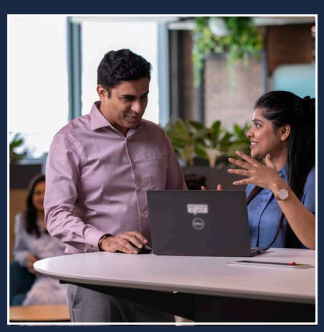
ABERDEEN CITY COUNCIL

bp

An integrated energy partnership

Hydrogen in Scotland

Skills and qualifications gap analysis



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Foreword

The UK is entering an exciting era, with low carbon hydrogen set to play a major role in delivering net zero[1, 2].

Energy sector growth, across the value chain, could play an important role in social and economic development[3] whilst delivering on our collective climate ambitions.

Investment in hydrogen consumption and production capacity in-line with UK and Scottish Government targets, could help create thousands of jobs, drive regional growth, and strengthen UK supply chain capability. The UK-wide hydrogen economy could be worth £900million and deliver over 9,000 high-quality jobs by 2030 - potentially rising to 100,000 jobs and be worth up to £13billion by 2050[4].

However, meeting these aims requires overcoming some significant emerging challenges. A shortage of skilled and experienced workers – through retirement, attrition and challenges in attracting talent to the sector – could prevent the UK from achieving its targets. This challenge could be exacerbated as demand growth in adjacent industries, such as offshore wind, could pull on similar skillsets, further reducing the size of the available talent pool.

There is, therefore, a strong case to support building a suitably qualified and experienced workforce. Anticipated market developments also pose an opportunity to support social mobility by providing opportunities for all and help deliver a just transition.

The Aberdeen Hydrogen Hub joint venture is committed to creating wider social and economic value for Aberdeen and the surrounding region, through supporting the hydrogen supply chain and developing hydrogen skills.

This report is a first step in playing a strategic leadership role in hydrogen skills development. It helps to define what skills are needed, assess the current skills landscape, and makes recommendations around suitable future skills provision.

Together with Aberdeen City Council and bp, we are working with governments and the wider sector, including industry partners, skills bodies, and training providers to help build a skill base capable of meeting the needs of this exciting low carbon hydrogen sector.

Dr Oliver Taylor
Chief Executive Officer bp Aberdeen Hydrogen Energy Ltd.

[1] Department for Energy Security and Net Zero and Department for Business, Energy & Industrial Strategy, 2021, UK Hydrogen Strategy
[2] Scottish Government, 2022, Draft Hydrogen Action Plan
[3] Scottish Hydrogen Assessment Project, 2020
[4] Department for Energy Security and Net Zero and Department for Business, Energy & Industrial Strategy, 2021, UK Hydrogen Strategy

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Both Scottish and UK government's energy policies place substantial focus on the hydrogen economy. Indeed, Scotland's ambitions include achieving 5GW of installed low carbon hydrogen production by 2030, and 25GW by 2045. To support the growth of the low carbon hydrogen sector, Scotland has designated 11 regional hydrogen hubs and over 60 projects have been identified. This includes the Aberdeen Hydrogen Hub (AHH) a Joint Venture (JV) between bp and Aberdeen City Council[5].

The scale of the hydrogen ambition, value proposition and consequent demands on talent pools is significant.

Investing in skills is therefore critical not only to deliver the hydrogen opportunity but also to help to contribute towards a just transition for North East Scotland. A developed workforce could create global competitive advantage for Scotland, with potential to access £25billion in Gross Value Added (GVA) and over 300,000 local jobs[6]. There is strong potential to transfer talent from oil and gas into renewables[7]. Many technical skills like engineering, project management, and data analysis could be directly transferrable while skills in safety, risk management, and regulatory compliance are essential for both industries. However, the demand for growth in adjacent sectors is a constraining factor and nurturing new sector-specific capabilities in digital, business and market development, and advocacy/regulatory model development is vital to help capture integrated value. Further downstream, the evolution of skills will be required, such as for inspection and maintenance of hydrogen fuel cells and to develop next generation hydrogen vehicles.

Access to a sufficient number of skilled people is likely to be a major challenge. Skills transferability could play a vital role in meeting the challenge, subject to the ability to release talent from oil and gas, and adjacent sectors such as in power, while recognising a significant proportion of the oil and gas workforce is approaching retirement[8]. Work is, however, underway and Scotland has a vibrant and developed skills ecosystem. Many organisations are building an increasingly detailed view of what the hydrogen sector needs and are developing standards and courses to meet the rising demand.

This report identifies five themes for the skills ecosystem to help meet demand:

1. Ensure interventions are truly data-led and respond to real demand for skills
2. Continue to invest in community and Science, Technology, Engineering and Mathematics (STEM) engagement to inspire people into the sector
3. Invest in new pathways that will upskill and reskill people for the hydrogen sector
4. Underscore inclusivity in the design of programmes and their outreach efforts
5. Harness the existing delivery landscape to create truly integrated responses

The Aberdeen Hydrogen Hub seeks to play a strategic leadership role in advancing hydrogen skills development and the contribution of this report is intended to help unify sector leaders, create a strong case for change, and inform more coordinated skilling efforts.

With Aberdeen Hydrogen Hub requiring relatively small volumes of direct skillsets for its initial phase, this work is about helping to build the foundation for industry growth in the longer-term, being a catalyst for change and providing a powerful learning opportunity.

Getting the skills piece right will help advance a just transition where everyone wins. It will support the transition to hydrogen production, ensure downstream organisations can use hydrogen, and those in the community are positioned to participate and benefit.

5 Scottish Government, 2022, Draft Hydrogen Action Plan
6 Scottish Hydrogen Assessment Project, 2020
7 According to Robert Gordon University, 2021, UK Offshore Energy Workforce Transferability Review, over 90% of the UK's oil and gas workforce have medium to high skills transferability and are well positioned to work in adjacent energy sectors.
8 Robert Gordon University, 2021, UK Offshore Energy Workforce Transferability Review

Executive summary

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Background: The role of Aberdeen in the hydrogen economy, and of bp Aberdeen Hydrogen Energy Limited

For decades, the Aberdeen City Region has been recognised as an energy leader and is now playing a pivotal role in the global energy transition[9]. The region has a unique position in the global energy supply chain, an extraordinary portfolio of low and zero-carbon assets and capabilities, and various large-scale infrastructure projects in the pipeline, supporting the drive to net zero.

Aberdeen is one of Europe's pioneering hydrogen cities. For more than ten years, Aberdeen City Council has been working to establish the city as a centre of excellence for hydrogen and fuel cell technologies and create a successful hydrogen economy in the region.

The council's H2 Aberdeen initiative aims to grow a hydrogen economy in the Aberdeen City Region, stimulating innovative hydrogen projects and the use of hydrogen technologies.

The Aberdeen Hydrogen Hub

In June 2020, the Hydrogen Hub concept was adopted into the City Council's Energy Transition and Strategic Infrastructure plans as part of a net zero vision. The vision for the hub aligns with the UK Government's hydrogen strategy which sets out the approach to develop a thriving low carbon hydrogen sector in the UK with an ambition to generate 5GW of renewable and low carbon hydrogen by 2030. It also aligns with the Scottish Government's Hydrogen Policy Statement and Draft Hydrogen Action Plan, both of which aspire for Scotland to become a leading nation in the production of reliable, competitive, sustainable hydrogen.

In March 2022, Aberdeen City Council and bp formed a joint venture – bp Aberdeen Hydrogen Energy Limited to deliver a scalable green hydrogen production, storage and distribution infrastructure in the city powered by renewable energy[10].

The Aberdeen Hydrogen Hub project is central to the H2 Aberdeen vision to expand the supply and demand for hydrogen in support of the city's net zero vision. It aims to harness the natural resources, skills and capacity in the North East of Scotland to create jobs in an exciting new energy sector that builds on our oil and gas heritage.

Phase one of the project is targeting first production from the end of 2024, delivering over 800kg of green hydrogen per day – enough to fuel 25 buses and a similar number of other fleet vehicles.

Future phases could see production scaled up through further investment to supply larger volumes of green hydrogen for rail, freight and marine, as well as supply of hydrogen for heat and potentially export.

This scaling could include connection to wind power in the future. bp has been successful in its Crown Estate Scotland INTOG (Innovation and Targeted Oil and Gas) bid to develop its innovation demonstrator floating offshore wind project. This project, which will help to grow bp's experience in floating offshore wind, has the potential, in the future, for energy from it to be integrated into the Aberdeen Hydrogen Hub.

It is envisaged that the Aberdeen Hydrogen Hub will be developed in three phases. This phasing reflects a response to growing demands for hydrogen:

- **Phase 1:** initial production for public and public sector consumption, including the provision of a resilient, cost-effective supply of hydrogen on a commercial basis to the market to support both existing and proposed transport projects.
- **Phase 2:** expansion, in the short to medium term, to supply larger volume of hydrogen for use by trucks, rail and marine.
- **Phase 3:** hydrogen for heat and export.

The approach taken by the Aberdeen Hydrogen Hub seeks to catalyse the growing use of hydrogen and decrease the levelised cost of production. Aggregating hydrogen demand across fleets, increasing production and supply of green hydrogen by connecting to large scale renewable generators, and coordinating supply chain and training could lower the price of hydrogen and catalyse use by road transport and other sectors seeking to decarbonise (heat, industry, maritime, rail etc.)[11].

Getting this right has potential to unlock significant economic value and be a driver for a just transition in the city. This could create significant economic opportunities as part of an energy transition in the city region, unlocking new economic opportunities worth upwards of £700million GVA to Scotland's economy by 2030, as well as thousands of high-value jobs in Aberdeen and the surrounding region[11]. Ensuring this growth is distributed in an equitable manner, that ultimately brings opportunities to those who have not benefited as strongly from previous waves of growth in Aberdeen, is a key driver for the hub.

9 Aberdeen City Council, 2020, A climate-positive city at the heart of the global energy transition: A Vision & Prospectus for Aberdeen

10 Aberdeen City Council, 2022, bp approved to deliver the Aberdeen Hydrogen Hub

11 Element Energy (2019) report commissioned by Aberdeen City Council in partnership with Opportunity North East (ONE) and Scottish Enterprise (SE)

4 **Case for change:** investing in skills for the hydrogen economy – an opportunity, a challenge, and an imperative

4.1 The opportunity: investing in job creation for Scotland and Aberdeen

The UK is entering a new era with hydrogen development which will require rapid expansion to support the UK Government's Hydrogen Strategy[12]. The race is on to capture the hydrogen opportunity in the UK as both UK and Scottish government policy seeks to enable significant economic growth and support energy resilience . The Scottish Hydrogen Policy Statement was published in December 2020. Within it, the Scottish Government confirmed its strong support for a strategic approach to the development of the hydrogen economy in Scotland and set a clear ambition of 5GW installed hydrogen production capacity by 2030 and 25GW by 2045[13].

This could be worth £25billion in annual gross contribution to GVA with over 300,000 jobs supported by 2045. This reflects the most ambitious scenario, based on the economic impact scenarios developed as part of the Scottish Hydrogen Assessment Project[14], that assume Scotland establishes itself as an exporter of green hydrogen to the EU.

There is, therefore, a strong case to build a suitably qualified and experienced workforce to support the sector and the journey towards net zero, providing an opportunity to accelerate social mobility, advance a just transition and build back better.

4.2 The challenge: the risk of skills availability

The challenges of building the UK's skills base are significant and there will be substantial challenges to overcome to meet future workforce projections. One of the most pressing issues is the prevalence of skill shortages, particularly in industries that require specialised technical knowledge or advanced training.

Skills shortages are a result of several factors, including for example, skilled workers retiring, changing technological demands, rate of growth of demand for hydrogen/renewable roles, economic shifts and a lack of training and education. These shortages can make it difficult to find qualified candidates for jobs and can limit the growth and competitiveness of businesses in key sectors.

The lack of skilled workers can lead to increased costs, reduced productivity, and lower overall economic growth.

The biggest skills challenge is the loss of skilled and experienced workers as they retire, and a lack of corresponding entrants to fill those gaps even to service known job roles[15]. Expertise currently lies in the oil and gas industry rather than hydrogen. The challenge of the sector will be to adapt through upskilling and/or attract new skilled workers to meet the changing workforce profile. The hydrogen sector will also need to compete against other emerging growth sectors such as offshore wind.

4.3 The imperative: underpinning Scotland's competitiveness, and a just transition

Investing in Scotland's workforce could help demonstrate the potential for a just transition through hydrogen, where everyone wins. It makes business sense – underpinning Scotland's competitiveness and the success of projects – and is the right thing to do for communities. Scotland will be competing to grow its hydrogen economy against a range of highly industrialised economies across Europe; investing in the workforce could help underpin Scotland's competitiveness. In the context of tight labour markets, giving investors and offtakers the confidence that a skilled workforce is in place to deliver projects on-time, in-budget, and that services can be secured, is one of many factors that helps position Scotland to win in the hydrogen economy.

Focused investment in workforce development is critical to maximising the benefits and to ensuring a contribution towards a just transition for North East Scotland. Operators across the value chain and their supply chain partners need readily deployable talent, and additional investment to support this. Effort is likely needed to ensure that those furthest from the labour market are upskilled and positioned to benefit from the hydrogen economy and its growth. This process provides an opportunity to build a more diverse workforce, but doing so will require focus from all parties concerned in skills, design and delivery.

12 Business, Energy & Industrial Strategy, 2021, UK Hydrogen Strategy
13 Scottish Government, 2020, Scottish Government Hydrogen Policy Statement
14 Scottish Government, 2020, Scottish hydrogen: assessment report
15 IDRIC, 2022, Hydrogen Skills Gap Study Landscape Review Executive Summary

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The role of this report and the need for a hydrogen skills and qualifications gap analysis for Scotland

A coordinated response is needed to ensure Scotland has sufficient skills availability to underpin its hydrogen growth ambition, and to advance a just transition. Clear understanding of demand, skills needed by the value chain, and existing skills supply must be matched with current and planned education initiatives and qualifications. All players must come together in an orderly way – hence the need for a coordinated response.

Part of what the Aberdeen Hydrogen Hub seeks to do is to play a strategic leadership role in the skills space; this report reflects a contribution to the debate, with the intent of supporting a more coordinated approach to hydrogen skilling. This early-stage skills gap analysis work – with an emphasis on understanding existing research, the existing skills landscape, and the skills demand that the Aberdeen Hydrogen Hub will produce – seeks to help uncover potential gaps and make suggestions around suitable future skills provision and meaningful interventions.

This work will also help inform what the Aberdeen Hydrogen Hub does next to support wider economic benefit from the project. The Aberdeen Hydrogen Hub joint venture has made several commitments across community benefits, the supply chain and training and skills, working in partnership with government and the wider sector including industry partners, skills bodies, and training providers to help build a skills base capable of meeting hydrogen demands.

This work sets out to provide a 'point of view' and inform a synthesis of existing research and stakeholder discussions. Its objectives include:

- **Synthesising existing knowledge around hydrogen skills** to understand what is needed to create a workforce able to construct and operate the Aberdeen Hydrogen Hub
- **Raising further awareness on skills and capabilities that require** developing in the hydrogen sector supply chain and providing insights into the skills required to enable the growth of the hydrogen industry in Scotland
- **Providing insights to inform the co-development of skills programmes** building on the existing services and activities of relevant public and private partners and stakeholders, commercial training and accreditation centres through existing regulatory bodies, regulators and certifying bodies, local higher and further education providers, and research institutes.

The role of this report

6

Demand: skills needed for hydrogen

Building a successful hydrogen economy requires a skilled workforce with the knowledge and expertise to design, build, operate, and maintain hydrogen-related systems and facilities.

Initial mapping of skills requirements informed conversations with stakeholders around where they see pinch points. This collective understanding is crucial for the development of a successful hydrogen economy, as it helps identify the steps that can be taken to address any skills gaps to subsequently build a skilled workforce to support the industry's growth.

6.1 Scale of the demand

Industry potential

This report did not set out to produce estimates for skills demand, but our research indicates that both the scale of skills required across the industry will be a challenge to meet along with developing the specific skills required. In the most ambitious scenario set out in the Scotland Hydrogen Assessment Project, establishing Scotland as an exporter of green hydrogen to Europe has the potential to be worth up to £25billion a year to the Scottish economy, with more than 300,000 jobs created by 2045[16].

As this report goes on to explore in the section on 'supply', many of these skills are generic and not specific to hydrogen and are often in high demand in other sectors. For example, many of the construction skillsets that hydrogen will require underpin a range of other low carbon infrastructure projects, as well as wider construction projects (including social infrastructure such as schools, hospitals, etc.).

Skills demand for bp Aberdeen Hydrogen Energy Limited (bpAHEL)

The direct footprint of bpAHEL and its project team, as well as the supply chain associated with the project, will be relatively small, particularly for initial phases. Ultimately the level of skills investment a project of this scale would ordinarily make is relatively minimal.

However, bpAHEL is looking to support the wider skills ecosystem for two reasons:

1. Investing in the long-term potential of bpAHEL – the plans for future phases of the bpAHEL will require an increased number of skills to support the project as it grows.

2. Helping to grow customer demand – although the bpAHEL project team's skills footprint may be small, in both construction and eventual operations, overlooking the importance of downstream operations and maintenance could undermine the project's success (and ability to scale) in the long run, if the requisite skills are not in place to support growing demand at the downstream end of the industry.

3. bp and Aberdeen City Council are both committed to catalysing a thriving energy sector in Scotland and supporting transition to net zero.

[16] Scottish Hydrogen Assessment Project, 2020

6.2 Overview of hydrogen skills (value chain lens)

This report takes a broad view of hydrogen skills requirements, considering the end-to-end value chain and not just the production-related activities the Aberdeen Hydrogen Hub undertakes.

This is because the success of the hydrogen industry relies on an integrated value chain, and for that value chain to function, the skills needed at each node must be available. A summary of example skills in this end-to-end value chain context is illustrated below:

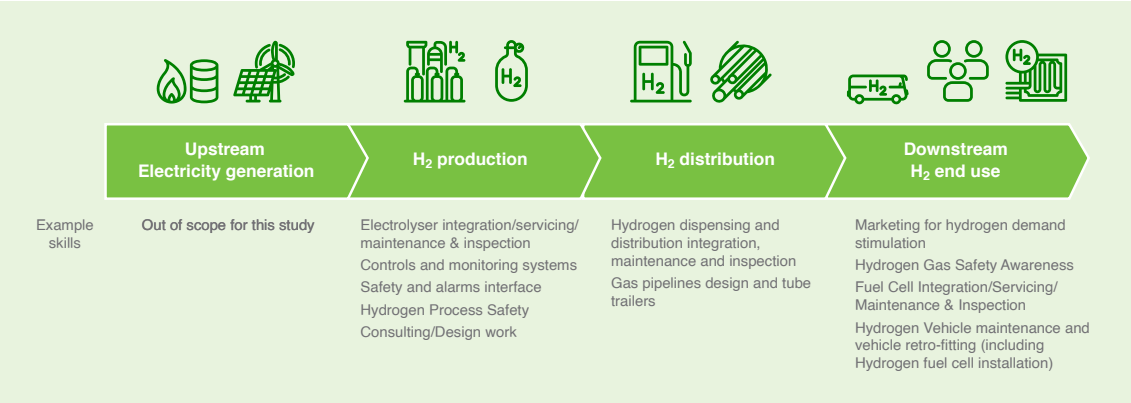

Figure 1: diagram to highlight a set of example skills needed across the hydrogen value chain from electricity generation to H2 end use (illustrative)

Upstream skills

At the hydrogen production point of the value chain, many of the skillsets required are typical of what it takes to design, build and operate large-scale energy infrastructure. This includes skills in areas such as project management, engineering, and operations – although with specific nuances in those job families based on hydrogen production processes (e.g., approaches to process safety that are fit for the properties of hydrogen as a substance).

Downstream skills

The distribution and end-use aspects of the value chain are critical – as demand cannot scale without customers being positioned to use hydrogen. Some end-use skills will be temporary and transitional, for example, the need for a growth in vehicle retrofitting skills, until new hydrogen vehicles overtake retrofitting activities. Other skills are more enduring, such as operationally focused, essential skills for vehicle technicians (integration, servicing, maintenance, and inspection), or health and safety awareness in the context of hydrogen gas. The advancement in these skills will be key to customer confidence in switching to hydrogen fuels, therefore increasing potential demand, as well as being operationally essential.

6.3 Critical skills areas (distinctive capabilities)

There are six capabilities that bp Aberdeen Hydrogen Energy Limited believes are critical to the development of the hydrogen industry and, through bp's own capability planning work, we have a view on evolutions required. These are not an exhaustive set of capabilities, but rather those that could be most critical to success.

Many of these skillsets recognise that unlocking the hydrogen opportunity requires an integrated approach. This includes linking production with potential offtakers, supporting offtakers through digitisation at the downstream end of the value chain, and the evolution of regulatory and commercial models that reflect the integrated nature of the hydrogen industry.

Specific and critical skills areas, which the hydrogen ecosystem should be catering for, can be seen below:

Skill area	Top skills	Description
Business and market development	Commercial and business development, competitor industry and customer focus, deal structuring, value chain management	Business and market development skills are critical to early stage hydrogen development due to lower margins for new and low energy, higher levelised cost of hydrogen, the growth of special purpose funding vehicles and the need to establish both markets and customer streams.
Projects	Leadership and end-to-end project management	Project management skills are critical in the delivery of hydrogen projects, ranging from early-stage appraisal/screening of opportunities, project controls, early commissioning, and full end-to-end project management.
Engineering	Mechanical, electrical, process and process safety	There is significant opportunity to drive down the levelised cost of hydrogen within and across value chains while driving up the potential value from engineering integration. This is front of mind in the engineering community at sub-discipline level. The question will be how to best deploy limited skills to the most valuable projects. For green hydrogen there are integration challenges (e.g. from offshore to hydrogen) and also the complication of grid connection. Upstream engineering in terms of the manufacturing of electrolysers /compressors and additionally the manufacturing of vehicles.
Health, Safety, Security and Environment (HSSE)	Risk assessment, HSSE data analytics and insights, regulatory analysis and compliance management	Additional skills for HSSE come from flammable or toxic impacts from blue and green hydrogen (hydrogen, ammonia, carbon dioxide) having a comparable Blue C+ severity potential with resilient hydrocarbons.
Advocacy	Advocacy, stakeholder engagement, analytical thinking, legal and regulatory environment and compliance	Developing policy in a highly technical complex field, managing complex internal and external relationships with multiple stakeholders, alongside periods of intensity and pressure. Analysis of policy and regulatory frameworks for hydrogen projects to support the development of advocacy policies has adjacent skills to those found in communications and advocacy, legal and government affairs.
Digital	All digital disciplines	There is a two-fold demand for digital skills: 1) deep technical skills to enable a 'digital first' approach to projects, and 2) those required by all disciplines to capitalise on technology advances and integration of new low carbon energy solutions across value chains. Technical skills span across most of the digital disciplines; with data and analytics, digital design and engineering, and digital science being critical and scarce. A 'digital first' development will require a mindset and behavioural shift for capital projects, that have traditionally focused on building assets and then integrating digital and technology processes. The industry advancement in simulation technology, remote monitoring and operations, and cyber security also requires investment in skills to support a lower cost base for hydrogen.

7

Supply: availability of skills for hydrogen industry growth

Having examined the skills required to grow the hydrogen industry, this section will look at how readily available some of those skills are. This is viewed across three lenses, which will be explored in turn:

1. **Potential transferability** – the extent to which literature suggests wider talent could be redeployed from other sectors and upskilled/reskilled.
2. **Wider factors impacting skills availability** – e.g., demographic trends in the region as related to the existing energy workforce.
3. **Industry perceptions** – and the extent to which those in the hydrogen sector are concerned about specific skillsets.

7.1 Insights on potential skills transferability into hydrogen

In the wider energy sector, there is significant optimism around the potential to transfer talent from oil and gas into renewables, creating potential supply. For example, around 100,000 (c. 50%) of the jobs required in the UK offshore energy industry in 2030 are projected to be filled by people transferring from existing oil and gas jobs to offshore renewable roles[17].

According to Robert Gordon University (RGU), over 90% of the UK's oil and gas workforce have medium to high skills transferability and are well positioned to work in adjacent energy sectors[18]. Two out of three people in the regional offshore energy workforce are currently involved with operating activities with the remainder focused on wider activities. By the end of this decade – and reflecting potential investment in new capabilities – this is expected to shift to a 50/50 split between operating and capital activities, with an increased demand for vocational skills and skilled trades[19, 20].

There are several skills that can be transferred from existing job roles (including from the oil and gas industry) to the low carbon, hydrogen, and renewable technologies sector with confidence[21]. For instance, many technical skills like engineering, project management, and data analysis are transferrable. Additionally, skills in safety, risk management, and regulatory compliance are also essential for both industries. Soft skills like communication, leadership, and problem-solving are critical in both fields. However, there may be some differences in the technology and the specific expertise required for each industry, and workers may need to undergo additional training to adapt to new practices and procedures. Research indicates that many hydrogen-sector skills can be absorbed into existing job roles with minimal reskilling[22].

Competition for talent with other renewable energy projects could be a challenge to delivering hydrogen sector growth. Those with skills and experience are now in demand across new and evolving value chains, creating situations where packages move beyond traditional reward packages.

There are several overlaps in the skills needed for hydrogen and offshore wind energy. Some examples include:

1. Engineering: both hydrogen production and offshore wind energy rely heavily on engineering principles and technologies. Engineers with experience in areas such as mechanical and electrical engineering may be well-suited for working in the hydrogen and offshore wind industries.

2. Project management: both hydrogen production and offshore wind energy involve large-scale projects that require effective project management skills to plan, organise, and execute.

3. Safety: safety is a key consideration in both hydrogen production and offshore wind energy, and professionals with experience in safety management may be well-suited for working in these industries.

4. Environmental regulations and permitting: both hydrogen production and offshore wind energy are heavily regulated and require compliance with various environmental regulations and permits. Professionals with experience in this area may be well-suited for working in these industries.

5. Technical skills such as welding, electrical installation, and maintenance, are also essential in both hydrogen and offshore wind energy.

6. Familiarity with computer-aided design (CAD) software and simulation tools may be useful for both the hydrogen and offshore wind energy industry.

7. Knowledge of grid integration and power system operations is also required for both hydrogen and offshore wind energy.

It is important to recognise that transferability may occur relatively gradually. There remains significant life in the North Sea oil and gas basin and the ability to meet the skills needed for the hydrogen sector may, for some time, additionally demand skills.

This creates a challenge in terms of meeting both oil and gas skills demand, the need for hydrogen skills and the requirements of the wider renewables sector - at a time of relatively low unemployment, and significant growth in skills demand to meet the UK and Scotland's net zero commitments.

7.2 Skills availability in the wider energy workforce, and other dynamics affecting skills supply

Several other factors impact potential supply of talent into the sector, driving both increases and decreases. These include:

- Losing skilled workers in the North Sea as they retire – which further exacerbates talent shortages, including opportunities around how to better harness experienced workers and provide opportunities to keep them engaged in the workforce.
- Shifting perceptions of the energy industry, and of particular technologies – for example, the potential to attract young people into the renewables sector given the opportunity to solve the challenges for reaching net zero, while attracting talent into oil and gas may become more challenging, despite continued demand for skills.
- Cross-regional linkages between talent markets – for example, anecdotally we have already seen some talent, that has been working in the Aberdeen area, returning home as opportunities in other parts of the country (e.g. the Teesside industrial cluster) open up closer to their home.
- Cross-sectoral linkages – for example, lack of workforce mobilisation data being shared between projects at a cross-sector level which creates competition for talent in labour markets.
- Ability to transfer skills – there is a lack of recognised accreditations/frameworks across industry to ensure efficient transferability of people from one industry to another. Without a standard set of competencies, that are recognised and valued across different sectors, employability and mobility of individuals are decreased. Accreditation frameworks help employers to easily identify and verify the skills and knowledge of job applicants, making the hiring process more efficient and effective.
- Competition for the same skills is intense - more companies are chasing a small pool of skilled and experienced people. This is exacerbated with new entrants into the energy industry (beyond renewables) and impacts regional supply, diversity and social mobility.

17 Robert Gordon University, 2021, UK Offshore Energy Workforce Transferability Review
18 Robert Gordon University, 2021, UK Offshore Energy Workforce Transferability Review
19 Robert Gordon University, 2022, Making the Switch
20 Both RGU reports capture both the offshore workforce and those working onshore supporting offshore operations. As such the reports capture blue hydrogen activities and carbon processing, transport and storage. They are yet to include green hydrogen, midstream and/or downstream hydrogen activities.
21 PWC, 2022, Developing Australia's Final hydrogen workforce
22 PWC, 2022, Developing Australia's Final hydrogen workforce

7.3 Industry perceptions on skills supply

As part of the stakeholder interviews, we focused on capabilities by project phase – as they relate to both upstream and downstream sectors. Interviewees were asked which hydrogen sector skills they were most concerned about based on current availability of people in those roles. The findings from this exercise are shown on the capability map below. This further reinforces the gaps in the availability of some of the distinctive capabilities required for the sector as set out in the previous section.

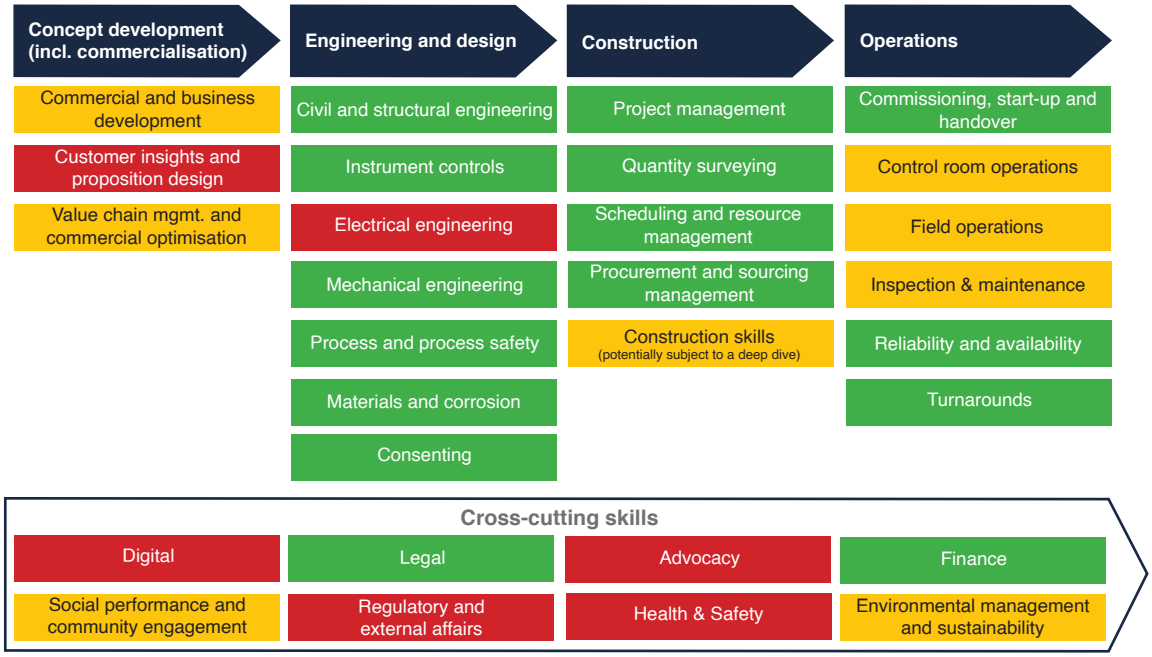

Figure 2: Heat map of skills in the hydrogen sector based on industry concerns around availability (red = high concern, amber = medium concern, green = low concern)

Stakeholders elaborated on several of these challenges, from input electricity generation through to downstream use:

- **Specific to green hydrogen** - intermittent renewables – steady power flow needed for electrolyser (Innovate UK are looking at power conversion and aggregating inputs).
- **Upstream manufacturing** – in terms of electrolysers/compressors but additionally the manufacturing of vehicles.
- **Electrical engineering** – critical across renewables, and for input supply of green energy to support the production of hydrogen.
- **Wider construction sector skills** – including common construction skills like welding, which will be in demand from multiple infrastructure projects and may need some specialist skills specific to the type of project they are working on.
- **Evolving technician skillsets** – with common skills potentially enabling technicians to transfer into and between industries, but specific domain understanding of hydrogen is also required.
- **Health, safety and environment** – given the high hazard nature of hydrogen and the need to manage health and safety as standards evolve in the hydrogen industry.
- **Digital** – applying digitisation across the hydrogen value chain, from optimising operations through to refuelling optimisation and an enhanced customer experience for fleets.
- **Downstream vehicle industry skills** – including production of new hydrogen vehicles (and associated skills in that industry), retrofitting (albeit likely for a limited time until production of new hydrogen vehicles exceeds retrofitted vehicles).

8

Provision: current landscape of qualifications and hydrogen skills interventions in Scotland

In responding to many of these skills challenges and opportunities, Scotland has a structured ecosystem involved in the provision of skills interventions. Each of these is briefly examined in turn in this section, namely through:

- **Government bodies** – both fully governmental and quasi-governmental, that shape the overall ecosystem
- **Learning delivery organisations** – of varying levels that provide learning that does, or could, relate to the hydrogen sector
- **Skills bodies** – that play a collaborative role in representing the sector and its needs

Working with organisations in this ecosystem, to influence the provision of skills for the hydrogen sector, is crucial to effect change at the scale and pace required to achieve the Scottish Government's hydrogen ambitions. As the previous sections highlighted, a challenge in both scale and type of skills in demand for hydrogen and scarcity of skills supply mean a concerted effort is needed to build skills for the future to underpin the growth of the sector.

8.1 Leadership and governance of the skills agenda in Scotland

Scotland has a skills-based approach to education and training, which focuses on developing the skills and knowledge needed for employment and civic participation. The government has implemented policies and initiatives to support this approach, such as:

- The "Developing the Young Workforce" programme, which aims to improve the employment prospects of young people by providing them with the skills and experience needed to succeed in the workforce.
- Invested in apprenticeships and vocational education to provide individuals with the hands-on training and qualifications needed for specific industries.
- The Scottish Funding Council provides funding for colleges and universities to support the delivery of vocational education and training.

Skills Development Scotland (SDS) is the national skills agency of Scotland, tasked with supporting individuals, businesses, and the wider economy to develop the skills needed to succeed. The organisation provides career advice, guidance, and funding to support individuals in their training and development, as well as working with employers to create tailored workforce development programs. SDS also works to promote the value of skills and training across Scotland and helps to shape the country's skills strategy, ensuring that skills development meets the needs of individuals and the economy.

8.2 Learning delivery – including through universities, technical and vocational education and training (TVETs) institutions

Scotland's university sector has a strong heritage of developing skillsets that support oil and gas and have already started to pivot to support the growth of renewables. The universities in Scotland play a leading role in renewables research (including on the skills landscape in renewables), and in delivering undergraduate, masters and PhD level courses that are relevant to the sector.

Technical and vocational education and training (TVET) institutions (both publicly and privately funded) will be key to meeting the demand for applied skillsets.

TVET in Scotland refers to a range of learning opportunities that are designed to provide learners with the practical skills and knowledge needed to succeed in the world of work. The system in Scotland is focused on providing learners with a range of qualifications and apprenticeships that are tailored to meet the needs of various industries. TVET programs cover a range of fields, including engineering, construction, healthcare, and hospitality, among others. Through partnerships with industry and employers, TVET in Scotland aims to provide learners with the skills they need to succeed in their chosen career and contribute to the country's economic growth.

8.3 Skills organisations

A number of skills organisations, collaborative initiatives and academic partners in Scotland are playing a key role in identifying the skills and competencies needed to support the growth of a hydrogen economy. They are working with industry to identify the skills needed to develop training and education programmes that equip the workforce with the skills needed to work with hydrogen technology safely and efficiently.

For hydrogen-related skills, organisations of note include:

- **Offshore Petroleum Industry Training Organisation (OPITO)** is playing a role in developing competency standards for the emerging hydrogen sector, including identifying the skills needed to support the safe and efficient production, storage, and distribution of hydrogen. As part of the North Sea Transition Deal's (NSTD) integrated 'people and skills' strategy, OPITO is leading the development of a Digital Skills Passport to reduce the duplication of certification requirements for workers transitioning from the oil and gas sector to new roles in low-carbon industries like hydrogen. Alongside the passport, the industry intends to create an aligned training and standards framework across oil and gas, offshore wind, hydrogen and carbon capture, utilisation and storage (CCUS), making it easier to build cross-industry careers.

- **The Energy Skills Alliance (ESA)** is made up of representatives from across the UK energy sector, Scottish and UK governments and agencies, regulators and trade unions. It is aligned with the ambitions of the Climate Emergency Skills Action Plan (CESAP). Working to deliver a skills strategy for a net zero energy industry, the work programmes of the ESA are contributing to the North Sea Transition Deal's People and Skills Plan. Additionally, work is already underway to align the NSTD with the Scottish Offshore Wind Energy Council (SOWEC) Skills Group.

- **The National Energy Skills Accelerator (NESA)** is a collaborative initiative between Robert Gordon University, the University of Aberdeen and North East Scotland College and is supported by key regional partners, including Skills Development Scotland and Energy Transition Zone Ltd (ETZ). Acting as a collaborative umbrella organisation, the NESA will provide a 'one stop shop' for industry to access a wide range of energy courses, skills development programmes and R&D capabilities in the partner institutions.

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Bridging the gap: insights and recommendations

There is a strong case to build a suitably qualified and experienced workforce to support Scotland's hydrogen sector and its journey towards net zero. There is a need to invest in expanding the supply of talent into the sector to meet growing demand and, while doing this, there is an opportunity to invest in talent in a way that supports a just transition where everyone wins.

This requires a truly cross-sectoral approach. Scottish and UK governments, businesses, training institutions, and learners themselves all have a role to play in investing in the development of the current and future workforce.

Five themes surfaced in discussions and analysis and should galvanise those working on the hydrogen skills ecosystem. These can be seen in the table below:

Theme	Description
1. Ensure interventions are truly data-led and respond to real demand for skills, informed by the wealth of existing work on hydrogen skills mapping	Ensuring that learning delivery produces talent that can competently operate in the hydrogen sector is ultimately in the best interests of the learner. That applies to both volumes of talent produced in specific areas, and the specific curricula in those areas being designed to meet employer needs. Organisations like NESA, the Hydrogen Skills Partnership, and others are already actively mapping requirements. Ensuring all parties truly understand this and design with this in mind must be the starting point for all skills interventions. In doing this, attempt to work across the energy sector and beyond, taking a cross-sectoral lens where possible. Ultimately multiple sectors are competing for the same talent, so a siloed approach risks underestimating what is truly needed.
2. Continue to invest in engagement, whether through STEM in the classroom or wider community engagement, to inspire people to take up hydrogen opportunities	With the scale of growing demand for the energy sector, and competition for other sectors, we will have to pull almost every lever to bring people into the sector (from new entrants and upskilling those already in the sector to reskilling experienced talent). This will only succeed if people understand the opportunities available to them and how the hydrogen sector works. Education must be at the heart of this - in schools, to illustrate how core STEM skills can be applied to opportunities in hydrogen, and in the wider energy sector, and with communities demonstrating that hydrogen can bring real opportunities. This is key to improving the diversity of the sector and ensuring that those who might not previously have benefited from growth in the region are able to access future hydrogen opportunities.
3. Invest in new pathways that will upskill and reskill people for the hydrogen sector	Work is already underway to invest in new certifications – from vocational training through to degree level modules – that will be relevant to the hydrogen sector. We need to think differently around how to deliver this and reach scale – for example, explore whether there are opportunities to develop apprenticeship courses or programmes that could serve multiple parts of the hydrogen value chain to better attract new talent into the sector (while enabling them to specialise as required for their specific roles). Take modular approaches, where possible, that can help unlock the value of existing skills by providing 'top-up' learning that can quickly plug the gaps in moving from other sectors into hydrogen within the same skill or discipline area.
4. Underscore inclusivity in the design of programmes and their outreach efforts – and set stretch ambitions to improve the diversity of the sector	Change brings opportunity – we are presented with significant opportunity to advance diversity and inclusion ambitions while delivering the skills development required to fill emerging gaps. We need to encourage those delivering skills initiatives to set stretch ambitions that encourage participation from diverse and/or excluded groups as much as practically possible. At the same time, it is important to recognise that reaching those furthest from the labour market is typically a higher cost, and that work might be met more through foundational education work or through government programmes and funding.
5. Harness the existing delivery landscape to create truly integrated responses to skills development, maximising pace and minimising duplication	Scotland has well-established mechanisms for coordinating the efforts of various stakeholders working on skills. With efforts to meet the needs of the hydrogen sector rapidly ballooning, this infrastructure can play a critical role. Inclusive of supply chains, consider creating a 'one-stop-shop' to understand what is going on across the sector to help those working on hydrogen skills challenges connect and, where possible, bring in external learnings from other countries to enhance delivery.

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Annex 1: literature reviewed

Published literature

- Aberdeen City Council, 2020, *A climate-positive city at the heart of the global energy transition: A Vision & Prospectus for Aberdeen*
- Aberdeen City Council, 2023, *bp approved to deliver the Aberdeen Hydrogen Hub*
- Business, Energy & Industrial Strategy, 2021, *UK Hydrogen Strategy*
- Department for Energy Security and Net Zero and Department for Business, Energy & Industrial Strategy, 2021, UK Hydrogen Strategy
- Element Energy (2019) report commissioned by Aberdeen City Council in partnership with Opportunity North East (ONE) and Scottish Enterprise (SE)
- Energy & Skills Council, Hydrogen Competence Framework
- ETZ Feasibility Study Report, February 2020
- IDRIC, 2022, *Hydrogen Skills Gap Study Landscape Review Executive Summary*
- NE Scotland Energy Transition Jobs and Skills report published by RGU's Energy Transition Institute
- North Sea Transition Deal (NSTD) Integrated People and Skills Strategy – resources from its first year work and initial report can be found here (May 2022)
- PWC, 2022, *Developing Australia's Final hydrogen workforce*
- Regional skills strategy for Aberdeen - Aberdeen City and Shire Regional Skills Assessment, March 2022 and Supporting Data Matrix along with Regional Skills Assessments
- Robert Gordon University, 2021, *UK Offshore Energy Workforce Transferability Review*
- Robert Gordon University, 2022, *Making the Switch: The future shape of the offshore energy workforce in the North-East of Scotland* here *and report* here *(May 2022)*
- Scottish Government, 2020, Scottish Government Hydrogen Policy Statement
- Scottish Government, 2020, Scottish hydrogen: assessment report
- Scottish Government, 2022, *Draft Hydrogen Action Plan*
- *Scottish Hydrogen Assessment Project, 2020*
- Skills for a net-zero economy: Insights from employers and young people GreenSkillsReport-2022_v3b.pdf (fenews.co.uk)
- UK Offshore Energy Workforce Transferability Review – this is a precursor to the Making the Switch Report and can be found here (2021)

Annex 1

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Annex 2: stakeholders engaged

- Aberdeen City Council and Aberdeenshire Council
- Energy Transition Zone Ltd (ETZ)
- Hydrasun
- Hydrogen skills subgroup of the North East Scotland Hydrogen Ambition Steering Committee
- National Energy Skills Accelerator (NESA)
- North East Scotland College (NESCol)
- OEUK research on skills
- OPITO
- Robert Gordon University (RGU)
- Scottish Government
- Skills Development Scotland (SDS)

Annex 2

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