plans will set out how specific sectors including energy, agriculture, infrastructure, waste, transport and others will contribute to meeting the targets and carbon budgets.

4.2.4 The principle of just transition runs right through the Act and ensures that Northern Ireland has a legal obligation to have regard to a just transition in all its emission reduction policies.

4.2.5 The Act sets a statutory requirement on all Northern Ireland departments to have regard to the just transition principle when deciding on their policies and proposals to be included in climate action plans. Each climate action plan must set out how these policies and proposals take account of this principle.

4.2.6 Section 30(3) of the Act sets out a definition of the just transition principle. This states the importance, in taking action to reduce Northern Ireland emissions and increase removals, of doing so in a manner which, so far as possible, achieves the just transition objectives. The Act details 11 objectives of how the just transition principle can be achieved including supporting jobs that are climate resilient and environmentally and socially sustainable, supporting low-carbon investment and infrastructure, creating decent, fair, and high-value work in a way which does not negatively affect the current workforce and contributing to a resource-efficient and sustainable economy.

4.2.7 So far as possible actions should also contribute to advancing equality of opportunity between men and women and supporting the social and economic needs of people in rural areas. The objectives further require that safeguarding against job losses or displacement, and that reducing with a view to eliminating, poverty, inequality, and social deprivation, is a relevant consideration in policy development.

4.2.8 Through these objectives the Act also stresses the important of engagement with workers, trade unions, communities, non-governmental organisations, and representatives of the interests of business and industry, and supporting the agriculture sector and other sectors of the economy that are likely to be most affected by action to reduce emissions and increase removals.

4.2.9 In support of this there is also a specific statutory commitment that a just transition fund for agriculture must be established to provide advice and assistance to the agricultural sector.

4.2.10 In addition, the Act requires the Department of Agriculture, Environment and Rural Affairs (DAERA) to establish a Just Transition Commission. Once established, the functions of the Commission will include overseeing the implementation of the just transition elements of the Act and providing advice to departments on how to ensure that all their policies comply with the just transition principle.

4.2.11 Both the Skills Strategy and the vision for a 10x Economy make it clear that an inclusive approach to economic growth means ensuring that everyone has the opportunity to participate and to benefit.

4.2.12 However, the evidence shows that there is still work to do to ensure that this can be true in Northern Ireland as it moves towards a net zero economy and leverages "green growth" opportunities. There are several factors at play which are limiting the extent to which working age individuals can benefit from this.

- First, rates of economic inactivity amongst the working age population are higher in Northern Ireland than in other UK nations and this trend is well established[9]. There will be several reasons for this, including a significant employment gap for people with disabilities, currently the worst in the UK[10]
- Secondly, compared to Ireland, Northern Ireland sees lower levels of educational attainment, with "a high proportion (…) leaving school without an upper secondary qualification", coupled with little comparative improvement over time in rates of early school leaving which has been double that of Ireland in recent years. Lower rates of attainment of post-secondary non-tertiary qualifications persist[11].

4.2.13 Together, early school leaving; lower educational attainment; a lack of post-secondary, non-tertiary qualifications (which tend to be associated with a higher wage premium) and a high rate of economic inactivity mean that there are significant barriers to many in the population accessing the benefits of the transition to net zero.

[9] Ulster University Economic Policy Centre, 'Northern Ireland Skills Barometer 2021' (2021), p.8.

[10] Northern Ireland Statistics and Research Agency, 'Disability Employment Gap in Northern Ireland 2020' (October 2021).

[11] Economic and Social Research Institute, 'A North-South Comparison of Education and Training Systems: Lessons for Policy' (April 2022), pp. 91-96.

4.3 Realising a Just Transition

4.3.1 Since a “just transition” can have different meanings depending on the specific challenges facing different international groups, nations and regions, the responses are diverse.

4.3.2 At a high level, a Declaration on "Supporting the Conditions for a Just Transition Internationally" was put in place at COP26, which includes supporting workers in their transition to new “green jobs”, supporting and promoting social dialogue and stakeholder engagement and ensuring the availability of local, inclusive, and decent work.

4.3.3 In other UK nations, there is a focus on supporting the specific skill areas deemed important for the net zero transition:

- Welsh Government is focusing particularly on STEM, as well as digital and data-related skillsets, project management, leadership and supply of educators and trainers[12]
- Scottish Government has identified a skilled workforce as one of its five policy programmes of action referenced in its Just Transition Plan, and will work to ensure that education and skills system reforms are “aligned to its wider socio-economic vision”

  More specifically, “a stronger, simplified lifelong learning system” will be developed and “the content and reach of the Green Jobs Workforce Academy”[13] will be expanded[14]

4.3.4 The challenges of large-scale decarbonisation, the cost-of-living emergency and the climate emergency demand a whole system transformation which requires a new approach to industrial planning.

[12] Welsh Government, ‘Just Transition to Net Zero – Call for Evidence’ (2022), p. 23.

[13] More information can be found on the My World of Work website (external link opens in a new window).

[14] ‘Draft Energy Strategy and Just Transition Plan, p.48, Scottish Government, 2023.

4.3.5 Policy development should prioritise engagement with the most marginalised groups:

- Skills training and education that helps to secure good, high value jobs in green industries
- Job security for those in industries that will play the biggest part in the transition – at every level
- Homes that are energy efficient and help to reduce fuel poverty
- Building infrastructure, transport and communities that support decarbonisation, to enhance biodiversity and which are resilient in the face of the impact of climate change that we are already feeling
- Making sure the costs do not burden those least able to pay and the benefits of the transition are felt by all

4.3.6 Furthermore, "Mission Zero – Independent Review of Net Zero"[15] recommends that progress on the just transition should be tracked via "robust regional green jobs statistics". These would provide a Local Government District level perspective, including more detailed analysis of green jobs on offer, protected characteristics and publicly available salary data.

[15] Mission Zero: Independent Review of Net Zero, Rt Hon Chris Skidmore MP, 2023.

5 Large-scale energy production

5.1 Introduction

5.1.1 This industry covers the following activities:

- Onshore wind
- Offshore wind
- Marine, wave and tidal

5.1.2 In 2021, the Northern Ireland Business Register and Employment Survey estimated that 400 people were employed in SIC code 35.11 Production of electricity. Meanwhile, the Low carbon and renewable energy economy estimates report around 600 people, primarily in onshore wind (c400) and solar (c100). There are a very small number of people employed in offshore wind, hydropower and battery storage.

5.1.3 The latest national employment projections by Warwick Institute for Employment Research and Cambridge Econometrics[16], suggest that employment across the electricity and gas industry (the closest approximation to electricity generation) is projected to remain broadly stable to 2035. This is broadly supported by data from the Northern Ireland Skills Barometer 2021 update which forecasts that the electricity and gas industries combined will grow by an estimated 1.5% per year.

5.1.4 However, this projection does not take into account the planned growth in offshore wind, which could see 1gigawatt (GW) installed by 2030 (the employment effects of this growth are currently unknown, as details around the amount of local content in the manufacturing and installation project phases is currently unknown).

5.1.5 Over the past month, the fuel mix of Northern Ireland's generated electricity has been made up of[17]:

- 52% from gas
- 42% from renewable energy (including wind, solar and hydro)
- 6% from coal

5.1.6 Hydrogen has the potential to be used in gas-fired power plants, although the technology is not expected to be available before 2030.

[16] The Skills Imperative 2035: Occupational Outlook – Long-run employment prospects for the UK, National Foundation for Educational Research, 2022.

[17] More information about Northern Ireland's electricity production mix can be found on the SONI website (external link opens a new window).

5.1.7 In addition to these generating technologies, battery storage is also recognised as an essential part of the mix – ironing out the peaks and troughs of intermittent renewables.

5.1.8 However, in Northern Ireland at the moment it is very much a nascent technology, with just 10megawatt (MW) of installed capacity operational[18] (albeit with a further 100MW under construction, 39MW having had planning permission granted and 50MW having had their planning permission submitted).

Onshore wind

5.1.9 Data from RenewableUK's Wind Energy Projects Database shows that there is currently 1,332MW of onshore wind operational in Northern Ireland, and a further 58MW under construction – almost all of which is from just four projects:

- Smulgedon (16MW)
- Clunahill (15MW)
- Cam Burn (14MW)
- Ballyutoag (12MW)

5.1.10 A further 527MW of capacity has received planning consent, with the largest projects being:

- Corlacky 47.3MW
- Pigeon Top 37.8MW
- Curraghmulkin/Dooish 30MW
- Corkey - Repower 29.9MW
- Dunbeg South 29.7MW
- Rigged Hill – Repower 28MW
- Ballyhanedin 24MW
- Murley 21.6MW

5.1.11 This pipeline of onshore wind projects, if delivered, could see total installed capacity in Northern Ireland of nearly 2GW.

Offshore wind

5.1.12 Within the Energy Strategy Action Plan 2022, under Action 14, states a target to develop an action plan to deliver 1GW of offshore wind from 2030.

5.1.13 However, at this point, no projects have received consent.

[18] The Renewable Energy Planning database can be found on the Department for Energy Security and Net Zero's website (external link opens a new window).

Marine, wave and tidal

5.1.14 Tidal energy production is still in its infancy, not just in Northern Ireland, but also across the UK. Data from RenewableUK shows that the only planned activity for tidal stream projects in Northern Ireland is Open Hydro's Fair Head project in County Antrim. This is one of the world's first commercial-scale tidal energy projects, with an array system of 100MW – enough to power 70,000 homes.

5.2 Skills demand – Current and future skills requirements

5.2.1 Cross-cutting specialist skills within these three industries include geoscience skills. These are essential as geological formations form the foundations for wind turbines, both onshore and offshore.

5.2.2 This requires skills associated with engineering geologists, hydrogeologists, geophysicists, geophysicist, geoscientist, geologist and geochemist.

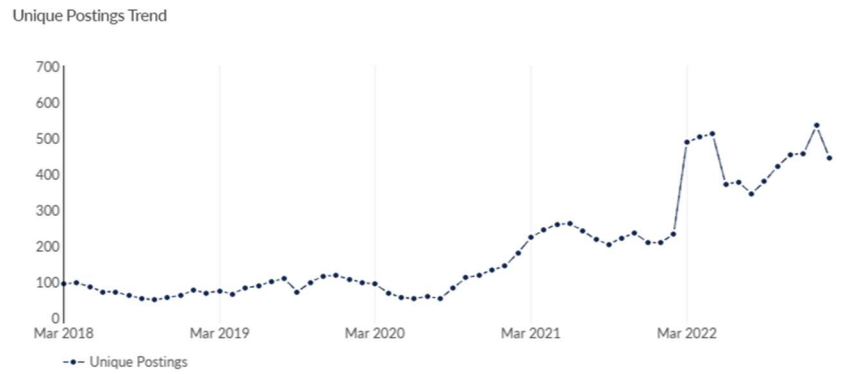
Onshore wind

5.2.3 The skills and workforce requirements of onshore wind in Northern Ireland are well understood by both employers and the training market and given the new project pipeline as it currently stands – at 585MW, equivalent to less than 50% of current operational capacity – gaining the skills required should not, in itself, present a significant challenge to the industry.

5.2.4 However, with demand for the required core skills (e.g. craft, mechanical/electrical engineering, etc.) likely to be increasing across all of the green industries (both in Northern Ireland and more substantially across Great Britain), the challenge of attracting and retaining the required volume of people should not be under-estimated.

5.2.5 As things stand at the moment, demand for onshore wind skills in Northern Ireland is very low. In the year ending 28th February 2023, there were 2,300 online job postings relating to the onshore wind industry across the UK[19] – just 37 located within Northern Ireland.

Figure 6: Number of online job postings relating to onshore wind (UK)



Source: Lightcast™, 2023.

5.2.6 The table below shows the top ten job titles being recruited and most sought-after skills associated with each job title (listed in order of magnitude):

Figure 7: Most sought-after job titles and associated skills

Job title	Most sought-after skills
Wind Turbine Technicians	Wind turbine maintenance Mechanical engineering Electrical equipment
Renewable Energy Analysts	Finance Business development Procurement
Project Managers	Project management Agile methodology Procurement
Renewable Energy Engineers	Electrical engineering Mechanical engineering Business development
Renewable Energy Consultants	Due Diligence Business Development Project Management
Project Developers	Land Tenure Business Development Grid Connections

[19] These vacancies were identified using the keywords “onshore wind” and excluding staffing/recruitment companies.

Job title	Most sought-after skills
Electrical Technicians	Electrical Wiring Electrical Engineering Electrical Systems
Asset Managers	Asset Management Finance Procurement
Renewable Energy Specialists	Business development Electrical engineering Due diligence
Project Development Manager	Project Management Procurement Business Development

Offshore wind

5.2.7 Although there is currently very little in the way of an offshore wind industry in Northern Ireland, the target of 1GW by 2030 shows considerable ambition – and with it the possible creation of around 1,500 new jobs across the value chain.

5.2.8 However, there is no visible pipeline of projects or government ambition beyond this date. In order to instil confidence from a skills investment perspective, a longer timeline of ambition is required from government.

5.2.9 As with onshore wind, the skills and workforce requirements of offshore wind are well understood by employers in the industry from existing projects in Great Britain (and around the world).

5.2.10 However, the volume of skills required, and in a relatively condensed timeframe if the 2030 target is to be met, suggests that the challenge of attracting and retaining the required skills could be considerable. Especially given:

i. Demand for the required core skills (e.g. craft, mechanical/electrical engineering, etc.) is likely to be increasing across all of the green industries (both in Northern Ireland and more substantially across Great Britain)

ii. The lead time to competency of new entrants into the industry through programmes such as apprenticeships could be as long as six years – meaning that a heavy reliance on recruiting experienced workers (including from outside of Northern Ireland) during the early project development stages is highly likely

5.2.11 The types of skills demanded across the project lifecycle of an offshore wind farm can vary considerably. The table below summarises sub-industries that make up the offshore wind industry and the skills and qualifications generally required by each.

Figure 8: Skill requirements by project stage for offshore wind

Skill area	Specific details
Development and project management	Generally, degree-level qualifications in relevant disciplines such as environmental sciences, economics, engineering and project management. **Port studies:** Degrees in environmental sciences, economics, engineering, project management. **Geotechnical and geophysical surveys:** Degrees in environmental sciences, geology; master's degree in oceanography, hydrography, geophysics, engineering geology and geotechnical engineering. **Wildlife surveys:** Degree or HND in biology, marine biology or environmental monitoring.
Turbine design and manufacture	Degrees in mechanical engineering and physics. Technical skills in welding, platers, electricians, fitters, etc. (via apprenticeships). Technical qualification in electrical and design engineering – welders, platers, pipe fitters, electricians, mechanical fitter and riggers. Research and development: degrees in physics, electrical/ mechanical engineering and maths.
Balance of plant	Qualifications in naval architecture, marine engineering, mechanical engineering, high voltage design engineering and technicians, geophysics and environmental sciences. **Geotechnical and geophysical surveys:** Degrees in environmental sciences, geology; master's degree in oceanography, hydrography, geophysics, engineering geology and geotechnical engineering. **Turbine tower supply:** Welding, plating, fabrication and blasting (via Apprenticeships). **Foundation supply:** Degree in civil, design, mechanical or fabrication engineering.
	Cable supply: Electrical engineering and product design engineering (high voltage design and technicians). **Substation supply:** Degree in product design engineering and electrical engineering.
Installation and commissioning	**Turbine and foundation installation:** Naval architecture and marine engineering. **Cable installation:** Degree in engineering or mechanical engineering. **Installation support:** Valid dive ticket. Degree in geophysics and environmental science. Vessel (master, mate, deckhand) certifications.
Operations, maintenance and service	**Turbine maintenance:** Technology-specific training; high-voltage equipment handling, certification to undertake lifting, climbing and rope access training. Strong electrical/control and instrumentation skillset. **Maintenance of the offshore substation**: High-voltage technicians; electrical or mechanical engineering. Supervisory control and data acquisition (SCADA) monitoring
Cross-cutting skills	**Vessel operations and maintenance:** Marine, electrical and mechanical engineering/operations (via apprenticeships and subsequent upskilling). **Vessel mate, deckhand and master:** Various mandatory certifications.

Source: Skills and Labour Requirements of the UK Offshore Wind Industry: 2018 to 2032, Aura/Energy & Utility Skills, October 2018.

5.2.12 A recent report by RenewableNI and BVG Associates highlights the areas where Northern Ireland could provide local content to the offshore wind supply chain:

Figure 9: Primary contributions of the Northern Ireland offshore wind supply chain

Development	Manufacturing
Development work requiring interaction with local stakeholders and the regulatory environment	Supply of foundations and offshore substation structures from Harland and Wolff
Site investigations and above water surveys	Supplying secondary steel for these components
Engineering design and consultancy	Construction of operation bases
Legal and financing expertise	

Installation	Operations, maintenance and services
Installation of onshore civils and electrical assets	Onshore logistics (a significant crossover with onshore wind
Port side activities of turbine and foundation installation	Offshore logistics a mixture of local and imported supply
Some involvement in offshore cable installation such as onshore connection and cable protection	General maintenance of turbines and balance of plant
	An enterprise hub could attract new companies to NI

Source: The Clean Revolution: Building Northern Ireland's Offshore Wind Industry, RenewableNI/BVG Associates, August 2022.

5.2.13 However, in order to achieve this, it is likely that local content targets will be required, and port infrastructure upgraded.

5.2.14 Specifically in relation to floating offshore wind (FLOW), people and skills requirements will increase the pressure on (but also offer an opportunity to) the following job roles[20]:

Blue collar trades such as:	
Onshore Construction Managers	Forklift Drivers
Onshore Construction Supervisors	Crane Drivers
Onshore Construction Shift Managers	Scaffolders
Onshore Site Foreman	Riggers
Onshore Site Chargehands	Painters
Skilled Welders	Site Labourers
Skilled Platters	Quayside Operatives
Skilled Electricians	

Marine crews such as:	
Captains	Crane Operators
Skippers	Mates
Towing Masters	Deckhands
Mooring Masters	Able Seafarers
Marine Engineers	1st Officers
SSLs (Section Stability Leaders)	

Subsea expertise such as:	
ROV Pilots	Party Chiefs
ROV Technicians	Surveyors

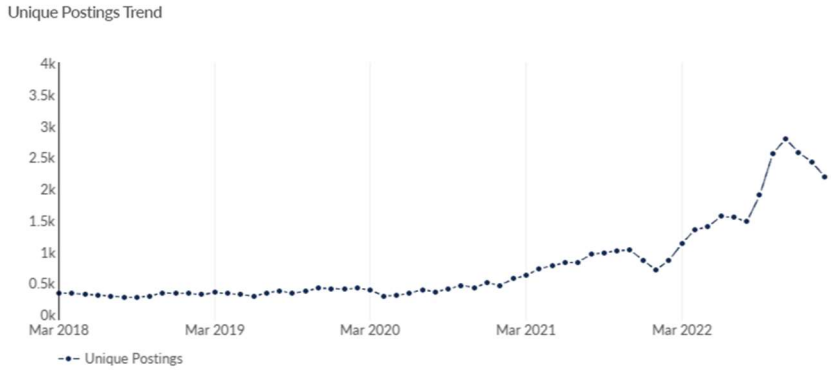
[20] Floating Offshore Wind: Risks to project development – People, Skills and Vocations, Opergy/Offshore Renewable Energy Catapult, June 2022.

5.2.15 Across the UK, there are a number of areas where skills shortages are already being felt[21]:

- **Consenting skills**: Caused by an increasing pipeline of major projects around the UK and calls on both developer consenting teams and the statutory consultee bodies
- **Electrical skills**: At both technician & engineer level, caused by increasing electrification across multiple industries increasing demand for these skills
- **High voltage** electrical skills: At a Senior Authorised Person (SAP) and technician level in respect of switchgear commissioning, cable jointers and cable terminators
- **Digital skills**: Focussed on analytics, science and engineering, caused by increasing demand for data systems and data reporting across multiple industries
- The **fabrication** workforce: The large numbers of welders that will be required is a real challenge, particularly if several projects occur at the same time in close proximity

5.2.16 Despite the embryonic status of the offshore wind industry in Northern Ireland, there are signs that recruitment is taking place. In the year ending 28th February 2023, there were 9,400 online job postings relating to the offshore wind industry across the UK[22] – just 67 of which were located within Northern Ireland.

Figure 10: Number of online job postings relating to offshore wind (UK)



Source: Lightcast™, 2023.

5.2.17 The table below shows the top ten job titles being recruited and most sought-after skills associated with each job title (listed in order of magnitude):

Figure 11: Most sought-after job titles and associated skills

Job title	Most sought-after skills
Offshore Managers	Procurement Business Development Finance
Offshore Project Managers	Project Management Procurement Project Engineering

[21] Floating Offshore Wind: Risks to project development – People, Skills and Vocations, Opergy/Offshore Renewable Energy Catapult, June 2022.

[22] These vacancies were identified using the keywords “offshore wind” and excluding staffing/recruitment companies.

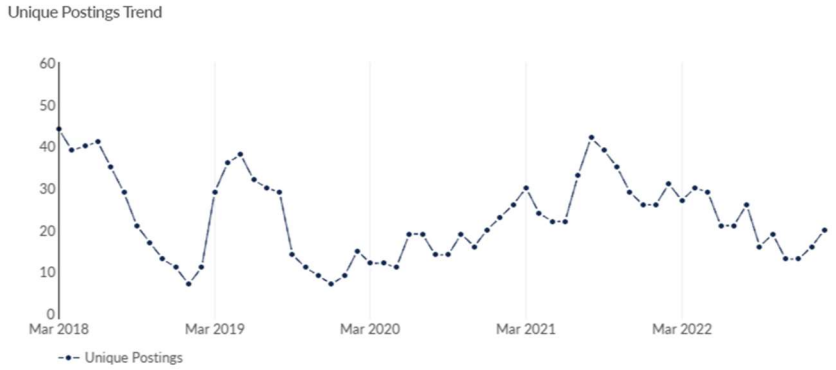
Job title	Most sought-after skills
Wind Turbine Technicians	Wind turbine maintenance Mechanical engineering Electrical equipment
Offshore Structural Engineers	Structural Engineering Engineering Design Process Steel Design
Renewable Energy Analysts	Finance Business development Procurement
Project Managers	Project management Agile methodology Procurement
Associate Directors of Marketing	Marketing Engineering Design Process Feasibility Studies
Renewable Energy Consultants	Due Diligence Business Development Project Management
Geotechnical Engineers	Geotechnical Engineering Civil Engineering Geology
Contracts Managers	Contract management Procurement Sub-contracting

Marine, wave and tidal

5.2.18 Given that there is currently no commercial activity in this industry in Northern Ireland at the moment and only one project is in the planning stage, it is not surprising that demand for the associated skills is virtually non-existent – and hence the training market is not making any moves to develop new provision.

5.2.19 In the year ending 28th February 2023, there were just 116 online job postings relating to the marine, wave and tidal industry across the UK[23] – none of them were located within Northern Ireland.

Figure 12: Number of online job postings relating to marine, wave and tidal (UK)



Source: Lightcast™, 2023.

[23] These vacancies were identified using the keywords "wave energy" or "tidal energy" and excluding staffing/recruitment companies.

5.2.20 The table below shows the top ten job titles being recruited and most sought-after skills associated with each job title (listed in order of magnitude):

Figure 13: Most sought-after job titles and associated skills

Job title	Most sought-after skills
Renewable Energy Analysts	Finance Business development Procurement
Graduate Mechanical Engineers	Mechanical Engineering Mechanical Design AutoCAD
Mechanical Design Engineers	Mechanical Design Mechanical Engineering SolidWorks (CAD)
Ocean Engineers	MATLAB Oceanography Data Analysis
Project Engineers	Project Engineering Mechanical Engineering Project Management
Electrical Design Engineers	Electrical Engineering AutoCAD Engineering Design Process
Modelling Engineers	C++ (Programming Language) Scripting Software Engineering
Principal Engineers	Engineering Design Process Agile Methodology Civil Engineering
Project Managers	Project management Agile methodology Procurement
Project Principals	Business Development Project Management Project Controls

5.3 Skills supply – Education and skills provision

5.3.1 It is likely that the main entry routes into both the offshore and onshore wind industry will be:

- Apprenticeships and graduates (potentially providing a "base load" of new talent for the next generation)
- From other, technically-related, industries (including those from other aspects of the wider energy industry – both onshore and offshore)
- Those with cross-industry skills (e.g. business/ commercial, IT and data analytics, drone/ ROV operators, etc.)

5.3.2 Therefore, having appropriate conversion programmes, as well as recognition of prior learning/experience, will be a crucial route to competency for the industry.

Further education

Traineeships

5.3.3 The Traineeship programme is delivered by the six further education colleges and work-based learning being provided by local employers. They allow an individual to achieve a full Level 2 qualification over a two-year, full-time programme.

5.3.4 Relevant Traineeships include:

- Engineering (which is being offered by all six further education colleges)
- Fabrication and welding (which is being offered by all six further education colleges)
- Plant maintenance (offered by South West College)

Apprenticeships

5.3.5 Developing the next generation of talent, in particular supporting apprenticeships is a key target of the Offshore Wind Industry Deal. Through the Deal, the industry has agreed a target of 2.5% of the workforce to be recruited through apprenticeship programmes[24].

5.3.6 There are a number of apprenticeship frameworks which are directly applicable to large-scale energy generation, including:

- Electrical power engineering (level 2 – also available for people aged 25+)
- Engineering (level 2 – also available for people aged 25+)
- Supply chain management (level 2)
- Electrical power engineering (level 3 – also available for people aged 25+)
- Electrotechnical (level 3)
- Engineering (level 3 – also available for people aged 25+)

[24] Offshore Wind Skills Intelligence Report, Offshore Wind Industry Council, May 2022.

Higher level apprenticeships (level 4+)

5.3.7 There are also a wide range of higher level apprenticeships available relating to various activities of:

- Advanced manufacturing and engineering (x18)
- Civil engineering (x4)
- ICT (x13)

Further education colleges

5.3.8 Based on information provided by the further education colleges to the GESIRG in January 2023, six programmes which are relevant to large-scale energy production, including:

- Level 3 Award in the Design, Installation and Commissioning of Electrical Energy Storage Systems
- Level 3 BTEC Extended Diploma in Engineering
- Foundation Degree in Electrical and Electronic Engineering
- Foundation Degree Mechanical and Manufacturing Engineering
- Level 5 certificate in Green Technologies
- Higher Level Apprenticeship/HND in Electrical and Electronic Engineering

5.3.9 SERC provides the OCN NI Level 5 Certificate in Green Technologies, including a subject unit in Electrical Energy Storage Systems.

Skill Up programme

5.3.10 Through the Skill Up programme, a range of free short courses are on offer from further and higher education providers across a wide range of subjects, including:

- Mechanical Engineering with Management (PG Cert)
- PG Cert in Engineering of Energy, Economics and the Environment
- Welding
- Zero Carbon Engineering (PG Cert/PG Dip)

5.3.11 These courses are an ideal way to enable people from outside of the industry (be they new entrants to the labour market or people transitioning from one industry to another) to upskill quickly.

Higher education

5.3.12 The two largest universities in Northern Ireland, Ulster University and Queen's University Belfast, offered a range of first degree courses in 2020/21. Overall, there were 735 starts on engineering and geographical sciences courses (145 of whom were female), including:

- Civil engineering: 240 starts (50 were female)
- Mechanical engineering: 195 starts (30 were female)
- Engineering (non-specific): 95 starts (15 were female)
- Electrical and electronic engineering: 95 starts (10 were female)
- Chemical, process and energy engineering: 80 starts (20 were female)
- Physical geographical sciences: 30 starts (20 were female)

5.3.13 There is currently no standalone geoscience degree available at either undergraduate or postgraduate level in Northern Ireland. Prospective students in this area have to travel outside of Northern Ireland to either Great Britain or Ireland.

5.3.14 The table below shows the number of STEM graduates from 2020/21 that entered employment in this industry.

Figure 14: Number of STEM graduates from Northern Ireland HE institutions that entered employment in the industry (2020/21)

Industry	Standard Industry Classification	Graduates in employment
Large-scale energy production	35.11 Production of electricity	10

Source: HESA Graduates Outcomes, 2020/21.

5.3.15 Given that the Northern Ireland Skills Barometer 2021 update reports that almost two-fifths (37%) of new workers in the period to 2030 will require level 6+ qualifications (i.e. undergraduate degree, masters, PhD) and that Northern Ireland will be short of nearly 3,000 level 4+ skilled people per year over the same period (with Engineering and Manufacturing Technologies being particularly in demand), the numbers enrolling on the courses listed above need to increase substantially.

5.4 Learning from around the UK

5.4.1 In addition to the apprenticeship frameworks that are currently available in Northern Ireland, there are a number of English apprenticeship standards that may be relevant:

- Engineering design and draughtsperson (level 3)
- Control technical support engineer (level 6)
- Electrical or electronic technical support engineer (degree) (level 6)

5.4.2 Sectoral Partnerships may wish to consider whether the development of equivalent frameworks might be of benefit to the industry in Northern Ireland.

5.4.3 Skills Bootcamps, offered across England, are free, flexible courses of up to 16 weeks duration. At the end of the course, each participant is offered a job interview with an employer.

5.4.4 There are a range of Skills Bootcamps relevant to this industry:

- Offshore Renewables
- Wind Turbine Technician Blade Repair
- Wind Turbine Technician Electrical
- Wind Turbine Technician Entry Level
- Wind Turbine Technician Painter
- Wind Turbine Technician Team Leader
- Functional Skills for the Green Wind Industry

6 Infrastructure

6.1 Introduction

6.1.1 This industry covers the following activities:

- Electricity networks
- Gas networks
- Water supply and wastewater treatment
- Heat networks

6.1.2 Employment in these industries is estimated to be in the region of 10,000 people[25].

35.12 Transmission of electricity	500
35.13 Distribution of electricity	450
35.14 Trade of electricity	200
35.22 Distribution of gaseous fuels through mains	*
35.23 Trade of gas through mains	*
36.00 Water collection, treatment and supply	1,300
37.00 Sewerage	300
42.2 Construction of utility projects	1,800
42.9 Construction of other civil engineering projects	5,400

6.1.3 Nearly three-quarters of these people are employed in construction/civil engineering activities.

6.1.4 From discussions with subject matter experts during the course of this research, it would appear that the consensus is that a figure of 10,000 employed people is an under-estimation – with the real figure likely to be in the region of 15,000 (this is probably caused by the categorisation of utility contractors being in parts of the construction

6.1.5 The latest national employment projections by Warwick Institute for Employment Research and Cambridge Econometrics[26], suggest that employment in the electricity, gas, water and sewerage industries will remain stable through to 2035.

6.1.6 This is broadly supported by data from the Northern Ireland Skills Barometer 2021 update which forecasts that the electricity and gas industries combined will grow by an estimated 1.5% per year.

6.1.7 However, these projections do not take into account the likely increases in investment in network growth and upgrades as part of the next price control periods set by the Utility Regulator which start in 2025 for electricity, 2026 for water and 2027 for gas.

6.1.8 The civil and specialised construction sub-industries of construction are projected to grow by around 20% by 2035.

[25] Northern Ireland Business Register and Employment Survey, 2021.

[26] The Skills Imperative 2035: Occupational Outlook – Long-run employment prospects for the UK, National Foundation for Educational Research, 2022.

6.2 Skills demand – Current and future skills requirements

6.2.1 The evidence collected for this research supports the general view that the technical aspects of craft roles are expected to remain fundamentally the same over the coming years – skills changing in an evolutionary, rather than revolutionary, manner. Therefore, the required general technical knowledge remains the same.

6.2.2 However, given (i) the expected increase in investment during the next price control period (from 2025) and (ii) the drive towards smarter networks, it is highly likely that an increased workforce and some new skills will be required over the remainder of the decade.

6.2.3 Where upskilling will be required, it will mainly be driven by the introduction of new technologies onto the assets – both in terms of installation, operation and maintenance and in dealing with increasing amounts of data being collected, analysed and used as business intelligence from both the assets and customers.

6.2.4 The three areas where the knowledge, skills and behaviours of operational/technical workers are likely to change moving forward are:

- **Digital/IT skills** – driven by the increase in Mobile Workforce Management (MWM) solutions that give the field workforce real-time information about customers, assets, outages, hazards, etc., enabling them to make the best decisions out in the field. This will require a new level of base IT skills (the ability to use mobile devices, email, IM, etc.) as well as solution/provider-specific skills.
- **New technologies** – for example, installing, operating and maintaining remote monitoring and related telecommunications equipment to allow asset performance data to be collected. Also, drones and similar devices are becoming a useful tool for monitoring and repairing assets.
- **Soft/meta skills** – Such as greater inter-personal and social competences, adaptability and customer engagement skills. Enabling workers to adapt to different situations and clients.

6.2.5 For the most part, this upskilling is likely to be incremental (and, potentially, product-specific) rather than a fundamental change to how someone does carries out their existing role. This, therefore, drives the need for modular learning and accreditation pathways (e.g. micro-credentials[27]).

6.2.6 To install and configure these technologies as part of a system, and not a standalone piece of equipment, will require such skills as a whole-system thinking mindset; knowledge of network automation technologies; increased testing and commissioning skills as well as isolation of multiple electricity feeds.

6.2.7 Field and operational personnel need to be aware of and ready for these devices. They will also need to understand when/why they activate – and if they do, what they need to do about it. While the core characteristics of some of these devices may be the same as the device they are replacing, how they behave could be different. Also, their lifespan is likely to be lower than the 40-50 years that is not uncommon with many of the mechanical devices currently utilised.

6.2.8 Detailed below are the current and future skills requirements for each of the four aspects of infrastructure.

Electricity transmission and distribution networks

6.2.9 Future demand for new and increasing skills is largely the result of the development and deployment of new generating technologies, smart networks and the increasing roll-out of low carbon technologies in the home, including heat pumps, solar PV, and electric vehicle charging points – all of which will increase demand for electricity in a two-way flow (both into and out of the home)[28].

6.2.10 Greater decentralised power generation will increase the number of live electricity feeds within a system, requiring workers to have extensive knowledge of how to shut down multiple power feeds prior to commencing work.

6.2.11 For example, as the progressive and iterative nature of technological adoption becomes apparent, enhanced skillsets will be needed by electrical engineers to design and evolve network systems capable of embedding, supporting and maintaining such technologies.

[27] Micro-credentials are short, credit-bearing courses that support higher education. Micro-credentials would not normally constitute an award in their own right, but they have standalone value and could also contribute to a recognised qualification. They potentially widen access to learners who might not have considered a more academic route to achieving a qualification.

[28] Advice report: The path to a Net Zero Northern Ireland, Climate Change Committee, March 2023.

6.2.12 Also, the shift to power electronics, the branch of electrical engineering that deals with the processing of high voltages and currents to deliver power, is bringing significant change in terms of how the network is operated and the knowledge and skills needed by electrical engineers. Since this change will see power being distributed via electronics rather than hard cables, new equipment will need to be introduced via training centres and staff will need to attend training centres regularly to be updated.

6.2.13 In 2018, Energy & Utility Skills conducted research on skills shortages within the electricity industry as part of the review of the UKs Shortage Occupation List by the Migration Advisory Committee (MAC). As a result of that research, all job roles that sit within the following occupations are now listed on the UK's Shortage Occupation List[29]:

- Civil Engineer
- Mechanical Engineer
- Electrical Engineer
- Electronics engineer
- Design and development engineer
- Production and process engineer
- Quality control and planning engineer
- Welding (only high integrity pipe welders)

6.2.14 More recent engagement with members of NSAP's Transmission & Distribution Network group and with companies operating specifically in the Northern Irish electricity industry suggests that priority areas for training at the moment are:

Craft and technical roles	
Craftsperson	Linesperson
Electrical Fitter	Maintenance Technician
HGV Driver	Overhead Linesworker
Instrumentation, Control & Automation Technician	Utilities Technician
Jointer	

Engineering	
Asset Engineer	Network Planners
Civil Engineering	New Product/Proposition Developer (new role)
Commissioning Engineer	Power Systems/Design Engineer
Control/Planning Engineer	Protection Engineer
DSO Engineer	SCADA Engineer
Electrical Engineer	Senior Authorised Person
Grid Connection Engineer	Structural engineer
High Voltage Engineer	Substation Electrical Engineer
Mechanical//Mechatronics engineer	

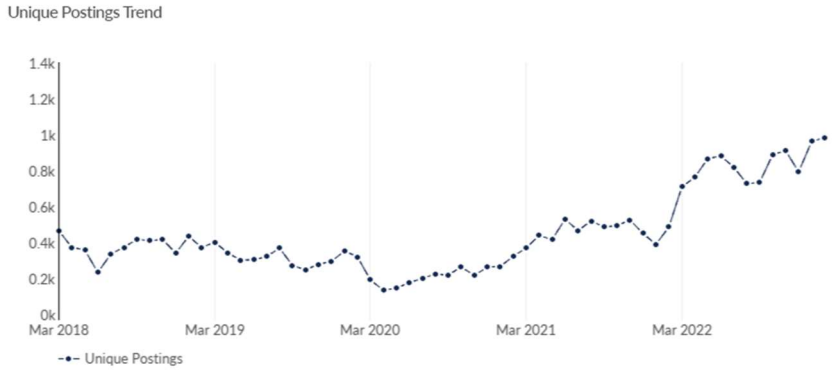
[29] More information in the UK's Shortage Occupation List can be found on the UK Visas and Immigration's website (external link opens a new window).

Other Specialisms	
Customer Service Manager	Outage Planning Manager
Cyber Security Specialist	Power System Analyst
Data Management Analyst	Project Management
Data Scientist	Quantity Surveyor
Innovation Manager	

6.2.15 A number of interviewees for this research mentioned the competition for craft skills from the fibre/telecoms industry which has attracted a lot of people from the power industry over the past three-to-four years – but also presents an opportunity to bring back in as the fibre programme progresses.

6.2.16 In the year ending 28th February 2023, there were 4,500 online job postings relating to the transmission and distribution of electricity across the UK[30] – 52 of them were located within Northern Ireland.

Figure 15: Number of online job postings relating to electricity transmission and distribution (UK)



Source: Lightcast™, 2023.

[30] These vacancies were identified using the keywords "electricity transmission" or "electricity distribution" and excluding staffing/recruitment companies.

6.2.17 The table below shows the top ten job titles being recruited and most sought-after skills associated with each job title (listed in order of magnitude):

Figure 16: Most sought-after job titles and associated skills

Job title	Most sought-after skills
Protection and Control Engineers	Electrical Engineering Control Engineering Engineering Design Process
Connections Managers	Grid Connections Electric Power Systems Electrical Engineering
Project Managers	Project Management Agile Methodology Stakeholder Management
Design Engineers	SolidWorks (CAD) 3D Modeling AutoCAD
Drafters	AutoCAD 3D Modeling SolidWorks (CAD)
Transmission Technicians	Electric Power Transmission Engineering Design Process High Voltage
VDC Engineers	Project Engineering Electric Power Transmission Engineering Design Process
Environmental Managers	Environmental Resource Management ISO 14000 Series Environmental Management Systems
Network Planners	Geographic Information Systems Automation Capacity Management
Principal Engineers	Engineering Design Process Agile Methodology Civil Engineering

Gas distribution networks

6.2.18 The challenges facing the gas distribution network operators over the coming years relate to the implications of moving away from delivering natural gas to customers and towards other fuels, particularly a blend of natural gas with biomethane and/or hydrogen. The skills implications of these two replacement gases can be quite different.

6.2.19 Biomethane is a straight replacement for natural gas, so the only considerations relate to the practicalities of injecting the gas into network – which essentially utilises the same technologies and skills as natural gas does now.

6.2.20 In relation to hydrogen, this is a two-stage process – blending hydrogen with natural before eventually, assuming pilots prove successful, moving to a 100% hydrogen gas network.

6.2.21 Whilst blending hydrogen with methane doesn't seem to present too many challenges for assets, switching to 100% hydrogen is a different proposition: burning pure hydrogen embrittles metal, meaning there are infrastructure and appliance considerations; and should things go awry, hydrogen can detonate, unlike methane which tends to deflagrate, meaning that different safety scenarios – and the skills they demand – must be fully anticipated.

6.2.22 Hydrogen will affect a range of well-established and highly skilled technician and tradesperson roles in the gas and electrical industries (e.g. gas fitter, electrical fitter, electrical instrumentation technician). These job roles may already work with natural gas or other gas fuel substitutes, and they will not assume new tasks or responsibilities as a result of the blending of hydrogen.

6.2.23 For many existing job roles, hydrogen will require either a slightly more complex execution of day-to-day tasks or background knowledge about its chemical properties[31].

6.2.24 Community tests are currently underway, with the hydrogen village trial due to report in 2026. The anticipated move to a 100% hydrogen gas supply will need new standards for skills in storage, transmission, and the installation of hydrogen appliances.

6.2.25 Work is currently way[32] to develop the installation standards and training specifications to safely enable the repurposing of existing natural gas systems for use with 100% hydrogen in domestic and non-domestic premises. This will lead to the updating of the IGEM/H/1 Hydrogen Reference Standard and create two new Hydrogen Enabling Standards covering domestic and non-domestic scenarios.

6.2.26 Energy & Utility Skills will finalise and implement the Hydrogen Competency Framework by developing an updated and expanded Training Specification, aligned to these new and updated standards developed by IGEM. The work is due to be completed by September 2023 and will cover the following aspects:

Hydrogen awareness	Trainers and Assessors
Field and Facility Operatives – Pressure Control / Mechanical	Gas Distribution
Distribution Network Construction	Distribution Network Directors and Senior Operational Managers
Distribution Network Emergency Response	Distribution Network Designers and Planners
Distribution Network personnel involved in electrical and instrumentation	Distribution Network Personnel involved in pressure control
Distribution Network Pipeline	Distribution Network policy makers

[31] Developing Australia's Hydrogen Workforce, Final Report, October 2022, PwC Consulting.

[32] By Energy & Utility Skills partnering with IGEM

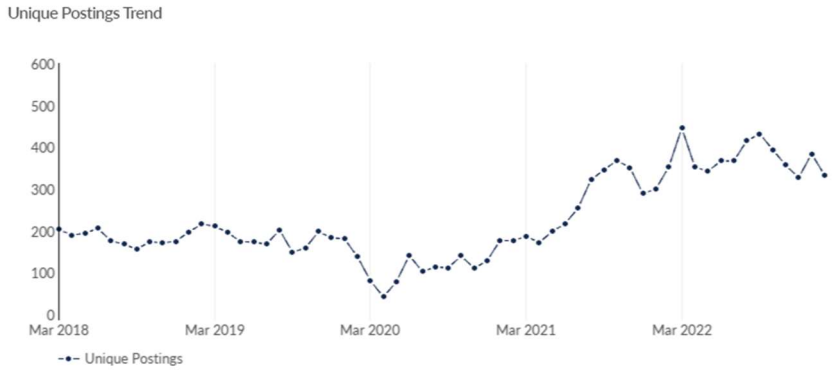
Transmission directors and senior managers	Field and Facility Operatives, First Line Managers and Supervisors (Electrical and Instrumentation)
Field and Facility Operatives, First Line Managers and Supervisors (Pipelines)	Field and Facility Operatives, First Line Managers and Supervisors (Pressure Control / Mechanical)
Transmission policy makers and System Design Engineers	

6.2.27 More widely across the gas distribution industry, Energy & Utility Skills identified in 2018, during the last review of the UKs Shortage Occupation List by the Migration Advisory Committee (MAC), a number of generic job roles that employers are finding it difficult to recruit from within the UK labour market due to there being a lack of people with the required skills and experience:

- Cyber Security – IT Lead
- Data Scientist
- Programme/Project Manager
- Security Architect – IT
- Senior/ Quantity Surveyor
- Technical Engineering Manager - Safety and Network Strategy

6.2.28 In the year ending 28th February 2023, there were 2,000 online job postings relating to the transmission and distribution of gas across the UK[33] – just 36 of them were located within Northern Ireland.

Figure 17: Number of online job postings relating to gas transmission and distribution (UK)



Source: Lightcast™, 2023.

6.2.29 The table below shows the top ten job titles being recruited and most sought-after skills associated with each job title (listed in order of magnitude):

[33] These vacancies were identified using the keywords "gas transmission" or "gas distribution" and excludes staffing/recruitment companies.

Figure 18: Most sought-after job titles and associated skills

Job title	Most sought-after skills
Drafters	AutoCAD 3D Modeling SolidWorks (CAD)
Technical Support Engineers	Technical Support Computer Science Endpoint Detection and Response
Product Managers	Product Management Environmental Social and Corporate Governance Agile Methodology
Distribution Assistants	Warehousing Excavation Construction
Gas Distribution Engineers	Technical Engineering Fluid Dynamics Network Monitoring
Product and Business Development Managers	Sensors Electrical Engineering Data Acquisition
Gas Operations Supervisors	Pneumatic Tools Pipe Laying Excavation
Gas Engineers	Maintenance Engineering Construction Systems Engineering
Network Supervisors	Risk Management Continuous Improvement Process Performance Management
Capital Project Managers	Project Management Procurement Contract Management

Water supply and wastewater treatment

6.2.30 Increasingly, the distinctions between the water industry and other aspects of the energy industry and circular economy are becoming harder to define and less useful from a research and policy perspective.

6.2.31 Water companies are significant consumers of electricity and are increasingly looking at how they can become carbon neutral by utilising technologies and techniques (and skills) that have traditionally been classified as being within the power industry.

6.2.32 Equally, creating value from sewerage through Anaerobic Digestion (AD) and the production of biogas is bringing into the industry gas and chemical industry technologies, techniques and skills (see section 8).

6.2.33 The water company of the future will require skills in electricity and gas industries in addition to skills for evolving water, chemical and environmental industries.

6.2.34 Wastewater re-use offers a means of reducing discharges and increasing water supply, without abstraction. A range of established and emerging technologies exist to enable this, including ultrafiltration; reverse osmosis; microfiltration; ozonisation and UV disinfection, while desalination enables the generation of drinking water from seawater[34].

6.2.35 The main skills challenges facing the water/wastewater industry relate to:

- Energy generation/efficiency
- Supporting the circular economy of water
- Nature-based solutions

6.2.36 Water/wastewater companies are taking steps to substantially increase their levels of energy efficiency and reduce their overall levels of energy consumption by investing in low carbon and renewable electricity to power activities such as filtration and pumping. Sometimes this is obtained via a contract with a renewable energy supplier; sometimes it is generated on site and often it may be a combination of the two. Wind, solar and hydroelectricity generation technologies all offer new sources of power for the water industry.

6.2.37 It is likely that the initial installation of these technologies will be undertaken by specialist contractors, as will repair and maintenance activities.

6.2.38 On a day-to-day basis, the role of the "Energy Manager" will become increasingly important to monitor and manage energy usage, adjust pumping schedules accordingly and generally ensure that plant is being operated as efficiently as possible. This role and skill set would be expected to interface with onsite generation capacity.

6.2.39 The combined effects of climate change (e.g. warmer/dryer summers and milder/wetter winters) and an expanding population are putting pressure on limited water resources, supporting the need for a more sustainable circular economy of water requiring new and advanced engineering skills.

6.2.40 Wastewater re-use offers a means of reducing discharges and increasing water supply, without abstraction. A range of established and emerging technologies exist to enable this, including ultrafiltration; reverse osmosis; microfiltration; ozonisation and UV disinfection. Furthermore, water purification technologies, including water desalination, enable generation of drinking water from seawater, helping to facilitate Circular Economy principles[35].

[34] The implications of future technological change for Scotland's infrastructure Report, Prepared by Frost and Sullivan, August 2019.

[35] The implications of future technological change for Scotland's infrastructure Report, Prepared by Frost and Sullivan, August 2019.

6.2.41 In developing these technologies and understanding the impact on the skills needed in the industry, water companies will collaborate with specialist engineering consultancies and universities. Once deployed, these new skills will be assimilated into the existing workforce.

6.2.42 However, the impact on skills is likely to be relatively small in volume, focussing on specialised niche skillsets. For example, where membrane technology is concerned (which is a proven technology and likely to be scaled up significantly over coming years), operation and use are safety-critical. There is no margin for error as often potentially harmful pharmaceuticals can be present in wastewater.

6.2.43 The need for nature-based solutions is a major driver for the water companies, policy-makers and industry leaders and is seen as crucial to sustaining reliable and sufficient water supplies and reducing water pollution.

6.2.44 Nature-based solutions encompass supporting and working with natural systems, such as trees, forests, wetlands and grasslands, often within a given catchment. For example, restoration of wetlands and other permeable surfaces can recharge groundwater levels and reduce flood risk (by slowing the flow of water during heavy rainfall so that it enters the watercourse at a more manageable speed). Increasing coverage of thriving woodland can filter water naturally, removing pollutants and reducing water treatment requirements. Greening can also help to regulate the release of water downstream, promoting natural water storage and mitigating flood risk[36].

6.2.45 The value of groundwater as part of the water supply system, and in the production of green hydrogen, is currently being developed. The use of groundwater has the potential to alleviate public and private water supply challenges and, at the same time, using less energy.

6.2.46 Geological Survey Northern Ireland is already working in collaboration Northern Ireland Water.

[36] More information can be found on the World Resources Institute's website (external link opens a new window).

6.2.47 Science-based skills that will have an increasingly important role to play in the industry moving forward – both within water companies and in the wider supply chain – include:

- Conservation biologist
- Ecologists
- Environmental scientist
- Geologist
- Hydrogeologists
- Hydrologist
- Limnologist

6.2.48 Entry level positions within scientific roles (e.g. lab technicians) are an area where recruitment of experienced people can be a challenge.

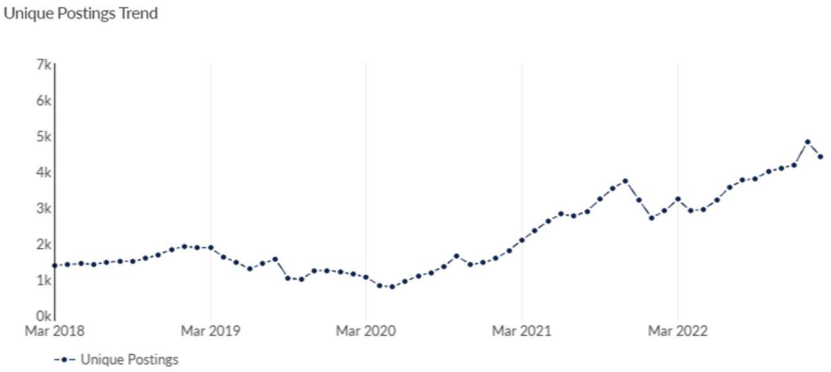
6.2.49 Research undertaken by Energy & Utility Skills in 2018 during the last review of the UKs Shortage Occupation List by the Migration Advisory Committee (MAC) produced a list of occupations that employers are finding difficult to recruit from within the UK labour market due to there being a lack of people with the required skills and experience:

- Chemical Engineer
- Civil Engineers
- Contract and Sourcing Managers
- Cyber Security – IT Lead
- Data Scientist
- Electrical Technicians
- Electronic EngineerSoftware Engineer
- Instrumentation, Control & Automation Technicians
- Mechatronic Engineer
- Process Engineer
- Procurement Specialist
- Programme/Project Manager
- Quantity Surveyor
- Regulatory Manager – Econometrician
- Solutions Architect

6.2.50 Catchment-based approaches require extensive stakeholder management and liaison. This might involve reaching agreement with land users, including industry or agriculture, to change their behaviour (because it is the right thing to do, rather than because there is any legal or regulatory obligation to do it). For example, engaging with landowners to reduce the use of metaldehyde, a slug control pesticide used by farmers[37].

6.2.51 In the year ending 28th February 2023, there were 19,300 online job postings relating to the water industry across the UK[38] – just 56 of them were located within Northern Ireland.

Figure 19: Number of online job postings relating to the water industry (UK)



Source: Lightcast™, 2023.

6.2.52 The table below shows the top ten job titles being recruited and most sought-after skills associated with each job title (listed in order of magnitude):

Figure 20: Most sought-after job titles and associated skills

Job title	Most sought-after skills
HGV Drivers	Manual Handling Safety Culture Hand Tools
Project Managers	Project Management Procurement Project Risk Management
Quantity Surveyors	Quantity Surveying Procurement Contract Management
Project Engineers	Project Engineering Civil Engineering Financial Management
Customer Service Advisors	Inbound Calls Outbound Calls Wastewater
Water Meter Readers	Data Collection Water Metering Smart Meter Systems

[37] More information can be found on the Institute of Water's website (external link opens a new window).

[38] These vacancies were identified using the Standard Industrial Classification code of 36 (Water Collection, Treatment and Supply) and excludes staffing/recruitment companies.

Job title	Most sought-after skills
Process Technicians	Sewage Treatments Sewage Sludge Treatment Pump Stations
Wastewater Manager	Wastewater Asset Management Sewage Treatments
Maintenance and Repair Managers	Manual Handling Excavation Trenching
Electrical and Mechanical Technicians	Electrical Engineering Electrical Systems Valves (Piping)

Heat networks

6.2.53 Heat networks, otherwise known as district heating, produces and transmits heat from a central point to a number of users, using a network of underground hot water pipes. They tend to lend themselves well to distinct scenarios – urban hubs (such as Belfast and Derry), industrial complexes and self-contained rural communities (e.g. a village).

6.2.54 There are currently 94 district heating schemes in NI[39], but only one supports an area that exceeds 100 homes, underlining that heat networks are not currently deployed at scale within Northern Ireland.

6.2.55 To design and develop an effective heat network requires:

- A suitable source of renewable low carbon energy
- Identification of an appropriate technology solution
- Sophisticated modelling of supply and demand
- Negotiation of access
- Commercial agreements and tariffs
- Installation and operation

6.2.56 Connection to building heating systems in a new-build scenario can be relatively straightforward, but integrating heat networks with existing building systems in retrofit context can be challenging.

[39] Heat Networks Market Study, Competition & Markets Authority, July 2018.

6.2.57 A variety of possible technologies can provide the input into a heat network including different types and sizes of power stations, energy from waste (EfW) facilities, industrial processes, biomass and biogas fuelled boilers and Combined Heat and Power (CHP) plants, gas-fired CHP units, fuel cells, heat pumps, geothermal sources, electric boilers and solar thermal arrays[40]. The skills needed for these technologies are considered throughout this report.

6.2.58 From the network perspective, existing workforce capacity and capabilities are insufficient to support the expected growth of the heat network industry[41].

6.2.59 The main skills gaps appear to revolve around:

- Control systems / PLC specialists
- Design engineers
- Engineers and developers
- Facilities and estate managers
- Geoscientists
- General installers
- Legal and finance
- Project managers
- Strategic-level project planners
- Surveyors
- Welders

6.2.60 Furthermore, town and country planners need to understand how to integrate heat network infrastructure into planning proposals and to do energy and transport assessments of early designs.

6.2.61 Typically, people in these roles do not currently have the breadth of skills and experience of heat network projects required to be considered proficient due to the embryonic nature of the heat network industry at the moment[42].

[40] What id a heat network?, Department for Business, Energy and Industrial Strategy.

[41] Heat Network Skills Review (June 2020), Department for Business, Energy & Industrial Strategy, p.11-14

[42] Heat Network Skills Review: BEIS research report no. 2020/020.

6.2.62 The specifics of the additional learning required to supplement existing skill sets were identified in a research project managed by Energy Saving Trust on behalf of the Scottish Government, under the auspices of the Heat Network Skills Initiative[43]. These included:

- Digitalised networks
- Heat network design principles
- Installation, operation and control of low temperature heat networks (including ambient loops)
- Smart technologies
- Specific project management approaches to heat network development

6.2.63 This table identifies the skills lacking across a number of crucial occupations[44].

Figure 21: Summary of skills lacking by occupation within heat networks

Occupation	Skills lacking	Severity of skills gap
Control System Specialist	New recruits lacking the full range of skills required, in particular lack direct experience	High
Energy Master Planner	Intricate knowledge of heat networks can be lacking among those transferring from other industries - also a lack of commercial and legal understanding	High
Heat Network Development Manager	Commonly possessing strong project management or engineering skills, but rarely both	High
Project Delivery Manager	Lacking experience and understanding of the heat network landscape, as well as commercial skills and of procuring large scale projects	High
Commercial / Operations Manager	Business acumen skills	Medium
Design Engineer	There is a limited theoretical or practical knowledge and understanding of heat networks	Medium
Financial Specialist	There is some relevant knowledge at more junior levels; those at more senior levels typically have limited experience of the heat network industry	Medium
Legal Specialist	While there is some relevant knowledge at more junior levels, those at more senior levels typically have limited experience of the heat network industry	Medium
Operations & Maintenance Technician/ Inspector	Lack of people who are able to inspect a system and understand it sufficiently to be able to resolve problems	Medium
Installer	It is relatively easy for installers to work across different industries. No particular skills are lacking in this occupation	Low

[43] Heat Network Skills Initiative (March 2021), Energy Saving Trust, p.8.

[44] Heat Network Skills Review: BEIS research report no. 2020/020.

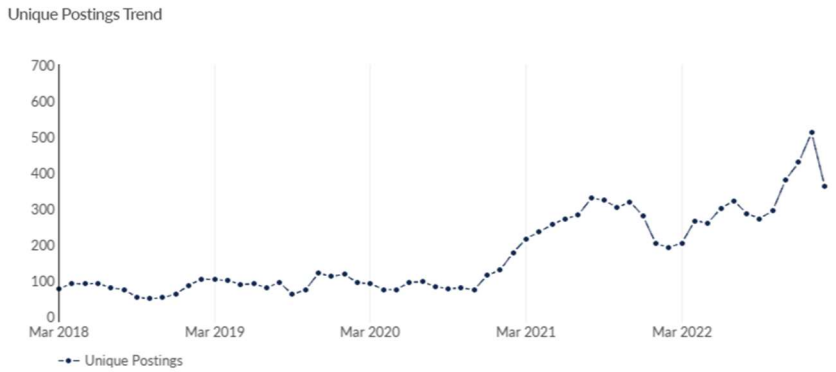
Occupation	Skills lacking	Severity of skills gap
Pipe Layer (including welding)	It is relatively easy for welders to work across different industries, so knowledge of heat network systems is often lacking (although these can be learnt with relative ease)	Low

6.2.64 A specialist skill that may be required within the heat networks – if heat is being obtained through geothermal means – are those associated with geoscience skills.

6.2.65 This requires skills associated with engineering geologists, hydrogeologists, geophysicists, geophysicist, geoscientist, geologist and geochemist.

6.2.66 In the year ending 28th February 2023, there were 1,700 online job postings relating to heat networks across the UK[45] – just 3 of them were located within Northern Ireland.

Figure 22: Number of online job postings relating to heat networks (UK)



Source: Lightcast™, 2023.

6.2.67 The table below shows the top ten job titles being recruited and most sought-after skills associated with each job title (listed in order of magnitude):

Figure 23: Most sought-after job titles and associated skills

Job title	Most sought-after skills
Renewable Energy Analysts	Finance Business Development Procurement
Carbon Analysts	Net Zero Carbon Footprint Reduction Carbon Management

[45] These vacancies were identified using the keywords "heat networks" and excludes staffing/recruitment companies.

Job title	Most sought-after skills
Energy Managers	Energy Management Energy Consumption Building Services Engineering
Commercial Modeller	Accounting Corporate Finance Revenue Stream
Public Affairs Managers	Public Affairs Stakeholder Engagement Public Policies
District Project Managers	Project Management Project Documentation Systems Development Life Cycle
Principal Consultants	Business Development Project Management Environmental Impact Assessments
Sustainability Consultants	Net Zero Environmental Social And Corporate Governance Sustainability Strategies
Project Managers	Project Management Agile Methodology Stakeholder Management
Heat Transfer Engineers	Heat Exchanger Mechanical Engineering Thermal Management

6.3 Skills supply – Education and skills provision

6.3.1 Generally speaking, compared to other green industries, infrastructure involves relatively small numbers of very specialised skill sets, in addition to core operational roles.

6.3.2 In relation to 100% hydrogen networks, only once they scale up in size and complexity, and industry/regulator-approved technical standards have been set, will educational institutions and private training providers enter the market.

6.3.3 In the meantime, any technical upskilling will largely be met by either the OEM/supplier and/or the "trial" network operators themselves on a "modular" basis as the technology is rolled out as business as usual, while awareness-type training is already well established, not least via the Skill up programme, further education colleges and the Hydrogen Training Academy.

6.3.4 While training provision is relatively well established across electricity, gas and water infrastructure, the supply of heat network training is relatively informal and ad hoc, with minor exceptions for specific technical expertise. Most organisations are reliant on internal training led by senior heat network experts. As such, the heat networks industry would benefit significantly from national accredited training standards across both technical and non-technical elements[46].

[46] Heat Network Skills Review: BEIS research report no. 2020/020, BEIS, June 2020.

Further education

Traineeships

6.3.5 The Traineeship programme is delivered by the six further education colleges of Further Education and work-based learning being provided by local employers. They allow an individual to achieve a full Level 2 qualification over a two-year, full-time programme.

6.3.6 Traineeships that may be relevant to the infrastructure industry are:

- Engineering (which is being offered by all six further education colleges)
- Fabrication and welding (which is being offered by all six further education colleges)
- Plant maintenance (offered by South West College)

Apprenticeships

6.3.7 There are a number of apprenticeship frameworks which are directly applicable to the infrastructure industries, including:

- Electrical power engineering (level 2 – also available for people aged 25+)
- Engineering (level 2 – also available for people aged 25+)
- Supply chain management (level 2)
- Water utility operations (level 2)
- Electrical power engineering (level 3 – also available for people aged 25+)
- Electrotechnical (level 3)
- Engineering (level 3 – also available for people aged 25+)
- Water and wastewater operations (level 3)

Higher level apprenticeships (level 4+)

6.3.8 There are also a wide range of higher level apprenticeships available relating to various activities of:

- Advanced manufacturing and engineering (x18)
- Civil engineering (x4)
- ICT (x13)

Further education colleges

6.3.9 Based on information provided by the further education colleges to the GESIRG in January 2023, there is a range of relevant programmes which are relevant to the infrastructure workforce, including:

- Level 2 in Hydrogen Safety
- Level 2 in Hydrogen Applications and Technologies
- Level 3 in Hydrogen Applications and Technologies
- Level 3 Hydrogen Applications and Technologies
- Foundation Degree in Electrical and Electronic Engineering

- Foundation Degree Mechanical and Manufacturing Engineering
- Higher Level Apprenticeship/HND in Electrical and Electronic Engineering
- Level 5 Train the trainer in Hydrogen Applications and Technologies
- Level 5 certificate in Green Technologies
- Level 6 PGCE Hydrogen Technologies

6.3.10 In the case of electricity, gas, water and heat networks, further education is more likely to be used as a career progression tool than as an entry route for new starters (i.e. pre-employment).

6.3.11 There are a small number of courses provided across the further education colleges that are applicable to the infrastructure industry, including in areas such advanced manufacturing engineering, Foundation Degree in Electrical and Electronic Engineering and Foundation Degree Mechanical and Manufacturing Engineering.

6.3.12 In addition, there are a range of generic courses relating to green technologies/industries and renewable energy. However, the majority of these appear to be awareness/introductory courses, rather than skills-based courses that aim to produce technically competent people in that subject area.

6.3.13 There are also courses in Electric Vehicle Charging Equipment (South Eastern Regional College) and Electric Vehicle Charging Equipment Installation (Southern Regional College).

Skill Up programme

6.3.14 Through the Skill Up programme, a range of free short courses are on offer from further and higher education providers across a wide range of subjects, including:

- Hydrogen Energy Systems (PG Cert)
- Hydrogen Safety
- Mechanical Engineering
- Mechanical Engineering with Management (PG Cert)
- PG Cert in Engineering of Energy, Economics and the Environment
- Welding
- Zero Carbon Engineering (PG Cert/PG Dip)

6.3.15 These courses are an ideal way to enable people from outside of the industry (be they new entrants to the labour market or people transitioning from one industry to another) to upskill quickly.

Higher education

6.3.16 The two largest universities in Northern Ireland, Ulster University and Queen's University Belfast, offered a range of first degree courses in 2020/21. Overall, there were 740 starts on engineering courses (130 of whom were female), including:

- Civil engineering: 240 starts (51 were female)
- Mechanical engineering: 190 starts (28 were female)
- Electrical engineering: 95 starts (10 were female)

6.3.17 There are currently no standalone geoscience degrees available at either undergraduate or postgraduate level in Northern Ireland.

6.3.18 Female take-up on STEM (35%), and particularly engineering courses (18%), is low and warrants continued attention.

6.3.19 During the interviews as part of this research, a constant theme was the high level of competition for new engineering graduates once they enter the labour market.

6.3.20 One employer in Northern Ireland seeks to combat this by sponsoring new starters on these courses throughout the term of their studies, augmented with work and summer placements – meaning that by the time the new graduate joins the company full-time after graduating, they have already built up significant real-world experience and awareness of the company's culture.

6.3.21 In addition, there were 1,140 starts on IT/software/computing courses (23% were female). Given the scale of competition for these skills from across the Northern Ireland (and GB) economy – and the growing importance of these skills to the future success of electricity, gas, water and heat networks – growing these numbers should be a priority.

6.3.22 The table below shows the number of STEM graduates from 2020/21 that entered employment in this industry.

Figure 24: Number of STEM graduates from Northern Ireland HE institutions that entered employment in the industry (2020/21)

Industry	Standard Industry Classification	Graduates in employment
Infrastructure	35.12 Transmission of electricity 35.13 Distribution of electricity 35.14 Trade of electricity 35.22 Distribution of gaseous fuels through mains 35.23 Trade of gas through mains 36.00 Water collection, treatment and supply 37.00 Sewerage 42.2 Construction of utility projects 42.9 Construction of other civil engineering projects	40

Source: HESA Graduates Outcomes, 2020/21.

6.3.23 However, given that the Northern Ireland Skills Barometer 2021 update reports that almost two-fifths (37%) of new workers in the period to 2030 will require level 6+ qualifications (i.e. undergraduate degree, masters, PhD) and that Northern Ireland will be short of nearly 3,000 level 4+ skilled people per year over the same period (with Engineering and Manufacturing Technologies being particularly in demand), the numbers enrolling on the courses listed above need to increase substantially.

Upskilling the workforce and transferability of skills

6.3.24 A consortium of organisations including NIE Networks, NI Water, Open Reach, Kier, Farran Construction, Construction Industry Training Board (CITB) and Energy & Utility Skills have joined forces to develop the “Combined Utilities Programme Pilot (NI)”. It is an entry level programme combining: first aid, safe digging, abrasive wheels, asset installation & cable avoidance, fire warden, Streetworks and CSR (Construction Skills Register) and would be recognised across the power, water, gas, telecoms/fibre industries, including its contractors.

6.4 Learning from around the UK

6.4.1 In addition to the apprenticeship frameworks that are currently available in Northern Ireland, there are a number of English apprenticeship standards that may be relevant:

- Dual fuel smart meter installer (level 2)
- Gas network operative (level 2)
- Gas network craftsperson (level 3)
- Electrical power networks engineer (level 4)
- Electrical power protection and plant commissioning engineer (level 4)
- Electrical or electronic technical support engineer (degree) (level 6)
- Infrastructure asset management professional (level 7) (in development)

6.4.2 Sectoral Partnerships may wish to consider whether the development of an equivalent framework might be of benefit to the industry.

6.4.3 Again in England, the Power Network Craftsperson standard (at Level 3) is currently one standard with three options: cable jointer, overhead linesperson, and substation fitter. However, this standard is currently undergoing a revision and will see the existing options becoming their own apprenticeship standard, resulting in new three apprenticeship standards:

- Power industry cable jointer
- Power industry overhead linesperson
- Power industry substation fitter

6.4.4 The justification for such change stems from the recognition that each role has a distinct set of knowledge and skills required for each role and to reflect the fact that to move from one role to another would require substantial additional training.

6.4.5 Once that has been completed, work will commence on reviewing the existing Level 4 apprenticeship standards for Electrical Power Network Engineer and Electrical Power Plant and Protection Commissioning Engineer.

6.4.6 In terms of aiding the transitioning of skills from other industries, a number of different options for "conversion programmes" (i.e. relatively short, mostly unaccredited training programmes) are being considered. For example, ECITB have a stated intention to develop an "Improvership" training model that will reskill existing workers (e.g. from steel fixer to welder)[47].

6.4.7 The Heat Training Grant supports trainees when taking short training courses relevant to heat networks. Training providers offering the grant can provide trainees with a £500 discount[48].

6.4.8 The Heat Network Skills Initiative in Scotland supported the development of a skilled workforce through a portfolio of four focussed short courses and online Masterclass programmes which are designed to address key skills gaps identified by the industry, sowing the seeds for further development and growth of heat network skills training in Scotland[49].

6.4.9 The Chartered Institution of Building Services Engineers has developed a "Heat Networks Code of Practice (CP1) course"[50] to ensure that the skills necessary to implement the code of practice are available across the building services industry. The Code has been written to cover all stages of the development cycle of a project from feasibility through design, construction, commissioning, and operation.

[47] Leading Industry Learning: ECITB Strategy 2023-25, ECITB, 2022.

[48] More information about the Heat Training Grant can be found on the gov.uk website (external link opens in a new window).

[49] Heat Network Skills Initiative (March 2021), Energy Saving Trust, pp.3-4

[50] More information can be found on the Chartered Institution of Building Services Engineers' website (external link opens a new window)

7 Domestic low carbon technologies and energy efficiency

7.1 Introduction

7.1.1 This industry includes the following activities:

- Home insulation
- Heat pumps
- Solar Photovoltaic and thermal
- Domestic electric vehicle charging points
- Hydrogen-ready boilers

7.1.2 Employment estimates that specifically relate to the provision of goods and services to domestic customers only is not available. However, it is estimated that 5,200 people are employed in the provision of such products and services to the entire market in Northern Ireland, including both domestic and non-domestic customer[51]:

- Energy efficient lighting: 2,600
- Other energy efficient products: 1,800
- Low carbon financial and advisory services: 400
- Energy monitoring, saving or control systems: 300
- Solar photovoltaic 100

7.1.3 Looking at the industry more broadly, the Northern Ireland Business Register and Employment Survey (2021) estimates that 18,800 people currently work in occupations that could, relatively easily, gain the skills required for these technologies – perhaps giving an estimate:

- 43.2 Electrical, plumbing and other construction installation activities 10,800
- 43.3 Building completion and finishing 5,000
- 43.9 Other specialised construction activities 3,000

[51] Low carbon and renewable energy economy estimates, 2021, ONS.

7.1.4 Data from the Northern Ireland Skills Barometer 2021 update forecasts that the whole of the construction, of which the workforce associated with domestic low carbon technologies sits within, will grow by an estimated 1.2% per year.

7.1.5 Data from the Census 2021 shows that just 5.3% of Northern Ireland's 769,000 households had any sort of renewable energy technology installed in it – including, solar panels for electricity, solar panels for heating water, biomass, wind turbine, air source, geothermal or other.

7.1.6 Clearly there is still some considerable way to go in order to achieve the ambition of all new heating appliance installations being zero-carbon by 2030 for off-grid gas homes and 2033 for on-grid gas homes.

7.1.7 The markets for these various low carbon technologies are very sensitive to government policies and incentives. Many of the interviews conducted for this research mentioned the lack of (i) policy certainty (particularly in relationship to which technologies/ solutions should be "first out of the blocks") and (ii) incentives[52] to improve consumer demand as being factors behind the low take-up of these technologies.

7.1.8 Once policy certainty and incentives are delivered (including quality measures such as Trustmark and MCS), consumer demand should follow, leading to businesses having the confidence to invest in skills[53].

[52] Consumers tend to respond more favourably to incentives that offer cheaper installation costs, rather than offer longer-term cost reduction benefits.

[53] Delivering Net Zero: A Roadmap for the role of heat pumps, Heat Pump Association, 2019.

7.2 Skills demand – Current and future skills requirements

7.2.1 The majority of skills associated with the installation of domestic low carbon technologies fall into two broad categories:

i. There are roles relating to assessment, advisors, co-ordinators, consultants and planners – these generally require higher level qualifications and specialist training

ii. There are roles relating to the actual installation and maintenance of the technologies – these are generally "skilled trades" and acquire their skills through programmes such as apprenticeships, manufacturer-specific short courses and on-the-job experience

7.2.2 In the case of advisers/co-ordinators/etc., significant expertise is required to develop a retrofit programme for a building. Each project requires the skills of a surveyor to assess current condition and any requirements for repair, an energy specialist to model current performance and design an upgrade solution, a project manager to supervise the retrofit programme, and various different trades people are required to implement all the recommendations[54].

7.2.3 Therefore, the role of the "Retrofit Co-ordinator" is very likely to be essential as they will identify, analyse and manage the technical and procedural risks that are frequent in household retrofit projects. They will ensure that energy efficiency measures are designed, specified, monitored, and evaluated after installation in line with PAS 2035, or any such equivalent scheme.

7.2.4 The challenge to the industry and its stakeholders will be to ensure that there is an appropriately sized and skilled Retrofit Co-ordinator workforce that can build and maintain trust in the whole home decarbonisation market. At the moment, this is not the case[55].

7.2.5 In relation to the existing installer workforce, the fundamentals of home heating and hot water will not change, and many already have many of the essential skills required for low carbon heating installation and will, with access to the right provision at the right time at the right cost, be able to upskill on these new technologies relatively easily.

[54] Building skill for net zero, Report prepared by Eunomia for CITB, March 2021.

[55] Building skill for net zero, Report prepared by Eunomia for CITB, March 2021.

7.2.6 All installations must be undertaken by suitably qualified trades. Crucial to this happening at the required scale moving forward will be having sufficient supply of qualified electricians and plumbers – which form the basis of most installer skillsets. This means that it can take up to four years to become fully qualified, which is a significant factor when to incorporate into any industry skills strategy.

7.2.7 There is a critical skills gap in repair skills for traditional buildings, but this is more a volume issue as these are not skills that are typically included in any formal training, they are normally picked up through on-the-job training.

7.2.8 In the commercial buildings industry, bringing experience of these technologies to architects, building designers, engineers and facilities managers will enable efficient, all-electric building design[56].

7.2.9 Ultimately, demand for these technologies – and therefore a skilled workforce – will be led by consumer demand, meaning that training provision will need to respond very quickly to upturns in demand from the market (most likely influenced by government policies/incentives), both in terms of upskilling the existing workforce and in enabling new entrants to join the workforce in as efficient and cost-effective way as possible.

7.2.10 Finally, there is a recognition that administrative skills, with a degree of technology-specific knowledge, is likely to be required by those organisations (e.g. government department or a managed service provider) who will be responsible for the administering or oversight of any energy efficiency/technology roll-out/incentivisation schemes.

7.2.11 In the following sections, we take a look at the skills requirements for each technology. Note, however, that we do not review the accreditation and regulation of skills and/or installation (e.g. MCS or Trustmark), which is outside of the remit of this research.

Home insulation

7.2.12 Within Northern Ireland, there is a high proportion of the housing stock that is poorly insulated, which makes the “fabric first” approach essential.

7.2.13 Fabric first is an approach which prioritises improving airtightness and reducing heat loss from the building envelope, prioritising areas of high loss such as roofs, windows and doors.

7.2.14 Insulation technicians perform important roles in this work by installing cladding and upgrading insulation, performing structural and other repair work, ensuring good airflow and proper ventilation and moisture-proofing.

[56] Harnessing heat pumps for net zero: The role of heat pumps in saving energy and cutting emissions, Australian Alliance for Energy Productivity (A2EP) and Energy Efficiency Council (EEC), February 2023.

7.2.15 They must also undertake cosmetic repair and finishing tasks such as plastering, sealing and painting to restore function and aesthetics.

7.2.16 Of the types of insulation available (loft, cavity wall, solid wall and floor), cavity wall insulation is the least intrusive, as it is applied externally, without significantly altering the appearance of the building. Loft insulation can be relatively nondisruptive, although this depends on the condition and accessibility of the loft space.

7.2.17 Although, loft insulation can usually be installed by low-skilled workers, each installation requires a survey to ensure that there are no issues requiring attention, such as frayed wiring, leaks or damp.

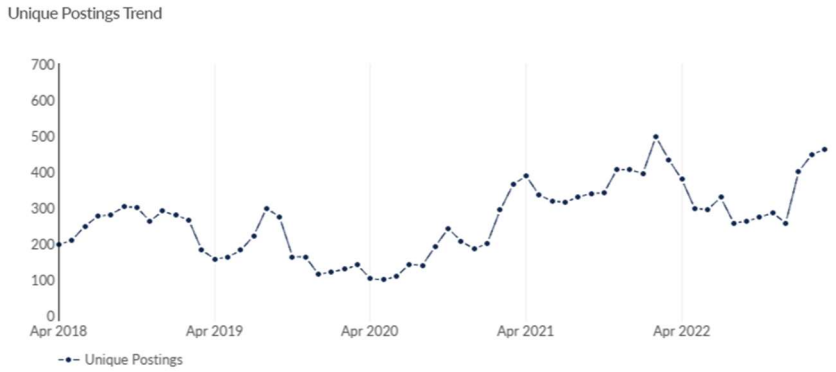
7.2.18 Cavity wall insulation also requires a survey and must be installed by qualified operatives (Level 2 NVQ Certificate in Insulation and Building Treatments – Cavity Wall Insulation).

7.2.19 Solid wall insulation can be applied internally or externally, but there are significant differences between installing at street level, compared to high-rise, with the latter requiring significant additional skills such as scaffolding and working at heights.

7.2.20 While many of the installation tasks can be delivered with lower levels of training, tasks such as surveying and designing each project, require deep knowledge of building systems, considerable experience and specialised training[57].

7.2.21 In the year ending 28th February 2023, there were just 1,800 online job postings relating to loft, cavity and solid wall insulation across the UK[58] – 17 of them were located within Northern Ireland.

Figure 25: Number of online job postings relating to loft, cavity and wall insultation (UK)



Source: Lightcast™, 2023.

[57] Building skill for net zero, Report prepared by Eunomia for CITB, March 2021.

[58] These vacancies were identified using the keywords "wall insulation" or "loft insultation" or "wall insultation" and excludes staffing/recruitment companies.

7.2.22 The table below shows the top ten job titles being recruited and most sought-after skills associated with each job title (listed in order of magnitude):

Figure 26: Most sought-after job titles and associated skills

Job title	Most sought-after skills
Insulation Installers	Insulation Installation Power Tool Operation Thermal Insulation
Home Surveyors	Surveying Building Services Engineering Construction
Dry Wall Installers	Drywall installation and repair Fire protection Product knowledge

Heat pumps

7.2.23 Typically, replacing a gas boiler with a heat pump requires consideration of a number of factors – such as appropriate system capacity, integration with other systems, sound, ventilation and electrical requirements. These skills are not necessary when replacing a gas boiler like-for-like.

7.2.24 Electrical installation, maintenance and repairs will remain the key technical skills of the industry. In the future these will need to be upgraded continually to meet technical changes[59].

7.2.25 Heat pumps also tend to require 32-amp electrical supplies, and therefore an installation will require someone on site that is Part P (of the Building Regs) qualified to be able to connect the power supply.

7.2.26 The high demand for plumbers and heating and ventilating engineers and similar tradespeople has been exacerbated by Brexit.

7.2.27 HVAC mechanics and those with equivalent qualifications can seek specialised training and become qualified heat pump installers – occupations that are in high demand in both the retrofit and new build industries.

7.2.28 The skills required to install heat pumps can be broken down into three categories[60]:

- Assessment and system design
- System installation
- Electrical work

[59] The Electrotechnical Skills Partnership Labour Market Intelligence Research, Pye Tait Consulting, March 2019.

[60] How to scale a highly skilled heat pump industry, Nesta, July 2022.

7.2.29 **Assessment and system design**: The first stage is typically the assessment of the property and the design of the heat pump system, taking into account a property's heating needs and the preferences of the customer. The process usually involves:

- Discussion with the customer to understand what they are looking for and surveying the property
- Performing heat loss calculations for the property to determine the heat pump size required
- Sizing heat emitters (eg radiators)
- Sizing pipework and materials
- Setting control options such as space heating controls and hot water controls

7.2.30 Heat loss calculations and heating system design are taught in gas and oil training courses, but they are rarely employed in practice during boiler installations. However, given that heat pumps run efficiently at lower flow temperatures than gas boilers, poor heat loss calculations and design can lead to the heat pump system not running at its most efficient[61]. Therefore, high-quality assessment and design is essential to any domestic heat pump installation.

7.2.31 **System installation**: The physical installation of the system involves fitting the heat pump and any auxiliary equipment into the property and making it operational by connecting it to the heating emitters and pipework.

7.2.32 The skills required to complete the installation are very similar to those required to install a gas boiler – generally speaking laying pipework, installing heating emitters and fitting in equipment.

7.2.33 As the design and assessment process requires a different skill set from the process of installing a heat pump, the MCS has reflected this by splitting the Heat Pump Standard into two separate standards: one for Heat Pump Design and one for Heat Pump Installation. This allows engineers to specialise on either process.

7.2.34 However, limitations on the ability of plumbers to offer a 'single-stop' service to replace a gas hot water system with a heat pump (due to the need for electrical trades licencing) has consistently been identified as a barrier to deployment. This is particularly important because gas boilers are generally replaced when they fail – requiring a replacement system to be implemented quickly. Development of training packages to allow a single trade to fully install heat pumps could materially accelerate deployment.

[61] Retrofitting homes for net zero heating: Regulatory change, Heat Pump Association, November 2020.

7.2.35 **Electrical work**: The electrical work requires a qualified electrician with knowledge of configuring the heat pump and the wiring and assessing the electrical network capacity. However, there is a shortage of qualified electricians on the market and it can take up four years to achieve this status.

7.2.36 Furthermore, as we have seen in relation to other domestic low carbon technologies such as heat pumps and solar PV, demand for electricians is expected to increase as these technologies establish themselves in the market and become cheaper to buy – perhaps driven by government incentives. Should the increase in demand for skills occur quickly, then it is likely that supply will fall short of demand due to the long lead-time to competency under current arrangements.

7.2.37 Widespread heat pump deployment will require both upskilling of the current workforce and the training of the next generation.

7.2.38 The first of these is fairly straightforward utilising existing training provision across the further education colleges. The latter requires (i) high quality and engaging careers education advice, information and guidance in order to attract young people and adults into these careers and then (ii) high quality entry level provision – while the latter exists (with the possible exceptions listed below), it is more questionable that for former does.

7.2.39 There are a number of skill areas that are perhaps not currently included within existing training provision:

- Higher level technical skills in order to integrate electronic and digital equipment in a “smart” setting
- Building physics, for example “U” values, moisture effects, characteristics of heating and ventilation systems
- Installing pipe networks with pumps, sensors and logic controls
- Building Information Management (BIM) to be able to track components from “cradle to grave” to save on materials, operational and maintenance costs

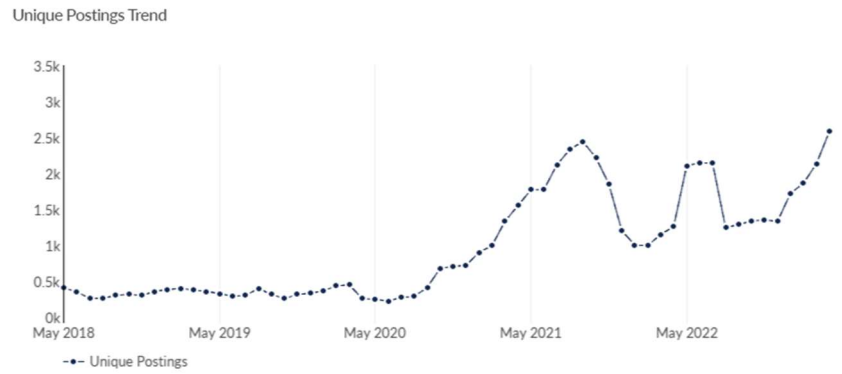
7.2.40 Also, in the future, it may be that more carbon efficient systems will be bigger with more complex electro-mechanical systems, incorporating a mix of technologies, which will require a more sophisticated skillset.

7.2.41 There are currently 642 MCS registered installers of air source heat pumps in Northern Ireland and 268 registered installers of ground source heat pumps[62].

[62] More information can be found on the MCS website (external link opens a new window).

7.2.42 In the year ending 28th February 2023, there were 9,100 online job postings relating to heat pumps across the UK[63] – just 39 of which were located within Northern Ireland.

Figure 27: Number of online job postings relating to heat pumps (UK)



Source: Lightcast™, 2023.

7.2.43 The main skills being sought were, perhaps unsurprisingly:

- Heat pump and refrigeration cycle
- Heating, Ventilation and Air Conditioning
- Maintenance engineering
- Building automation

Solar Photovoltaic and thermal

7.2.44 Jobs roles needed in the system design phase include[64]:

- Engineering Technician
- IT Specialist
- Power Systems Engineer
- Residential PV System Designer
- Software Engineer
- Solar Energy Systems Designer
- Structural Engineer
- Utility Interconnection Engineer

7.2.45 Solar PV installers in the UK typically have an electrical/electrician background, while solar thermal requires more plumbing-based skills. both roles are supplemented with roofing skills such as scaffolding and working at heights.

[63] These vacancies were identified using the keyword "heat pump" and excludes staffing/recruitment companies.

[64] More information can be found on the Solar Career Map's website (external link opens a new window).

7.2.46 The essential skills and competences for a solar installer are:

- Mount panels securely using a specified mounting system and on the defined position and inclination
- Test procedures in electricity transmission: Perform tests on powerlines, cables and pipework
- Inspect electrical supplies
- Comply with legal regulations, follow health and safety procedures.
- Install electrical and electronic equipment and circuit breakers

7.2.47 Jobs roles needed during the installation phase include:

- Electrician with Solar Expertise
- HVAC Technician with Solar Expertise
- Plumber with Solar Expertise
- Roofer with Solar Expertise
- Solar Assembler / Basic Installer
- Solar Crew Chief
- Solar Project Manager
- Solar PV Installer
- Solar PV Technician (commercial/utility)
- Solar Service Technician (residential)

7.2.48 The electrical work requires a qualified electrician with knowledge of configuring the solar equipment. However, there is a shortage of qualified electricians on the market and it can take up to four years to achieve this status.

7.2.49 Furthermore, as we have seen in relation to other domestic low carbon technologies such as heat pumps and EV charging point installation, demand for electricians is expected to increase as these technologies establish themselves in the market and become cheaper to buy – perhaps driven by government incentives. Should the increase in demand for skills occur quickly, then it is likely that supply will fall short of demand due to the long lead-time to competency under current arrangements.

7.2.50 In order to increase the number of solar installers and other roles required by the industry, high quality and engaging careers education advice, information and guidance will be required in order to attract young people and adults into these careers.

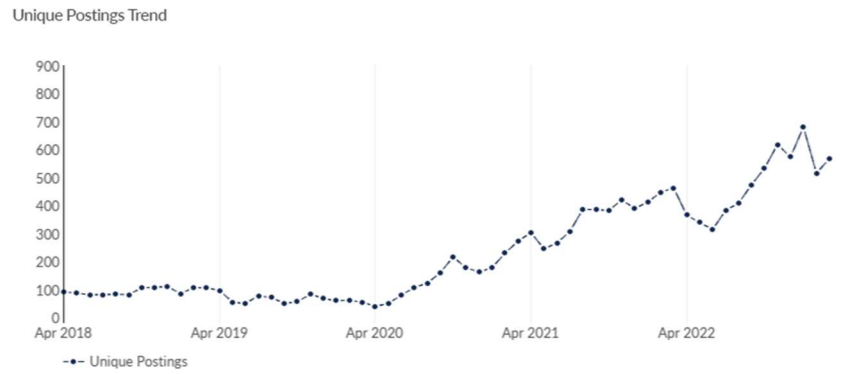
7.2.51 There is then the need for high quality entry level provision. Within Northern Ireland at the moment, it appears that South Eastern Regional College is the only college that offers solar PV and thermal training.

7.2.52 There are currently 1,165 MCS registered installers of solar PV in Northern Ireland, and 149 installers of solar thermal[65].

[65] More information can be found on the MCS website (external link opens a new window).

7.2.53 In the year ending 28th February 2023, there were 2,600 online job postings relating to solar PV and thermal across the UK[66] – 22 of them were located within Northern Ireland.

Figure 28: Number of online job postings relating to solar PV and thermal (UK)



Source: Lightcast™, 2023.

7.2.54 The most sought-after skills within these job postings were (listed in order of magnitude):

- Solar Energy Systems Installation
- Roofing
- Electrical Wiring
- Electrical Engineering
- High Voltage
- Commissioning
- Surveying
- Risk Analysis
- Solar Design
- Construction

Domestic electric vehicle charging points

7.2.55 As installing an EV charging point counts as notifiable work under Part P of the Building Regulations, an installer must be a registered electrician with a Competent Person Scheme in order to sign the installation legally.

[66] These vacancies were identified using the keywords "solar PV" or “solar thermal” and excludes staffing/recruitment companies.

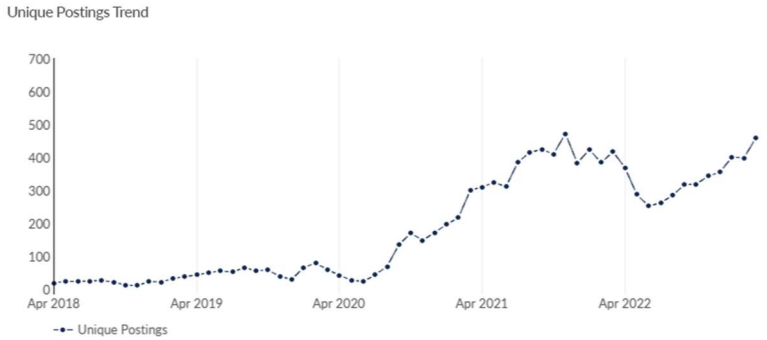
7.2.56 The only other requirement is to undergo an appropriate EV charging point installation course – either by an appropriate training provider or by a charging point manufacturer.

7.2.57 One of the biggest skills challenges the industry could face is gaining the required workforce in a short timeframe should customer demand ramp up significantly as, to become a registered electrician can take up to four years.

7.2.58 Furthermore, as we have seen in relation to other domestic low carbon technologies such as heat pumps and solar PV, demand for electricians is expected to increase as these technologies establish themselves in the market and become cheaper to buy – perhaps driven by government incentives. Should the increase in demand for skills occur quickly, then it is likely that supply will fall short of demand due to the long lead-time to competency under current arrangements.

7.2.59 In the year ending February 2023, there were 1,800 online job postings relating to the installation of electric vehicle charging points across the UK[67] – 15 of them were located within Northern Ireland.

Figure 29: Number of online job postings relating to the installation of electric vehicle charging points (UK)



Source: Lightcast™, 2023.

7.2.60 The most sought-after skills within these job postings were:

- Electric Vehicle (EV) Installation
- Three-Phase
- Electrical Wiring
- Electrical Engineering
- Customer Engagement
- Commissioning

[67] These vacancies were identified using the keywords "EV charging point" OR "electric vehicle charging point" and excludes staffing/recruitment companies.

Hydrogen-ready boilers

7.2.61 Several manufacturers have already developed hydrogen-ready domestic heating boilers. These can run on natural gas until hydrogen arrives, then they are converted in a matter of hours.

7.2.62 Unsurprisingly, as this is a developing technology, hydrogen boiler installation is one area where the current installer workforce say they lack the required skills and knowledge. This, however, does not necessarily represent an insurmountable challenge[68].

7.2.63 All gas installers in the UK are already highly trained and registered with Gas Safe, and the additional training required to work with hydrogen is expected to take only about one day for these to complete.

7.2.64 The size of the workforce needed for the conversion is highly dependent upon the required speed of the conversion programme implemented by the gas distribution networks (and customer demand – if the conversion is voluntary).

7.2.65 Careful consideration will have to be given as to how the conversion programme is rolled out. If all networks go at the same time, this could overwhelm training providers.

7.2.66 Working closely with Government and IGEM, Energy & Utility Skills has produced the Hydrogen Competency Framework[69] to ensure that new hydrogen appliances are installed to the highest safety standards.

7.2.67 The Hydrogen Competency Framework details how hydrogen is different to natural gas and what the implications are for natural gas engineers. The associated skills matrix identified a number of areas where a practical demonstration of skills will be required:

- Risk assessment
- Acceptable materials
- Tightness testing
- Purging practice
- Commissioning
- Combustion analysis
- Leakage detection
- Handover and future Maintenance
- Dealing with PRE

[68] Building skill for net zero, Report prepared by Eunomia for CITB, March 2021.

[69] More information about the Hydrogen Competency Framework can be found on Energy & Utility Skills' website (external link opens a new window).

7.2.68 There are also areas where a “comprehensive” understanding will be required by the workforce:

- Properties of hydrogen
- Behaviour of hydrogen
- Appliance design changes
- Installation procedures
- Ventilation
- Metering

7.2.69 Furthermore, “active awareness” will be required in areas such as:

- Legislation and applicable regulations
- Products of Combustion
- Unsafe situations

7.3 Skills supply – Education and skills provision

7.3.1 Training in this industry is commercial and very competitive, with the consensus being that training providers will develop their facilities and provision to meet demand as and when it occurs.

7.3.2 Transferring skills from the boiler manufacturing workforce to making heat pumps could be critical both for safeguarding employment and harnessing existing skills[70]. Whilst the technology is different, many of the engineering and component assembly processes are similar.

7.3.3 However, from a forward planning perspective, one of the main challenges the industry in terms of developing its workforce in a timely manner is that, to become a fully trained heat pump engineer, a new trainee must typically first qualify as a plumber or gas and oil heating engineer before attending a heat pump specific training course. As this prerequisite can take up to four years, it makes it particularly difficult for the heat pump industry to attract newcomers with no previous experience[71].

[70] Heat Network Skills Review: BEIS research report no. 2020/020, BEIS, June 2020.

[71] How to scale a highly skilled heat pump industry, Nesta, July 2022.

7.3.4 Retraining existing gas and oil heating engineers or plumbers is a more straightforward process, particularly given the overlap in skills needed to install a heat pump and those needed to install a gas or oil boiler. This means that for boiler engineers and plumbers, a three to five-day heat pump training course is usually sufficient to gain the necessary installation and, more importantly, assessment and design knowledge needed to get started as a heat pump engineer.

Further education

Traineeships

7.3.5 The Traineeship programme is delivered by the six further education colleges of Further Education and work-based learning being provided by local employers. They allow an individual to achieve a full Level 2 qualification over a two-year, full-time programme.

7.3.6 Traineeships that may be relevant to this industry include:

- Brickwork
- Carpentry and joinery
- Electrical installation (electrician's mate)
- Plumbing (plumber's mate)
- Floor and wall tiling
- Painting and decorating

Apprenticeships

7.3.7 There are a number of apprenticeship frameworks which are directly applicable to large-scale energy generation, including:

- Construction (level 2)
- Heating, ventilating, air conditioning and refrigeration (level 2)
- Plumbing (level 2)
- Construction crafts (level 3)
- Construction technical (level 3 – also available for people aged 25+)
- Gas utilisation, installation and maintenance (level 3)
- Heating, ventilation, air conditioning and refrigeration (level 3)
- Plumbing and heating (level 3)

7.3.8 Only one of these frameworks listed above is available to people aged over 25 years, which, considering the likely volume of new entrants needed, could be a limiting factor in meeting future requirements.

Higher level apprenticeships (level 4+)

7.3.9 There are also a wide range of higher level apprenticeships available relating to various activities of the Built Environment (x16).

Further education colleges

7.3.10 Based on information provided by the further education colleges to the GESIRG in January 2023, there are a range of relevant programmes:

- Level 2 in Construction - Carpentry & Joinery
- Level 2 in Hydrogen Safety
- Level 2 in Hydrogen Applications and Technologies
- Level 3 in Hydrogen Applications and Technologies
- Level 3 CPD Hydrogen Applications and Technologies
- Level 4 Collaboration in Building Information, Modelling/Management
- Level 5 certificate in Green Technologies
- Level 5 Train the trainer in Hydrogen Applications and Technologies
- Level 6 PGCE Hydrogen Technologies
- Construction and Built Environment - 3D Building Modelling

7.3.11 Excellent NVQ qualifications exist around the core trade roles, but take up is limited. Far more new gas engineers are currently being trained than heat pump engineers. Whilst colleges continue to train excellent plasterers, electricians, joiners and so on, they are taught little or nothing about retrofitting whole dwellings. A more strategic approach to this challenge is required.

3.1.1 SERC provides the OCN NI Level 5 Certificate in Green Technologies, including unts in Ground and Air Source Heat Pumps, Solar Photovoltaic Systems, and Solar Thermal Decarbonisation of Hot Water Systems.

7.3.12 The potential for an A Level in construction has been discussed since 2017, with CITB NI establishing a Construction Teachers Forum to share good practice, identify issues particular to construction teachers and develop revision and teaching resources.

7.3.13 From this, two sub-committees were established: one to look at GCSE/occupational studies and one to look at the development of an A Level in construction.

Skill Up programme

7.3.14 Through the Skill Up programme, there is a range of free short courses are on offer from further and higher education providers across a wide range of subjects, including:

Award in Hydrogen Skills (Level 2 & Level 3)	Level 4 Hybrid
Commercial Gas	Low Energy Buildings
Domestic Electrical Installers	Managed Learning Programme Gas
Electrical Energy Storage Systems	NOCN Bim/ Revit
Ensuring Air Tightness in Domestic Retrofit Project	OFTEC
F-Gas	Passive Housing Designer Level 4
Gas Auditing	Passive Housing Tradesperson Level 4

Gas Safety Awareness in Social Housing	PG Cert in Engineering of Energy, Economics and the Environment
Green Technologies Level 5 Award Certificate and Extended Certificate	Retrofitting
Hydrogen Energy Systems (PG Cert)	Solar PV
Hydrogen Safety	Solar Thermal
Initial Verification and Certification of Electrical Installations	Understanding the Maintain and repair of pre 1919 Buildings
Installation and Maintenance of Air Source Heat Pumps	Level 2 Hydrocarbon Refrigeration
Installation and Maintenance of Heat Pump Systems	Unvented Training and Assessment
Installation of External Wall Insulation for Domestic Retrofit	Water Regulations for Heat Pumps
Installation Requirements for Heat Recovery Mechanical Ventilation Systems in Domestic Retrofit Projects	Welding
Intro to Hydrogen Boilers	Zero Carbon Engineering (PG Cert/PG Dip)
LCL Awards Level 3 Award in the Installation and Maintenance of Air Source Heat Pumps BSU PT-G	

7.3.15 These courses are an ideal way to enable people from outside of the industry (be they new entrants to the labour market or people transitioning from one industry to another) to upskill quickly.

Private training providers

7.3.16 Home energy modelling courses are available for Building Regulations and for Energy Performance Certificate surveys for house sales and rentals. Such courses can expect to become more complicated and professionalised to increase accuracy.

7.3.17 Organisations like Elmhurst and SAVA offer training in home energy software for Building Designers and Technicians.

7.3.18 The H_2 Gas Safe Lab in Ballymena (the first of its kind in the UK and Ireland) is designed to provide practical training in hydrogen Gas Safe skills and is aimed particularly at the Gas Safe plumbing and heating industry.

7.3.19 The objective of this mobile lab space is to provide a safe, reliable teaching space for use by further education colleges and private training providers throughout Northern Ireland to teach learners about the basics of dealing with hydrogen gas mixtures.

Higher education

7.3.20 The table below shows the number of STEM graduates from 2020/21 that entered employment in this industry.

Figure 30: Number of STEM graduates from Northern Ireland HE institutions that entered employment in the industry (2020/21)

Industry	Standard Industry Classification	Graduates in employment
Domestic low carbon technologies and energy efficiency	43.2 Electrical, plumbing and other construction installation activities 43.3 Building completion and finishing 43.9 Other specialised construction activities	15

Source: HESA Graduates Outcomes, 2020/21.

7.4 Learning from around the UK

7.4.1 In addition to the apprenticeship frameworks that are currently available in Northern Ireland, there are a number of English apprenticeship standards that may be relevant:

- Dual fuel smart meter installer (level 2)
- Smart home technician (level 3)
- Low carbon heating technician (level 3) (in development)
- BEMS (building energy management systems) controls engineer (level 4)
- Building services engineering senior technician (level 4)
- Construction design and build technician (level 4)
- Heritage construction specialist (level 5)
- Building control surveyor (integrated degree) (level 6)
- Building services design engineer (degree) (level 6)
- Building services engineering site management (degree) (level 6)
- Design and construction management (degree) (level 6)
- Architect (integrated degree) (level 7)

7.4.2 Sectoral Partnerships may wish to consider whether the development of an equivalent framework might be of benefit to the industry.

7.4.3 The most relevant apprenticeship standard, which is currently still in development, is the Low Carbon Heating Technician standard. Further information is available on the Institute for Apprenticeships & Technical Education's website (external link opens in a new window).

7.4.4 Skills Bootcamps, offered across England, are free, flexible courses of up to 16 weeks duration. At the end of the course, each participant is offered a job interview with an employer.

7.4.5 There are a range of Skills Bootcamps relevant to this industry:

- Future Homes - Towards Net Zero Carbon Buildings
- Green Heating Technologies
- Green Skills & Retrofit
- Solar Photovoltaic Systems
- Solar PV for Roofers
- Solid Wall Insulation
- Upskilling Gas Engineers from Level 2 to Level 3
- Upskilling Smart Metering Engineers and Gas Engineers
- Upskilling Smart Metering Engineers to Level 3 Gas Engineers
- Zero Carbon Buildings

8 Industrial processes

8.1 Introduction

8.1.1 This industry includes:

- Production of liquid fuels
- Production of hydrogen
- Carbon capture and storage

8.1.2 Estimates of current employment in this industry are not produced. However, the Northern Ireland Business Register and Employment Survey (2021) does report 200 people employed in industries closely aligned with gas production[72]. The Low carbon and renewable energy economy estimates (2021) do not provide an published data.

8.1.3 The latest national employment projections by Warwick Institute for Employment Research and Cambridge Econometrics[73], suggest that employment in the petroleum and chemicals industries are projected to remain stable through to 2035.

8.1.4 However, this projection does not take into account the expected (but unquantified) growth in this industry as articulated by employers during this research, particularly in relation to hydrogen production and, more likely over the longer-term, carbon capture and storage.

8.1.5 In terms of obtaining the skills needed across these industries moving forward, it is possible that the existing oil and gas workforce could be a useful source. Over 90% of the UK's oil and gas workforce have medium to high skills transferability and are well positioned to work in these adjacent energy industries[74]. However, with oil and gas being seen as a crucial element of the UK's energy security at the moment, it is unlikely that an influx of offshore workers will occur any time soon.

Production of liquid fuels

8.1.6 The refining industry is currently engaged in a low-carbon transition through investment in research and development projects and its early deployment of new technologies – all of which can take some time to complete[75].

[72] 20.1 Manufacture of basic chemicals, fertilisers and nitrogen compounds, plastics and synthetic rubber in primary forms; 20.2 Manufacture of pesticides and other agrochemical products; 35.21 Manufacture of gas

[73] The Skills Imperative 2035: Occupational Outlook – Long-run employment prospects for the UK, National Foundation for Educational Research, 2022.

[74] UK Offshore Energy Workforce Transferability Review, Robert Gordon University, May 2021.

[75] Taken from the Innovation News Network's website (external link opens a new window).

8.1.7 Innovation in the industry is in both the process and its application through increasingly using combinations of new feedstocks, such as biomass and vegetable oils, and cutting GHG emissions along with developments in its applications in transport and heating.

8.1.8 The industry also has the opportunity to expand its onsite use of electricity and hydrogen and further exploit synergies with other industries[76].

8.1.9 The Future Ready Fuel campaign is testing logistics for a potential transition to renewable liquid fuels for the estimated 1.7 million UK properties that use oil for heating, with the industry currently developing innovative 'drop-in' biofuels[77].

Production of hydrogen

8.1.10 By becoming an economically-viable and flexible fuel energy carrier, as well as an important enabler for the global energy transition, hydrogen is gathering significant momentum.

8.1.11 Northern Ireland is well-positioned to accelerate hydrogen innovation and deployment, with its significant wind resource, modern gas network, interconnection to Ireland and Great Britain, availability of salt cavern storage and strong reputation for engineering and manufacturing.

8.1.12 Investment activity focusses specifically on projects which support the four end uses of hydrogen[78]:

- Transport
- Power – biomass, hydrogen production, energy from waster
- Grid injection (e.g. for home heating)
- Other industries (including for example, oil refining, ammonia production, methanol production and steelmaking)

8.1.13 The Oxygen and Hydrogen Demonstrator Project currently underway at Kinnegar Wastewater Treatment Works exemplifies the impact of public industry partnership teamed with private industry enterprise working together to kick start the hydrogen narrative in Northern Ireland.[79]

Carbon capture, usage and storage (CCUS)

8.1.14 CCUS is a new industry that will capture the carbon produced from a range of industrial processes before it gets into the atmosphere. Although in its early stages of development, CCUS is seen as an essential enabler of a net zero future.

[76] More information can be found on the Innovation News Network's website (external link opens a new window).

[77] More information can be found on the Future Ready Fuel's website (external link opens a new window).

[78] Developing Australia's Hydrogen Workforce, Final Report, October 2022, PwC Consulting.

[79] More information can be found on the Department for the Economy's website (external link opens a new window).

8.1.15 CCUS is available for both the upgrading of biogas to biomethane and the subsequent use of biomethane in gas power stations or hydrogen production plants. Although it is likely to be the mid-2030s before we see it deployed at scale.

8.1.16 It will also require the subsequent transportation of the captured carbon to a place of storage – which may be outside of Northern Ireland. All this will require significant investment and infrastructure development[80].

8.1.17 CCUS offers a unique opportunity to create the low-carbon industries of the future which can compete in the global low-carbon market[81].

8.2 Skills demand – Current and future skills requirements

8.2.1 The move to an advanced zero emissions industrial economy is being driven by political, industry and market forces, and hence policy, strategy and trends at international, national and local levels will strongly influence demand for skills and future skills in the production of liquid fuels, carbon capture and storage and the production of hydrogen.

8.2.2 Cross-cutting specialist skills within these three industries include geoscience skills. These are essential as geological formations are where carbon dioxide can be stored.

8.2.3 This requires skills associated with engineering geologists, hydrogeologists, geophysicists, geophysicist, geoscientist, geologist and geochemist.

Production of liquid fuels

8.2.4 Although the overall demand for liquid hydrocarbons is expected to reduce over the coming decades, this industry will continue to play a central role in fuelling both transport and industry.

8.2.5 As we move toward a Net-Zero future, companies will increasingly need to find innovative ways to improve process efficiency and introduce new technologies that can help them to decarbonise.

[80] Advice report: The path to a Net Zero Northern Ireland, Climate Change Committee, March 2023.

[81] More information about CCUS can be found on the CCS Association's website (external link opens a new window).

8.2.6 Reducing carbon emissions will require careful management to avoid disruption to our daily lives, minimise rising costs, and mitigate wider economic impacts. Therefore, it is paramount that employers have access to the skills they need to maintain resilience while they continue to advance their strategies for long-term sustainability.

8.2.7 However, less than half of employers in the industry believe their current workforce has the right skillset to support their organisation's transition to net zero with sustainable technologies. A further 23% were unsure[82].

8.2.8 62% of employers expect demand for engineering skills, of various disciplines, to increase over the next ten years, and 46% expected demand for operations and maintenance technicians and operatives to increase.

8.2.9 Engineering is also the area where most current skills shortages are being felt. There proportion of employers saying that current skills shortages were either moderate or severe by occupation was:

- Engineering professionals (69% of employers)
- Operations and maintenance technicians and operatives (53%)

8.2.10 The most commonly experienced challenges regarding recruitment were:

- Low numbers of applicants with job-specific knowledge and/or industry experience (77% of employers)
- Low numbers of applicants with the required level of skills and/or qualifications (77%)
- Competition from other employers/ industries (69%)
- Not enough interest in the role (31%)

8.2.11 Furthermore, employers are more pessimistic about being able to retain their workforce in the workforce compared to now – with competition from within the industry, and from other industries, expected to become more intense.

8.2.12 Looking forward, the knowledge, skills and behaviours that will become more important over the next 10 years are:

- Digital skills (69% of employers)
- Innovation (62%)
- Digital security (62%)
- Managing change (54%)
- Managing risk (54%)
- Technology identification and application (54%)

[82] Future skills for the downstream sector, UKPIA/Cogent Skills, 2022.

- Compliance (38%)
- Creative thinking (46%)
- Designing, implementing, controlling & optimising new processes (46%)
- Health & Safety (38%)

8.2.13 In order to address future skills challenges, most employers will increase the amount of training that they deliver and seek to maximise the use of apprenticeships.

8.2.14 The concept of industrial clustering could support the development of the liquid fuels industry. This could help support the development of attractive career pathways, including offering a more comprehensive early learning pathway (e.g. shared apprenticeships) as well as clearer career progression across the value chain.

Production of hydrogen

8.2.15 The expansion of employment in the hydrogen industry is largely expected to draw on existing skills, and as such, should not present any major challenge in terms of a skills gap[83].

8.2.16 With regards to electrolysis, the skills involved in the electricity generation industry, and in particular renewables and nuclear components, come readily transfer across.

8.2.17 Hydrogen UK[84] will soon be undertaking new strategic research into the hydrogen economy and the types of skills required to enable the UK to become a global leader. The need for the connection of learning institutions, vocational education, research groups and technical bodies will be essential to maximising these opportunities.

8.2.18 Ensuring the portability of skills and the mutual recognition of professional qualifications to enable transition without re-certification will be crucial[85]. As the expansion of employment in the hydrogen industry will largely draw on existing skills, unnecessary retraining will want to be avoided.

8.2.19 The production of green hydrogen represents an opportunity to convert renewable energy, particularly onshore wind energy, which is produced during periods of curtailment. This hydrogen can then be used in transport, power generation, home heating and other industrial processes as required.

8.2.20 However, at the moment, a functioning market for hydrogen does not exist within Northern Ireland[86].

[83] The economic impact of hydrogen and fuel cells in the UK, H2FCSupergen, March 2017.

[84] More information can be found on the Hydrogen UK website (external link opens a new window).

[85] North Sea Transition Deal, BEIS/OGUK, March 2021.

[86] Northern Ireland's Future Hydrogen Demand and Capability, Frontier Economics, 2022.

8.2.21 If action is taken quickly and decisively to create an environment where the research talent and business acumen available in Northern Ireland can combine with the existing infrastructure and utility provision, there is the opportunity to provide security of energy supply, affordable fuel to the consumer and make significant progress towards our net-zero carbon targets.

8.2.22 The Climate Change Committee's Sixth Carbon Budget Analysis[87], reports that between 8% - 25% of industrial energy demand in Northern Ireland could be met by hydrogen in 2050.

8.2.23 An estimated timeline for the development of the hydrogen economy is thought to be:

- Early 2020s
  - Some transport (buses, early HGV, rail & aviation trials)
  - Industry demonstration
  - Neighbourhood heat trial
- Mid 2020s
  - Industry applications
  - Transport (HGV, rail & shipping trials) village heat trial
  - Blending (tbc)
- Late 2020s
  - Wide use in industry power generation & flexibility; transport (HGVs, shipping)
  - Heat pilot town (tbc)
- Mid-2030s onwards
  - Full range of end users including steel; power system; greater shipping & aviation
  - Potential gas grid conversion

8.2.24 Growth in the hydrogen economy will generate new employment opportunities across a wide variety of industries, combining technology, big data, business and precision engineering.

8.2.25 Whilst many of the future jobs are still to be defined, as the hydrogen value chain touches numerous different types of technologies and manufacturing industries, many of these jobs will be underpinned by skills that already in the industry[88],[89] or can be readily transferred in from adjacent industries, most notably offshore oil and gas (though this will require attracting people from outside of Northern Ireland, principally Scotland and the North East of England).

[87] More information about the Sixth Carbon Budget can be found on the CCS Association's website (external link opens a new window).

[88] More information can be found on Hydrogen UK's website (external link opens a new window).

[89] Hydrogen Forecast to 2050, Energy Transition Outlook 2022, DNV.

8.2.26 Job roles critical to hydrogen production include:

- Engineers
  - Chemical engineer
  - Civil engineer
  - Commissioning engineer
  - Electrical engineer
  - Electronics engineer
- Technicians and tradesperson
  - Control room officer
  - Electrical fitter
  - Electrical Instrumentation Technician
  - Electrician
  - Fitter and Turner
  - Gas Fitter (industrial)
  - Process Control Technician

8.2.27 As the hydrogen industry develops, engineering job roles are anticipated to face relatively low levels of augmentation, as the fundamental tasks and responsibilities they undertake will largely remain consistent with current job roles.

8.2.28 They will face minimal upskilling and capability development requirements and will have high transferability between various hydrogen projects. These engineers will most likely be familiar with hydrogen's basic characteristics, handling properties, and safety principles, and will be equipped with the problem-solving skills to address the fundamental parameters of any project.

8.2.29 Although the majority of skills development will be centred around upgrading of existing skills, it is expected that specific upskilling will be required for the relating to the installation, commissioning, servicing and operation of electrolysers.

8.2.30 Areas of significant skills gaps in Northern Ireland are most likely to occur in engineering and manufacturing technologies and science and mathematics.

8.2.31 However, challenges will exist primarily due to needing:

- More people with the existing skills
- To train people in new technologies and processes

8.2.32 For this reason, it is crucial that actions are in place to equip the industry with the right set of skills that will enable its development.

8.2.33 Moreover, the workforce will need to be aware of the environmental and social impacts of hydrogen production and use, such as water consumption, carbon footprint, and public perception[90].

Carbon capture, usage and storage

8.2.34 CCUS is an important enable of a net zero future, as it has the potential to mitigate the carbon emissions of power generation and many industrial and chemical processes – thus both creating new jobs and safeguarding those in industries which are currently substantial carbon emitters.

8.2.35 Although Northern Ireland is different from the rest of the UK in that only 17% of carbon emissions come from major emitters[91], achieving decarbonisation of heavy industry and the nation's net zero targets is extremely unlikely without CCUS and the long-term sequestering of CO2.

8.2.36 However, the decarbonisation of heat and transport in Northern Ireland is likely to transfer carbon emissions to the electricity and hydrogen producing industries.

8.2.37 Local geological storage has unproven potential in Northern Ireland. While significant storage could be realised within the Portpatrick, Larne and Peel Basins, the development of new infrastructure to support storage (when compared to shipping it to North Sea storage options) is unlikely to be economically attractive, at least in the medium term.

8.2.38 As per the Committee on Climate Change report, further analysis of these sites is recommended if large scale storage is to be deployed in Northern Ireland.

8.2.39 With the industry still in the early stages of development and deployment, it is very difficult to assess the skills – types and volume – required for an established CCUS industry in Northern Ireland.

8.2.40 However, developments in other parts of the UK suggests that existing skillsets held by people in adjacent industries such as oil and gas, chemicals and non-renewable energy generation should be readily transferrable to CCUS projects[92].

[90] More information about the skills and competencies needed for hydrogen combustion engine professionals can be found on LinkedIn (external link opens a new window).

[91] Carbon Capture, Utilisation and Storage potential in Northern Ireland, A Report by the Bryden Centre, Queen's University Belfast, April 2021.

[92] A blueprint for the green workforce transformation, IEMA/Deloitte, 2022.

8.2.41 In research carried out by the Energy Institute[93] of UK energy professionals, CCUS was among the most cited destinations for those expecting to move to another field within the energy industry as a result of net-zero. However, half of respondents cited barriers to their personal development, including a lack of appropriate training courses being available.

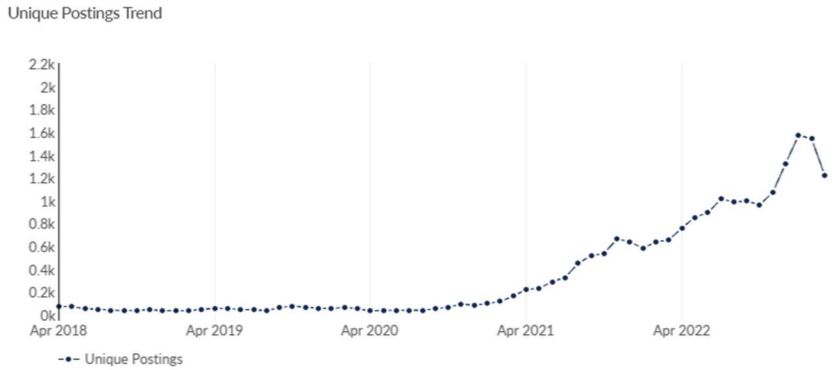
8.2.42 Whilst the UK lacks operational large-scale CCUS plants, there are operational demonstration projects (Drax bioenergy carbon capture pilot plant), test facilities (UK Carbon Capture and Storage Research Centre Pilot-scale Advanced Capture Technology) and active research programmes (such as at Imperial College London and the University of Edinburgh) to support development.[94]

8.2.43 The development of the East Coast Cluster in England illustrates increasing demand for CCUS skills, including[95]:

- Machine Installers
- Pipe Fitters
- Technicians and Welders
- Geothermal Technicians
- Geologists
- Civil Engineers
- Geophysics
- Underground construction and tunnelling

8.2.44 In the year ending 28th February 2023, there were 5,500 online job postings relating to CCUS across the UK[96] – 27 of them were located within Northern Ireland.

Figure 31: Number of online job postings relating to CCUS (UK)



Source: Lightcast™, 2023.

[93] More information can be found on the Energy Barometer 2021 website (external link opens in a new window).

[94] The Energy Innovation Needs Assessment for carbon capture, utilisation and storage can be found on the gov.uk website (external link opens in a new window)

[95] Hull and East Yorkshire LEP, Green Jobs and Skills Analysis, December 2021, EU Skills.

[96] These vacancies were identified using the keywords "carbon capture" or "CCUS" or "CCS" and excludes staffing/recruitment companies.

8.2.45 The most sought-after skills within these job postings were:

- Engineering Design Process
- Project Management
- Business Development
- Carbon Capture And Storage
- Construction
- Chemical Engineering
- Process Engineering
- Risk Analysis

8.3 Skills supply – Education and skills provision

8.3.1 Across different aspects of the hydrogen industry there will need to be some retraining to ensure awareness of the different properties of hydrogen, but this is likely to be relatively modular upgrades to knowledge, although a roll-out of such training across large numbers if required over a relatively short period could be a challenge.

Further education

Traineeships

8.3.2 The Traineeship programme is delivered by the six further education colleges of Further Education and work-based learning being provided by local employers. They allow an individual to achieve a full Level 2 qualification over a two-year, full-time programme.

8.3.3 Traineeships that may be relevant to the industrial processes industry are:

- Engineering (which is being offered by all six further education colleges)
- Fabrication and welding (which is being offered by all six further education colleges)
- Plant maintenance (offered by South West College)

Apprenticeships

8.3.4 There are only three apprenticeship frameworks which are directly applicable to industrial processes:

- Engineering (level 2 – also available for people aged 25+)
- Supply chain management (level 2)
- Engineering (level 3 – also available for people aged 25+)

Higher level apprenticeships (level 4+)

8.3.5 There are also a wide range of higher level apprenticeships available relating to various activities of:

- Advanced manufacturing and engineering (x18)
- Civil engineering (x4)
- ICT (x13)

Further education colleges

8.3.6 Based on information provided by the further education colleges to the GESIRG in January 2023, there are a range of relevant programmes:

- Level 2 in Hydrogen Applications and Technologies
- Level 2 in Hydrogen Safety
- Level 3 Hydrogen Applications and Technologies
- Level 3 in Hydrogen Applications and Technologies
- Level 3 Hydrogen Fuel Cell Technology
- Level 5 Certificate in Green Technologies
- Level 5 Train the trainer in Hydrogen Applications and Technologies
- Level 5 Award in Green Technologies - Sustainable Alternative Biofuels
- Level 6 PGCE Hydrogen Technologies

8.3.7 SERC's Level 5 Certificate in Green Technologies, including units in Hydrogen Production Systems and Technologies and Sustainable Alternative Biofuels.

Skill Up programme

8.3.8 Through the Skill Up programme, a range of free short courses are on offer from further and higher education providers across a wide range of subjects, including:

- Assembling and Testing Fluid Systems
- College Award in Hydrogen Skills (Level 2 & Level 3)
- Hydrogen Energy Systems (PG Cert)
- Hydrogen Level 2
- Hydrogen Safety

8.3.9 These courses are an ideal way to enable people from outside of the industry (be they new entrants to the labour market or people transitioning from one industry to another) to upskill quickly.

Higher education

8.3.10 The two largest universities in Northern Ireland, Ulster University and Queen's University Belfast, offered a range of first degree courses in 2020/21. Overall, there were 740 starts on engineering courses (130 of whom were female), including:

- Chemical, process and energy engineering: 80 starts (20 were female)
- Chemistry: 65 starts (30 were female)
- Environmental science: 55 starts (25 were female)

8.3.11 Higher Education partners Queens University Belfast and Ulster University are collaborating to develop a Level 7 postgraduate certificate in hydrogen power and are planning to expand their existing hydrogen Continuous Professional Development (CPD) courses.

8.3.12 There is currently no standalone geoscience degree available at either undergraduate or postgraduate level in Northern Ireland. Prospective students in this area have to travel outside of Northern Ireland to either Great Britain or Ireland.

8.3.13 The table below shows the number of STEM graduates from 2020/21 that entered employment in this industry.

Figure 32: Number of STEM graduates from Northern Ireland HE institutions that entered employment in the industry (2020/21)

Industry	Standard Industry Classification	Graduates in employment
Industrial processes	20.1 Manufacture of basic chemicals, fertilisers and nitrogen compounds, plastics and synthetic rubber in primary forms 20.2 Manufacture of pesticides and other agrochemical products 35.21 Manufacture of gas	<5

Source: HESA Graduates Outcomes, 2020/21.

8.3.14 Given that the Northern Ireland Skills Barometer 2021 update reports that almost two-fifths (37%) of new workers in the period to 2030 will require level 6+ qualifications (i.e. undergraduate degree, masters, PhD) and that Northern Ireland will be short of nearly 3,000 level 4+ skilled people per year over the same period (with Engineering and Manufacturing Technologies being particularly in demand), the numbers enrolling on the courses listed above need to increase substantially.

Hydrogen Training Academy

8.3.15 Through the Hydrogen Training Academy, the Hydrogen Fuel Cell Skills Lab[97] will facilitate training and up-skilling in this area. It comprises a suite of hydrogen training equipment, and is designed to provide a hands-on, educational hub which provides an overview of the technology and how it can be implemented.

8.3.16 The Academy's subject areas are:

- Level 5 Train the Trainer KnowHy[98] Hydrogen Production
- Level 3 Course Development H2 Gas Safe
- Level 3 Course Development Hydrogen Technologies
- Level 7 Course Development
- PG Cert Hydrogen Power

8.3.17 The development of the learning journey will therefore cover level 2 to level 7 across a range of hydrogen subject areas, focusing on developing the skills required to maximise opportunities in the Hydrogen and Clean Technology industries.[99]

8.3.18 The lab will facilitate training and up-skilling which will impact a wide range of industries, including the energy, transport, manufacturing, engineering and construction industries. It will provide a hands-on, educational hub and an overview of this progressive technology and how it can be implemented. The Fuel Cell Trainer teaches the basic principles of electrolysers and fuel cell systems. It offers extensive experimenting capabilities and instruction material as well as predefined experiments.

8.3.19 Beyond the initial pilot period there are plans to further refine and mainstream the Hydrogen Training Academy provision as a core part of an expanding 'green' economy offering in the Borough. The 'green' economy offering includes proposals for the i4C Innovation and Cleantech Centre to be located at Saint Patrick's Barracks regeneration site in Ballymena. The project will represent a capital investment of £23m, co-funded under the Belfast Region City Deal and is scheduled to open in late 2026.

[97] More information can be found on the Invest Mid & East Antrim website (external link opens in a new window).

[98] KnowHy is an online, hands-on educational programme for technicians working with hydrogen and fuel cell systems.

[99] More information can be found on the Invest Mid & East Antrim website (external link opens in a new window).

8.4 Learning from around the UK

8.4.1 In addition to the apprenticeship frameworks that are currently available in Northern Ireland, there are a number of English apprenticeship standards that may be relevant:

- General welder (arc processes) (level 2)
- Electrical, electronic product service and installation engineer (level 3)
- Pipe welder (level 3)
- Plate welder (level 3)
- Electrical or electronic technical support engineer (degree) (level 6)
- Electronic systems principal engineer (level 7)

8.4.2 Sectoral Partnerships may wish to consider whether the development of an equivalent framework might be of benefit to the industry.

8.4.3 A Skills Bootcamp is provided in the Principles of Carbon Capture and Storage. This new course in CCUS is the first-of-its-kind and is designed to provide learners with the higher-technical skills and knowledge to operate this climate-saving technology.[100]

8.4.4 The UK's 'first' National Occupational Standard (NOS) for hydrogen production, storage, and transportation is set to be developed to help shape the skills required for hydrogen-based jobs. Cogent Skills will develop the standard following a successful contract bid, in a crucial step towards establishing a highly skilled and competent workforce, underpinning the UK's ambitions of boosting the development and deployment hydrogen technologies.

8.4.5 The new occupational standards will set out the standards of performance which individuals must achieve, together with the knowledge and skills required to work safely and effectively in the hydrogen production, storage and transportation industry.[101]

[100] More information can be found on Selby College's website (external link opens a new window).

[101] More information can be found on Cogent Skills' website (external link opens a new window).

8.4.6 Within the UK, Drax and Selby College have developed an "Introduction to Carbon Capture and Storage'" programme[102], which is equivalent to a Level 4 programme, that aims to equip a range of employees, supply chain workers and college students with a basic knowledge of how Bioenergy with carbon capture and storage (BECCS) works and the theory and practice behind the technology.

8.4.7 An example of a transition programme making a positive impact is the ECITB's Accelerated Experience and Learning Programme (AELP)[103], which is a retraining programme aimed at 'industry jumpers'. Many of the technical skills and behaviours required in the nuclear industry were identified as being comparable with those working in the coal station, including a similar safety and security culture as well as the turbines and control room. The AELP recognised and built on the existing skills of the workers from Cottam to provide a path to becoming a 'suitably, qualified and experienced person' in 12 rather than 18 months.

8.4.8 Bringing together industry and academia, is the Hydrogen Training Day[104]. The training modules from this course bring together higher education, vocational education learners, local authorities and industry, including students at NESCol, Robert Gordon University, Aberdeen University, and staff from local garages and haulage companies. As one of the largest providers of vocational education and training in Scotland, NESCol puts sustainability at the heart of its curriculum and operations.

8.4.9 This includes working closely with partners across the North East of Scotland to develop and deliver courses supporting a low carbon economy. The modules are based on the HyTrEc2 Skills Framework project findings and are aimed at upskilling the current labour force to be hydrogen-ready. The training modules to be piloted include: Introduction to Hydrogen Safety/Handling, Hydrogen Storage, Applications of Hydrogen as well as a current training on offer at NESCol for electric vehicles.

[102] Hull and East Yorkshire LEP, Green Jobs and Skills Analysis, December 2021, EU Skills.

[103] Skills Transferability in the Engineering Construction Industry, ECITB, 2020.

[104] More information can be found on Aberdeen City Council's website (external link opens new window).

8.4.10 Academic specialists in hydrogen from the University of Birmingham are delivering Level 5 'Train the Trainer' hydrogen training to representatives from the Further Education industry. The trainees, including representatives from Belfast Metropolitan College and Northern Regional College, have then drawn upon their training to develop and accredit two Level 3 hydrogen courses for delivery across key industries.

8.4.11 The World Hydrogen Leaders' Hydrogen and Derivatives as Heavy Transport Fuels course[105] covers: understanding the market drivers and most likely use cases for green ammonia, methanol, hydrogen or synthetic e-fuels.; understanding the range of fuels available and consideration of the transition requirements from fossil fuels and future operating cost implications, including:

- Transport industry decarbonisation
- Properties of an ideal clean heavy-duty transportation fuel
- Clean fuels for aviation
- Clean maritime fuels
- Clean fuels for mining vehicles
- Clean fuels for trains, trucks, and buses.

8.4.12 Regarding higher education, an internet search using "liquid fuels" generated 10 undergraduate courses and 7 postgraduate courses provided by a number of universities across Great Britain[106], including:

Figure 33: "Liquid fuels" undergraduate and postgraduate course (GB)

Undergraduate		
Queen Mary University of London	Sustainable Energy Engineering with Industrial Experience	MEng (Hon) 5 years
University of Lincoln	Ecology & Conservation	MBio 4 years
University of Aberdeen	Engineering (mechanical with oil & gas studies)	BEng 4 years
Aston University	Engineering & Applied Science Foundation Programme	BSc(Hons) 4-5 years
Solent University	Renewable Energy Engineering	BEng(Hon) 3 years
Solent University	Renewable Energy Engineering with Science & Engineering Foundation Year	BEng(Hon) 4 years
Queen Mary University of London	Sustainable Energy Engineering	MEng(Hon) 4 years
University of Glasgow	Astronomy and Physics	Msci(Hons) 5 years BSc(Hons) 4 years

[105] More information can be found on the Hydrogen World Leaders' website (external links opens new window).

[106] More information can be found on the UCAS website (external links opens new window).

Undergraduate		
Queen Mary University of London	Chemical Engineering	BEng(Hon) 3 years MEng (4 years)
University of Glasgow	Chemical Physics	BSc(Hons) 4 years Msci(Hons) 5 Years
Postgraduate		
University of Birmingham	Integrated Study in Fuel Cells & their Fuels	PhD 4 years
University of Birmingham	Fuel Cell & Hydrogen Technologies	MSc 1 year
University of Nottingham	Hydrogen Fuel Cells & their Applications	PhD 4 years
University of Birmingham	Hydrogen Fuel Cells & their Applications	MRes 2 years
University of Nottingham	Resilient Decarbonised Fuel Energy Systems CDT	EngD 4 years
Cranfield University	Advanced Chemical Engineering	PgCert 1 year
University of London	Energy Geosciences	MSc 2 years

8.4.13 The EKC Group[107] is an alliance of colleges across Kent which instils green skills for the future generation, it aims to be the leader among Further Education providers in delivering education sustainably and equipping students with green skills and resources for their lives and careers.

- Enhancing current apprenticeships to ensure that they meet the needs of the employers within the growing green economy
- Creating new apprenticeships to reflect new occupations to help reach net zero.

8.4.14 North East Scotland College joined forces with major players in green hydrogen, the education industry and supply chain to launch the Hydrogen Skills Partnership[108]. The partnership comprises ScottishPower, ITM Power, Arcola Energy, NESCol, Robert Gordon University, Energy Transition Zone Limited, Skills Development Scotland, Aberdeen University and the University of St Andrews based Hydrogen Accelerator.

8.4.15 It aims to show the potential for green, sustainable skills and high-value jobs emerging from a future hydrogen industry. This initiative builds upon the existing National Energy Skills Accelerator (NESA) programme.

[107] Taken from "A blueprint for the green workforce transformation" which can be found on the Institute of Environmental Management and Assessment's website (external link opens a new window).

[108] More information can be found on the North East Scotland College's website (external links opens new window).

8.4.16 The Scottish Hydrogen Innovation Network (SHINE) [109] supports the close collaboration between academia, industry and governments to ensure knowledge exchange and learning across projects. This aims to close key gaps in knowledge regarding the production and cost reduction, use, transport and storage of hydrogen as well as its integration into the wider energy system.

8.4.17 RPS provide self-paced e-learning CCUS course to provide participants with an awareness and understanding of subsurface CO_2 storage, CO_2 flow in the subsurface, monitoring of the CO_2 storage site and addresses the key issues of reservoir depth, well design, reservoir lithology and quality.

8.4.18 Looking at global research programmes, the Top 10 Carbon Capture University Research Programs identified by The Carbon Herald are:[110]

- University of Aberdeen CCU Research – Carbon Capture Machine
- Imperial College London – CCS Research Program
- MIT CCUS Center
- Arizona State University – The Center For Negative Carbon Emissions
- Stanford University Center For Carbon Storage
- University of Cambridge Carbon Capture, Storage And Use Research
- University Of Michigan – Global CO2 Initiative
- Sheffield University Research Into Carbon Dioxide Utilization
- University of Wyoming's Center For Carbon Capture And Conversion
- Texas University Carbon Management Program

[109] Hydrogen Action Plan, Scottish Government, Riaghaltas na h-Alba, 2022.

[110] More information can be found on the Carbon Herald's website (external link opens a new window).

9 Circular economy

9.1 Introduction

9.1.1 In a linear economy, natural resources are extracted, used to produce goods, which are consumed and then disposed of. In a circular economy, natural resources are reused, repaired, reprocessed and recycled – disposal is the act of last resort.

9.1.2 For the purpose of this research, we consider the skills implications of developments within four areas:

- Biomass
- Anaerobic digestion
- Production of biogas/biomethane
- Waste management and recycling

9.1.3 Reliable estimates of the current total workforce currently employed in the circular economy in Northern Ireland are not available.

9.1.4 While the ONS estimates that 5,900 people are currently employed in waste management and recycling activities[111], employment in biomass and biogas production are not available.

9.1.5 The latest national employment projections by Warwick Institute for Employment Research and Cambridge Econometrics[112], suggest that employment in the waste management industry is projected to grow by around 22% between 2020 and 2035. This is equivalent to around 1,000 jobs.

Biomass

9.1.6 Data taken from the Renewable Energy Planning Database[113] shows that in January 2023 there was 20MW of biomass operational in Northern Ireland. However, there are no further planned projects in the database.

[111] Northern Ireland Business Register and Employment Survey, 2021.

[112] The Skills Imperative 2035: Occupational Outlook – Long-run employment prospects for the UK, National Foundation for Educational Research, 2022.

[113] The Renewable Energy Planning database can be found on the Department for Energy Security and Net Zero's website (external link opens a new window).

9.1.7 Whilst biomass is often presented in a binary “good” or “bad” light for the planet, the Association for Renewable Energy & Clean Technology (REA) are of the view that reality is one of more gradation, and with the right conditions it can contribute to the climate solution, even at large scale. Leading climate authorities around the world, such as the UK’s climate Change Committee, the International Energy Agency (IEA) and the UN Intergovernmental Panel on Climate Change (IPCC) are clear that bioenergy has a role to play in the net-zero future.[114]

9.1.8 Using sustainable biomass as a source of energy can reduce the cost of meeting carbon reduction targets and can provide energy for a mixture of low carbon heat, power, gas and liquid transport fuels[115].

Anaerobic Digestion

9.1.9 Data taken from the Renewable Energy Planning Database[116] shows that in January 2023 there was 13.4MW of anaerobic digestion operational in Northern Ireland, with a further 21.7MW having received planning permission.

9.1.10 Anaerobic Digestion (AD) can be used to produce biogas from food waste, sewage sludge, silage and animal manures. The biogas can be upgraded via scrubbing technologies into biomethane and subsequently injected into the gas network[117].

9.1.11 In 2021, the Anaerobic Digestion and Bioresources Association (ADBA) submitted the UK Anaerobic Digestion and Biogas Industry Climate Declaration to the Prime Minister[118], whereby the industry commits to doing everything in its powers to deliver the greatest possible carbon reduction for the UK.

9.1.12 The five relevant industry developments identified by ADBA are[119]:

- Renewable Heat
- Renewable Transport fuels
- Food Waste
- Agriculture
- Wastewater

Production of biogas/biomethane

9.1.13 Manure and silage account for the majority of biogas feedstocks.

[114] More information can be found on The Association for Renewable Energy & Clean Technology’s website (external link opens a new window).

[115] The Bioenergy: Enabling UK biomass, Energy Technologies Institute, 2015.

[116] The Renewable Energy Planning database can be found on the Department for Energy Security and Net Zero’s website (external link opens a new window).

[117] Advice report: The path to a Net Zero Northern Ireland, Climate Change Committee, March 2023.

[118] More information can be found on the Anaerobic Digestion and Bioresources Association website (external link opens a new window).

[119] More information can be found on the Anaerobic Digestion and Bioresources Association website (external link opens a new window).

9.1.14 Biogas produced via AD can be upgraded to network-quality biomethane. As biogas is around 40% CO_2, this can be separated and captured as part of the upgrading process.

9.1.15 Biomethane can be injected into the gas network, displacing fossil gas. However, this should only be seen as an interim measure and biomethane should only be injected into the gas network to replace fossil gas and not at the expense of other low-carbon energy (e.g. hydrogen produced from electrolysis) or maintaining unabated consumption of methane (e.g. for heating buildings).

9.1.16 Any remaining biomethane can be used for electricity or hydrogen production, with carbon capture, utilisation and storage (CCUS) used to capture the resultant CO_2. This use of biomethane primarily achieves this reduction through sequestration of CO_2, which acts as a form of greenhouse gas removal[120].

9.1.17 Northern Ireland has a strong agricultural and agri-food base which provides considerable potential for locally produced biogas, along with the technology already employed.

9.1.18 There are around 80 anaerobic digestion plants producing biogas, used in the main for CHP plants. The opportunity to expand the base, either on or off the farm, to produce biomethane for injection into the gas network was noted.

Waste management and recycling

9.1.19 The Industrial Plans for Waste Management[121] state that it needs to be ensured at least 70% of waste is recycled by 2030.

9.1.20 Whilst there will always be a need for some form of waste management, it is the management of resources that will take future priority[122].

9.1.21 This transition will offer opportunities to collaborate with other industries – by influencing their design, harvesting their materials or supplying their supply chains with secondary resources – as well as showcasing the industry's skills.

9.1.22 It is felt that if the waste management industry can influence the system, and work, amongst others, with designers, technologists, data scientists, chemists and behavioural specialists, it will be able to support the much-needed changes in society and industry and amplify its impact.

9.1.23 End of Waste (EoW) plays a vital role in the circular economy as it defines the point at which a material or component is no longer subject to waste regulation and can be sold, used and regulated as any other raw material or product.

[120] Advice report: The path to a Net Zero Northern Ireland, Climate Change Committee, March 2023.

[121] More information can be found on the Climate Change Act (Northern Ireland) 2022 webpage (external link opens a new window).

[122] Improving the way we regulate circular resources in the UK: Presidential Report 2022, CIWM.

9.2 Skills demand – Current and future skills requirements

Biomass

9.2.1 Across the UK, biomass has created new jobs and investment in ports and freight infrastructure, an example being the Immingham Renewable Fuel Terminal (IRFT) in Humber which is the world's largest biomass terminal.

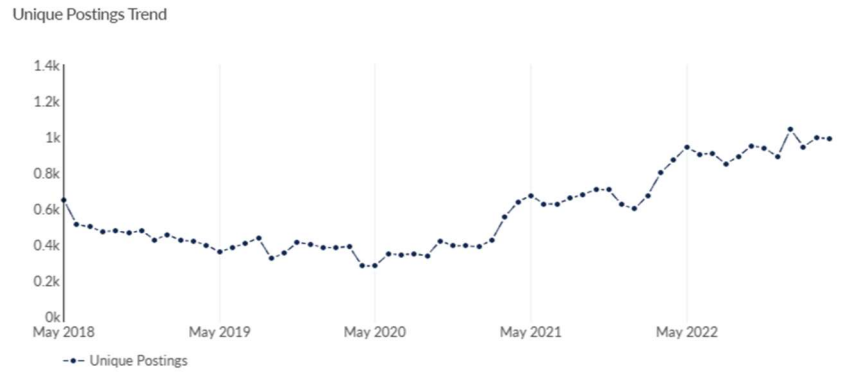
9.2.2 Critical job roles within biomass include:

- **Biomass Plant Technicians**: Operating biomass fuel burning boilers or biomass fuel gasification system equipment, inspecting biomass power plant or processing equipment, recording or reporting damage and mechanical problems, recording or reporting operational data, measuring and monitoring raw biomass feedstock, including wood, waste or refuse materials
- **Biomass Engineers**: Responsible for installing, repairing and maintaining pipes, fixtures, plant and other plumbing used for heating, water distribution and waste water disposal in residential, commercial and industrial buildings. The skills and qualifications for a Biomass Engineer are a proven level of ability usually attained through 3 years' experience working as a qualified and competent plumbing and heating engineer
- **Biomass Plant Managers**: Require a strong background in science and mathematics, physics, biology, chemistry, with a strong background in mechanical, engineering, production and processing, design and chemistry

9.2.3 In the year ending February 2023, there were 4,800 online job postings relating to biomass across the UK[123] – 90 of them were located within Northern Ireland.

[123] These vacancies were identified using the keywords "biomass" and excludes staffing/recruitment companies.

Figure 34: Number of online job postings relating to biomass (UK)



Source: Lightcast™, 2023.

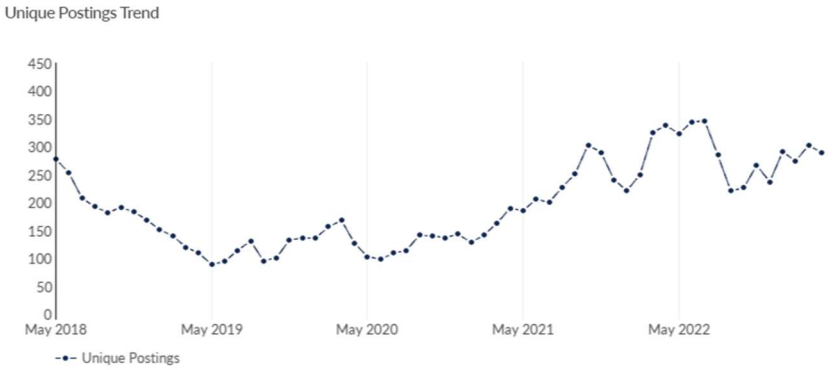
9.2.4 The most sought-after skills within these job postings were:

- Boilers
- Mechanical Engineering
- Electrical Engineering
- Process Engineering
- Maintenance Engineering

Anaerobic Digestion

9.2.5 In the year ending February 2023, there were 1,500 online job postings relating to biomass across the UK[124] – just 11 of them were located within Northern Ireland.

Figure 35: Number of online job postings relating to anaerobic digestion (UK)



Source: Lightcast™, 2023.

[124] These vacancies were identified using the keywords "anaerobic digestion" and excludes staffing/recruitment companies.

9.2.6 The most sought-after skills within these job postings were:

- Digestive System
- Mechanical Engineering
- Electrical Engineering
- Supervisory Control And Data Acquisition (SCADA)
- Maintenance Engineering
- Waste Management
- Wastewater
- Sewage Treatments
- Water Treatment

9.2.7 The expansion of AD capacity will require a greater number of skilled Systems Process Engineers who will be needed in mostly remote rural areas where these sites will be located.

9.2.8 These will be supported by an increasing number of process operatives and technicians, along with roles in sales and innovation which will be required to grow the market for AD products[125].

9.2.9 In considering the lack of skilled engineers in the industry and the importance to limit the environmental impact of biogas production there is significant employment potential for engineers to work both in industrial plants and in the increasing number of merchant AD sites that take commercial and household food waste.

9.2.10 There is the potential to translate opportunities into new career destinations for graduates in view of the current shortage of technicians and bioengineers with adequate experience in areas such as laboratory working, quality control and commercial business.

9.2.11 There is the need to match the locations of skill supply with the rural locations which will demand these skills; making such geographic areas attractive and inclusive.

9.2.12 Transferable skills will become increasingly important as technologies advance, industries shift and new markets open up. Flexibility needs to be encouraged in the workforce to enable skills that are developed now can be applied to different directions as the industry grows.

[125] The Future of Work: Baseline Employment Analysis and Skills Pathways for the Circular Economy in Scotland, Leonore te Bokkel, Fiona Craig and Sarah Wotton, Zero Waste Scotland and Esther Goodwin Brown and Joke Dufourmont, Circle Economy, 2023.

9.2.13 In agriculture, Farm Directors will need to develop a greater awareness of the value of by-products for producing energy through onsite AD facilities along with the benefits of co-digestion, supported by specialist bioresource advisors.

9.2.14 Farms will need to be supported in utilising digestates for agronomic benefits such as soil health. The recovery of high-value nutrients from digestates is currently an unexplored area which provides employment opportunities for biologists and ecologists in finding alternative uses for digestates.

9.2.15 Bioresource Advisors, specialised in working with the agricultural industry, will be needed to support on-farm staff with a better understanding of the AD process; providing advice and training on equipment that can be used to make the process more efficient in-house. Knowledge transfer of AD and biorefining can be delivered by early adopters, agri-tech innovation centres and fully functioning demonstrator farms.

Production of biogas/biomethane

9.2.16 The bioeconomy expansion has the potential to produce value from by-products from agriculture, forestry, fishing and the wider food and drink industry. Expansion of the bioeconomy will require the development of roles and competences across agri-food industries as well as biotechnology.

9.2.17 With Northern Ireland estimated to be 3-4 years behind GB in the adoption of biomethane, there is the potential for Northern Ireland to follow the developments implemented on the mainland.

9.2.18 Growth in the biorefining industry will support significant employment opportunities relating to new technology introduction and the larger range of products produced from the process.

9.2.19 However, in the short term, there are no real concerns regarding skills needs for biomethane – rather it is the shortage of people (as opposed to skills) which is the main issue facing the industry (as it is on many of the other green industries).

9.2.20 As the biorefining industry grows, so will the range of job opportunities due to the myriad of potential destinations for bioresources.

9.2.21 Skills that will be critical to the industry moving forward include:

- **Biogas Technicians**: Requires knowledge in natural gas liquids recovery processes, the various facets of natural gas, qualities, hazards & applications of fuel gas, biomass conversion and the theoretical & practical applications of mechanics
- **Biochemists, Industrial and Life Scientists**: Practical laboratory experience, with a degree in Life Sciences, Environmental, Material Science, Ecological Sciences or Chemical Engineering
- **Bioresource Advisors:** Requiring degrees in Material Science, Ecological Sciences or Environmental Sciences
- **Bioresource Planners:** Requiring a degree in Biology, Material Sciences or Life Sciences

- **Logistics Managers**: Requiring a degree or advanced qualification in Supply Chain Management or Business Administration

9.2.22 Alongside this, Quality Control Managers and Biochemical Engineers will be vital for ensuring controlled and high-quality processes within plants, utilising their practical experience of working in laboratories and quality control expertise.

9.2.23 Growth in biorefining capacity will increase the complexity of logistics systems, calling for Harvest Operatives, Logistics Managers and Supply Chain Analysts to ensure that feedstock is consistent and not contaminated or does not have to travel extensive distances.

9.2.24 Legal and related skills may be required to deal with regulatory changes and policies introduced as a result of biomethane production, distribution and storage.

Waste management and recycling

9.2.25 Waste is a design flaw. In design, important considerations and decisions have to be made with the whole life-cycle in mind: how a product is manufactured, how it is used, and what happens when it is no longer needed or wanted. If it cannot be repaired, remanufactured, refurbished or even recycled easily or in a cost-effective manner, it will end up in landfill[126].

9.2.26 Without changes to how we design products, buildings, business models and cities, we will not be able to decouple economic growth from resource consumption, drive innovation and open up new markets.

9.2.27 The importance of circular design is a theme cutting across all parts of the economy. Key elements include material selection, standardised components and designing not just for use but for deconstruction, disassembly, remanufacture and recyclability.

9.2.28 However, circular design will not become mainstream without demand. To embed circular design, actors along the value chain, including building users, investors and regulators, need to engage in the process.

9.2.29 Seven competencies relevant in the context of circular design have been identified[127]:

1. Circular Impact Assessment: Estimating the environmental impact over multiple use cycles to support decision-making during the design process
2. Design for Recovery: Incorporating recovery strategies during the design process while taking into account multiple use cycles
3. Design for Multiple Use Cycles: Foreseeing the consequences of prolonged use and multiple use cycles

[126] The Future of Work: Baseline Employment Analysis and Skills Pathways for the Circular Economy in Scotland, Zero Waste Scotland/Circle Economy, 2023.

[127] Circular Economy Competencies for Design, Deborah Sumter, et al., 2020.

4. Circular Business Models: Concurrently developing the circular product, service, and business model
5. Circular User Engagement: Engaging users in the use and the (end-of-use) return of products
6. Circular Economy Collaboration: Identifying, mapping, facilitating, and managing the collaboration between external stakeholders in operationalising a circular business model
7. Circular Economy Communication: Telling coherent stories about the circular offerings

9.2.30 Jobs in the circular economy are likely to involve a combination of more traditional skills, such as the skills used for repair, sorting and spotting faults during production processes, and more novel skills such as those associated with modular design and material compositions[128].

9.2.31 In many cases, working with circular business models will require more diverse and adaptive skills and mindsets. Soft skills for collaborating across industries and service-related skills will equally as important as hard skills for programming, operating and repairing equipment.

9.2.32 Workers need the right knowledge, skills and mindset In order to achieve greater circularity in the economy, people and employers will need to develop new skills to adapt to changing environments. Activities and services will become focused on reusing materials and closing material cycles – processes that require diverse skills in design and engineering as well as practical labour-intensive roles. The skills that will be needed include[129]:

- Demand planning/supply chain management
- Digital/data analysis
- Engineering
- Environmental
- Marketing
- Materials handling
- Smart design
- Trades/craft skills

9.2.33 One of the main challenges that the industry faces in attracting and retaining these skills, is the attractiveness of the industry in terms of the nature of the jobs being undertaken – particularly in relation to young people.

[128] The Future of Work: Baseline Employment Analysis and Skills Pathways for the Circular Economy in Scotland, Zero Waste Scotland/Circle Economy, 2023.

[129] Draft Circular Economy Strategy for Northern Ireland, Department for the Economy, 2022.

9.2.34 There is also the perception that those working in waste management, whilst being a highly diverse industry, do not require regular skills development[130].

9.2.35 However, industry has evolved, and continues to evolve, from a basic public health service of collecting and disposing of waste, to one focused on material management, maximising the value of resources used in products and services, and minimising carbon and wider environmental impacts, including hazard reduction.

9.2.36 The occupations which will be most important for driving the industry forward are reported as:

- Near-term 2023 - 2030
  - Roles associated with policy development and implementation
  - Design of products and packaging
  - Regulation and compliance
  - Collections and operations including drivers
  - Recycling managers
  - Reuse and repair operations (including volunteering roles)
  - Material sorting
  - Reprocessing (chemists and engineers)
- Medium-term 2030 - 2035
  - Circular economy specialists
  - Renewable energy specialists (materials, engineering)
  - Change managers
  - Manufacturing – remanufacture
  - Industrial reuse and repair
  - Chemists and material scientists
- Long-term 2035 – 2040
  - Net zero – carbon capture and storage
  - Automation
  - AI

9.2.37 An increasing aspect of the overlap between construction (a focus area of the Circular Economy Strategy[131]) and waste management and recycling is Closed-loop Cycling of Building Materials and Components, which means building materials are no longer sent to landfill, but downcycled for use in other industries. This will create jobs in the sourcing, sorting, testing and supply of high-quality secondary materials.

[130] CIWM Presidential Report 2021, Skills for the Future: The Journey to 2030, The Chartered Institution of Wastes Management (CIWM).

[131] Draft Circular Economy Strategy for Northern Ireland, Department for the Economy, 2022.

9.2.38 Because the ability to capture, reuse and recycle building materials and components is strongly linked with the way buildings are deconstructed, Site Analysts and Deconstruction Auditors will need to use different approaches to locate and reduce damage to reusable components or recoverable materials from buildings. They will ensure site harvest management plans are in place, replacing site waste management plans in order to reflect the value that can be harvested from buildings.

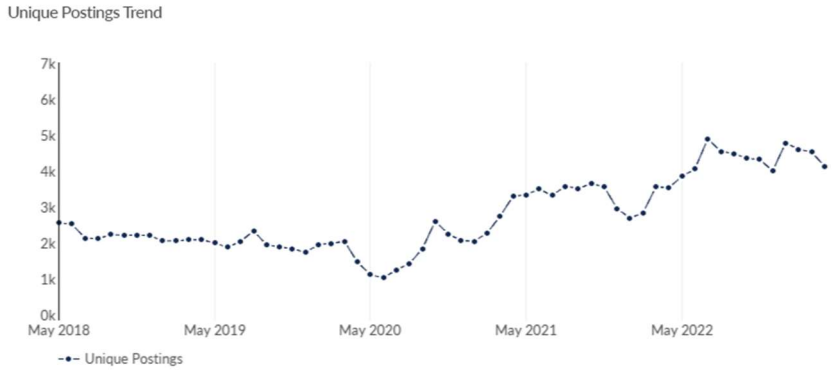
9.2.39 Demolition Labourers, Supervisors and Technical Managers will also need to understand the value of secondary products, components and materials and the processes required to prevent material contamination, facilitate efficient recycling and minimise damage to recovered elements.

9.2.40 Architects will need to work in new ways to promote the reuse of materials and disassembly of buildings through their designs, while Material Scouts will be concerned with finding secondary materials and products in the region that could be used for new construction projects.

9.2.41 This will be crucial to changing practice and preventing contractors, both public and private, from reverting to primary materials, particularly due to the time sensitive nature of the construction contracts which typically limit the level of collaboration and planning required in a circular economy.

9.2.42 In the year ending February 2023, there were 21,000 online job postings relating to biomass across the UK[132] – just 160 of them were located within Northern Ireland.

Figure 36: Number of online job postings relating to waste management and recycling (UK)



Source: Lightcast™, 2023.

[132] These vacancies were identified using the Standard Industrial Classification codes of 38 (Waste Collection, Treatment and Disposal Activities; Materials Recovery) and 39 (Remediation Activities and Other Waste Management Services) and excludes staffing/recruitment companies.

9.2.43 The most sought-after skills within these job postings were:

- Waste management
- Plant/machinery operation
- Business development
- Supply chain
- Forklift truck
- Environment health and safety

9.3 Skills supply – Education and skills provision

9.3.1 The Draft Circular Economy Strategy states that the circular economy needs to be embedded in our entire education system – from further education colleges and universities providing the skills and delivering traineeships, apprenticeships and Sectoral Partnerships to drive changes through revised industry standards and qualification requirements[133].

9.3.2 In future, the principles of a circular economy (materials, remanufacturing, eco-design, recyclability, and practices that extend product lifetimes) will need to be integrated into all aspects of the value chain, but especially in design, engineering, construction, industrial processes and customer service.

9.3.3 For new skills requirements, new provision will be required. This will particularly affect provision relating to:

- Practical repair skills
- Technical skills to address a broad range of areas including:
  - Chemical recycling
  - Treatment of carbon fibre
  - EV battery recycling

[133] Draft Circular Economy Strategy for Northern Ireland, Department for the Economy, 2022.

Further education

Traineeships

9.3.4 The Traineeship programme is delivered by the six further education colleges of Further Education and work-based learning being provided by local employers. They allow an individual to achieve a full Level 2 qualification over a two-year, full-time programme.

9.3.5 The only Traineeships that may be relevant to the waste management and circular economy industries are:

- Engineering (which is being offered by all six further education colleges)
- Fabrication and welding (which is being offered by all six further education colleges)
- Motor vehicle (heavy) (which is offered by four further education colleges)
- Plant maintenance (offered by South West College)

Apprenticeships

9.3.6 There are only three apprenticeship frameworks which are directly applicable to the circular economy:

- Engineering (level 2 – also available for people aged 25+)
- Supply chain management (level 2)
- Sustainable resource management (level 2)
- Engineering (level 3 – also available for people aged 25+)
- Sustainable resource management (level 2)
- Water and wastewater operations (level 3)

Higher level apprenticeships (level 4+)

9.3.7 There are also a wide range of higher level apprenticeships available relating to various activities of:

- Advanced manufacturing and engineering (x18)
- Civil engineering (x4)
- ICT (x13)

Further education colleges

9.3.8 Based on information provided by the further education colleges to the GESIRG in January 2023, there are just three relevant further education programmes:

- Level 5 certificate in Green Technologies
- Level 2 in Recycling and Waste Management
- Level 2 and 3 in Sustainable Resource Management

9.3.9 SERC provides the OCN NI Level 5 Certificate in Green Technologies, including a unit in Anaerobic Digestion.

Skill Up programme

9.3.10 Through the Skill Up programme, a range of free short courses are on offer from further and higher education providers across a wide range of subjects, including:

- PG Cert in Engineering of Energy, Economics and the Environment
- Zero Carbon Engineering (PG Cert/PG Dip)
- Advanced Manufacturing Leadership
- Innovation and Technology
- Mechanical Engineering with Management (PG Cert)
- Green Technologies Level 5 Award Certificate and Extended Certificate
- HVO Bio Oils

9.3.11 These courses are an ideal way to enable people from outside of the industry (be they new entrants to the labour market or people transitioning from one industry to another) to upskill quickly.

Higher education

9.3.12 The two largest universities in Northern Ireland, Ulster University and Queen's University Belfast, offered a range of first degree courses in 2020/21. Overall, there were 260 starts on physical and environmental science courses (200 of whom were female), including:

- Biology/Ecology: 140 starts (80 were female)
- Chemistry: 65 starts (30 were female)
- Chemical, process and energy engineering: 80 starts (20 were female)
- Environmental sciences: 55 starts (25 were female)

9.3.13 There are currently no standalone geoscience degrees available at either undergraduate or postgraduate level in Northern Ireland.

9.3.14 The table below shows the number of STEM graduates from 2020/21 that entered employment in this industry.

Figure 37: Number of STEM graduates from Northern Ireland HE institutions that entered employment in the industry (2020/21)

Industry	Standard Industry Classification	Graduates in employment
Circular economy	38 Waste collection, treatment and disposal activities; materials recovery 39 Remediation activities and other waste management services	10

Source: HESA Graduates Outcomes, 2020/21.

9.3.15 Given that the Northern Ireland Skills Barometer 2021 update reports that almost two-fifths (37%) of new workers in the period to 2030 will require level 6+ qualifications (i.e. undergraduate degree, masters, PhD) and that Northern Ireland will be short of nearly 3,000 level 4+ skilled people per year over the same period (with Engineering and Manufacturing Technologies being particularly in demand), the numbers enrolling on the courses listed above need to increase substantially.

9.4 Learning from around the UK

9.4.1 In addition to the apprenticeship frameworks that are currently available in Northern Ireland, there are a number of English apprenticeship standards that may be relevant:

- Metal recycling general operative (level 2)
- Metal recycling technical manager (level 5)

9.4.2 Sectoral Partnerships may wish to consider whether the development of an equivalent framework might be of benefit to the industry.

9.4.3 Skills Bootcamps, offered across England, are free, flexible courses of up to 16 weeks duration. At the end of the course, each participant is offered a job interview with an employer.

9.4.4 There are a range of Skills Bootcamps relevant to this industry:

- Strategies for a Sustainable and Circular Economy
- Sustainability

10 Transport

10.1 Introduction

10.1.1 This industry includes the following activities:

- EV vehicle repair & maintenance (the installation of charging points is covered in section 6 - Domestic low carbon technologies and energy efficiency)
- Hydrogen fuel cells

10.1.2 It is estimated that around 600 people are currently employed in activities relating specifically to these two industries[134].

10.1.3 However, total employment in the motor vehicle manufacturing and repair industry is estimated to be nearer 16,000 – perhaps giving an estimate of the potential workforce in this industry given (i) the ban on the sale of new petrol and diesel cars and vans from 2030 and (ii) their likely high level of skills transferability into green transport technologies:

- 29.10 Manufacture of motor vehicles: 500
- 29.20 Manufacture of bodies (coachwork) for motor vehicles; manufacture of trailers and semi-trailers: 1,400
- 49.31 Urban and suburban passenger land transport: 3,800
- 45.2 Maintenance and repair of motor vehicles: 4,300
- 52 Warehousing and support activities for transportation: 5,600

10.1.4 The latest national employment projections by Warwick Institute for Employment Research and Cambridge Econometrics[135], suggest that employment in the land transport industry in Northern Ireland is projected to grow by around 19% between 2020 and 2035 - equivalent to around 3,000 jobs.

[134] Low carbon and renewable energy economy estimates, 2021, ONS

[135] The Skills Imperative 2035: Occupational Outlook – Long-run employment prospects for the UK, National Foundation for Educational Research, 2022.

10.2 Skills demand – Current and future skills requirements

EV vehicle repair & maintenance

10.2.1 Demand for EV vehicle repair & maintenance skills will obviously reflect their market share of vehicles on the road. Across the whole of the UK in 2021, 19% of new vehicles registered had a plug[136], compared to 10% in Northern Ireland[137]. This underlines the scale of the challenge ahead if the 2030 ban on the sale of new petrol and diesel cars and vans is to be achieved.

10.2.2 The Institute of the Motor Industry (IMI) estimate that around 16% of the UK's qualified technicians are able to safely work on electric vehicles[138].

10.2.3 They also report that, contrary to popular belief, research shows that electric vehicles may not be less complicated to maintain than conventional petrol or diesel vehicles. So the notion that one technician can service more EVs than non-EVs is no longer valid, and that garages and workshops should not presume they will require fewer technicians to service EVs.

10.2.4 The IMI predicts that by 2030, the UK will need 103,000 TechSafe qualified technicians to work with electric vehicles, increasing to 124,000 by 2032. However, current forecasts of qualified technicians suggest that there will be a shortfall of 16,000 technicians by 2032.

10.2.5 This risk could compromise vehicle safety and erode consumer confidence in the ability of garages to service, maintain, and repair electric vehicles – which, coupled with "range anxiety" and the relatively low volume of charging points – will do little to help meet the already challenging 2030 zero emission vehicle target.

10.2.6 In relation to public transport, Translink aims to be climate positive by 2050 through the electrification of its bus fleet and generation of renewable energy and hydrogen.

10.2.7 One the biggest challenges they face is the long lead-time to the deployment of the required infrastructure – in terms of electricity and hydrogen refuelling.

10.2.8 The upskilling required for maintenance technicians has been a challenge as electric buses operate at a higher voltage than diesel powered engines. This training has mainly been delivered in-house in conjunction with the vehicle suppliers. However, training for the drivers is light at just one day per driver.

[136] More information can be found on the Zapmap website (external link opens a new window).

[137] Advice report: The path to a Net Zero Northern Ireland, Climate Change Committee, March 2023.

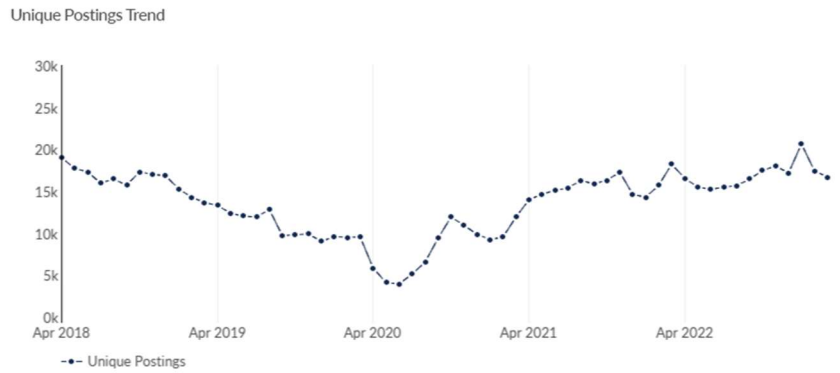
[138] EV TechSafe Technician Forecasts, Institute of the Motor Industry, March 2023.

10.2.9 Repair and maintenance of the electricity and hydrogen infrastructure is carried out by specialist contractors.

10.2.10 Translink are also looking at electrifying trains, but, again, the long lead-time for the required infrastructure means this is unlikely to happen until well into the 2030s.

10.2.11 In the year ending 28th February 2023, there were 83,500 online job postings for Vehicle Technicians, Mechanics and Electricians across the UK[139] – 700 of them were located within Northern Ireland.

Figure 38: Number of online job postings relating to Vehicle technicians, mechanics and electricians (UK)



Source: Lightcast™, 2023.

10.2.12 The table below shows the top job titles being recruited and most sought-after skills associated with each job title (listed in order of magnitude):

Figure 39: Most sought-after job titles and associated skills

Job title	Most sought-after skills
Vehicle Technicians	Vehicle Maintenance Safety Standards Work Order
HGV Technicians	Vehicle Maintenance Vehicle Inspection Product Knowledge
Testers	Vehicle Maintenance Automotive Industry Regulatory Compliance
HGV Mechanics	Vehicle Systems Mechanics Vehicle Maintenance
Motor Vehicle Technicians	Vehicle Maintenance Mechanics Automotive Engineering

[139] These vacancies were identified via the Standard Occupational Classification code of 5231 (Vehicle Technicians, Mechanics and Electricians) and excludes staffing/recruitment companies.

Job title	Most sought-after skills
Repair Technicians	Control Of Substances Hazardous To Health Spray Painting Electrical Diagnostics And Repairs
Vehicle Mechanics	Vehicle Maintenance Vehicle Systems Electrical Diagnostics And Repairs

Hydrogen fuel cells

10.2.13 Hydrogen fuel cells are similar to electric batteries in that they produce electricity without combustion or emissions, but unlike electric batteries, fuel cells do not run down or need to recharge—as long as there's a constant source of fuel and oxygen which, when the infrastructure is in place, would be like refuelling a petrol or diesel vehicle.

10.2.14 For heavy vehicles, long distances, unpredictable routes, high uptime requirements, and the importance of high payloads make this industry particularly difficult to decarbonize[140].

10.2.15 Therefore, it is likely that there will be a significant increase in hydrogen-powered vehicles both on the road and on infrastructure construction sites[141].

10.2.16 This assumes that the market is confident enough that there is sufficient hydrogen being produced (which may not be the case at the moment). Translink currently pay three-four times more for their hydrogen fuel than their diesel.

10.2.17 Hydrogen fuel cell professionals need to have a solid foundation in engineering principles and practices, such as[142]:

- Thermodynamics
- Fluid mechanics
- Combustion
- Heat transfer
- Mechanical design

10.2.18 They need to be able to apply these principles to design, model, test, and optimize fuel cell systems and components, such as pistons, valves, injectors, spark plugs, and exhaust systems.

[140] More information can be found on the McKinsey & Company website (external link opens a new window).

[141] More information can be found on The Construction Index website (external link opens a new window).

[142] More information can be found on the LinkedIn website (external link opens a new window).

10.2.19 Additionally, they need to be able to use various tools and software, such as computer-aided design (CAD), computational fluid dynamics (CFD), and engine simulation software, to perform engineering tasks and analysis.

10.2.20 They also need to have a deep understanding of hydrogen as a fuel – its properties, characteristics, and behaviour – and how it is produced, stored, transported, and distributed. They also need to know how hydrogen interacts with different materials, such as metals, plastics, and composites, and how to prevent or mitigate hydrogen embrittlement, corrosion, leakage, and explosion.

10.2.21 The level of augmentation expected of technician and tradesperson job roles will vary greatly depending on the specific role. The most significant job role change will be faced by automotive mechanical and electrical technicians. These job roles will need to adapt to the unfamiliarity and complexity of hydrogen fuel cell vehicles and their associated systems[143].

10.2.22 In addition, first responders will also need awareness and some specific training in how to deal with basic depowering and reinitialising procedures to ensure safe work practices around dangerous high voltage systems.

10.2.23 The scale of augmentation for existing job roles are likely to be moderate for:

- Truck driver
- Marine master/operator
- Heavy vehicle operator
- Plant machinery operator

10.2.24 However, the level of augmentation will be high for:

- Heavy duty fitter
- Automotive electrician
- Light vehicle technician
- Heavy vehicle technician
- Vehicle body repair technician

10.2.25 They will need a basic understanding of the operations and functions of proton exchange membrane fuel cells and when replacement is necessary (e.g. due to the cell's degradation over time).

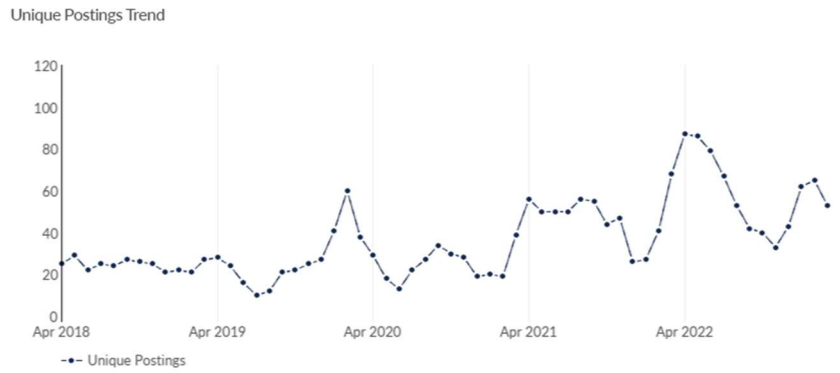
10.2.26 They will need to work with high voltage systems, including learning how to depower them so that repair or maintenance work can be undertaken.

[143] Developing Australia's Hydrogen Workforce, Final Report, October 2022, PwC Consulting.

10.2.27 In the fishing fleet industry, marine engineers[144] will require an understanding of fuel cell technology, how it functions, and what components in the propulsion system may be safely handled for repair. They will also need an understanding of high pressure hydrogen storage systems and how they function.

10.2.28 In the year ending 28th February 2023, there were just 300 online job postings relating to Fuel Cells, Fuel Cell Design or Fuel Cell Vehicles across the UK[145] – none of them were located within Northern Ireland.

Figure 40: Number of online job postings relating to fuel cells (UK)



Source: Lightcast™, 2023.

10.2.29 The primary skills required by these jobs were:

- Fuel Cells
- Materials Science
- Chemistry
- Chemical Engineering

[144] Developing Australia's Hydrogen Workforce, Final Report, October 2022, PwC Consulting.

[145] These vacancies were identified using the keywords "Fuel Cells", "Fuel Cell Design" and "Fuel Cell Vehicles" and excludes staffing/recruitment companies.

10.3 Skills supply – Education and skills provision

Further education

Traineeships

10.3.1 The Traineeship programme is delivered by the six further education colleges and work-based learning being provided by local employers. They allow an individual to achieve a full Level 2 qualification over a two-year, full-time programme.

10.3.2 Traineeships that may be relevant to the transport industry are:

- Auto electrics (offered by two further education colleges)
- Motor vehicle (heavy) (offered by four further education colleges)
- Motor vehicle (light) (offered by all six further education colleges)
- Vehicle body repair (offered by two further education colleges)
- Vehicle fitting (offered by two further education colleges)
- Vehicle paint refinishing (offered by one further education college)

Apprenticeships

10.3.3 There are a range of apprenticeship frameworks which are directly applicable to transport:

- Bus and coach engineering and maintenance (level 2)
- Driving goods vehicles (level 2)
- Passenger carrying vehicle driving – bus and coach (level 2)
- Rail industry (level 2)
- Rail services (level 2)
- Vehicle fitting (level 2)
- Vehicle maintenance and repair (level 2)
- Vehicle parts (level 2)
- Bus and coach engineering and maintenance (level 3)
- Driving goods vehicles (level 3)
- Vehicle fitting (level 3)
- Vehicle maintenance and repair (level 3)
- Vehicle parts (level 3)

10.3.4 However, neither the level 2 or level 3 Vehicle maintenance and repair apprenticeship framework contain any content relating to electric vehicles.

Higher level apprenticeships (level 4+)

10.3.5 The only higher level apprenticeships that are relevant tot he transport industry relate to supply chain management:

- Supply chain & logistics – FdSc in Logistics & Supply (Northern Regional College)
- Transport and supply chain management - Foundation degree in transport and supply chain management (South West College)

Further education colleges

10.3.6 Based on information provided by the further education colleges to the GESIRG in January 2023, there are a wide range of relevant programmes:

- Level 2 Electric Vehicle
- Level 2 in Hydrogen Applications and Technologies
- Level 2 IMI Award EV Hazard Management
- Level 2 Award in Electric/Hybrid Vehicle Routine Maintenance Activities
- Level 2 Electric/Hybrid Vehicle Routine Maintenance Activities
- Level 2 Hybrid Electrical Vehicle Maintenance
- Level 3 Hydrogen Applications and Technologies
- Level 3 Hydrogen Fuel Cell Technology
- Level 3 in Hydrogen Applications and Technologies
- Level 3 – Domestic Electric Vehicle Charging Equipment Installation
- Level 3 IMI Award Hybrid Electrical Vehicle Maintenance
- Level 3 Electric Vehicle
- Level 3 Hybrid Electric Vehicle Maintenance
- Level 3 Award in the Installation and Commissioning of Electric Vehicle Charging Equipment in Domestic, Commercial and Industrial locations
- Level 3 Award in Electric/Hybrid Vehicle System Repair and Replacement
- Level 5 certificate in Green Technologies
- Level 5 Train the trainer in Hydrogen Applications and Technologies
- Level 6 PGCE Hydrogen Technologies

10.3.7 Through the Hydrogen Training Academy, the Hydrogen Fuel Cell Skills Lab[146] will facilitate training and up-skilling in this area. It comprises a suite of hydrogen training equipment, and is designed to provide a hands-on, educational hub which provides an overview of the technology and how it can be implemented.

10.3.8 SERC provides the OCN NI Level 5 Certificate in Green Technologies, including a unit in Electrical Vehicle Charging Systems.

Skill Up programme

10.3.9 Through the Skill Up programme, a range of free short courses are on offer from further and higher education providers across a wide range of subjects, including:

- Award in Hydrogen Skills (Level 2 & Level 3)
- Electric Vehicle Charging Equipment Installation
- Electric Vehicle Level 2 and 3
- Electric/Hybrid Vehicle Routine Maintenance Activities Level 2 Award
- Electric/Hybrid Vehicle System Repair and Replacement Level 3 Award
- Heavy Vehicle Repair Level 3 IMI
- Hybrid Electrical Vehicle Repair
- Hydrogen Energy Systems (PG Cert)
- Hydrogen Fuel Cell Technology
- Hydrogen Level 2
- Hydrogen Safety
- IMI Skills in Diagnosing Motor Vehicle Faults Where No Prescribed Process or Format is Available
- Light Vehicle Maintenance and Repair
- PG Cert in Engineering of Energy, Economics and the Environment
- Zero Carbon Engineering (PG Cert/PG Dip)

10.3.10 These courses are an ideal way to enable people from outside of the industry (be they new entrants to the labour market or people transitioning from one industry to another) to upskill quickly.

[146] More information can be found on the Invest Mid East Antrim website (external link opens a new window).

Higher education

10.3.11 The two largest universities in Northern Ireland, Ulster University and Queen's University Belfast, offered a range of first degree courses in 2020/21. Overall, there were 740 starts on engineering courses (130 of whom were female), including:

- Chemistry: 65 starts (30 were female)
- Chemical, process and energy engineering: 80 starts (20 were female)
- Environmental science: 55 starts (25 were female)

10.3.12 The table below shows the number of STEM graduates from 2020/21 that entered employment in this industry.

Figure 41: Number of STEM graduates from Northern Ireland HE institutions that entered employment in the industry (2020/21)

Industry	Standard Industry Classification	Graduates in employment
Transport	29.1 Manufacture of motor vehicles 49 Land transport and transport via pipelines 52 Warehousing and support activities for transportation	25

Source: HESA Graduates Outcomes, 2020/21.

10.4 Learning from around the UK

10.4.1 In addition to the apprenticeship frameworks that are currently available in Northern Ireland, there are a number of English apprenticeship standards that may be relevant:

- Heavy vehicle service and maintenance technician (level 3)
- Transport and warehouse operations supervisor (level 3)
- Road transport engineering manager (level 4)

10.4.2 Sectoral Partnerships may wish to consider whether the development of an equivalent framework might be of benefit to the industry.

10.4.3 Skills Bootcamps, offered across England, are free, flexible courses of up to 16 weeks duration. At the end of the course, each participant is offered a job interview with an employer.

10.4.4 There are a range of Skills Bootcamps relevant to this industry (although there are none specific to hydrogen fuel cells):

- Electric Vehicle (EV) & Hybrid
- Electric vehicle charging
- Electric Vehicle Maintenance
- Electric Vehicles Academy
- Electrification, EV and Hybrid Maintenance and Repair
- EV Charging Installer
- EV Maintenance, Repair and Diagnostics of heavy vehicles
- Electronics – Power electronics, machines and drives (PEMD)

10.4.5 Again in England, there is a T Level in Maintenance, Installation and Repair for Engineering and Manufacturing which includes an option to specialise in the Maintenance, installation, and repair of light and electric vehicles.

10.4.6 The University of Birmingham offers an MSc in Fuel Cell and Hydrogen Technologies[147].

10.4.7 The University of Nottingham offers a PhD (Research) in Hydrogen Fuel Cells and their Applications[148]. This PhD is part of the Midlands Energy Consortium and is run in collaboration with the Centre for Hydrogen and Fuel Cell Research at the University of Birmingham.

[147] More information can be found on the UCAS website (external link opens a new window).

[148] More information can be found on the UCAS website (external link opens a new window).

11 Agriculture

11.1 Introduction

11.1.1 With society facing major challenges from a growing population and climate change, the imperative to grow more food locally has never been greater.

11.1.2 Innovation and technological development is key to tackling these challenges. Through innovation in seeds, crop protection, digital tools, and agriculture practices, the agri-tech industry is advancing sustainability and efficiency across the entire agriculture value chain.

11.1.3 Furthermore, the industry also has significant potential in the area of energy production, particularly in bioenergy (biomass, biofuels, biogas), wind power and solar photovoltaics. It is estimated that farmers own or host over half of the UK's solar power and anaerobic digestion capacity, as well as the majority of wind power[149].

11.1.4 The agriculture industry in Northern Ireland is fragmented and characterised by a large number of small producers (with limited resources).

11.1.5 In 2021, it was estimated that there were around 52,000 farmers and workers in Northern Ireland[150].

11.1.6 The latest national employment projections by Warwick Institute for Employment Research and Cambridge Econometrics[151], suggest that employment across the agriculture industry is projected to remain broadly stable to 2035.

[149] Delivering Britain's clean energy from the land, NFU/NFU Cymru/NFU Scotland/Ulster Farmers' Union, 2016.

[150] Northern Ireland Agri-Food Sector Key Statistics December 2022, Department for Agriculture, Environment and Rural Affairs.

[151] The Skills Imperative 2035: Occupational Outlook – Long-run employment prospects for the UK, National Foundation for Educational Research, 2022.

11.2 Skills demand – Current and future skills requirements

11.2.1 In terms of developing the skills of the workforce, there are two areas of focus:

1. The knowledge, skills and behaviours needed to make informed environmental and climate related decisions
2. The technical skills needed to implement the required actions

11.2.2 On this first point, CAFRE[152] is the principal centre for knowledge enhancement in the agricultural industry (as well as farm support more generally) and plays a key role developing and engendering the knowledge, skills, behaviours and practices of a modern agriculture industry.

11.2.3 Much of their work reflects the need for new innovations, initiatives, knowledge and working practices to improve environmental and climate mitigating actions by businesses – and the need for to disseminate this effectively and efficiently around the agriculture industry.

11.2.4 It is by increasing levels of knowledge and understanding that will drive the behavioural change which will result in the industry changing how it undertakes its operations and improves the impact that they have on the environment and climate.

11.2.5 The ascent of environmental farming and circular agriculture practices will lead to an increased demand for specialist advisors, including agronomists and animal nutritionists: independent advisors on soil health and animal feed quality, respectively, and ways to monitor, manage and maintain it.

11.2.6 Technical ecological knowledge of soils, nutrients and proteins is necessary, combined with interpersonal skills and empathy for different farms and farmers' situations and needs.

11.2.7 Initiatives to restore and improve woodland, rewet bog and peatlands and cultivate biodiversity through hedgerow management can also generate job opportunities for those in rural communities[153].

11.2.8 Increased use of automation and data-based technologies is driving a skills change in the industry. For example:

- The use of data within precision agriculture is changing the way crops and livestock are grown and managed – resulting in less waste of the inputs and more accuracy in outputs
- Crop science is increasing quality and consistency

[152] More information can be found on the College of Agriculture, Food & Rural Enterprise website (external link opens a new window).

[153] The Circularity Gap report: Northern Ireland, Circle Economy, 2022.

11.2.9 For example, data can now be collected using drones or handheld sensors which, when combined with maps, allow farmers to identify and rectify problems such as poor irrigation, plant density, and disease which can directly affect crop yields and profitability. This data ability allows smaller farmers to increase yields more effectively and compete with the resources of larger farms.

11.2.10 Younger people and new entrants will be the driving force behind many of the agri-tech developments happening in the industry over the coming years and improving productivity, efficiency and environmental protection.

11.2.11 In terms of developing the workforce of the future, increasing levels and quantities of skills are likely to be required in areas such as[154]:

- Agricultural meteorology
- AI and robotics
- Business and commercial management
- Data science
- Digital skills
- Engineering disciplines (electrical, mechanical and others)
- Environmental economists
- Environmental restoration planning
- Food scientists/technologists
- Fuel efficient driving
- Scientists of varying specialisms
- Software development/engineering
- Soil and water conservation
- Water resource management

11.2.12 Other areas of innovation that may impact upon the skills of the wider agriculture and land-based industries include:

- Soil sequestration, where atmospheric carbon is stored in soil and vegetation
- Reducing beef herd methane emissions through changes in genetics, diet or grazing management[155]
- Increasing water efficiency, it will be critical that farmers and land managers ensure sustainable abstraction for irrigation
- Organic farming techniques
- Crop diversification

[154] Skills for a greener future: A global view, International Labour Organisation, 2019.

[155] Gjerek M, Morgan A, Gorennor and Liz Hutton at the Department during the work. Brown N, Womersley G (2021). Diesel Use in NSW Agriculture and Opportunities to Support Net Zero Emissions. Sydney: Australian Alliance for Energy Productivity for NSW Department of Primary Industries.

11.2.13 These skills are being added to and/or adapted by existing occupations and will require more technical knowledge be spread across both mid-level skills and higher-level skills.

11.2.14 These skills, together with raising awareness of greenhouse gas emissions, are vitally important to ensure the industry contributes to a net-zero future.

11.2.15 This provides an opportunity to attract more young people into the agricultural industry as it engages those with technology and data skills in an industry that has not traditionally done so. It also provides an opportunity to attract experienced people with these skills from other industries as decision-makers and business managers.

11.3 Skills supply – Education and skills provision

11.3.1 The challenge for learning and skills providers will be to integrate new learning content into core agricultural provision, such as:

- AI and robotics
- Data science
- Digital skills
- Engineering disciplines (electrical, mechanical and others)
- Scientists of varying specialisms
- Software development/engineering
- Business and commercial management
- Food scientists/technologists

College of Agriculture, Food and Rural Enterprise (CAFRE)

11.3.2 CAFRE is the principal centre for knowledge enhancement in the agricultural industry (as well as farm support more generally) and plays a key role developing and engendering the knowledge, skills, behaviours and practices of a modern agriculture industry.

11.3.3 CAFRE offer a wide range of courses at various levels in areas such as agriculture, equine and land-based Engineering.

Further education

Traineeships

11.3.4 The Traineeship programme is delivered by the six further education colleges and work-based learning being provided by local employers. They allow an individual to achieve a full Level 2 qualification over a two-year, full-time programme.

11.3.5 Traineeships that may be relevant to agriculture are:

- Agriculture (offered by one further education college)
- Animal care (offered by one further education college)
- Horticulture (offered by one further education college)
- Land based engineering (offered by two further education colleges)
- Plant maintenance (offered by one further education college)

Apprenticeships

11.3.6 There are a number of apprenticeship frameworks which are directly applicable to agriculture and land-based activities:

- Agriculture (level 2)
- Animal care (level 2)
- Environmental Conservation (level 2)
- Land-based engineering (level 2)
- Agriculture (level 3)
- Animal care (level 3)
- Environmental Conservation (level 3)
- Land-based engineering (level 3)
- Trees and timber - level 3

11.3.7 None of these frameworks above are available to people aged over 25 years, which could be a limiting factor in terms of meeting future requirements.

Higher level apprenticeships (level 4+)

11.3.8 There are no higher level apprenticeships currently available that relate to the agriculture industry (only to food and drink manufacture).

Further education colleges

11.3.9 Based on information provided by the further education colleges to the GESIRG in January 2023, there is only one relevant programme in agriculture:

- Level 2 Award in Reducing Carbon Footprints through Environmental Action

Higher education

11.3.10 At HE level, just 50 starts were recorded in 2020/21 in agricultural subjects (25 of whom were female). While this partly reflects the level of skills required in the industry (i.e. normally between levels 2 to 4), a lack of higher skills may hinder innovation in the industry.

11.3.11 The table below shows the number of STEM graduates from 2020/21 that entered employment in this industry.

Figure 42: Number of STEM graduates from Northern Ireland HE institutions that entered employment in the industry (2020/21)

Industry	Standard Industry Classification	Graduates in employment
Agriculture	01 Crop and animal production, hunting and related service activities 02 Forestry and logging 81.3 Landscape service activities	10

Source: HESA Graduates Outcomes, 2020/21.

11.4 Learning from around the UK

11.4.1 In addition to the apprenticeship frameworks that are currently available in Northern Ireland, there are a number of English apprenticeship standards that may be relevant:

- Arborist (level 2)
- Poultry worker (level 2)
- Countryside worker (level 2)
- General farm worker (level 2)
- Horticulture or landscape construction operative (level 2)
- Crop technician (level 3)
- Forest craftsperson (level 3)
- Livestock unit technician (level 3)
- Poultry technician (level 3)
- Arboriculturist (level 4)
- Assistant farm manager (level 4)
- Countryside ranger (level 4)
- Horticulture and landscaping technical manager (level 5)
- Agriculture or horticulture professional adviser (level 6)
- Environmental practitioner (Degree) (level 6)
- Professional arboriculturist (level 6)
- Professional forester (integrated degree) (level 6)

11.4.2 In addition, in Scotland they have the following Modern Apprenticeship frameworks available:

- Rural Skills (levels 5 and 6/7 – equivalent to level 2 and 3-5 in Northern Ireland respectively)
- Rural and Land Use Management at SCQF (Level 8 – equivalent to level 4/5 in Northern Ireland)

11.4.3 Sectoral Partnerships may wish to consider whether the development of an equivalent framework might be of benefit to the industry.

11.4.4 Skills Bootcamps, offered across England, are free, flexible courses of up to 16 weeks duration. At the end of the course, each participant is offered a job interview with an employer.

11.4.5 There are a two Skills Bootcamps relevant to this industry:

- Land Management and Arboriculture
- Arboriculture

11.4.6 Relevant qualifications provided by the agriculture specialist Harper Adams University in England include the following relevant undergraduate and postgraduate courses[156]:

- PgC/PgD MSc Data Science for Global Agriculture, Food and Environment
- BSc (Hons) Environmental Land Management
- Extended Degree Wildlife Conservation and Environmental Management
- BSc (Hons) Zoology with Environmental Management

[156] More information can be found on the Harper Adams University website (external link opens a new window).

12 Fisheries and marine environment

12.1 Introduction

12.1.1 In 2021, it was estimated that there were around 1,800 workers in the Northern Ireland fishing industry[157].

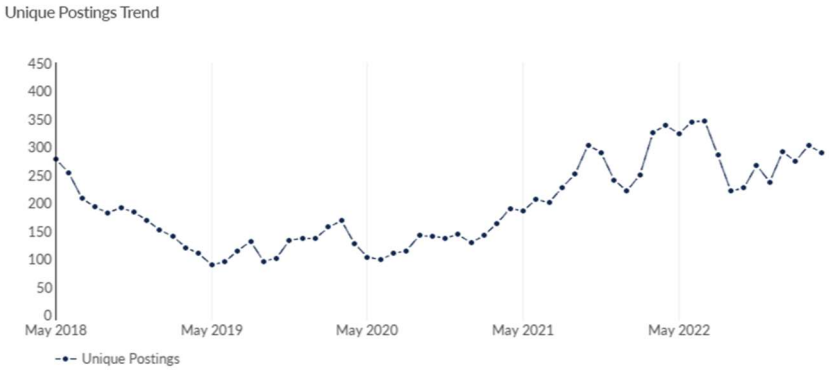
12.1.2 The latest national employment projections by Warwick Institute for Employment Research and Cambridge Econometrics[158], suggest that employment in the agriculture and fisheries industries combined are projected to remain stable through to 2035.

12.1.3 Industrial production of value-added fishery products can generate significant amounts of nutrient-rich discards and process effluents. These are rich sources of nutrients, industrially important ingredients and also bio-energy.

12.2 Skills demand – Current and future skills requirements

12.2.1 In the year ending February 2023, there were 800 online job postings relating to biomass across the UK[159] – just 25 of them were located within Northern Ireland.

Figure 43: Number of online job postings relating to fisheries and aquaculture (UK)



Source: Lightcast™, 2023.

[157] Northern Ireland Agri-Food Sector Key Statistics December 2022, Department for Agriculture, Environment and Rural Affairs.

[158] The Skills Imperative 2035: Occupational Outlook – Long-run employment prospects for the UK, National Foundation for Educational Research, 2022.

[159] These vacancies were identified using the Standard Industry Classification code of 03 (Fishing and Aquaculture) and excludes staffing/recruitment companies.

12.2.2 The most sought-after skills within these job postings were:

- Aquaculture
- Animal Husbandry
- Boat Handling
- Machinery
- Hydrology
- Biosecurity
- Data Analysis
- Land Tenure
- Biology

12.2.3 Decarbonising the fishing fleet will have a significant impact on the skills involved in the fishing fleet – moving away from diesel engines and deploying ammonia (solid oxide fuel cells), hydrogen and battery electric engines.

12.2.4 DAERA are currently working with industry to develop a plan for the transition to a net zero fishing fleet which will affect the skillsets of:

- Vessel manufacturers and engineers who will require the skills to manufacture and maintain vessels and equipment with new electric / hydrogen / alternative fuel / hybrid technology
- Skippers and crew members will require the skills to operate vessels with this technology and to trouble shoot when issues occur at sea

12.2.5 While it is too soon in the net zero transition to define what skills gaps are likely for fisheries, conversations must begin now to understand the range of gaps that will need to be filled across the various technologies and fleets.

12.2.6 Rapid changes in vessel design and infrastructure run the risk of creating skills deficits, such as a lack of specialised engineers.

12.2.7 Novel fuels will require a greater reliance on supporting engineering skills from onshore, and less ability for mechanical maintenance/servicing direct from crew (due to the higher potential risks associated with the alternative fuels currently in consideration).

12.2.8 A shortage of marine engineers and fishing vessel crew members is already being experienced in the industry.

12.2.9 Blue carbon sequestration is the process of capturing and storing carbon dioxide (CO_2) from the atmosphere in coastal and marine ecosystems. These ecosystems, such as tidal marshes, have a unique ability to sequester and store large amounts of carbon in their biomass and sediments.

12.2.10 The skills needed for blue carbon sequestration vary depending on the specific project or activity. However, in general the skills that are often required include:

- Scientific knowledge: An understanding of the science of carbon sequestration and coastal and marine ecosystems, including knowledge of the different types of blue carbon ecosystems, how they store carbon, and the factors that can affect their carbon sequestration rates
- Technical skills: Such as the ability to conduct surveys, collect data, and analyse results
- Communication skills: Blue carbon projects often involve working with a variety of stakeholders, including scientists, policymakers, and the public. Effective communication skills are essential for building relationships, sharing information, and gaining support for blue carbon projects.
- Problem-solving skills: Such projects often involve complex challenges, such as managing competing interests, dealing with uncertainty, and overcoming obstacles. Problem-solving skills are essential for developing and implementing effective solutions to these challenges.

12.2.11 In addition to these general skills, there are a number of specific skills that may be required for certain blue carbon projects. For example, projects that involve restoring or rehabilitating blue carbon ecosystems may require skills in wetland restoration, marine ecology, or environmental engineering. Projects that involve monitoring and assessing blue carbon stocks may require skills in remote sensing, GIS, or statistical analysis.

12.2.12 Crucial skills in the area of river/water management include:

- Environmental Impact Assessment
- Environmental Policy
- Environmental Scientist
- Geologist
- Hydrologist
- Surveying

12.2.13 Owners and operators of fishing boats in UK waters are asked to abide by – and contribute to – complex systems of assessment and management, but a lack of investment in fisheries education has left many without the tools they need to navigate modern fisheries science and management systems[160].

12.2.14 In determining and engaging with the market for these skillsets, it is important to include the wide range of stakeholders involved in the fisheries industry, such as:

- Consultants
- Department of Agriculture, Environment and Rural Affairs
- Local authorities
- The Department of Communications, Energy and Natural Resources in the Republic of Ireland
- The Fisheries Conservancy Board for Northern Ireland
- The Freshwater Biological Association
- The Loughs Agency
- The various Rivers Trusts
- Universities
- Water/wastewater companies

[160] More information can be found on the Fishing into the Future website (external link opens a new window).

12.3 Skills supply – Education and skills provision

12.3.1 There is little relevant currently provision on offer outside of that offered by specialist organisations such as NIFPRO Training Company and the Sea Fish Industry Training Association. There are currently no traineeships, higher level apprenticeships, or further education college provision – and only one relevant apprenticeship framework (in Environmental conservation).

12.3.2 However, provision to meet the new skills required to decarbonise the fishing fleet are yet to be made available as the technology is still being developed. This is a situation that will need careful monitoring in order to avoid future skills shortages.

Further education

Traineeships

12.3.3 The Traineeship programme is delivered by the six further education colleges and work-based learning being provided by local employers. They allow an individual to achieve a full Level 2 qualification over a two-year, full-time programme.

12.3.4 There are no Traineeships currently available that are relevant to the fisheries industry.

Apprenticeships

12.3.5 There is only one apprenticeship framework which is directly applicable to fisheries industry – Environmental conservation (level 3).

12.3.6 This framework is not available to people aged over 25 years.

Higher level apprenticeships (level 4+)

12.3.7 There are no higher level apprenticeships applicable to the industry.

Further education

12.3.8 No relevant provision is currently being delivered by the six further education colleges.

Skill Up programme

12.3.9 Through the Skill Up programme, there are a range of free short courses on offer from further and higher education providers across a wide range of subjects. However, none of them appear to relate directly to the fisheries industry.

12.3.10 These courses are an ideal way to enable people from outside of the industry (be they new entrants to the labour market or people transitioning from one industry to another) to upskill quickly.

Higher education

12.3.11 The two largest universities in Northern Ireland, Ulster University and Queen's University Belfast, offered a range of first degree courses in 2020/21. Overall, there were 260 starts on physical and environmental science courses (200 of whom were female), including:

- Biology/Ecology: 140 starts (80 were female)
- Chemistry: 65 starts (30 were female)
- Environmental sciences: 55 starts (25 were female)

12.3.12 The table below shows the number of STEM graduates from 2020/21 that entered employment in this industry.

Figure 44: Number of STEM graduates from Northern Ireland HE institutions that entered employment in the industry (2020/21)

Industry	Standard Industry Classification	Graduates in employment
Fisheries and marine environment	03 Fishing and aquaculture	0

Source: HESA Graduates Outcomes, 2020/21.

12.4 Learning from around the UK

12.4.1 In addition to the apprenticeship frameworks that are currently available in Northern Ireland, there are a number of English apprenticeship standards that may be relevant:

- Fisher (level 2)
- Maritime mechanical and electrical mechanic (level 2)
- Marina and boatyard operative (level 2)
- Port operative (level 2)
- Seafarer (deck rating) (level 2)
- Boatbuilder (level 3)
- Boatmaster (level 3)
- Jack-up barge master - non-propelled unit (level 3)
- Keeper and aquarist (level 3)
- Marine electrician (level 3)
- Marine engineer (level 3)
- Marine pilot (level 3)
- Port agent (level 3)
- Port marine operations officer (level 3)
- Ship's master less than 500 gross tonnage near coastal (level 3)
- Uncrewed marine vehicle specialist (level 3)
- Water environment worker (level 3)
- Workboat crewmember (level 3)
- Small vessel chief engineer (level 4)
- Environmental practitioner (Degree) (level 6)
- Harbour master (level 6)
- Marine surveyor (degree) (level 6)
- Naval architect (level 6)
- Marine technical superintendent (degree) (level 7)
- Ecologist (degree) (level 7)

12.4.2 Sectoral Partnerships may wish to consider whether the development of equivalent frameworks might be of benefit to the industry.

12.4.3 Focussing on supporting people in the fishing industry to engage with fisheries science, management and sustainable business practices, Fishing into the Future offers two courses:

- The Introduction to Sustainable Fishing programme offers an introduction in fisheries science and management
- The Business of Fishing programme develops the skills of all fishermen and professionals involved in quota-based fisheries

12.4.4 Furthermore, The Fishing Porthole offers further resources and support to the fishing industry, including bite-sized learning and other resources to give people working within the UK seafood industry the confidence, knowledge and connections to take an active role in fisheries management and data collection.

13 Data, digital and specialist IT skills

13.1 Introduction

13.1.1 A constant theme throughout the industries discussed in this report is the need for greater levels of skill and competency in the areas of data, digital and specialist IT skills. Although there is a clear need to upskill the existing workforce, a key focus for education and skills providers should be on creating a more flexible, multi-skilled and technologically-aware workforce[161].

13.1.2 As the energy industry in particular moves toward a more interconnected, decentralized system, it is becoming more challenging to maintain the safety and reliability of assets as many of the legacy technologies in use today were never designed to be integrated across data-sharing networks.

13.2 Skills demand – Current and future skills requirements

13.2.1 Demand for data scientists and data engineers has risen by over 231% across the UK in the past five years[162].

13.2.2 Looking forward, national employment projections suggest that employment levels in Computing services and Information services is expected to increase by 16% between 2020 and 2035[163].

13.2.3 Across the green industries and circular economy, employers are looking to improve communication links across the field workforce – making it simpler, safer, and smarter through the adoption of digital technologies.

13.2.4 Mobile Workforce Management (MWM) solutions give the field workforce real-time information about customers, assets, outages, hazards, and more, will enable them to make the best decisions. It also enables improved scheduling.

[161] UKCS Workforce Dynamics: The Skills Landscape 2019-2025, OPITIO/Robert Gordon University, 2019.

[162] Dynamics of Data Science Skills: How can all sectors benefit from data science talent? The Royal Society, 2019.

[163] The Skills Imperative 2035: Occupational Outlook – Long-run employment prospects for the UK, National Foundation for Educational Research, 2022.

13.2.5 There are likely to be two aspects to the upskilling requirement of MWM:

- Base IT skills – the ability to use mobile devices, email, IM, etc.
- Solution-specific skills – likely to be provided by the solution provider

13.2.6 While action on the first of these, base IT skills for the craft workforce, is beginning to take place, it is piecemeal and could potentially benefit from some consistency in terms of learning content within technical training provision. Action on the latter will largely depend on timing and the specifics of the technology/ solution being implemented.

13.2.7 There are a number of IT, software and cyber security occupations currently listed on the UK's Shortage Occupation List that the green industries could potentially benefit from if recruiting from overseas[164]:

- IT business analysts, architects and systems designers – all jobs
- Programmers and software development professionals – all jobs
- Web design and development professionals – all jobs
- Information technology and communications professionals not elsewhere classified – only cyber security specialist

13.2.8 Cyber security roles in the energy industry will benefit from a dual cyber security skillset, meaning they need to be proficient in both IT and operational technology (OT). Understanding communications technology and engineering equipment, as well as their interactions, is a niche skillset that not many individuals possess in the wider labour market and will be a key aspect of training and development of these people within the power industry.

[164] More information is available from the gov.uk website (external link opens a new window).

13.2.9 Related to this is DevOps, a form of agile software development that requires close collaboration between programmers, analysts and operations engineers. Instead of large OT projects where IT developers work in relative isolation, DevOps introduces a daily rhythm of small iterative changes to constantly upgrade, improve and fix applications – IT and OT work hand-in-hand.

13.2.10 This dual cyber security skillset will be increasingly vital in the energy industry as IT and OT continue to merge, suggesting that the future IT workforce will need to be trained in explicitly energy-related skills.

13.2.11 Similarly, IT professionals are increasingly being asked to interact with SCADA systems as digitisation and cloud connectivity are disrupting how SCADA systems interact and relate with critical IT infrastructure[165]

13.2.12 According to the World Economic Forum, the top emerging job roles in the energy and utilities industry are AI Specialist, Data Scientist and Data Engineer[166].

Figure 45: Top 10 emerging roles and skills in data and AI

Top 10 emerging roles within data & AI	Top 10 skills requested for data & AI roles[167]
Artificial Intelligence Specialist	Software Development Principles
Data Scientist	Scripting Languages
Data Engineer	Machine Learning
Big Data Developer	SQL Databases and Programming
Data Analyst	Data Science
Analytics Specialist	Project Management
Data Consultant*	Java
Insights Analyst*	Data Analysis
Business Intelligence Developer	Javascript and JQuery
Analytics Consultant	Database Administration

13.2.13 In the year ending 28th February 2023, there were 852,000 online job postings relating to data and digital occupations across the UK[168] – 11,000 of them were located within Northern Ireland.

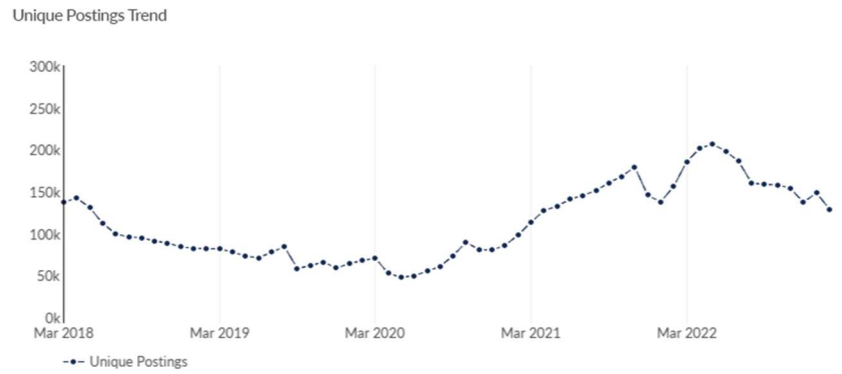
[165] More information is available from the Skills Lab website (external link opens a new window).

[166] The Future of Jobs Report, World Economic Forum, 2020.

[167] Understanding the UK AI Labour Market: 2020, Ipsos MORI, 2021.

[168] These vacancies were identified using the Standard Occupation Classification code of IT Specialist Managers (2133), IT Project and Programme Managers (2134), IT Business Analysts, Architects and Systems Designers (2135), Programmers and Software Development Professionals (2136), IT Operations Technicians (3131), IT User Support Technicians (3132) and IT Engineers (5245) and excludes staffing/recruitment companies.

Figure 46: Number of online job postings relating to data and digital occupations (UK)



Source: Lightcast™, 2023.

13.2.14 The table below shows the top ten job titles being recruited and most sought-after skills associated with each job title (listed in order of magnitude):

Figure 47: Most sought-after job titles and associated skills

Job title	Most sought-after skills
Data Engineers	Data Engineering Python SQL
Business Analysts	Business Analysis Agile Methodology Business Requirements
Software Engineers	Software Engineering Software Development C#
Data Analysts	Data Analysis SQL Power BI
DevOps Engineers	DevOps Amazon Web Services Linux
Solutions Architects	Solution Architecture Agile Methodology Microsoft Azure
Java Developers	Java Agile Methodology JavaScript
Data Scientists	Data Science Python Machine Learning
Software Developers	C# JavaScript SQL
Data Architects	Data Architecture Data Modelling Data Warehousing

13.3 Skills supply – Education and skills provision

13.3.1 By utilising existing education and qualification provision, obtaining the necessary core skills could be relatively straightforwardly – however, as these skills are also demanded across much of the economy, attracting and retaining them in the green industries and circular economy could prove to be challenging.

Further education

Traineeships

13.3.2 The Traineeship programme is delivered by the six further education colleges and work-based learning being provided by local employers. They allow an individual to achieve a full Level 2 qualification over a two-year, full-time programme.

13.3.3 There are currently no Traineeships relevant to the data, digital and IT skillsets.

Apprenticeships

13.3.4 There are a number of apprenticeship frameworks which are directly applicable to large-scale energy generation, including:

- IT and telecoms professional (level 2 – also available for people aged 25+)
- IT user - level 2 apprenticeship framework
- Information Technology (level 3 – also available for people aged 25+)
- IT user (level 3)

Higher level apprenticeships (level 4+)

13.3.5 There are also a wide range of higher level apprenticeships available relating to various digital and IT activities:

- Cloud computing, analytics and security for industry- Foundation degree in cloud computing, analytics and security
- Cloud computing technologies- Foundation degree in cloud computing technologies
- Computing- Foundation degree (FdSc) in computing
- Computing systems - BSc (Hons) computing systems
- Cyber security & digital forensics- Foundation degree in cyber security & digital forensics
- Cyber Security & networking (top up)- BSc cyber security and networking
- Cyber security and networking infrastructure - Foundation degree in cyber security and networking infrastructure
- Level 6 Computing for Industry (top up) - BSc (Hons) degree in computing for industry (top-up)
- Software cloud and application development - Foundation degree in cloud and application development
- Software and cloud application development (top up)- BSc Software & cloud application development
- Software development - FdSc software development
- Software engineering with digital technology partnership - BEng Software engineering with digital technology partnership

13.3.6 There are no apprenticeship frameworks, at any level, which relate specifically to the analysis or handling of data, which is increasingly being sought across the green industries and circular economy.

Further education colleges

13.3.7 All six further education colleges offer some form of data, digital and IT course.

Skill Up programme

13.3.8 Through the Skill Up programme, there are more than 70 different free short courses are on offer from further and higher education providers across a wide range of subjects, including subject areas such as:

- Artificial intelligence
- Machine learning
- Cyber security
- Computer science
- Data analytics
- Data science
- Digital marketing
- Various programming languages

13.3.9 These courses are an ideal way to enable people from outside of the industry (be they new entrants to the labour market or people transitioning from one industry to another) to upskill quickly.

Higher education

13.3.10 With 50% of data scientists in the energy industry having a master's level degree or higher, higher education provision is crucial to the development of data teams in the energy industry[169].

13.3.11 The two largest universities in Northern Ireland, Ulster University and Queen's University Belfast, offered a range of first degree courses in 2020/21. Overall, there were 1,140 starts on data, digital and IT courses (260 of whom were female), including:

- Computer science: 665 starts (135 were female)
- Information technology: 80 starts (25 were female)
- Information systems: 105 starts (25 were female)
- Software engineering: 205 starts (40 were female)
- Artificial intelligence: 10 starts (5 were female)
- Business computing: 75 starts (30 were female)

[169] Data Science Skills in the Energy Sector: Survey Results, Energy Systems Catapult, March 2023.

13.4 Learning from around the UK

13.4.1 In addition to the apprenticeship frameworks that are currently available in Northern Ireland, there are a number of English apprenticeship standards that may be relevant:

- Cyber security technician (level 3)
- Data Technician (level 3)
- Digital support technician (level 3)
- Software development technician (level 3)
- Applications support lead (level 4)
- Business analyst (level 4)
- Cyber security technologist (level 4)
- Data analyst (level 4)
- DevOps engineer (level 4)
- Digital forensic technician (level 4)
- Digital Product Manager (level 4) (in development)
- Software developer (level 4)
- Data engineer (level 5) (in development)
- Cyber security technical professional (integrated degree) (level 6)
- Data scientist (integrated degree) (level 6)
- Digital and technology solutions professional (integrated degree) (level 6)
- Digital user experience (UX) professional (integrated degree) (level 6)
- Artificial intelligence (AI) data specialist (level 7)
- Digital and technology solutions specialist (integrated degree) (level 7)
- Spatial data specialist (level 7) (proposal in development)

13.4.2 In addition, in Scotland they have a Modern Apprenticeship in Data Analytics Technical Apprenticeship at SCQF (level 8 – equivalent to level 4/5 in Northern Ireland).

13.4.3 Sectoral Partnerships may wish to consider whether the development of an equivalent framework might be of benefit to the industry.

13.4.4 The Office for National Statistics (ONS) is leading the way in developing a degree level apprenticeship in data science on behalf of the public and private industries. The course is one of a number of new offerings at the new Data Science Campus.[170]

[170] More information is available from the Data Science Campus' website (external link opens a new window).

13.4.5 The National Cyber Security Centre (NCSC) provides certified training schemes[171], ensuring high quality content and delivery via a variety of study options (classroom, online, self-paced e-learning, in-house, online virtual classroom). They certify three levels of skills training:

- Awareness level — giving newcomers a thorough foundation in cyber security
- Application level — in-depth courses for professional development
- Courseware — to be used in conjunction with a certified trainer and quality management system

13.4.6 There are a wide range of Skills Bootcamps available across England in relation to data and digital skills, including:

Skills Bootcamp Title	
Agile Project Management	Data science
AI for Environmental Sustainability	DevOps
Analysing Data	Digital Marketing
Applied Cyber Security	Environmental Data Analytics
Artificial intelligence	Environmental Data Science
Cloud Computing	Front-End Web Development
Coding	Infrastructure Technician
Computer Science	Network Engineer
Cyber Security	Software Developer
Data analysis	Software Engineer
Data Literacy	

[171] More information is available from the National Cyber Security Centre's website (external link opens a new window).

14 Recommendations

Based on the findings of this research, the following recommendations are made:

14.1 Engage with young people to make them aware of the available learning and career pathways

Short-term (i.e. during 2023)

14.1.1 It is worth noting that the labour market entrants of 2030 will be starting in Year 8 in September 2023.

Figure 48: Age of current school students and their likely entry into the labour market

School Year	Age in 2023/24 academic year	Year entering the workforce
Year 14	17-18	2024
Year 13	16-17	2025
Year 12	15-16	2026
Year 11	14-15	2027
Year 10	13-14	2028
Year 9	12-13	2029
Year 8	11-12	2030

14.1.2 Clear learning and career pathways for critical roles within each of the green industries should be developed that articulate the learning, qualification and experience requirements from entry level through to level 8.

14.1.3 Working with the Careers Occupational Information Unit, there is an urgent need to produce careers education advice, information and guidance (CEAIG) materials that highlight the career opportunities available in each of the eight industries included in this report.

14.1.4 Similarly, a review of materials supplied to and used by the Careers Services should also be undertaken. A crucial element of this work will be to revamp the employee value proposition with a focus on the values and ambitions of the industries.

14.1.5 Consider how best to develop and deliver short learning/ information events for careers teachers/professionals.

14.1.6 It is understood that a Careers and Skills Portal for Northern Ireland is currently being planned, so consideration should be given to how it can best support the green industries and circular economy. There are similar websites in Scotland (completed) and Wales (still under development, although intelligence relating to the energy industry is already present):

- Future Jobs Wales (for more information, see the Future Jobs Wales website (external link opens in a new window)
- My World of Work (for more information, see the My World of Work website (external link opens in a new window)

14.1.7 Ways of creating closer industry and school links should be investigated, promoted and actively supported, such as:

- Enterprise Adviser Network (information about becoming an Enterprise Advisor is available on The Careers & Enterprise Company's website (external link opens in a new window)
- Founders4Schools (for more information, see the Founders4Schools website (external link opens in a new window)
- STEM Ambassadors (information about becoming a STEM Ambassador is available on the STEM Learning website (external link opens a new window)
- Work experience placements pupils
- Engage and support the Pupil Support Services
- Providing practice interviews for students

Medium-term (during 2024 & 2025)

14.1.8 Course content at Key Stage 3 should be reviewed in the context of the green industries and circular economy to ensure that they engender interest in the current and future careers.

Long-term (out to 2030)

14.1.9 DfE and other stakeholders should consider how to maintain, update and publish the latest developments in skills and workforce requirements of the green industries and circular economy. For example, this may include a refresh of this research (circa every two years), or one or more annually produced reports based on third party data.

Feedback from stakeholder event

14.1.10 On 28th April 2023, more than 90 industry stakeholders and employers met in-person and online in Belfast for the Launch of Green Energy Skills Research and Workshop. The main discussion points coming out of that event were:

- The need to articulate opportunities, via a multi-facetted (i.e. not just schools), regional approach, from primary to 18 – and it needs to be inspirational!
- Articulate potential career/learning/earning journeys
- Need to reaching out/engage young people outside of the school/education system
- More work experience, project-based activities and "sector weeks" (along the lines of Apprenticeship week)

14.1.11 In order to assess whether progress is being made in combatting the challenges highlighted in this research, a number of measures are proposed:

- Number of students engaged/funded/sponsored
- Number (and diversity) of students progressing onto green further and higher education provision
- Number of website visits and enquiries to the Careers and Skills Portal for Northern Ireland

14.1.12 These may require new measurement systems and cross-organisation data collection/shared to be introduced.

14.2 Ensure opportunities for all by widening access to learning and careers opportunities

14.2.1 A common theme throughout this research has been the need for additional people to enter the green workforce over the coming years – untapping the latent skills in the population and ensuring a just transition for all.

14.2.2 It was widely commented upon throughout the interviews for this research that the development of solutions needs to be industry-led, rather than being constrained within current policy and funding boundaries.

Short-term (i.e. during 2023)

14.2.3 Over the course of 2023, work should commence on identifying innovative and practical ways of improving the supply of people into the green industries for the following:

- Disadvantaged and deprived communities – Consider what additional support may be required in order to open up opportunities for those in deprived areas and/or with low educational attainment (for example, pre-employment or pre-apprenticeship support programmes)

- Economically inactive – Reducing the barriers for economically inactive people to enter/re-enter the labour market, particularly those:
  - With physical or learning disabilities
  - With caring responsibilities
  - Who are retired
- Females – (particularly in technical, engineering and managerial roles)[172]
- Long-term unemployed
- Refugees – Consider ways of reaching out and engaging with the refugee population to identify and utilise their skills
- Youth unemployed

14.2.4 Options should be investigated as to how to incentivise/promote participation from these groups on provision at all levels – from Skill Up programmes and traineeships, through to apprenticeships, further education and higher education.

14.2.5 This incentivisation/promote should focus on the green industries/circular economy as included in this report.

- An example of this might include the sponsoring under-graduates on relevant STEM/IT/data courses, augmented with work and summer placements

14.2.6 Such incentives/sponsorship may be linked to agreeing to work in Northern Ireland for a certain number of years (e.g. five) following graduation.

14.2.7 Ways of promoting the opportunities available in the Northern Ireland green industries and circular economy to Northern Irish HE students in Ireland and Great Britain should be investigated – with the potential incentivisation to return to apply their newly-acquired skills in their home nation.

[172] For example: Building on/supporting the work of Women in STEM Northern Ireland. More information about The Trades Fit Expo: Young Women in Trades and Tech can be found on the Victoria Government's website (external link opens a new window).

14.2.8 In conjunction with industry employers, education and skills providers and other relevant agencies, a review should be undertaken to identify “quick wins” in terms of conversion training from other industries into specific areas in the green industries and circular economy. This should include a review of the available provision on the Skill Up and Assured Skills programmes to ensure they offer relevant provision/opportunities for the green industries and circular economy.

- There are approximately 45,000 people working in occupations in other industries of the economy that could, potentially, transfer their skills into the green industries

14.2.9 Consideration should be given to how a more proactive approach could be taken to support the upskilling/reskilling of people who are at risk of losing their current job or any employed in declining industries/occupations.

14.2.10 DfE and other stakeholders should review the mechanisms by which they communicate the support available to businesses and individuals to ensure the right information is imparted to the right audience in the most appropriate manner.

Medium-term (during 2024 & 2025)

14.2.11 More work needs to be done to understand and address why so few STEM graduates enter employment in the green industries. In 2020/21, of the 5,100 graduates with a pass from a First Degree course from an HE institution in Northern Ireland, 3,800 entered employment or self-employment – but just 115 of these did so in the green industries covered by this research.

Figure 49: Number of graduates entering employment in the green industries

Industry	Standard Industry Classification	Graduates in employment
Large-scale energy production	35.11 Production of electricity	10
Infrastructure	35.12 Transmission of electricity 35.13 Distribution of electricity 35.14 Trade of electricity 35.22 Distribution of gaseous fuels through mains 35.23 Trade of gas through mains 36.00 Water collection, treatment and supply 37.00 Sewerage 42.2 Construction of utility projects 42.9 Construction of other civil engineering projects	40
Domestic low carbon technologies and energy efficiency	43.2 Electrical, plumbing and other construction installation activities 43.3 Building completion and finishing 43.9 Other specialised construction activities	15
Industrial processes	20.1 Manufacture of basic chemicals, fertilisers and nitrogen compounds, plastics and synthetic rubber in primary forms 20.2 Manufacture of pesticides and other agrochemical products 35.21 Manufacture of gas	<5
Circular economy	38 Waste collection, treatment and disposal activities; materials recovery 39 Remediation activities and other waste management services	10

Industry	Standard Industry Classification	Graduates in employment
Transport	29.1 Manufacture of motor vehicles 49 Land transport and transport via pipelines 52 Warehousing and support activities for transportation	25
Agriculture	01 Crop and animal production, hunting and related service activities 02 Forestry and logging 81.3 Landscape service activities	10
Fisheries and marine environment	03 Fishing and aquaculture	0
Total number of graduates entering employment in the green industries		**115**

Source: Northern Ireland Business Register and Employment Survey, 2021 and Agricultural Workforce in the United Kingdom at 1 June.

Long-term (out to 2030)

14.2.12 Employers and stakeholders should consider how more can be done to create social value as a means of raising awareness of the various green industries and the role that they play in a sustainable, vibrant economy.

Feedback from stakeholder event

14.2.13 On 28th April 2023, more than 90 industry stakeholders and employers met in-person and online in Belfast for the Launch of Green Energy Skills Research and Workshop. The main discussion points coming out of that event were:

- Keep the focus on equality, diversity and inclusivity (including neurodiversity)
- Promote more flexibility in working practices
- Promote the opportunities to Northern Irish people (including students) in Ireland and GB

14.2.14 In order to assess whether progress is being made in combatting the challenges highlighted in this research, a number of measures are proposed:

- Total headcount and levels of diversity in the workforce
- Number of students engaged/funded/sponsored

14.3 Ensuring effective pathways to competency

14.3.1 One of the major challenges in developing new pathways to competency (for example, apprenticeships) is that it can take a number of years to (i) develop the qualification and (ii) for learners to become competent through it.

14.3.2 As the pace of technological change in the industry accelerates, it will be important to consider alternative routes to competence other than formal qualification structures, such as an Apprenticeship programme, in terms of meeting specific skills needs in the near-term. Therefore, innovative, more flexible pathways may need to be investigated.

14.3.3 It was widely commented upon throughout the interviews for this research that the development of solutions needs to be industry-led, rather than being constrained within current policy and funding boundaries.

14.3.4 Effective pathways to competency are need at all levels of the workforce – from entry level (level 2) through to higher skills levels; while the largest volume of skills demands will be at level 3-4.

14.3.5 Apprentices in the electrotechnical industry are seen as vital for its future, with employers seeing them as a way to overcome the ageing workforce and to create succession plans where needed[173].

14.3.6 However, there are challenges to be over-come in this area if demand from employers is to increase. For example, retaining apprentices once they complete their learning programme can be a major issue for smaller companies and those lower down the supply chain. The risk of having their newly-completed apprentices "poached" by other organisations who are willing to pay a higher salary (but not invest in the actual training programme) means that, for many, it is a risk not worth taking.

14.3.7 Also, the transactional nature of contractor supply chain means that visibility of future work is low; this results in a lack of investment in long-term training programmes such as Apprenticeships.

Short-term (i.e. during 2023)

14.3.8 In conjunction with the Sectoral Partnerships, review both the range and content of relevant apprenticeship frameworks to ensure that they meet the current and future requirements of the green industries and circular economy.

- This point also applies to further and higher education provision

[173] Labour Market Intelligence Research, NET/ECA/The Electrotechnical JIB/TESP/Select/Unite, March 2019.

14.3.9 The content of relevant existing apprenticeship frameworks that are used by employers in the green industries and circular economy should be reviewed to ensure that their data, digital and IT requirements are fully recognised.

- This point also applies to further and higher education provision

Medium-term (during 2024 & 2025)

14.3.10 Information provided from the six further education colleges lists more than 80 courses associated with the green industries. However, the majority of these appear to be awareness/introductory courses, rather than skills-based courses that aim to produce technically competent people in that subject area.

14.3.11 Therefore, colleges should review the extent to which their provision is able to extend into the delivery of technical skills leading to technically competent people.

14.3.12 This might be achieved through the establishment of a green industry/circular economy further education hub amongst the further education colleges.

14.3.13 There are currently no standalone geoscience degrees available at either undergraduate or postgraduate level in Northern Ireland, while the number of post-primary schools offering either A Level or GCSE courses is limited to one school only. Students that do go on to study geoscience at degree level have to travel outside of Northern Ireland to either GB or Ireland.

14.3.14 The development of an applied environmental geoscience undergraduate degree would be essential to address the identified skills gap in this area.

14.3.15 DfE should seriously consider what arrangements are put in place once funding for the current Skill Up programme ends in March 2024. It is likely that such initiatives will be crucial to the reskill and upskilling of workers looking to enter the green industries and circular economy over the coming years.

14.3.16 Sectoral Partnerships should consider implementing a scheme for apprentice “sharing” within and across related industries (see Thames Water’s shared apprenticeship as an example[174]). This would allow apprentices to gain an understanding of the whole value chain they’re working in and how their decisions and actions have a wider impact on the value chain.

[174] More information about Thames Water’s shared apprenticeship programme can be found on the Thames Water website (new link opens an external window).

14.3.17 Consider whether it might be appropriate to widen the remit of Sectoral Partnerships to encompass a “watching brief” over all provision related to their industry, including initiatives such as Skill Up and Assured Skills Academies, through to further education and higher education.

14.3.18 Consider introducing cohorts of apprenticeships for specific cohorts of under-represented groups (e.g. females on technical frameworks)

14.3.19 Government should consult with industry as to how Apprenticeship Levy flexibilities could be achieved to ensure that employers are able to maximise the impact of the available funds.

14.3.20 Part of this discussion could include the expansion of apprenticeships to people of all ages, thereby encouraging their use a tool to upskill the existing workforce as well as people moving into the new green/ circular economy industries from other industries.

14.3.21 In order to improve the capacity and capabilities of the trainer/lecturer workforce, consider how closer engagement between employers and education and skills providers can be encouraged and supported (e.g. facilitate “guest lecturers” from industry).

14.3.22 Working with relevant industry stakeholders across the different green industries, consider how their regulatory/compliance skills and knowledge requirements can be best supporting and kept up-to-date.

Long-term (out to 2030)

14.3.23 Employers are calling for greater flexibility in skills systems, so that training can be more modular, with shorter programmes enabling upskilling and reskilling, and that duplication of training in common role elements is avoided.

14.3.24 A Technical Skills Visa or Passporting system, aligned with current competency registration schemes, could support this. This is important because if the recruitment of young people into green job roles is a material challenge, then schemes which support older people to extend or transfer roles become more valuable.

14.3.25 Possibilities for “micro-credentials” need to be explored further. Micro-credentials are short, credit-bearing courses that support higher education. Micro-credentials would not normally constitute an award in their own right, but they have standalone value and could also contribute to a recognised qualification. They potentially widen access to learners who might not have considered a more academic route to achieving a qualification.

14.3.26 Regularly review the range and content of apprenticeship, further and higher education provision to ensure they continue to meet industry requirements.

14.3.27 Education and skills providers should be encouraged to review their current provision, and provide future provision, in ways that acknowledge and support different learning styles and methods, including innovations such as micro-learning, mobile learning, immersive technologies (e.g. virtual and augmented reality), and gamification.

14.3.28 Monitor the development of new technologies and how they are being deployed and impacting upon the green workforce – and seek to develop new or updated provision as appropriate in a timely manner.

Feedback from stakeholder event

14.3.29 On 28th April 2023, more than 90 industry stakeholders and employers met in-person and online in Belfast for the Launch of Green Energy Skills Research and Workshop. The main discussion points coming out of that event were:

- Need a strategic plan that covers secondary schools through to higher education
- Increase number and scope of apprenticeships
- Implement a cyclical review of all pathways, both individually and as an holistic all industry/all age approach – who owns this?

14.3.30 In order to assess whether progress is being made in combatting the challenges highlighted in this research, a number of measures are proposed:

- Qualification/course take-up and success rates
- Progression of course leavers/qualifiers - % employed in green industries/circular economy
- Satisfaction levels of students
- Proportion of businesses in the green industries and circular economy that report skills shortages and skills gaps
- Gross Value Added by the industries
- % of Apprenticeship Levy that is unspent

14.4 Ensuring Northern Ireland plays its role the development of UK solutions

14.4.1 Government stakeholders and industry representative organisations should consider how collaboration with their counterparts in Scotland and Wales might provide economies of scale when seeking to address common issues, and how this collaboration might be enacted.

14.4.2 Relevant employers and stakeholders should ensure that the Green Jobs Delivery Group is made aware of new skills needs relating to the transition to a zero-carbon, resource efficient economy, and that its work recognises the differences in Northern Ireland's skills system, particularly as it relates to available funding, are identified and minimised and delivers a localised focus on skills investment.

14.4.3 The Green Jobs Delivery Group is cognisant of the more flexible approach to skills provision developed through programmes such as Skill Up, Assured Skills and Skills Focus. Continued close employer involvement will be the key to developing this type of provision to meet emerging employer skills needs in a timely, effective and efficient manner.

14.4.4 Ensure that all appropriate accreditations/certifications from Great Britain, Europe and globally are built into the Northern Ireland system to ensure ready transfer of skills.

14.5 Industry-specific recommendations

In addition to the overall recommendations listed above, there are a number of industry-specific actions that government, stakeholders and employers should consider implementing:

Large-scale energy production

Short-term (i.e. during 2023)

14.5.1 In the GB offshore wind industry at present, much of the equipment manufacturing takes places overseas. In order to capitalise on the potential employment opportunities throughout the value chain, Northern Ireland stakeholders should review how best to support and incentivise the offshore wind industry to maximise local content in the manufacturing and installation of offshore assets.

14.5.2 In order to combat the general lack of awareness about the opportunity that offshore wind presents for stable and well-paid careers, awareness campaigns should be considered in order to attract new skilled workers and influence the thoughts of those still in school – particularly in the coastal communities local to projects and ports, including those smaller ones that will host storage facilities.

Medium-term (during 2024 & 2025)

14.5.3 Government should develop a longer-term pipeline of projects (beyond the current 2030 ambition) which can instil confidence in the market and provide certainty in terms of investment in learning and training, and career decisions.

Long-term (out to 2030)

14.5.4 In future iterations of this research, the workforce and skills requirements of commercial-scale battery storage technologies should also be included. This technology will become increasingly important to the energy system as a means of ironing out the peaks and troughs of intermittent renewable energy technologies.

Infrastructure

Short-term (i.e. during 2023)

14.5.5 Consideration should be given to whether specific provision should be developed specifically to cater for the skills needed to design, build, operate and maintain heat networks. This applies to colleges and universities in Northern Ireland.

14.5.6 Colleges to review content of their provision to make sure it covers awareness and understanding of heat networks.

Medium-term (during 2024 & 2025)

14.5.7 Building on the Combined Utilities Programme Pilot, businesses in the electricity, gas, water and heat network industries should seek out further opportunities to collaborate more closely on identifying and addressing their common skills issues across network infrastructure.

14.5.8 Consider the value of a specific conversion programme to bring craft trades from the fibre/telecoms workforce into/back into the power workforce.

14.5.9 Engage with all parties in the heat networks industry to establish the requirement for nationally accredited training standards – in conjunction with partners in Great Britain.

Domestic low carbon technologies and energy efficiency

Short-term (i.e. during 2023)

14.5.10 Sectoral Partnerships should investigate whether a similar framework to the Low Carbon Heating Technician standard[175] in England might be appropriate.

14.5.11 Consider what approaches could be taken to incentivise accreditation to Trustmark and MCS standards.

Medium-term (during 2024 & 2025)

14.5.12 Consider the development of an A Level qualification to support entry into construction professions.

Long-term (out to 2030)

14.5.13 In future iterations of this research, the workforce and skills requirements of domestic battery storage technologies should also be included. This technology will increasingly be coupled with a range of domestic low carbon technologies as part of a whole-system approach to decarbonising home heating.

Industrial processes

Short-term (i.e. during 2023)

14.5.14 Although the majority of skills development will be centred around upgrading of existing skills, it is expected that specific upskilling will be required for the installation, commissioning, servicing and operation of electrolysers.

14.5.15 Consider how government policies can support the concept of industrial clustering around industrial processes. This could help support the development of attractive career pathways, including offering a more comprehensive early learning pathway (e.g. shared apprenticeships) as well as clearer career progression across the value chain.

Medium-term (during 2024 & 2025)

14.5.16 Review, with industry, the extent to which conversion courses are needed to support the decarbonisation of industrial processes.

14.5.17 Monitor developments in the carbon capture, usage and storage industry to ensure that evolving skills demands are fully understood and that provision is fit for purpose.

[175] Further information is available on the Institute for Apprenticeships & Technical Education's website (external link opens in a new window).

Long-term (out to 2030)

14.5.18 The already acute shortage of technical skills to meet current demand in other industries will be exacerbated as industrial decarbonisation programmes accelerate. This is likely to require a significant increase in the number of FE students in Engineering and Manufacturing Technologies and Construction, Planning and the Built Environment.

Circular economy

Short-term (i.e. during 2023)

14.5.19 The circular economy is more than end of life waste management and recycling, it requires whole lifecycle and systems thinking across the value chain. Therefore, consideration needs to be given as to how this can be incorporated into school and tertiary curricula, so the circular economy becomes synonymous with the Northern Irish economy.

Medium-term (during 2024 & 2025)

14.5.20 Establish clear learning and career pathways that can be used to promote the industry.

Long-term (out to 2030)

14.5.21 Monitor the scale of developments in the various aspects of the circular economy to ensure that evolving skills demands are fully understood and that provision is fit for purpose.

Transport

Short-term (i.e. during 2023)

14.5.22 Review the content of the level 2 and 3 Vehicle maintenance and repair apprenticeship frameworks to ensure it contains sufficient content relating to electric and hydrogen fuel cell vehicles.

Medium-term (during 2024 & 2025)

14.5.23 Monitor the scale of developments in the fuel cell vehicle market to ensure that evolving skills demands are fully understood and that provision is fit for purpose.

Agriculture

Short-term (i.e. during 2023)

14.5.24 Consult with industry and schools regarding what activities could be put in place/expanded upon to engender a positive lived experience and connection with the agriculture and land-based industries for young people in school (e.g. through work experience, visits, etc.).

Medium-term (during 2024 & 2025)

14.5.25 Implement the findings of the industry/schools review of potential activities.

14.5.26 Review all core agricultural learning provision to ensure that it is "future-proof" in terms of incorporating new skills/understanding such as utilising new technologies, analysing and using data, environmental science, environmental protection, etc.

Long-term (out to 2030)

14.5.27 Monitor the scale of developments in the agri-tech market to ensure that evolving skills demands are fully understood and that provision is fit for purpose.

Fisheries and marine environment

Short-term (i.e. during 2023)

14.5.28 There is little relevant provision currently on offer outside of that offered by specialist organisations such as NIFPRO Training Company and the Sea Fish Industry Training Association.

14.5.29 There are currently no traineeships, higher level apprenticeships, or further education college provision – and only one relevant apprenticeship framework (in Environmental conservation).

14.5.30 Sectoral Partnerships, industry stakeholders and employers need to consider whether additional provision/entry routes may be needed to attract and train the workforce needed across all aspects of the fisheries and marine environment industries.

Medium-term (during 2024 & 2025)

14.5.31 Monitor the development of technologies aimed at decarbonising the fishing fleet – particularly in terms of running and repairing alternative fuel engines – and seek to develop new upskilling/conversion provision in a timely manner.

Data, digital and specialist IT skills

Short-term (i.e. during 2023)

14.5.32 Consider what can be done to promote the green industries and circular economy as attractive career options for those currently studying data, digital and IT skills at all levels of education.

Medium-term (during 2024 & 2025)

14.5.33 Increasing/incentivising participation in IT/software/computing-related provision, at all levels, should be a priority due to their increasing demand across all industries.

14.5.34 Investigate the potential demand for modular upskilling courses relating to:

- Industry context for data, digital and IT specialists
- Data, digital and IT upskilling for the existing workforce

14.6 The Green Energy Skills Industry Reference Group (GESIRG)

14.6.1 The GESIRG should now take the findings of this research and its recommendations and use them to develop an achievable and measurable action plan, with clear ownership and responsibility for delivery.

Annex 1 – List of contributing organisations

Energy & Utility Skills would like to thank the following organisations for their contributions to this research:

- All-Ireland Sustainability Network
- Belfast Harbour
- Belfast Metropolitan College
- CITB NI
- Department for Communities
- Department for the Economy
- Department of Agriculture, Environment and Rural Affairs
- Economic & Social Research Institute
- Electricityworx
- Energystore
- Firmus Energy
- Fisheries Innovation & Sustainability
- Geo Drilling Solutions
- Geological Survey of Northern Ireland
- Geoscience Ireland
- Gilbert-Ash
- Health and Safety Executive Northern Ireland
- Hydrogen Training Academy
- Invest Northern Ireland
- Mutual Energy
- North Channel Wind
- Northern Ireland Electricity Networks
- Northern Ireland Housing Executive
- Northern Ireland Water
- Northern Regional College
- Phoenix Natural Gas
- RenewableNI
- Samson Training
- Severn Trent
- Severn Trent Green Power
- South West College
- Strategic Investment Board Northern Ireland
- System Operator for Northern Ireland
- The Chartered Institution of Wastes Management
- Translink
- Triterra
- TrustMark
- WSP