FLOATING OFFSHORE WIND CENTRE OF EXCELLENCE

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FLOATING OFFSHORE WIND

RISKS TO PROJECT DEVELOPMENT - PEOPLE, SKILLS, AND VOCATIONS

Authors: Opergy Limited., Martin Dronfield, Johnathan Reynolds.

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PREFACE

The primary goal of this Floating Offshore Wind people, skills and vocational study is to future-cast the required People, Skills, and Vocations needed to deliver against the UK's Floating Offshore Wind targets out to 2040, and to identify any areas of threat to that delivery.

The UK is already home to the world's largest deployment of offshore wind, however floating turbines, deployed in deeper waters than conventional fixed turbines, will boost energy capacity even further by allowing wind farms to be situated in new areas around the UK coastline where wind strengths are at their highest and most productive.

With global gas prices at record highs, the UK is determined to strengthen energy security further by deploying home-grown renewable technologies to reduce our dependency on volatile fossil fuels. In January 2022, the UK Energy Minister Greg Hands said:

"We are already a world leader in offshore wind and floating technology is key to unlocking the full potential of the seas around Britain. These innovative projects will help us expand renewable energy further and faster across the UK and help to reduce our exposure volatile global gas prices."

Floating Offshore Wind offers a huge future opportunity to help develop a clean energy foundation for the UK and in doing so support the efforts to achieve NET Zero by 2050. It will allow the UK energy sector to develop and grow the people, skills and vocations employed in the sector, as well as providing significant opportunities to develop young people through training schemes, apprenticeships, and graduate roles.

A further opportunity will be, the ability to set from day one, meaningful diversity and inclusion targets around gender and ethnicity within an industry that can not only support their inclusion but offer them highly skilled and well-paid job for them to build careers.

The growing FOW sector, people, skills, and vocational requirements outlined in this report also offer opportunities for a workforce in transition from Oil & Gas, the military and other routes to enter the sector, and these will be essential in achieving the challenges set by the growth being forecast.

However, the scale of the opportunity (and as such the challenge) must not be underestimated,

The base case growth being forecast offers unprecedented opportunity, with up to 1263 floating structures (an average of 123 per year), 1227 nacelles and 3681 blades to be installed by 2040 with a combined industry need for circa 7.5 million tonnes of steel in the same period.

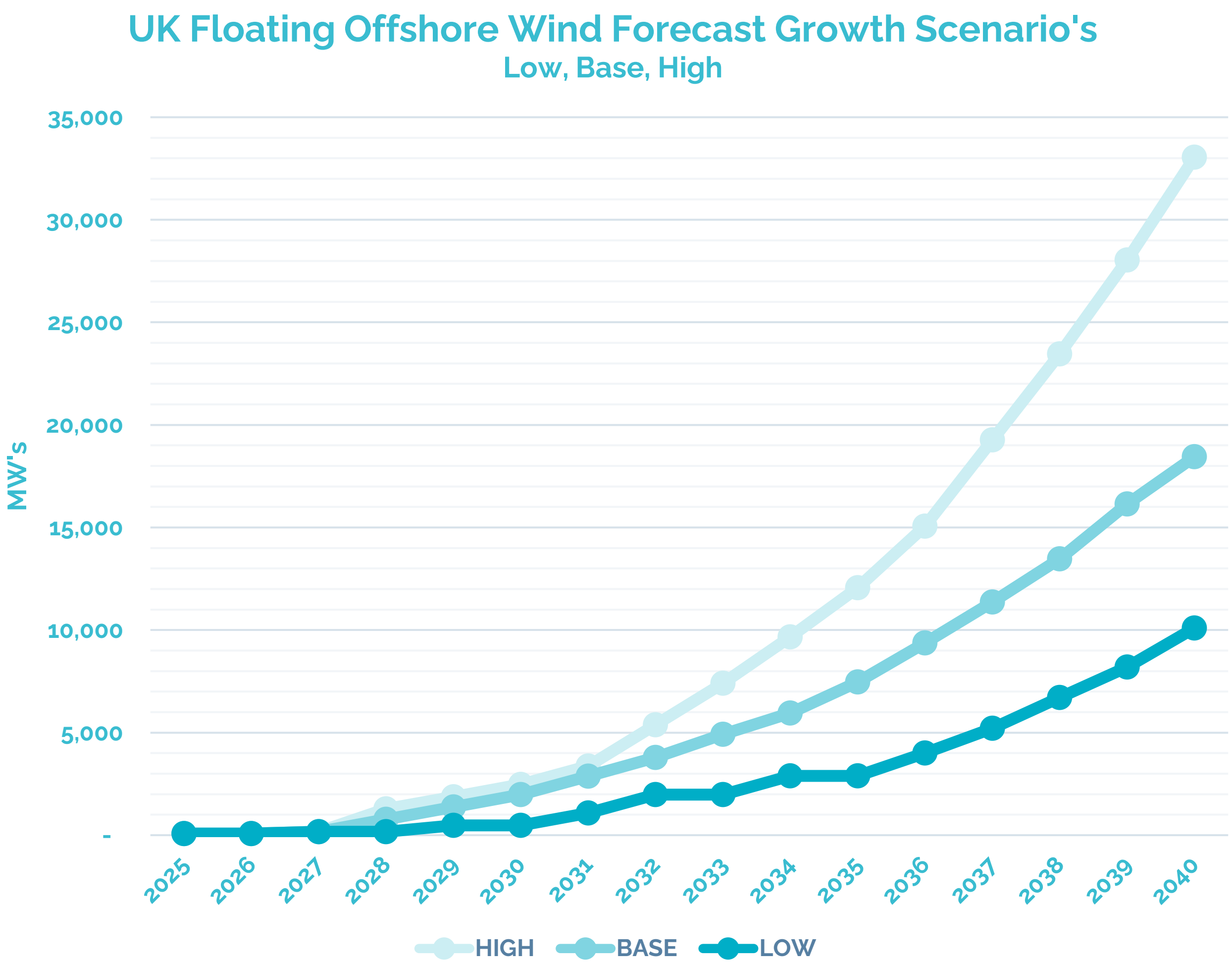
These numbers become even more challenging if you consider that by 2050 there could be up to 3267 floating structures needed (an average of 163 per year).

This report concludes that, using a **base case forecast growth scenario of 18,4GW** of floating offshore wind in the UK by 2040. combined with the results of a desk-based, model baseline 510MW project as the starting point, the forecast total FOW active jobs in the UK at the end of 2040 could be:

31,793 jobs

It should be noted that this forecast number of jobs, is for all active jobs required to support the UK sector and not only UK based roles.

Underpinning this report and the analysis that went into producing it are three scenarios of growth for the FOW sector in the UK and out to 2040 these scenarios are highlighted in the graphic below.



- The **Low** scenario suggests 474MW of FOW in the UK by 2030 and 10GW by 2040.
- The **Base** scenario suggests 2GW of FOW in the UK by 2030 and 18.5GW by 2040.
- The **High** scenario suggests 2.4GW of FOW in the UK by 2030and 33GW by 2040.

The report overlays this forecast capacity growth with job numbers from a desk-based Model 510MW Project, these numbers are extrapolated forward (allowing for improvements in both productivity and technology) in line with the forecast capacity growth.

The numbers of jobs calculated in the desk-based Model 510MW Project is:

3,653 jobs

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NOMENCLATURE

Active Jobs	Full time positions created directly by the growth in the industry in developer and operator organisations that are active at any given time.
AFBE	The Association for Black and Minority Engineers
Array Cable	The primary cable(s) for transporting electricity from one turbine to another or from a turbine string to a substation
Array	A collection of floating offshore wind structures working together and connected to create a combined electricity generation output
Blue Collar	A collective term referring to manual workers, both skilled and un-skilled
CITB	Construction Industry Training Board
Clean Energy	Energy produced from non-carbon emitting sources
CoE	Centre of Excellence
Common Taxonomy	A consistent method of describing and articulating people, skills, and vocations by organising them into job families and sub families
CTV	Crew Transfer Vessel
Deployment Scenario's	A range of future potential growth scenarios for Floating Offshore Wind in the UK
Direct Jobs	Full time positions created directly by the growth in the industry in developer and operator organisations
DNO	Distribution Network Operator
ECITB	Engineering Construction Industry Training Board
EPIC	Engineering, Procurement, Installation and Commissioning
ESP	Energy Skills Partnership
ETIP	The European Technology & Innovation Platform for Ocean Energy, is a platform for ocean energy experts to share knowledge and identify solutions
EU	European Union
Export Cable	The primary cable(s) for transporting electricity from an offshore wind farm array to onshore
FOW	Floating Offshore Wind
FOW CoE	Floating Offshore Wind Centre of Excellence
FTE	Full Time Equivalent, is a unit that indicates the workload of an employed person in a way that makes workloads comparable across various contexts. FTE is often used to measure a worker's involvement in a project, or to track cost in an organisation, for example 2 x welders working for 6 months on a project is 2 Jobs but 1 FTE.
GHG	Greenhouse Gas
GVA	Gross Value Added
GW	Giga Watts
GWEC	Global Wind Energy Council
GWO	Global Wind Organisation, a large provider of offshore wind training standards
HV	High Voltage

Improvement Factors	Annual % reductions in future job numbers because of improved technology, productivity, and efficiency
Indirect Jobs	Full time positions created within the supply chain because of the growth in the industry
IREC	International Renewable Energy Congress
IRENA	International Renewable Energy Association
Jobs	Individual roles that need to be performed to deliver a project or task, they may or may not be full time, for example 2 x welders working for 6 months each on a project is 2 Jobs but 1 "person year" of effort or FTE.
LCOE	Levelised Cost of Energy
M	Million
MW	Mega Watts
NORMS	Industry accepted average amounts of person hours required per tonne of steel fabricated, developed over many years
NSTD	North Sea Transition Deal
O&M	Operations and Maintenance
ONS	Office for National Statistics
OPITO	A large global provider of training standards
ORE Catapult	Offshore Renewable Energy Catapult
OSS	Offshore Substation
OWIC	Offshore Wind Industry Council
Pilot Projects	Very early-stage projects design to prove technology
RUK	Renewable UK, a large renewable energy trade association
SAP's	Senior Authorised Persons
Skills Gaps	An area or sector of the workforce need that can be filled by training the existing workforce
Skills shortage	An area or sector of the workforce that requires the recruitment of more people into the industry
SOV	Service Operations Vessel
SOWEC	Scottish Offshore Wind Energy Council
STEM	Science, Technology Engineering and Mathematics
Supply Chain	Service providers and manufacturing organisations that through contracts support the development or growth in the industry
Vocation	A person's main occupation to which they are particularly suited
White Collar	A collective term referring to workers who performs professional, desk, managerial, or administrative work. White-collar work may be performed in an office or other administrative setting.

1 CREDITS

The Offshore Renewable Energy Catapult's (ORE Catapult) **Floating Offshore Wind Centre of Excellence** (FOW CoE) and **Opergy Limited** wish to credit and thank the following for their contribution in the creation of this report:

Offshore Wind Industry Council

For the use of their offshore wind annual people and skills survey data from both 2021 and 2022 survey and reports. This data has been invaluable for comparison of the model project outputs with the survey results at a job family level and to provide an overall offshore wind [both fixed and floating] view of the future UK people and skills needs.

With special thanks to both Danielle Lane and Celia Anderson in this regard.

Renewable UK

For their co-operation and willingness to collaborate around content and alignment of this report and the annual people and skills survey results and for allowing Opergy Limited to use its privileged access to the people & skills survey data [see above] as a set of comparative data in the preparation of this report.

With special thanks to Melanie Onn, Dan McGrail, and Michael Chesser in this regard.

Acteon Group & InterMoor Limited

For their active collaboration and significant support in peer reviewing the desk-based model 510MW project built by Opergy Limited and for their willingness to commit resources free of charge to review [sometimes on a line-by-line basis] the assumptions drawn into the model 510MW project.

With special thanks to Ivan Harnett, Alan Duncan, Matthew Heyman, Mark Prentice, Colin Ellis, and Jeremy Mileham in this regard.

Kincardine	cobra Principle Power
For their active collaboration and support in peer reviewing the concepts and assumptions made in the model 510MW project built by Opergy and for sharing their experiences and learnings from projects already built or projects being developed. With special thanks to Alan Macaskill.	

Mr Martin Graystone	
For providing his considerable offshore and construction support to Opergy Limited to peer review the model project on a line-by-line basis and for providing guidance and experiential checks of the fabrication norms used. With special thanks to Martin Graystone.	

2 INTRODUCTION

As part of the effort to boost the UK's floating offshore wind (FOW) industry, ORE Catapult has established the FOW CoE to develop an internationally recognised initiative to reduce the cost of energy from floating wind.

The FOW CoE is helping to accelerate the build-out of floating wind farms, create opportunities for the UK supply chain, and drive innovations in manufacturing, installation, and O&M.

The FOW CoE is a collaborative programme with the following industry, academic and stakeholder partners:

The FOW CoE commissioned this FOW People, Skills, and Vocation's report to provide the industry with a set of benchmark figures, views, and conclusions on the future numbers of people, skills, and vocations likely to be needed in the UK for the country to take advantage of the huge opportunity to build-out FOW at the rapid scale of growth required to support the achievement of the UK's net zero targets.

FOW is expected to play a critical role in the UK achieving its net zero emissions targets. The FOW industry anticipates that in the medium-term (i.e., present – 2030), FOW deployment will grow from early-stage pilot projects to full commercial arrays. From 2030 onwards, several deployment scenarios (high, medium, and low) have been identified that will challenge the current supply chain and workforce to meet the rise in demand for their skills.

This challenge can be seen as a unique opportunity for new jobs and a boost to the UK supply chain. As the FOW industry ramps up there will be a need for a considerable number of direct and indirect jobs within the UK to support the sector.

These jobs will be created by the development of a new skilled workforce as well as providing opportunities for existing skilled personnel to transition across from other energy sectors in roles such as construction, fabrication, deployment, and operations of a FOW site.

This report attempts to identify the key skillsets required to consent, design, construct and then operate and maintain a FOW wind farm. Further to this, this report will also assess the current and projected future markets for the provision of these resources to determine where access to these skillsets may be constrained in the future, and hence inhibit the timely and cost-effective delivery of FOW projects.

The report considers all resources required to deliver the large-scale FOW projects, in particular those which are forecast to potentially be in short supply. In identifying these areas, it will potentially assist industry in planning project delivery and stimulate supply chain investment in key areas.

Some of these required resources have long lead times and as such it is important to assess and identify any anticipated significant supply issues many years in advance.

The report assesses people, skills and vocations for individuals directly and indirectly employed by FOW throughout all lifecycle stages: onshore at the quayside; onboard vessels and elsewhere offshore. These are expressed in terms of numbers of jobs as both **job numbers** (Jobs) and **full-time equivalents** (FTE). This is achieved by future casting the outputs from a model 510MW array.

Understanding the relationships and sensitivities between Jobs and FTE (which are expressed in years, months, days, or hours in the report) is important in both understanding the way the inputs for this report have been built and for assessing its validity.

The basic design construct of the model 510MW project is that the work phases (and the itemised line items of work that fall within them) are presented down the left-hand axis of the model and the people, skills, and vocations taxonomy (the job types) are shown along the top axis of the model.

The model is then populated by the calculated, actual numbers of people required to deliver a line item categorised by the job type. Note, Management, Corporate Services and People Development are spread evenly across all work types rather than calculated.

The sum of the numbers of people across each line item is then taken as the total number of Jobs against that line item and by using the duration of each line item (in months) the FTE figures for each are calculated

Hypothetically, if the project model were to increase in size (e.g., from 510MW to 1020MW) some line items would increase in duration to manage with the increased workload or numbers (i.e., manufacturing of components). However, some items (i.e., O&M) would not increase in duration but would likely require an increase in the actual numbers of people (jobs) to deliver the increased work within the same duration.

As projects get bigger (or smaller), across all the several types of work in the project there is a blend of what activity durations increase and what activity job numbers increase. As a result of this, a project double in size would almost certainly not observe a doubling of the number of jobs required. However, it is important to note that in this case the FTE figure would be much closer to a doubling.

It is worth noting that a 510MW project was selected to represent a single early project, but it is believed that this model is scalable and could be part of a larger project at a later date.

The whole project lifecycle is considered in the model, from development, through to construction and operation. However, decommissioning is excluded as it is considered too far in the future for meaningful conclusions to be drawn.

The report utilises high, base, and low-level deployment scenarios for FOW between now and 2040 provided to the authors by the ORE Catapult.

Understanding the levels of future people, skills & vocations required in the FOW industry will be critical to enabling the significant growth that has been forecast in the UK in the lead up to 2050 in support of the UK's Net Zero ambitions. This report sets out to try to provide that understanding.

The report has been compiled by Opergy Limited under commission from the ORE Catapult and draws upon a combination of desk-based people, skills & vocational research & modelling and a range of industry experiences and knowledge. It uses the range of agreed deployment scenarios to deliver a future cast view of what people, skills & vocations will be required in the sector and by when, on a year-by-year basis.

The report uses the same common taxonomy of people, skills and vocations used by the Offshore Wind Industry Council (OWIC) and Renewable UK (RUK) in their annual skills survey and report. In doing so, aligns the two and enables comparability and both OWIC and RUK are thanked for their co-operation in making this possible.

The outputs of this report, as well as the recently published OWIC annual offshore wind people & skills survey & report have also been fed into the overall energy industry future casts being published as part of the North Sea Transition Deal (NSTD) People & Skills Plan currently being compiled by OPITO. The authors are convinced of the value brought to the offshore energy industry by this collaboration and cross data integration. This level of cross sector collaboration is essential if the offshore energy sector is to achieve the transition of its workforce from industry sectors in transition to industry sectors fuelling the clean energy future growth.

It is hoped that this report will become an important industry reference document and provide the reader with robust evidence of the scale of people and skills growth that will be needed over the coming years to support the UK's ambitious growth in FOW. It also deliberately highlights the fact that many of the required people, skills and vocations needed in FOW going forward are already in short supply.

In preparing this report the authors followed 5 logical steps detailed below:

1. significant desk-based research was carried out into existing views of the FOW industry situation, **a literature review**, with particular emphasis on people, skills, and vocations;
2. a desk top "Model Floating Offshore Wind Project" was then created based upon a line-by-line analysis of the requirements for **design, build and operation of a 510MW floating array** and then **how many people, skills & vocations are needed for this;**
3. the model project numbers where then **forward cast** utilising a range of FOW industry growth forecasts provided by the ORE Catapult;
4. further research into the existing situation with people, skills and vocations in the UK energy sector was then carried out and **a literature review** pulled together with particular emphasis on existing people, skills, and vocations to understand any shortfalls;
5. **conclusions** were then drawn providing views on what steps could or should be taken to address those gaps.

A significant amount of work and cross checking has gone into the desk based "Model Floating Offshore Wind Project" and the authors are grateful to those who have helped do this and accept that there will be varying opinion on the research, the assumptions, the model and future cast numbers. The primary goal of the model project was to provide scale and direction to the industry, and we believe this has been achieved.

The authors, Opergy Limited and the ORE Catapult FOW CoE of course welcome any constructive feedback or ideas to improve future models.

Credit EURACTIVE & WindPlus

3 INDUSTRY CONTEXT – GROWTH OF FLOATING OFFSHORE WIND

With opportunities in shallow waters becoming scarce and limited in space, IREC – (*Floating offshore wind turbines: Challenges and opportunities*), states that FOW can serve as a solution and make the most of deeper waters with higher wind speeds.

The UK government has signalled its support to FOW through its *10-Point Plan*, *Energy White Paper*, and the *Net Zero Strategy*. It has set a goal for 1GW *(recently increased to 5GW)* of capacity by 2030. It describes this target as a "steppingstone" to further growth in the UK, helping to develop jobs and opportunities in the associated industrial supply chain and place the UK at the forefront of FOW.

The Crown Estate (*Celtic Sea Floating Wind Programme*), meanwhile, is targeting 4GW of new capacity in the Celtic Sea alone by 2035. While The Carbon Trust (*Floating Wind Joint Industry Project Phase I Summary*) suggests the UK can have 5GW of capacity by 2030, albeit with low certainty. It also forecasts 29.2GW of capacity worldwide. *(These figures have been recently increased in reports by both ORE Catapult and DNV)*

In terms of the impact on jobs, estimations are a little harder to come by. The UK government has forecast that the growth of offshore wind as a whole – 40GW *(recently increased to 50GW)* by 2030, which includes 1GW *(recently increased to 5GW)* of FOW – will support 60,000 *(recently increased to over 90,000)* jobs in 2030. As for FOW alone, ORE Catapult, Renewable UK, and Scottish Renewables (*Unlocking the UK's Floating Wind Potential*) suggest the UK will need close to 100GW of offshore wind to deliver net zero by 2050, with up to 50% of this floating wind – 60% if aggregate installed capacity exceeds 150GW. It estimates this would create more than 29,000 jobs in FOW and deliver £43.6bn in GVA by 2050.

The report cites the UK's world leading skills and experience in fixed bottom offshore wind, oil and gas, and subsea engineering as leaving it well placed to develop a FOW industry. On oil and gas, it advises it will support a transition of highly skilled jobs from that industry into offshore wind.

The role of oil and gas in floating wind is repeated by ETIP Wind (*Floating Offshore Wind, Delivering Climate Neutrality*) – an opportunity to provide sustainable alternatives for Europe's offshore workforce – and Policy Exchange (*The Future of the North Sea*), which highlights the transferable skills of oil and gas workers in designing and operating floating platforms in offshore environments for FOW.

There is also crossover with the fishing industry, with a role for guard or support vessels during construction of a FOW farm, one that could be filled by fishing vessels or their crew (ORE Catapult – *Floating Offshore Wind and Fishing Interaction Roadmap*), as well as an opportunity for industrialised coastal regions impacted by a decline in shipbuilding to repurpose their infrastructure for FOW (Wind Europe – *Floating Offshore Wind – A Policy Blueprint for Europe*).

Other documents speak of challenges with regards to an insufficient supply chain (ORE Catapult – *Floating Offshore Wind Technology and Operations Review*) and the impact of Brexit, as UK floating wind demonstration projects have so far relied on overseas products and services (University of Strathclyde – *Offshore wind, ready to float?*).

Hywind Floating Offshore Wind – Image Courtesy of Equinor

4 RESEARCH METHODOLOGY

The primary goal of this FOW People, Skills and Vocational study is to future-cast the required people, skills, and vocations needed to deliver against the UK's FOW targets out to 2040.

To do this, the authors of the report relied upon several critical inputs:

1. a detailed understanding of the current published information available and industry views on people, skills, and vocations in the FOW sector **The FOW Literature Review**;
2. a data set of the current numbers of people involved in the FOW industry to use as a basis for future casting. As this does not exist, it was agreed that they would create **The Desk Based Model Project**;
3. an agreed set of assumptions against which the theoretical model project could be built, these were agreed as **The Model Project Assumptions**;
4. a standard nomenclature to use for describing people, skills, and vocations throughout the work, they created **The Common Taxonomy**;
5. an agreed industry future growth forecast to use as the basis of extrapolating today's numbers from the model project forward, this was supplied by the ORE Catapult, **The Forecast Growth Model**;
6. an agreed set of steel fabrication norms against which the fabrication and construction sections of the model project could be compared and measured, the **Steel Fabrication Norms**;
7. an agreed improvement factor to be used in the modelling to recognise the year-on-year improvement of technology and productivity within the FOW sector, **The Improvement Factors**;
8. a detailed understanding of the current published information available on any people, skills and vocational shortages in the existing energy markets **The Skills Gaps Literature Review**.

4.1 Floating Offshore Wind Literature Review

A detailed desk top literature review was carried out and looked at a considerable number of published documents, reports and articles focused on FOW. These were reviewed in detail and then summarised with the high-level overview published in section 4 of this report and the detail in the appendices

The literature review was focussed primarily on the last three years of available data, reports, and publications (although a small number older than this where also reviewed) and created an information foundation on which the thinking behind this report was based.

Not all data reviewed or captured was utilised in the preparation and creation of this report, and the application of 'relevance' was applied, some degree of applicability was used, and the authors ask the readers to keep this in mind when reviewing the findings.

The documents reviewed are listed in Appendix A.

4.2 The Desk Based Model Project

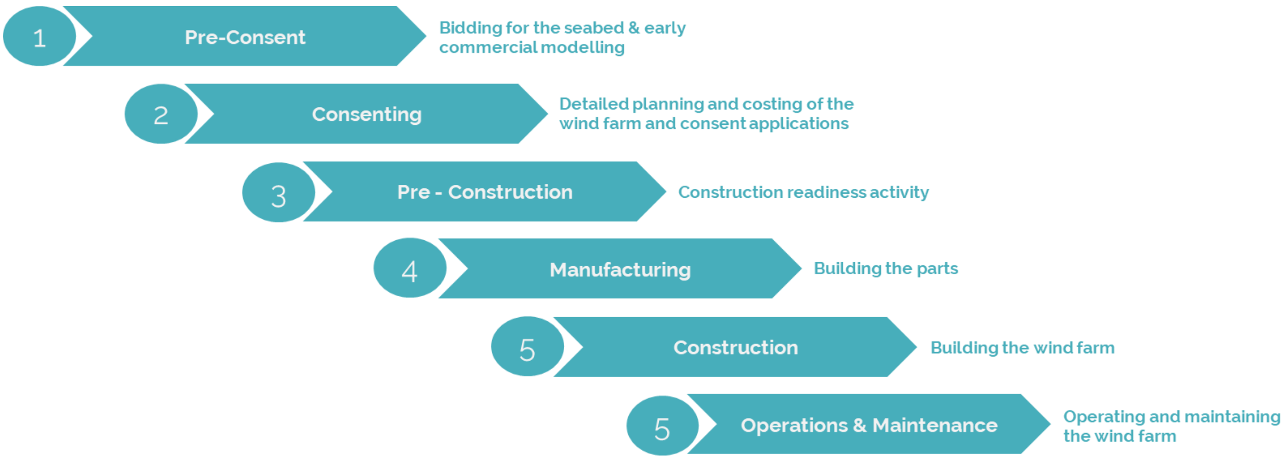
It was clear from the start of discussions surrounding the production of this report that there were no meaningful current datasets of people, skills and vocations involved in the FOW sector that could be used as the foundation of a future cast. This was driven in the main by the real lack of any at scale activity in the sector currently.

Both the 2021 and the 2022 OWIC annual offshore wind people and skills survey do contain small returns with limited numbers of people designated as FOW. However, in both cases these where less than 1% of the total and in both cases less than 100 people. As such it was felt that these not anywhere near high enough to be representative.

To over-come this problem, ORE Catapult and Opergy decided early in the project to build a desk-based model project to try to calculate the numbers of people, skills and vocations that would be needed to consent, design, build and operate, an at scale FOW array.

The scale and assumptions used to create this model can be found further in this report but essentially the model started by breaking down everything that needs to be performed to consent, design, construct and operate a floating array into the 6 phases of a project which are shown in the graphic below.

The whole project lifecycle is considered, from development, through to construction and operation, however, decommissioning is excluded as it is considered too far in the future for meaningful conclusions to be drawn.



Each of these primary phases shown in the diagram above were then broken into sub-phases, with each sub-phases containing several line items of activities.

1 . Pre-Consent

1.1 Concept Design / 1.2 Pre-Consent Procurement / 1.3 Initial Survey / 1.4 Early Consenting Works

- aviation & marine access studies;
- coastal process studies;
- engineering studies;
- fishing & Marine Mammal studies;
- human impact studies;
- onshore archaeological studies;
- pre-consent procurement;
- early seabed geophysical and geotechnical studies;
- ornithological studies;
- offshore wind farm life cycle modelling;
- pre-consent application works;
- project economic analysis;
- wind energy planning & modelling.

2. Consenting

2.1 Environmental Assessment / 2.2 Scoping Report

- hydrographic survey;
- marine mammal survey;
- offshore benthic / pelagic survey;
- shallow water geophysical survey;
- environmental impact assessment studies;
- front end engineering;
- marine & economic risk management studies;
- offshore communications studies;
- onshore civil engineering design;
- UXO desk based investigation;
- consent application works;
- project detailed commercial modelling.

3. Pre-Construction

3.1 Survey / 3.2 Detailed Design / 3.3 Procurement / 3.4 Site Preparation

- offshore geophysical & geotechnical survey;
- cable stability analysis;
- detailed design - cable solution;
- detailed design - floating foundation;
- detailed design - Mooring Solution;
- Detailed Design - Transition Piece And Tower;
- Detailed Design Of Oss Topsides & Structures;
- Export Cable Lay Engineering ;
- Foundation Monitoring Systems;
- High Voltage [Hv] Engineering ;
- Pre-Construction Procurement;
- Construction / O&M Port;
- Offshore Demarcation Buoys;
- Seabed Cable Route Clearance.

4. Manufacturing

4.1 Cables / 4.2 WTG's / 4.3 Tower Structures / 4.4 Floating Foundations / 4.5 Substation / 4.6 Secondary Equipment

- cable protection systems;
- export cables;
- inter-array cables;
- WTG;
- WTG blades;
- tower structures;
- transition steelwork;
- OSS floating foundation;
- OSS topsides;
- floating foundations – cans;
- floating foundations – tubulars;
- davit cranes;
- shore base pontoons;
- cable floatation;
- seabed anchors;
- mooring chain.

5. Construction

5.1 Fabrication & Assembly / 5.2 Cable Installation / 5.3 WT Structure Transport & Installation / 5.4 Substation Transport & Installation / 5.5 Handover & Commissioning

- marine & shore base site set up;
- onshore substation construction;
- onshore civil - shore end pull-in;
- FOW asset assembly;
- export cable lay;
- inter-array cable laying [IAC];
- onshore cable installation;
- FOW asset mooring pre-lay;
- floating asset towage;
- floating asset installation;
- FOW OSS towage;
- FOW OSS installation;
- commissioning;
- WTG temporary offshore power including refuelling.

6. Operations & Maintenance

6.1 OEM Warranty / 6.2 Topsides BOP / 6.3 Subsea BOP / 6.4 Onshore

- aviation services & helicopters operations;
- OEM warranty services;
- wind turbine blade inspection & repair;
- BOP topsides equipment, inspection, lifting, climbing & safety devices;
- operation of crew transfer vessels (CTV);
- operation of service operation vessels (SOV);
- BOP subsea [cables, seabed, floatation, cable burial, U/W structures];
- FOW mooring monitoring;
- OSS subsea [foundation, cable entry & cable burial inspection];
- onshore assets O&M.

4.3 Common People, Skills & Vocations Taxonomy

Being able to use a common language to articulate people, skills, and vocations across a report such as this and then across a series of energy sectors is essential.

There exists today (as far as the authors could establish) no common energy skills taxonomy models, and as such, for the purposes of this report the decision was taken to build on the taxonomy used in the work already carried out by OWIC and Renewable UK in their 2021 and 2022 annual people and skills survey.

The common skills taxonomy used in the OWIC annual People & Skill Survey and Report (and originally built by Opergy) was expanded to give a much more in-depth view of the FOW blue-collar workforce.

It originally contained the following blue collar workforce split:

- senior;
- skilled;
- semi-skilled;
- manual.

For the purposes of this FOW report, this basic level of description was expanded to include the following sections:

- construction;
- O&M;
- electrical;
- mechanical;
- marine;
- aviation;
- subsea.

The idea being that a common framework could be adopted that would not only provide a comprehensive list of people, skills, and vocational descriptors but that also could be "read across" from one report to the other.

Job Family	Job Family Sub Groups	Approx. Skill Levels England	Typical Roles
Management	Leadership	Skill Level 7/8	Company Board roles - Company Directors - C Suite roles etc…
	Management Corporate	Skill Level 6/7	Head of…, Senior Vice President, Director in Title etc…
	Management Operational	Skill Level 6/7	Head of…, Senior Vice President, Director in Title etc…
Technical / Professional	Technical	Skill Level 6/7	Engineers, Naval Architect…
	Professional	Skill Level 7/8	Lawyers, Doctors, Senior Consultant, Consultants, Senior Auditor, Auditor etc…
Corporate Services	Corporate Services Human Resources (HR)	Skill Level 6/7	Advisor, Partner, Manager etc…
	Corporate Services Information Technology (IT)	Skill Level 5/6	Helpdesk Technician, Software, Hardware etc…
	Corporate Services Finance	Skill Level 5/6	Accountant, Bookkeeper, General Ledger Clerk etc…
	Corporate Services Legal	Skill Level 7/8	General Counsel, Legal Advisor, Paralegal etc…
	Corporate Services General	Skill Level 4/5	Office Manager, Facilities Manager etc…
	Corporate Services Administration	Skill Level 2/3	PA, Secretary, Executive Assistant etc…
HSEQ	Health & Safety	Skill Level 5	Advisor, Partner, Manager etc…
	Quality	Skill Level 5	Advisor, Partner, Manager etc…
	Environmental	Skill Level 5	Advisor, Partner, Manager etc…
People Development	People Development & Skills	Skill Level 5	Trainer, Teacher, instructor etc…
	Graduate	Skill Level 5	Various
	Trainee	Skill Level 3	Various
	Apprentice	Skill Level 3	Various
Commercial	Sales	Skill Level 5	Sales Manager, BD Manager, Sales Executive etc…
	Marketing	Skill Level 5	Marketing Executive, Marketing Manager etc…
	Commercial	Skill Level 5	Commercial Executive, Commercial Manager etc…
	Procurement	Skill Level 5	Buyer, Procurement Officer
Construction General Operatives	Senior Construction	Skill Level 5	Supervisor, Shift Manager, Foreman, Chargehand etc…
	Skilled Construction	Skill Level 4	Welder, Plater, Pipefitter etc…
	Semi-Skilled Construction	Skill Level 3	Forklift Driver, Driver, Crane Driver, Scaffolder, Rigger, Painter etc…
	Manual Construction	Skill Level 3	Labourer, Groundworker, Quayside Operative etc…
O&M	Senior O&M	Skill Level 5	Supervisor etc…
	Skilled O&M	Skill Level 4	Turbine Technician, Statutory Inspector, etc…
	Semi-Skilled O&M	Skill Level 3	Scaffolder, Rigger, Painter etc…
	Manual O&M	Skill Level 3	Labourer, Quayside Operative etc…
Electrical	Senior Electrical	Skill Level 5	Electrical SAP etc… Senior Electrical Tech, Senior Electronic Tech
	Skilled Electrical	Skill Level 4	Electrical Supervisor, Level 7 Electrical Technician… Electrical Tech, Electrician, Electronic Tech
	Semi-Skilled Electrical	Skill Level 3	Cable Jointer etc…
	Manual Electrical	Skill Level 3	Cable puller etc…
Mechanical	Senior Mechanical	Skill Level 5	Senior Mechanical Tech
	Skilled Mechanical	Skill Level 4	Mechanical Supervisor, Level 7 Mechanical Technician, Mechanical Technician
	Semi-Skilled Mechanical	Skill Level 3	Fitter, mechanic
	Manual Mechanical	Skill Level 3	Manual mechanical operative
Marine	Senior Marine	Skill Level 5	Captain, Skipper, Mooring Master etc… OIM, DPO, SSL (Section Stability Leader)
	Skilled Marine	Skill Level 4	1st Officer, DPO, Marine Engineer etc… SSL
	Semi-Skilled Marine	Skill Level 3	CRO, Crane Operator
	Manual Marine	Skill Level 3	Mate, Deckhand, Able Seafarer etc… Roustabout, facilities crew etc
Aviation	Senior Aviation	Skill Level 6/7	Pilot etc…
	Skilled Aviation	Skill Level 5/6	Navigator, Senior Crew etc…
	Semi-Skilled Aviation	Skill Level 3	HLO etc…
	Manual Aviation	Skill Level 3	Groundcrew, Loading Crew etc…
Subsea	Senior-Subsea	Skill Level 5	Diving Supervisor, Survey Party Chief etc…
	Skilled-Subsea	Skill Level 4	Diver, ROV Pilot, Surveyor etc…
	Semi-Skilled-Subsea	Skill Level 3	Diver/Tech etc…Subsea Engineer
	Manual-Subsea	Skill Level 3	Deck Crew etc…

Table 1 - Common Skill Taxonomy, Job Family Sub-groups, and skills levels

4.4 Future Floating MW Growth Models

To future cast the results coming out of the desk-based model project, the authors needed a UK FOW industry growth forecast to use as the people, skills, and vocations growth denominator. This was provided by the ORE Catapult.

The data shown in the tables below was provided by the ORE Catapult and provided a **Low**, case, **Base** case, and **High** case GW growth forecast for FOW in the UK.

The growth figures in the table were used as the denominator to future cast the baseline numbers of people, skills and vocations provided by the model project. They are in fact the basis of the Low, Base and High case forecast numbers provided by the report.

The **75GW** case is the total of all offshore wind in the UK by 2050 and the numbers shown in the body of the table are for FOW only – For the **Low-Case** displayed below it shows there being **10,1GW** of floating wind in the UK by 2040.

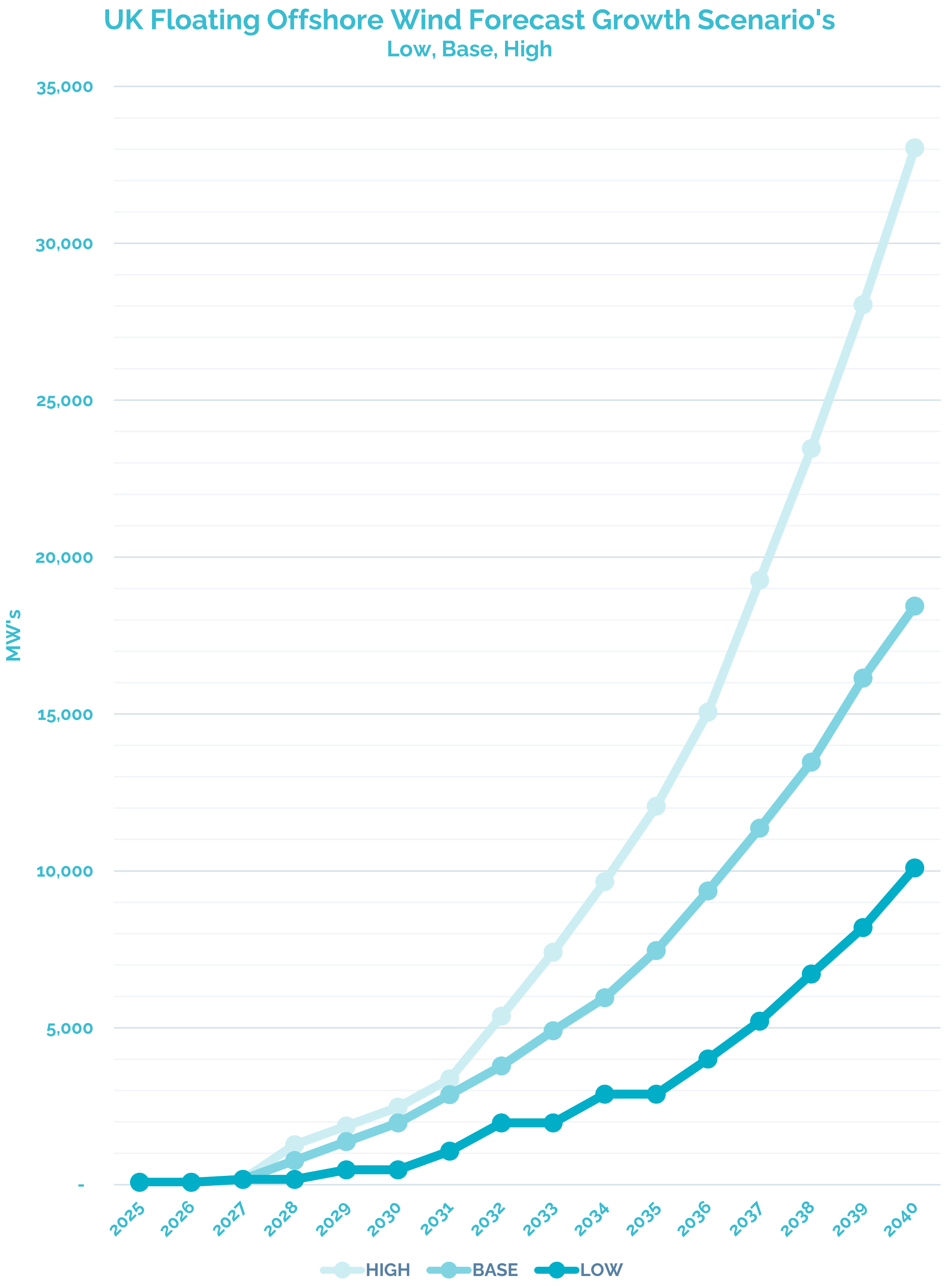
Scenario	2025	2030	2035	2040	2045	2050
Total MW	78	474	2889	10097	19597	29000

The **100GW** case is the total of all offshore wind in the UK by 2050 and the numbers shown in the body of the table those for FOW only – For the **Base-Case** displayed below it shows there being **18,4GW** of floating wind in the UK by 2040

Scenario	2025	2030	2035	2040	2045	2050
Total MW	78	1974	7464	18444	31656	49000

The **150GW** case is the total of all offshore wind in the UK by 2050 and the numbers shown in the body of the table those for FOW only – For the **High-Case** displayed below it shows there being **33GW** of floating wind in the UK by 2040

Scenario	2025	2030	2035	2040	2045	2050
Total MW	78	2474	12064	33044	61296	95000


UK Floating Offshore Wind Forecast Growth Scenario's
Low, Base, High
35,000
30,000
25,000
20,000
15,000
10,000
5,000
-
MW's
2025
2026
2027
2028
2029
2030
2031
2032
2033
2034
2035
2036
2037
2038
2039
2040
HIGH
BASE
LOW

4.5 Model Assumptions

To build the desk-based model project, several assumptions were made.

Some of them directly influence the numbers of people, skills, and vocations in the model, whilst other simply set background for the thinking needed when assessing the various people, skills, and vocational numbers.

The following assumptions were taken to enable the build:

- the model project was based upon an overall nameplate size of **510 MW**;
- the model project was based upon an individual turbine size of **15 MW**;
- the model project was based upon **34 turbines**;
- the model project was based upon anchored **triangular semi-submersible structures**;
- the model project is based upon a fabrication & pre-assembly output rate of **2 structures per month**;
- the floating foundation weight in in the model project was assumed at **4,000 tons**;
- the floating offshore substation foundation weight in the model project was assumed at **4,000 tons**;
- the floating offshore substation topsides weight in the model project was assumed at **2,500 tons**;
- the mooring anchor type used in the model project is a **driven pile anchor**;
- there are 6 asset phases used in the model project, **(1) pre-consent, (2) consent, (3) manufacturing, (4) Pre-construction, (5) constriction and (6) operations & maintenance**;
- the **pre-consent** duration in the model project was assumed at **24 months**;
- the **consent** duration in the model project was assumed at **24 months**;
- the **pre-construction** duration in the model project was assumed at **12 months**;
- the **manufacturing** duration in the model project was assumed at **18 months**;
- the **construction** duration in the model project was assumed at **24 months**;
- the **operations & maintenance** duration in the model project was assumed at **360 months**;
- the annual industry **Productivity / Efficiency** increase in the model project was assumed at **1.25% per annum compounded** (see 6.8) ;
- the annual Industry **Technology** increase in the model project was assumed at **2.5% per annum compounded** (see 6.8) ;
- the report assumes that Fabrication & Assembly operations are conducted in a **single fabrication yard in the UK**;
- the report assumes that **manufactured components** are delivered to the single fabrication and assembly yard;
- the report assumes that **cable lay operations** [both array & export) each utilise a **2-vessel strategy**;
- the report assumes that floating wind turbine foundations and floating substation foundation **transport and installation** operations utilise a **2-vessel strategy**;
- the annual operations & maintenance in the model project was assumed to utilise a **SOV**;
- the report assumes that all annual **subsea maintenance & inspection** is carried out utilising a **1-vessel strategy**;
- the report assumes that **mooring pre-lay** would be done at all locations ahead of the foundation T&I over a **duration of 8 months**;
- the report assumes an **array cable** length of **1.25 km each** with **34** of them;
- the report assumes an **export cable** length of **150 km** each with 2 of them (100KM offshore and 50 KM onshore);
- the report assumes a **water depth** at the installation location of **150 metres**.

4.6 Steel Fabrication NORMS

Four (4) high level fabrication norms were adopted alongside the model and used to check the accuracy or validity of the people, skills, and vocational number outputs in the model itself.

It should be noted, they were not used to directly calculate the various people, skills, and vocational numbers on a line-by-line basis as this was left to the experience of those drawing the model together and contributing to it.

The 4 norms used to check the model outputs are shown in the table below:

Complexity of Steel	Hours Range
(1) Large structural steel [Basic]	Normal estimating range of between **10 - 20** person hours per ton completed
(2) Large structural steel [non-complex]	Normal estimating range of between **20 - 40** person hours per ton completed
(3) Large structural steel [medium-complex]	Normal estimating range of between **40 - 70** person hours per ton completed
(4) Large structural steel [complex]	Normal estimating range of between **70 - 90** person hours per ton completed

The calculations based upon these steel fabrication norms to check the model outputs are shown in the table below:

	Norm hour / tonne	Weight (tons)	Total Number	Total Person hours	Total Person days	Total Person Years	Total In Model	Delta
Towers	15	1700	34	867,000	96,333	428	407	-21
Floating foundations	30	4000	34	4,080,000	453,333	2,015	2027	12
OOS Topsides	90	2500	1	225,000	25,000	111	115	4
OSS Foundation	40	4000	1	160,000	17,778	79	84	5
Pile Anchor	15	80	106	127,200	14,133	63	66	3

The output of these calculations shows that:

- for the 34 turbine towers in the model project each weighing 1700 tonnes and using a norm of 15 hour per tonne (towers where classed as Basic), a total of 867,000 hours, 96,333 days or 428 years would be theoretically needed. In the model there is an allowance for 407 years (a delta of -21 years) and so it was deemed accurate enough for the purposes of this study;

- for the 34 floating turbine foundations in the model project each weighing 4000 tonnes and using a norm of 30 hours per tonne (turbine foundations where classed as Non-Complex), a total of 4,080,000 hours, 453,333 days or 2,015 years would be theoretically needed. In the model there is an allowance for 2027 years (a delta of +12 years) and so it was deemed accurate enough for the purposes of this study;

- for the 1 floating offshore substation topside in the model project weighing 2500 tonnes and using a norm of 90 hour per tonne (substations where classed as Complex), a total of 225,000 hours, 25,000 days or 111 years would be theoretically needed. In the model there is an allowance for 115 years (a delta of +4 years) and so it was deemed accurate enough for the purposes of this study;

- for the 1 floating offshore substation foundation in the model project weighing 4000 tonnes and using a norm of 40 hour per tonne (substations foundations where classed as Medium-Complex), a total of 160,000 hours, 17,778 days or 79 years would be theoretically needed. In the model there is an allowance for 84 years (a delta of +5 years) and so it was deemed accurate enough for the purposes of this study;

- for the 106 pile anchors in the model project each weighing 80 tonnes and using a norm of 15 hour per tonne (pile anchors where classed as Basic), a total of 127,200 hours, 14,133 days or 63 years would be theoretically needed. In the model there is an allowance for 66 years (a delta of +3 years) and so it was deemed accurate enough for the purposes of this study.

4.7 Hours, Days and Years Calculations

To provide results expressed in durations (FTE) as well as jobs, baseline assumptions were needed on the methodology of calculating these durations. The following were the two sets of assumptions made:

Productive working hours per day

A working day in the model was calculated using the following logic:

- total hours per shift **12 hrs**;
- less lunch **-1 hr**;
- less 2x breaks **-1 hr**;
- less walking time **-1 hr**;
- total productive hours **9 hrs**.

Productive working days per year

A working day in the model was calculated using the following logic:

- total days per year **365 days**;
- less holidays **-25 days**;
- less Bank holidays **-11 days**;
- less weekends **-104 days**;
- total productive days **225 days**.

Figure 1 - Onshore assembly… Floating turbines, like this semi-submerged model, can be assembled in harbour or near shore and towed into position

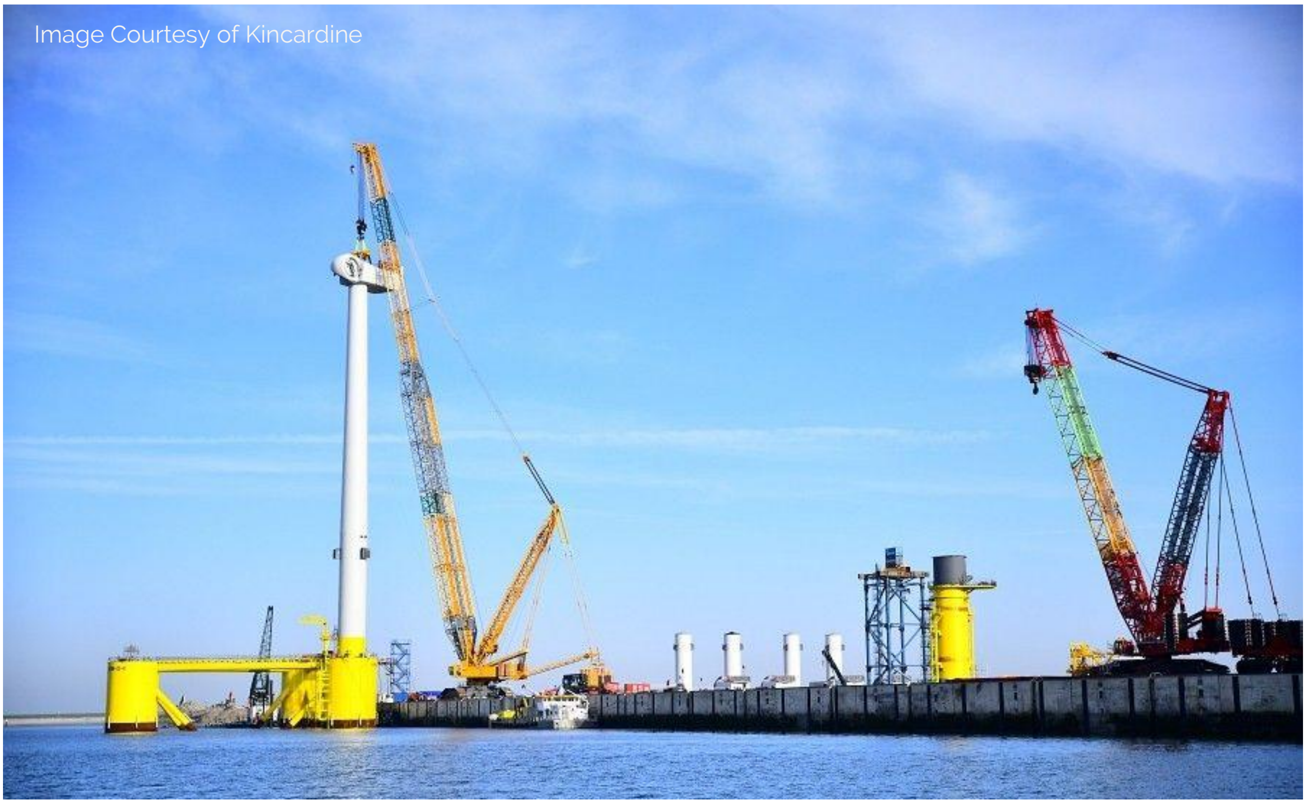


Figure 2 0 – Vestas V164 9.5MW Turbine being installed onto the Kincardine FOW foundation

4.8 Technology & Efficiency Improvements

The FOW sector remains immature and is yet to become cost effective from a Levelised Cost of Energy (LCOE) perspective. By the nature of its current position, it can reasonably expect to see significant improvements in its LCOE over the coming years bought about by both improvements in the technology being used and in the improvements in the efficiency of its operations, processes, and people.

These reductions in LCOE will also be seen in an equivalent manner in the numbers of people needed by the industry. In simple terms, we will need less people to achieve the same MW output over time.

In considering the above, and to ensure the future cast job numbers are credible, it was important that these "over time" improvements were taken into consideration when forecasting future people, skills, and vocations.

To do this, two year-on-year improvement factors where incorporated into the calculations. The first was focused on productivity and efficiency and from 2030 an annual improvement was set at **1.25%**. The table below shows the compound rolling effect on any future numbers.

1.25%	The compound Year on Year effect on the future people and skills of **Productivity & Efficiency increases**														
2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040
100%	100%	100%	100%	100%	100%	98.75%	97.52%	96.30%	95.09%	93.90%	92.73%	91.57%	90.43%	89.30%	88.18%

In simple terms this means that a given activity in 2025 that takes 1000 hours of effort would take 881.8 hours of effort in 2040 to do the same thing.

The second was focussed on technology improvement and from 2030 an annual improvement was set at **2.50%**, the table below shows the compound rolling effect on any future numbers.

2.50%	The compound Year on Year effect on the future people and skills of **Industry Technology improvements**														
2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040
100%	100%	100%	100%	100%	100%	97.50%	95.06%	92.69%	90.37%	88.11%	85.91%	83.76%	81.67%	79.62%	77.63%

In simple terms this means that a given activity in 2025 that takes 1000 hours of effort would take 776.3 hours of effort in 2040 to do the same thing.

These 2 factors when combined have the following overall effect on the future cast of people, skill, and vocations:

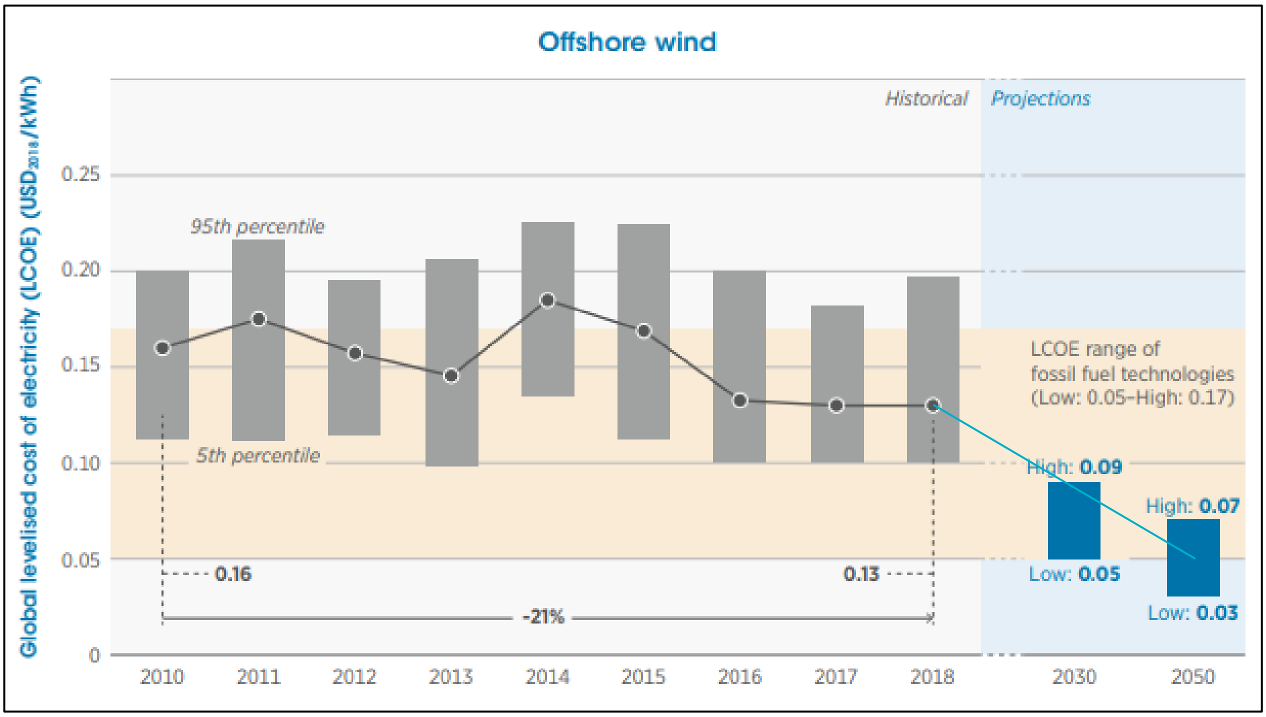
The combined [overall] compound effect on the future overall people & skills requirements															
2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040
100%	100%	100%	100%	100%	100%	96.25%	92.58%	88.98%	85.46%	82.01%	78.64%	75.33%	72.09%	68.92%	65.81%

In simple terms this means that a given activity in 2025 that takes 1000 hours of effort would take 658.1 hours of effort in 2040 to do the same thing.

The two factors discussed were applied to the future forecast hours to ensure that the final outputs took into consideration these improvements.

The basis of the factors used (1.25% and 2.5%) come from (and are in line with) several offshore wind industry LCOE reduction forecasts for FOW that come from a variety of sources. These were looked at during the literature review and include forecasts from the ORE Catapult, the International Renewable Energy Association (IRENA) and the Global Wind Energy Council (GWEC).

The graphic below from IRENA is typical of the outputs reviewed and shows the forecast LCOE reduction in the period discussed.



4.9 Model Outputs

The completed desk-based model project produced the following figures:

3,653

Individual Jobs

11,484

person years (FTE)

2,583,800

person days (FTE)

23,254,198

person hours (FTE)

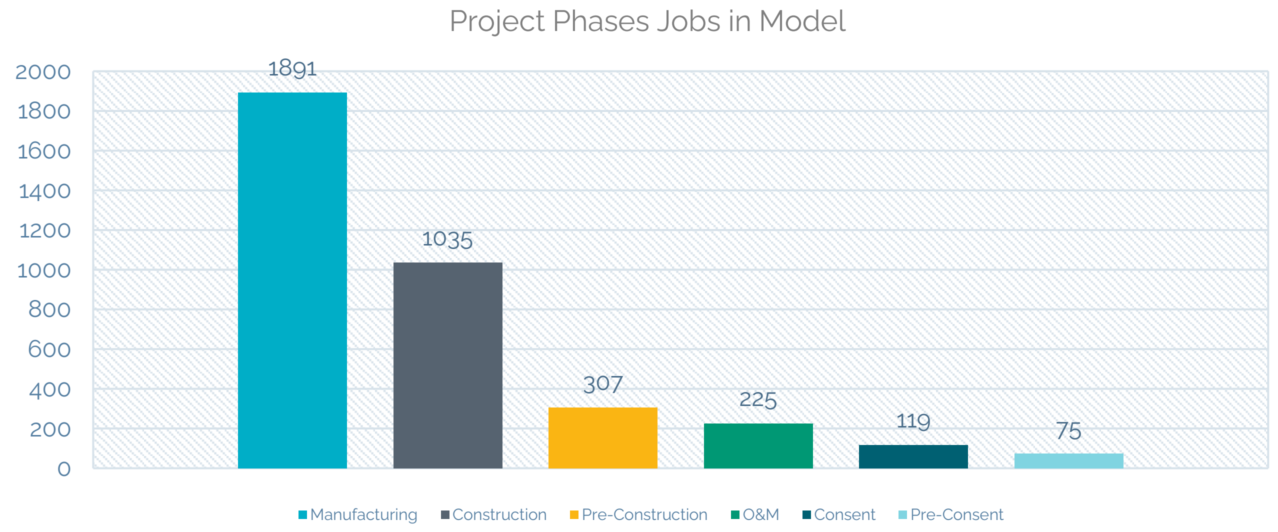
Required to pre-consent, consent, pre-construct, manufacture, construct, and operate and maintain a 510MW floating array for a 30-year duration – they do not include any allowance for decommissioning.

Further analysis of the outputs from the desk-based model are provided in the graphics across the following pages.

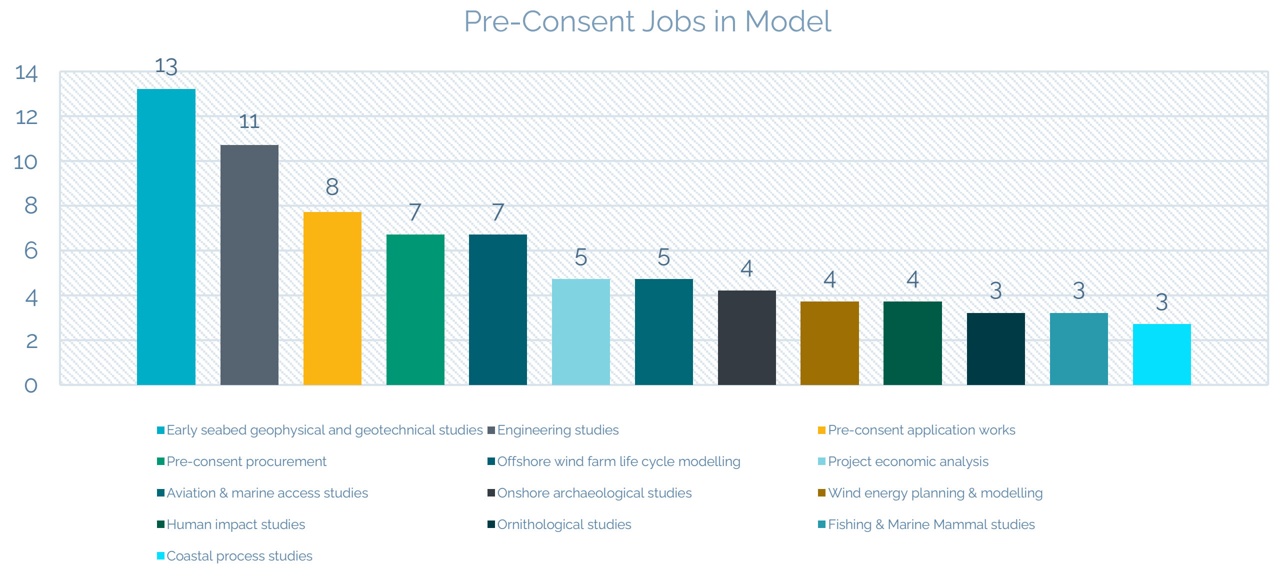
Breakdown of Jobs Involved in a 510MW Floating Offshore Wind Array Project with a 30 Year Lifetime						
Work Phase	**Sub-Phases**	**Example Activities**	**No of Individual Jobs**	**Total Person-Years (FTE)**	**Total Person Days (FTE)**	**Total Person Hours (FTE)**
Pre-Consent (24-months)	- Conceptual Design - Pre-Consent Procurement - Initial Survey - Early Consenting Works	- Aviation & marine access studies - Ornithological Studies - Wind Farm Life-Cycle modelling - Project Economic Analysis	75	69	15,501	139,511
Consenting (24-months)	- Environmental Assessment - Scoping Report	- Hydrographic Survey - Front End Engineering - Environmental Impact Assessment Survey - Project Detailed Commercial Graphic	119	153	34,376	309,382
Pre-Construction (24-months)	- Survey - Detailed Design - Procurement - Site Preparation	- Offshore Geophysical & Geotechnical Survey - Cable Stability Analysis - Pre-Construction Procurement - Construction / O&M Port	307	284	63,982	575,838
Manufacturing (12-months)	- Cables - WTG's - Tower Structures - Sub- Station	- Cable Protection Systems - Transition Pieces - WTG Blades - Davit Cranes	1,891	3,256	732,530	6,592,767
Construction (24-months)	- Fabrication & Assembly - Cable Installation - Substation Transport & Installation - Handover & Commissioning	-Onshore Civil Construction - Export Cable Laying - FOW Asset T&I - Commissioning	1,035	964	216,974	1,952,763
Operations & Maintenance (360-months)	- OEM Warranty - Topsides BOP - Subsea BOP - Onshore	- OEM Warranty Service - Operation of SOVs - FOW Mooring Monitoring - Onshore Assets O&M	225	6,758	1,520,438	13,683,938
			3,653	11,484	2,583,800	23,254,198

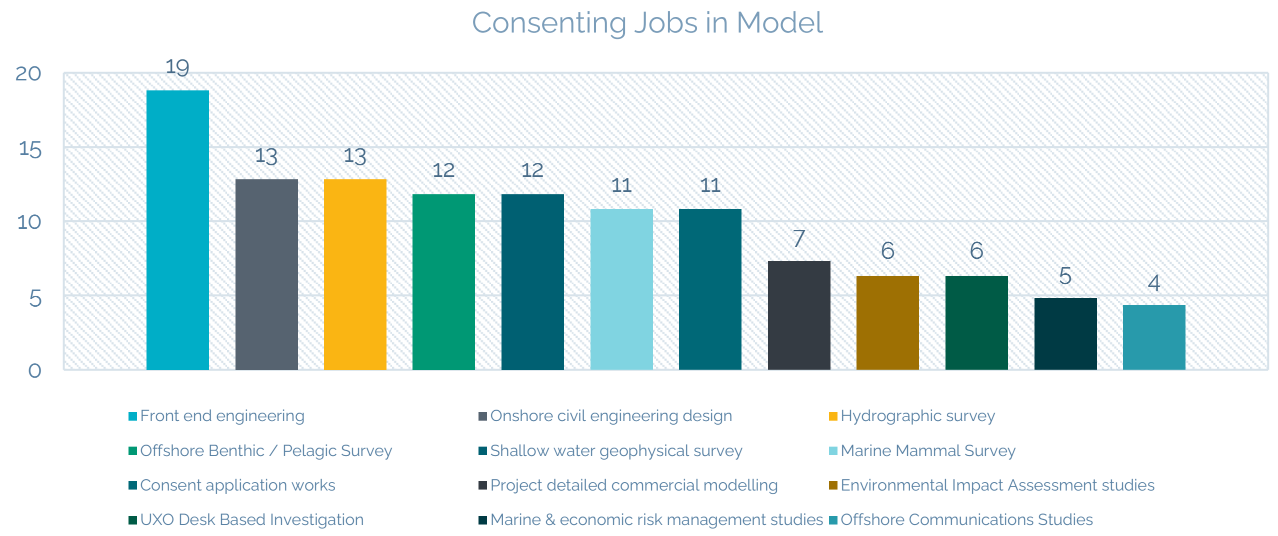
The following graphs show the number of jobs in the model. As described in the document nomenclature, the are individual roles that need to be performed to deliver a project or task. They may or may not be full time, for example 2 x welders working for 6 months each on a project is 2 Jobs but 1 "person year" of effort.

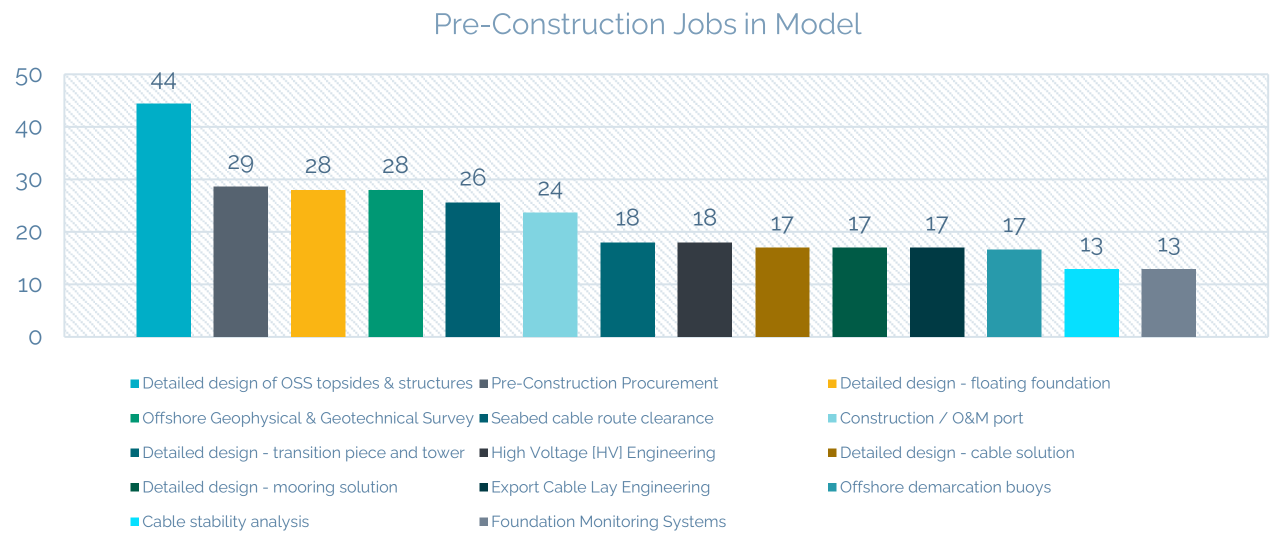
They include everybody involved including both direct and in-direct roles, and jobs based in the UK and abroad.

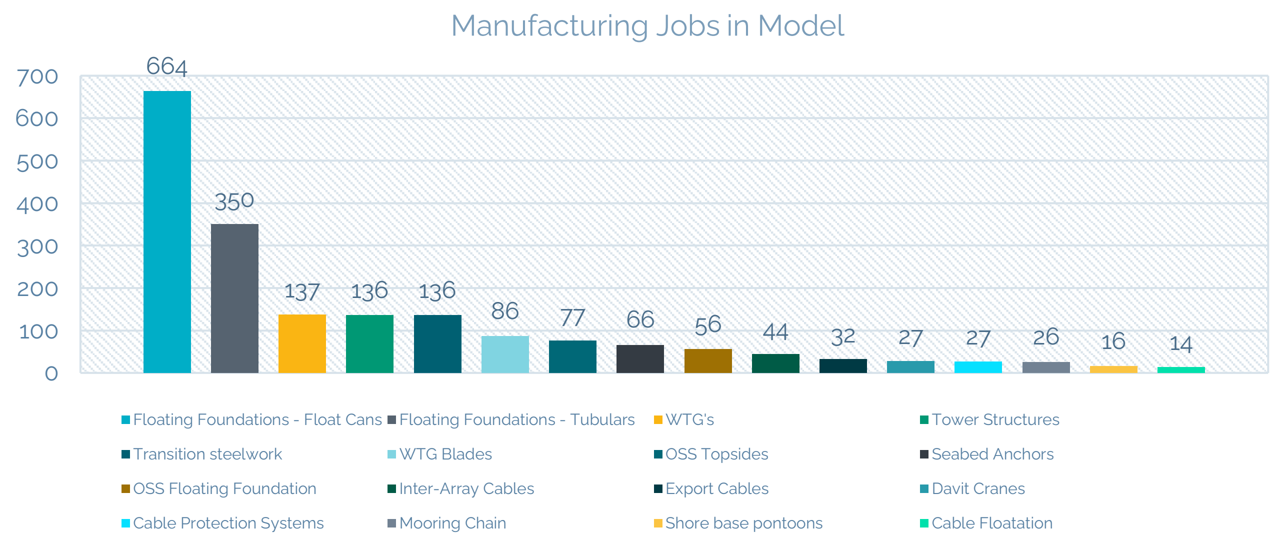


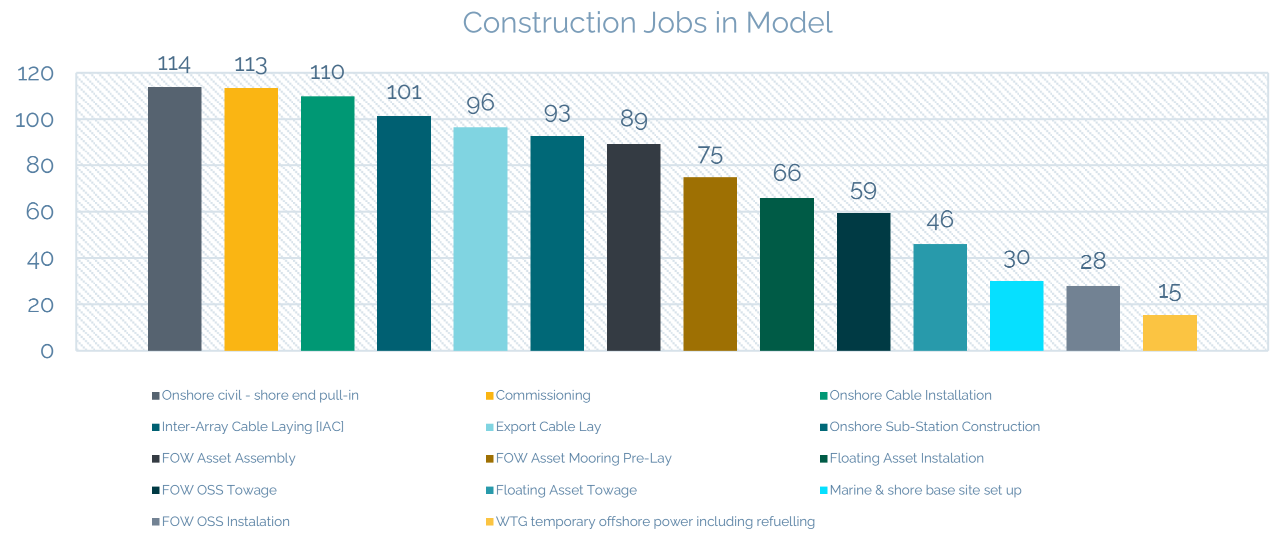
The graphic above show jobs by phase in the desk-based model in order of scale. Not surprisingly, construction & manufacturing job dominate the requirements.

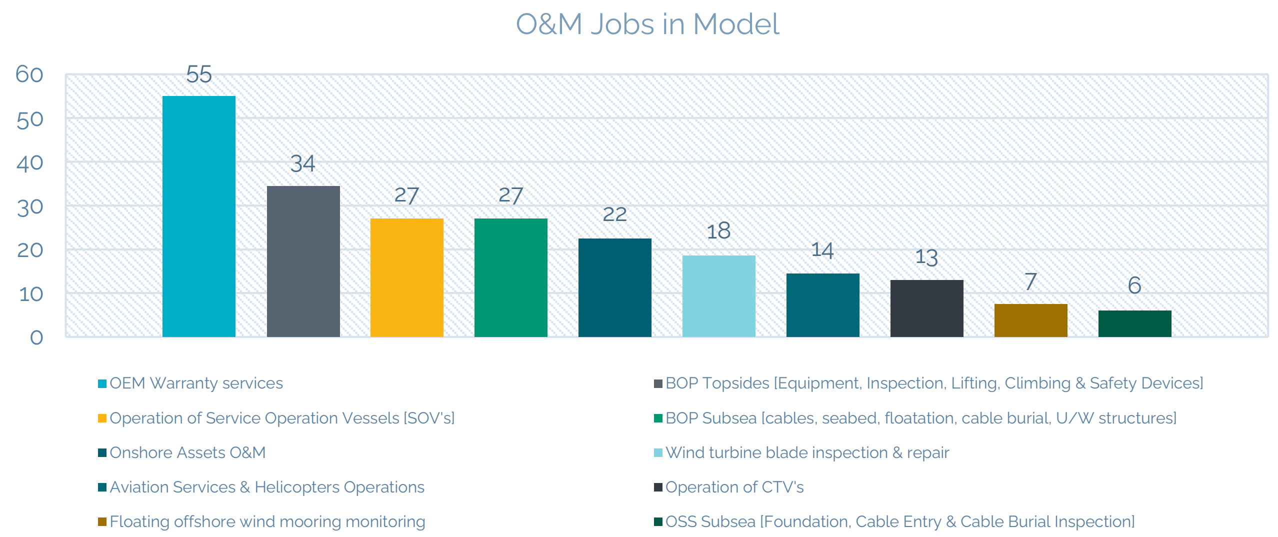



Consenting Jobs in Model
20
15
10
5
0
19
13
13
12
12
11
11
7
6
6
5
4
Front end engineering
Onshore civil engineering design
Hydrographic survey
Offshore Benthic / Pelagic Survey
Shallow water geophysical survey
Marine Mammal Survey
Consent application works
Project detailed commercial modelling
Environmental Impact Assessment studies
UXO Desk Based Investigation
Marine & economic risk management studies
Offshore Communications Studies


Pre-Construction Jobs in Model
50
40
30
20
10
0
44
29
28
28
26
24
18
18
17
17
17
17
13
13
Detailed design of OSS topsides & structures
Pre-Construction Procurement
Detailed design - floating foundation
Offshore Geophysical & Geotechnical Survey
Seabed cable route clearance
Construction / O&M port
Detailed design - transition piece and tower
High Voltage [HV] Engineering
Detailed design - cable solution
Detailed design - mooring solution
Export Cable Lay Engineering
Offshore demarcation buoys
Cable stability analysis
Foundation Monitoring Systems


Manufacturing Jobs in Model
700
600
500
400
300
200
100
0
664
350
137
136
136
86
77
66
56
44
32
27
27
26
16
14
Floating Foundations - Float Cans
Floating Foundations - Tubulars
WTG's
Tower Structures
Transition steelwork
WTG Blades
OSS Topsides
Seabed Anchors
OSS Floating Foundation
Inter-Array Cables
Export Cables
Davit Cranes
Cable Protection Systems
Mooring Chain
Shore base pontoons
Cable Floatation


Construction Jobs in Model
120
100
80
60
40
20
0
114
113
110
101
96
93
89
75
66
59
46
30
28
15
Onshore civil - shore end pull-in
Commissioning
Onshore Cable Installation
Inter-Array Cable Laying [IAC]
Export Cable Lay
Onshore Sub-Station Construction
FOW Asset Assembly
FOW Asset Mooring Pre-Lay
Floating Asset Instalation
FOW OSS Towage
Floating Asset Towage
Marine & shore base site set up
FOW OSS Instalation
WTG temporary offshore power including refuelling


O&M Jobs in Model
60
50
40
30
20
10
0
55
34
27
27
22
18
14
13
7
6
OEM Warranty services
BOP Topsides [Equipment, Inspection, Lifting, Climbing & Safety Devices]
Operation of Service Operation Vessels [SOV's]
BOP Subsea [cables, seabed, floatation, cable burial, U/W structures]
Onshore Assets O&M
Wind turbine blade inspection & repair
Aviation Services & Helicopters Operations
Operation of CTV's
Floating offshore wind mooring monitoring
OSS Subsea [Foundation, Cable Entry & Cable Burial Inspection]

5 FUTURE FLOATING OFFSHORE WIND WORKFORCE FORECASTS

Based on the results of the desk-based model project, and future casting based on the projected deployment scenarios, applying both technology improvement and efficiency factors, the active jobs (see definition in nomenclature) forecast in 2040 under Low, Base, and High case are as follows:

Total Active Jobs in 2040 **LOW Case** **10.1GW**	**22,225**	Active Jobs per GW in 2040 **LOW Case** **10.1GW**	**2,201**
Total Active Jobs in 2040 **BASE Case** **18.4GW**	**31,793**	Active Jobs per GW in 2040 **BASE Case** **18.4GW**	**1,724**
Total Active Jobs in 2040 **HIGH Case** **33GW**	**67,367**	Active Jobs Per GW in 2050 **HIGH Case** **33GW**	**2,039**

Under the LOW case growth scenario, the results forecast **22,225** total active direct and indirect jobs in the FOW sector in 2040.

Under the BASE case growth scenario, the results forecast **31,793** total active direct and indirect jobs in the FOW sector in 2040.

Under the HIGH case growth scenario, the results forecast **67,367** total active direct and indirect jobs in FOW sector in 2040.

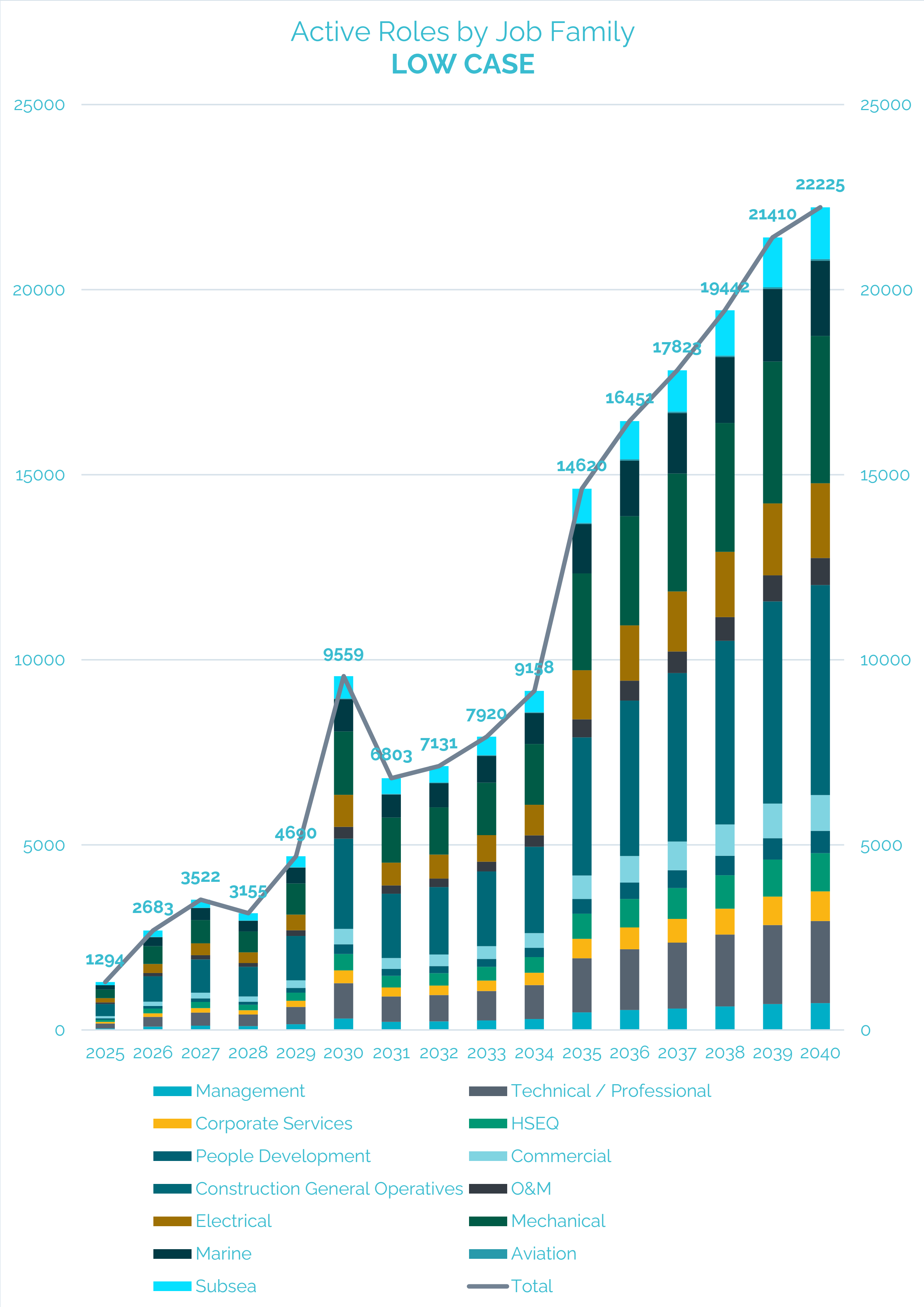
Based on the results of the 2021 OWIC Skills Survey, there are currently less than 500 dedicated jobs in floating wind, compared to 31,082 total jobs in the UK offshore wind industry, which give some indication of the scale of the potential growth

One of the differentiators and drivers of such significant job's growth is the size, scale, and volume required in manufacturing floating foundations. Based on the forecast models, an average of **80 floating foundations per year** will be required to meet the base case deployment scenario, assuming manufacturing commencing from 2025 onwards to 2040. This average increases to **130 foundations per year** taking into consideration the base case forecast to 2050 with an increase of 30GW of additional capacity, or 3GW installed per year.

The following graphics, show the breakdown of forecast active jobs requirements by job family and project phase for each of the LOW, BASE, and HIGH case scenarios.

In all scenarios, Manufacturing and Construction has the highest share of active jobs with Mechanical, Technical and Professional roles following with the next largest proportions.

The graphs show peaks and troughs especially in the early years of 2027, 2028, 2029 and 2030 which are caused simply by the increase and decreased in year-on-year activity


Active Roles by Job Family
LOW CASE
25000
20000
15000
10000
5000
0
1294
2683
3522
3155
4690
9559
6803
7131
7920
9158
14620
16451
17823
19442
21410
22225
2025 2026 2027 2028 2029 2030 2031 2032 2033 2034 2035 2036 2037 2038 2039 2040
Management
Technical / Professional
Corporate Services
HSEQ
People Development
Commercial
Construction General Operatives
O&M
Electrical
Mechanical
Marine
Aviation
Subsea
Total

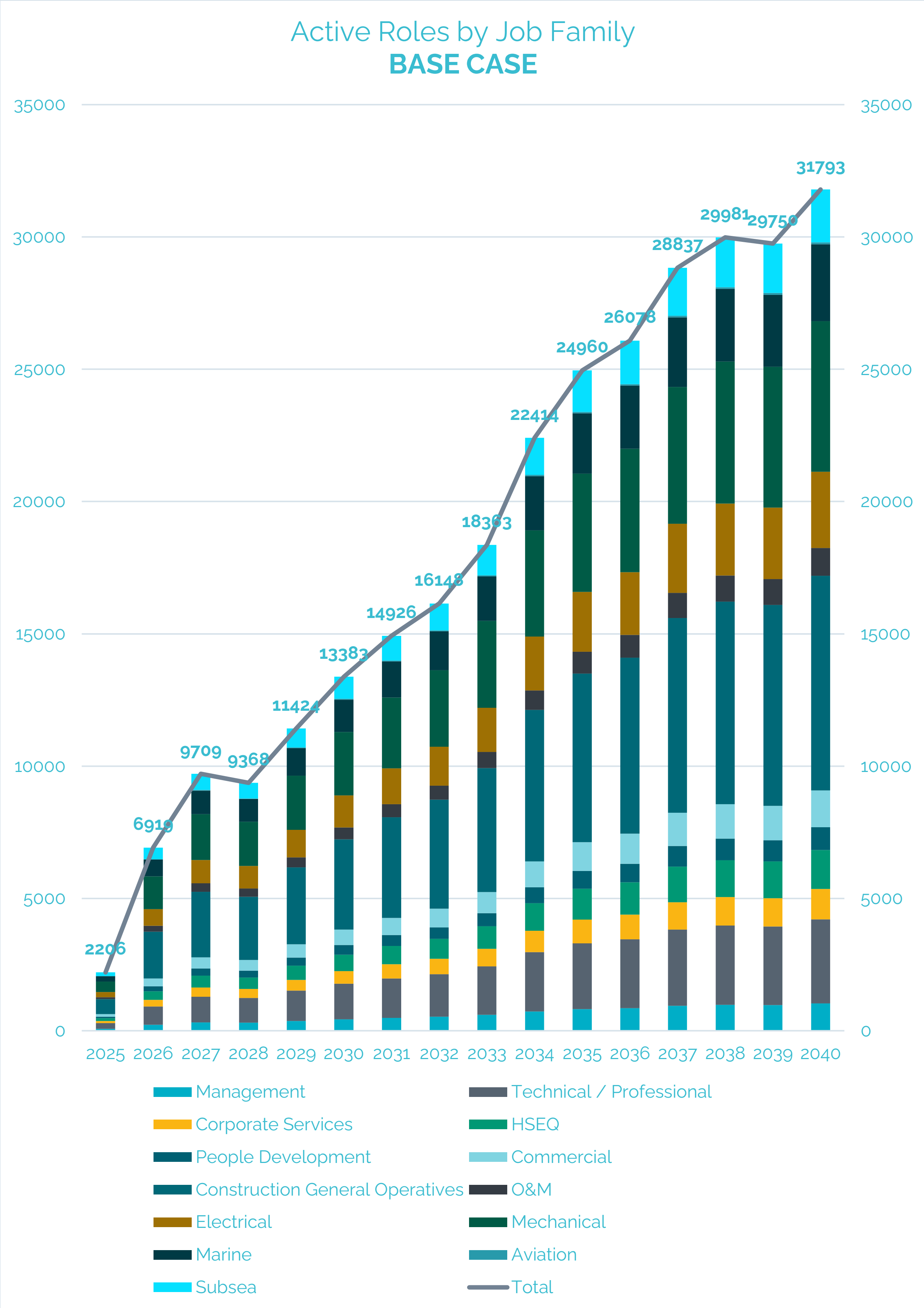


Figure 4 – shows a more detailed breakdown of year-on-year growth of active job requirements by Job Family under the BASE Case

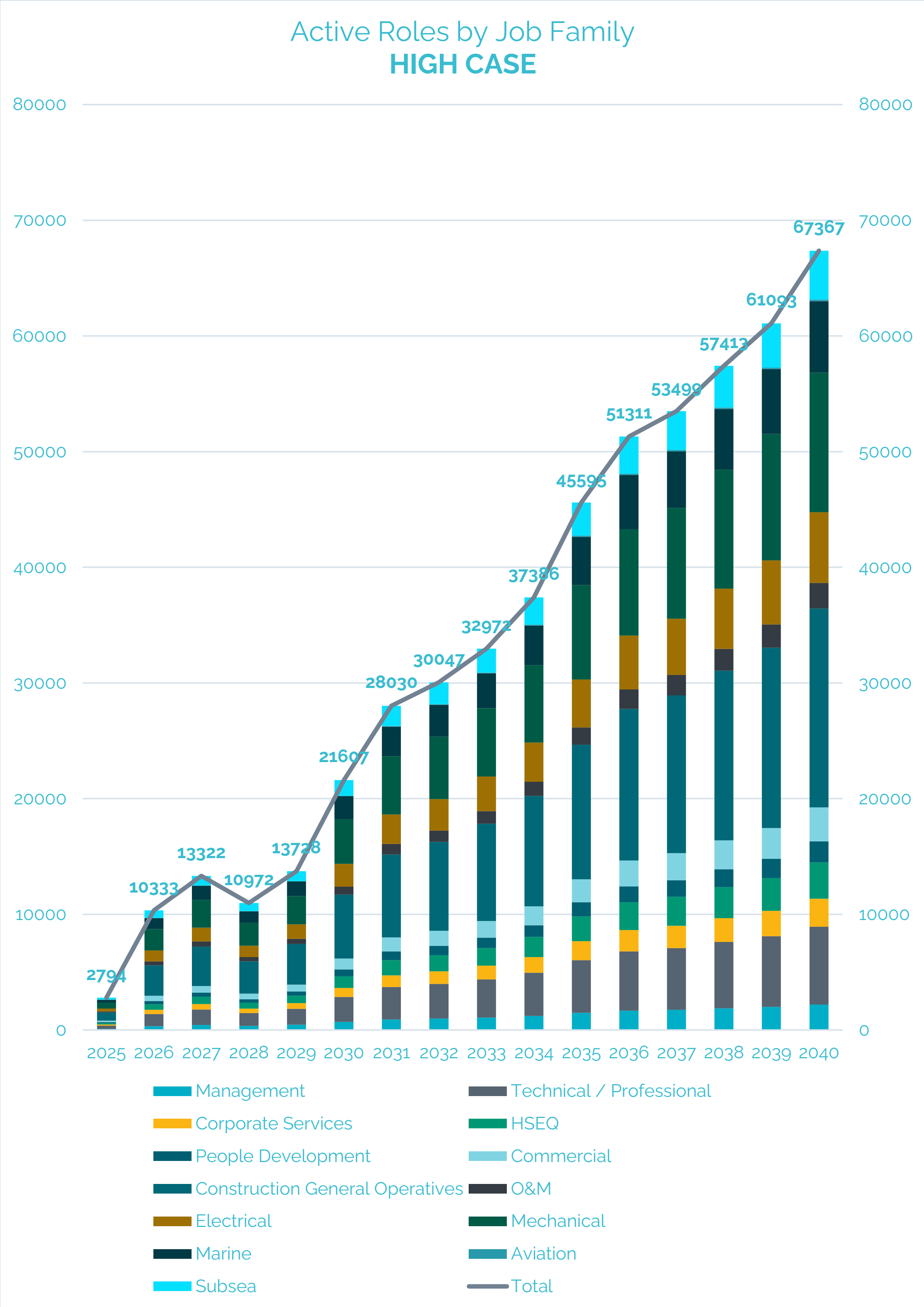


Figure 5 – Shows a more detailed breakdown of year-on-year growth of active job requirements by Job Family under the HIGH Case

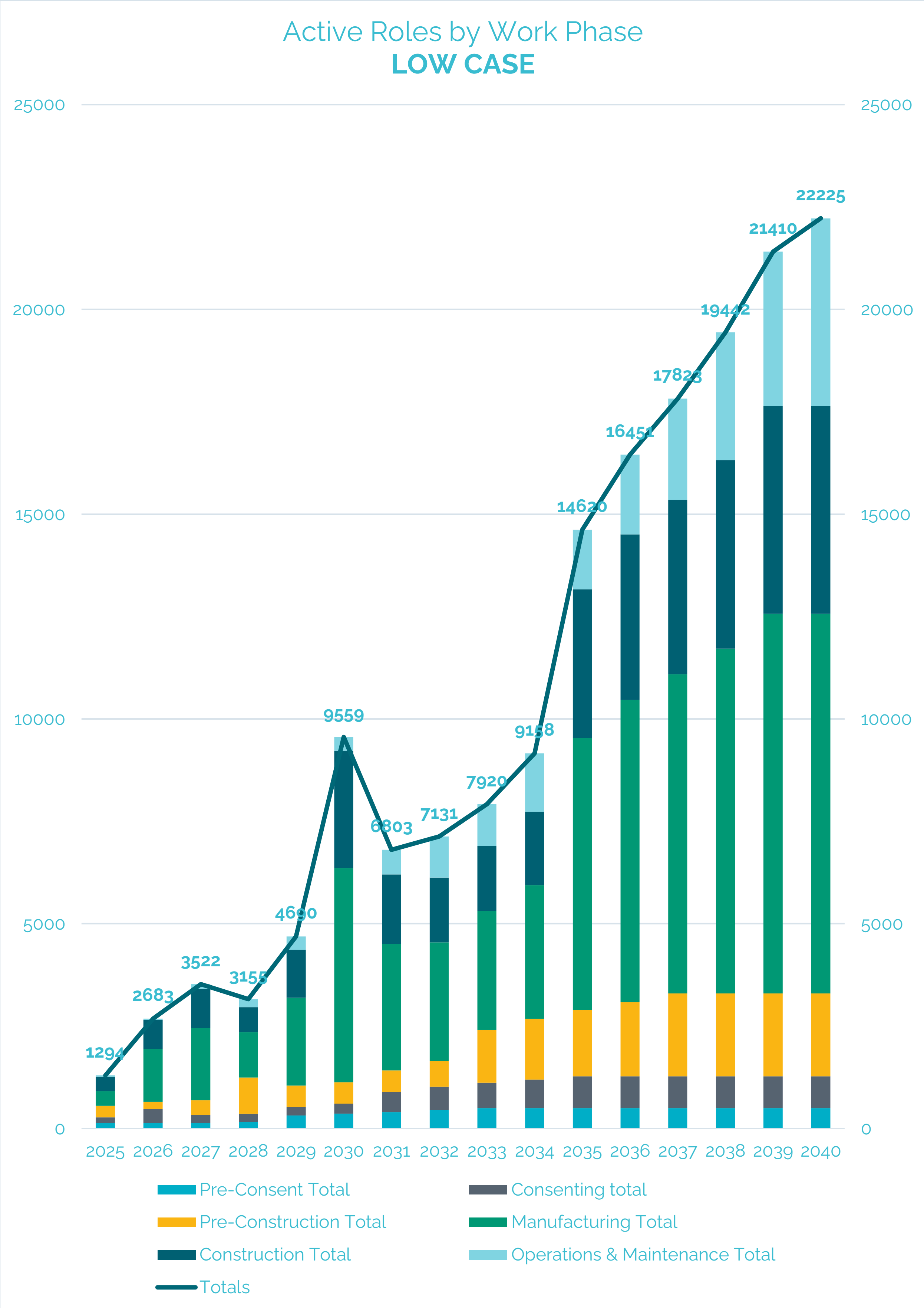


Figure 6 – shows a more detailed breakdown of year-on-year growth of active job requirements by project phase under the LOW Case

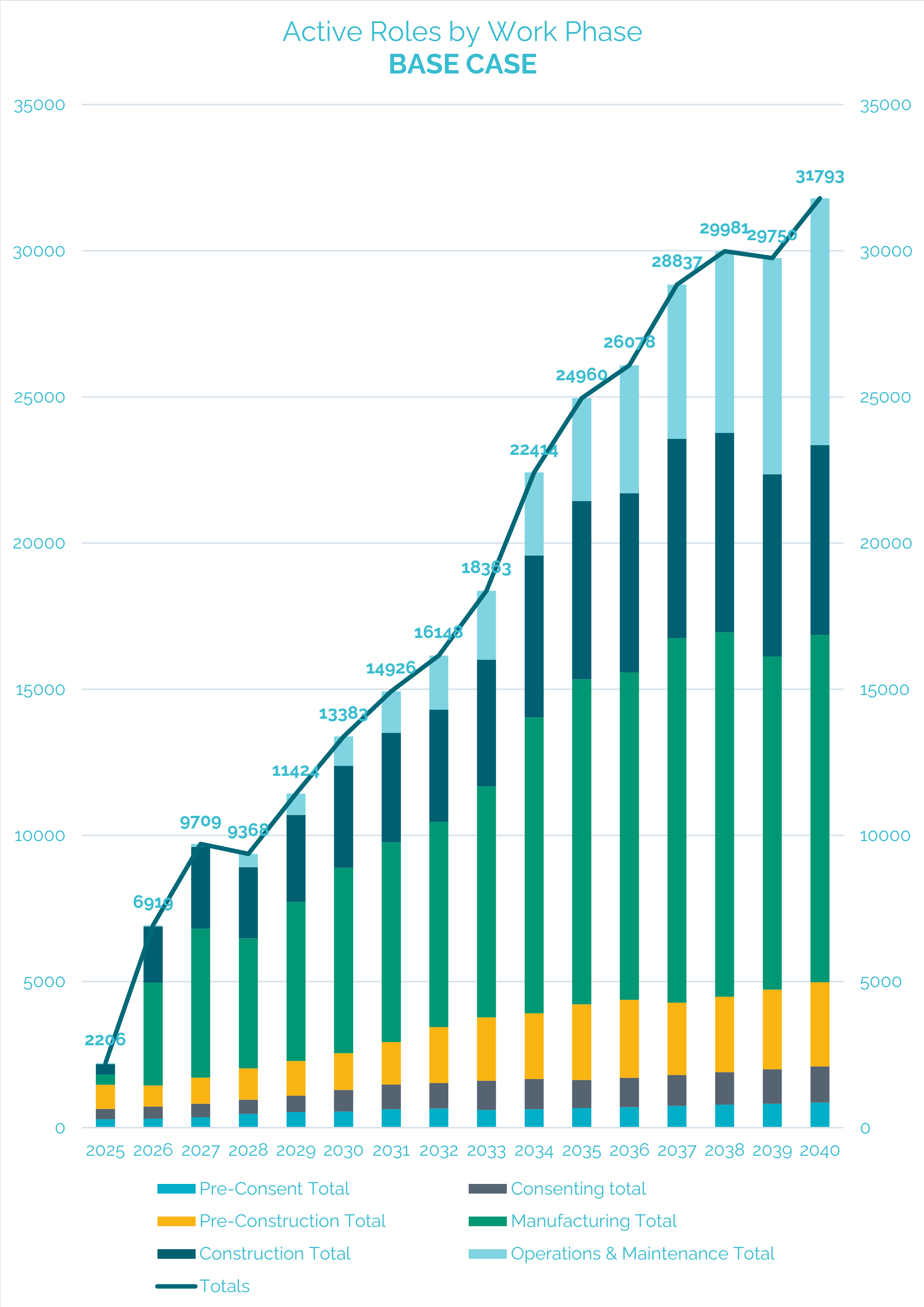


Figure 7 – shows a more detailed breakdown of year-on-year growth of active job requirements by project phase under the BASE Case

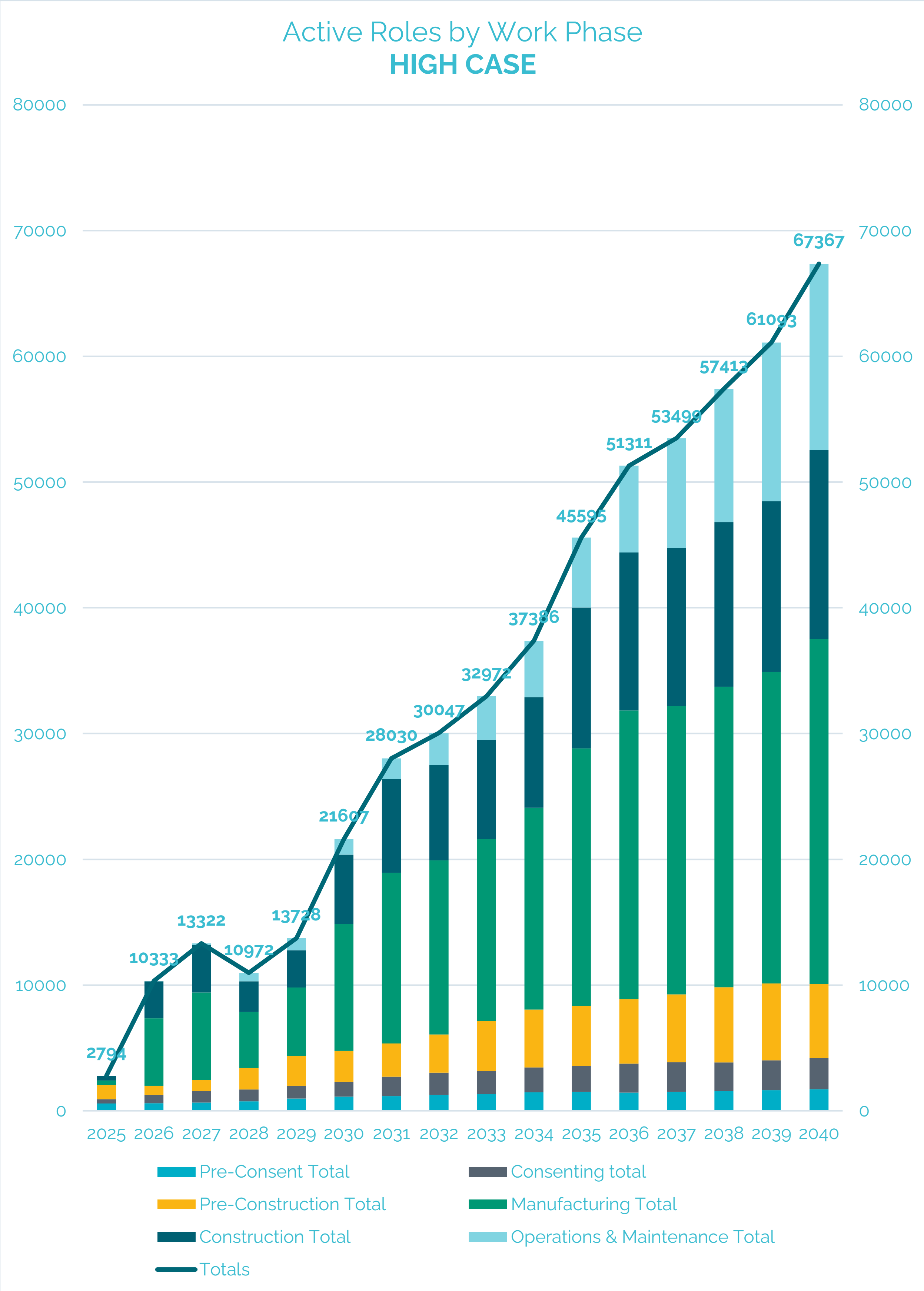


Figure 8 – shows a more detailed breakdown of year-on-year growth of active job requirements by project phase under the HIGH Case

6 FLOATING OFFSHORE WIND PEOPLE & SKILLS

6.1 Overview

The significant demand for additional skilled personnel to be brought into FOW in the coming years, may well be the single biggest challenge the sector faces. However, some of the skills gaps and shortages that floating wind may face are being addressed through the Offshore Wind Sector Deal work as they are beginning to impact on fixed bottom offshore wind.

The overarching challenges of the shortage of engineers including electrical and digital skills at both basic and specialist levels, have been an issue in the UK for many years. Unless the situation changes, the UK will lose the world leading skills position that it has held which was due in part because of its ability to attract engineers or cheaper workers from overseas. For "blue collar" roles that predominate in floating wind, importing talent will not be an option and following the pandemic there will be less people in UK available on the labour market. There is also still the perception that floating wind is a "highly skilled" sector, not recognising that floating wind could bring a significant opportunity to support some of the economically "cold spots" in UK as well as focusing on the increasing the representation from minority populations.

6.2 Definitions

The terms "skills gaps," "skills shortages" and "labour shortages" are used interchangeably giving some confusion in this area. An understanding and appropriate use of the terms will be required in the completion of future Contract for Difference Supply Chain Plans and so defined below.

A skills gap can be filled by training the existing workforce. A skills shortage requires the recruitment of more people into the industry. By implication, if there were a ready number of people in the market with the required skills, there would not be a shortage and so skills shortages are associated with insufficient applicants with the skills, experience, qualifications required to fill vacancies. A labour shortage is relating to the number of people required and not their skills.

6.3 Existing Skills Gaps and Shortages

There are numbers of areas with existing skills gaps and shortages that will be exaggerated by the growth in FOW.

Consenting skills – as increased projects are put forwards for consenting, the need for people with the environmental and marine knowledge also increases. The statutory nature conservation bodies and regulators are already finding challenges recruiting due to competition within the industry and the lack of awareness of this as a potential career path. This is being addressed by one of the Offshore Wind Sector Deal workstreams.

Project managers - there is an increasing shortage of project managers with the ability to manage major projects. The short-term solution is to attract from other sectors, but more will need to be done to provide routes for employees to develop and upskill. One potential route is to use project management apprenticeships.

Digital skills – the demand for basic digital skills is universal, and demand for more advanced digital skills continues to grow. Floating wind is developing at a time that employers are finding students do not have the basic skill level required, existing employees need upskilled and that there are insufficient specialists available in data analysis, data science and data engineering. Skills gaps are developing where engineers need to have a much higher skill level in, for example, data analysis.

Whilst a shortage of Senior Authorised Persons (SAPs - responsible for electrical safety) is currently giving a concern in the fixed bottom industry in the UK, if not addressed this will also present an issue for the floating wind sector. Whilst the numbers required are relatively low, a shortage has the potential to disrupt the delivery of projects.

Another area of specialisms that are in short supply are the high voltage skills and cable jointers. Both could benefit from a collaborative approach to working with other sectors e.g., military for high voltage and nuclear for cable jointing.

The fabrication work force is also an area for concern. The sheer number of welders required is a major concern, with existing work being undertaken by SOWEC (Scottish Offshore Wind Energy Council) and the ESP (Energy Skills Partnership) to gain a better understanding of the numbers, timing, and geographical location of ScotWind projects. A flow of projects will reduce the challenge, but a coincidence of several projects will place significant demands for welders.

We have seen many references to an existing shortfall in offshore marine rolls currently, indeed this was an area that came up most during the building of the Model Project and again this is an area that will be exaggerated by the growth in FOW

6.4 Longer term

The competition for engineering and digital skills will only increase, and in the tightest employment market for 50 years, the number of people available for work is reducing. In the build up to the development of the floating wind sector, there is a significant opportunity to improve the flow of information to people on the number of jobs, skills and qualification requirements, geographical locations (including overseas), potential employers etc. to ensure that people can make informed decisions on their careers at a much earlier stage.

As part of the dissemination, it is critical that more should be done in schools for students, teachers, and parents, not only encouraging far more to be excited about a STEM based future but to help recognise how other subjects can contribute to a role in the wind industry – in onshore, or offshore fixed bottom throughout the transition to floating. This will require a coordinated strategy delivering a sustained and impactful effort from all stakeholders including government, educational institutions, and industry to ensure the delivery of net zero rather than the sectors competing for people and skills.

7 UNDERSTANDING THE WIDER PEOPLE & SKILLS LANDSCAPE

Various government publications over the last few years have addressed the issue of skills gaps, including the most recently released, *Levelling Up White Paper*.

As one of its "levelling up missions," it pledges that by 2030, the number of people successfully completing high-quality skills training will have "significantly increased" in every area of the UK, with 200,000 more people successfully completing high-quality skills training annually in England. There will be 80,000 more completing courses in the lowest skilled areas to drive this progress.

The *Energy White Paper,* meanwhile, proposes developing a strategy for upskilling through the Green Jobs Taskforce and a National Skills Fund. It homes in on analysis from the London School of Economics, which estimates over 6M people have skills that will be affected by the transition to clean energy, representing 21% of current jobs.

It highlights this as an opportunity to develop new skills across a range of career pathways and ensure key sectors, such as construction (2.2M people employed) are fit for a clean energy future. It notes the need for more installers to retrofit existing buildings with energy efficiency and clean heat measures, or to ensure new-build homes are zero carbon ready. It further notes the Green Jobs Taskforce was tasked with producing an action plan for net zero skills across a range of sectors, targeting 2M net zero jobs by 2030, pinpointing the skills needed now, as well as those required long-term.

The *Green Jobs Taskforce Report*, which sets out a series of recommendations built around three key themes of driving investment in net zero to support excellent quality green jobs in the UK; building pathways into good green careers; and a just transition for workers in a high carbon economy.

It is under the second theme where the greatest reference to skills gaps is made. It notes how there will be significant increases in demand for green skills, with all levels of government, the education sector, industry, and unions needing to collaborate to address longer-term skills gaps and ensure lifelong pathways into good green careers are built.

To specifically address future and current skills gaps, it calls for the skills, knowledge and behaviours required for people to move into green jobs should be embedded into the curricula of relevant subjects at all stages in the learning cycle.

It also identifies a need for further education colleges that can provide regional and national hubs of expertise in zero carbon skills, saying these should build on the role of College Business Centres and the expansion of Institutes of Technology, to play a key role in levelling up the skills base, supporting regions to overcome persistent employment and productivity challenges and, ensuring high-quality delivery of training, which can plug both skills gaps and skills shortages.

It also references the need to diversify the workforce, noting the sector is not accessing talent from the widest possible pool.

The *Heat and Buildings Strategy*, meanwhile, identifies potential skills gaps when it comes to improving energy efficiency of building fabric, citing 105,000 energy efficiency installers, levels 2-4; 15,000 energy efficiency assessors, levels 2-4; and 10,000 retrofit coordinators, level 5. Citing the CITB, it puts the estimated training demand timeline at 1-4 years for training facilities and courses to 12,000 people per year, before after 5-10 years, 30,000 people are being trained per year. The government pledges to support training and new routes of entry in key skills shortage areas.

Elsewhere, the *Net Zero Strategy* warns of how skills gaps could hamper the net zero transition, if left unaddressed, and pledges to work alongside industry to build evidence on them, assess how far existing interventions are on course to address them, and where appropriate, identify further opportunities to flex key skills programmes to support green sectors and occupations. It specifically cites the risk of skills shortages in the decarbonisation of buildings – e.g. A lack of heat pump installer numbers.

8 CONCLUSIONS

FOW offers a huge future opportunity to develop a clean energy foundation for the UK and to develop and grow the people, skills and vocations employed in the sector, as well as providing significant opportunities to develop young people through training schemes, apprenticeships, and graduate roles.

It also offers the energy industry an exciting opportunity, to set from day one, meaningful diversity and inclusion targets around gender and ethnicity within an industry that can not only support their inclusion but offer them highly skilled and well-paid jobs for them to build careers.

The growing FOW sector, people, skills, and vocational requirements outlined in this report also offer opportunities for a workforce in transition from Oil & Gas and from the military or other routes and will be essential in achieving the challenges set by the growth.

The research, modelling and interaction with the industry whilst compiling this report together with the outputs from the forecast model have brought to the fore, several areas worthy of highlighting as conclusions or perhaps areas for further discussion and debate. Most of them are people, skills and vocations related but others are focussed on the FOW sector generally may provide the reader context.

This report concludes that:

1. **There appears to be a fundamental shift upwards in the numbers of blue-collar people, skills and vocations required by the FOW sector when compared to the current Fixed Wind (FW) sector:**
   - in FW, the average blue-collar workforce represents circa **45%** of the total workforce (data from the OWIC annual surveys in 2020 and 2021);
   - in FOW, the average blue-collar workforce represents circa **70%** of the total workforce (data from the desk-based model project built to underpin this report).

   This fundamental shift in workforce requirement appears to be created by the significant increase in onshore fabrication of the sizable floating foundations and mooring assembly's which are essentially new components in the manufacturing phase that does not exist in FW.

2. **There appears to be considerably less people, skills and vocations employed in the offshore construction and assembly of FOW assets when compared to the current FW sector.**

   This seems to be due to the shift away from the asset assembly activities being carried out offshore in FW (towers assembly, tertiary steel assembly, nacelle assembly and blade assembly), as in FOW they become carried out onshore in the fabrication and assembly ports.

3. **There is a sizeable increase in the numbers of marine people, skills, and vocations required for the marine towing and anchor handling activities associated with FOW when compared to the FW sector.**

   This appears to be due to the significant amount of FOW assets being towed from the onshore fabrication and assembly ports to the installation location, an activity that does not occur in the FW sector.

4. **There is an increase in the numbers of subsea people, skills, and vocations required for the marine installation and anchoring and hook up activities associated with FOW when compared to the FW sector.**

   This appears to be due to the significant amount of FOW moorings and mooring chains being installed at the offshore locations, an activity that does not occur in the FW sector.

5. **There seems to be a small reduction in the numbers of technical and professional people, skills, and vocations in the FOW sector when compared to the current FW sector.**

   This may be due to the increasingly repetitive nature of the design of assets in the FOW sector and the increasing industry productivity and technology efficiencies being fed into those designs.

6. **The changes to the people, skills, and vocational requirements in the FOW sector when compared to the FW sector (because of conclusions 1 to 5 above) will increase the pressure (but also offer an opportunity) on an increasing demand for the following example people, skills, and vocations:**

   Blue collar trades such as:

   - Onshore Construction Managers;
   - Onshore Construction Supervisors;
   - Onshore Construction Shift Managers;
   - Onshore Site Foreman;
   - Onshore Site Chargehands;
   - Skilled Welders;
   - Skilled Platters;
   - Skilled Electricians;
   - Forklift Drivers;
   - Crane Drivers;
   - Scaffolders;
   - Riggers;
   - Painters;
   - Site Labourers;
   - Quayside Operatives.

   Marine crews such as:

   - Captains;
   - Skippers;
   - Towing Masters;
   - Mooring Masters;
   - DPOs;
   - SSLs (Section Stability Leaders);
   - 1st Officers;
   - Marine Engineers;
   - Crane Operators;
   - Mates;
   - Deckhands;
   - Able Seafarers.

   Subsea expertise such as:

   - ROV Pilots;
   - ROV Technicians;
   - Party Chiefs;
   - Surveyors.

7. The existing people, skills and vocational challenges in the FW sector will become exaggerated by the significant growth in FOW across the following people, skills, and vocational areas:

- Consenting skills are an area of shortage that the FW sector is already exposed to. As an increasing pipeline of major projects are beginning to go through the National Strategic Infrastructure Planning (NSIP) process and calls on both developer consenting teams and the statutory consultee bodies [such as Natural England) are increasing;
- Electrical skills, both technician & engineering, are already giving cause for concern in the FW sector as increasing electrification of our society means increasing competition from other many other sectors as well as on the international stage;
- HV Electrical skills, at a Senior Authorised Person (SAP) level, but also at a technician level in respect of switchgear commissioning and experienced cable jointers and cable terminators;
- Digital skills focussed upon analytics, science and engineering are also already giving cause for concern in the FW sector as increasing demand for data systems and data reporting across industry and our society also means increasing competition. In the short term this appears to be in data management but longer term there is an increasing concern over general level of base level digital skills and most of the digital specialisms;
- The fabrication work force is also an area that raises concerns. The large numbers of welders that would be required is a real challenge. Some existing work is currently underway by SOWEC (Scottish Offshore Wind Energy Council) and the ESP (Energy Skills Partnership) to gain a better understanding of the numbers, timing, and geographical location of ScotWind projects, and an increase in the numbers of projects will help, however several projects at once will place significant strain on for instance welders.
- Engineering continues to lose popularity amongst our younger generations, with the numbers entering the disciplines falling on a year-by-year basis.

9 RECOMMENDATIONS

1. **The people, skills and vocational challenges, gaps and potential shortages outlined in items 1 to 7 above suggest several actions or solutions be considered by the FOW industry.**

   As part of the dialogue with stakeholders and suppliers to the FOW sector carried out in the preparation of the desk-based model, several suggestions were made in relation to people, skills, and vocations, these are listed below:

   - The industry should consider the creation of blue-collar workforce training centres close to FOW port facilities;
   - Given the scale of steel fabrication that will be needed in FOW, lessons should be taken on board by the FOW sector from the current efforts in the new build nuclear industry about the creation of welding centres of excellence, welding schools and common technical standards (ref TWI);
   - More generally the FOW sector should consider the establishment of new (or collaborative arrangements put in place with existing) training and education centres of excellence focussed on the areas identified with potential gaps or shortfalls;
   - Apprenticeship standards should be aligned to make it easier for young people to enter or transition into the FOW sector;
   - The FOW sector should take on board existing learning and best practice, a good example being that the work done by the Energy Skills Partnership in Scotland has meant that the colleges are well placed to support the industry going forward and allows it to react far quicker, have more consistency in training delivery and can prepare over the longer term more effectively;
   - The FOW sector needs to focus it's effort at the attraction of younger people into the industry, for example in schools, put in effort to enhance the numbers of girls attracted to do STEM subjects.

2. **The importance of the transitional workforce becoming available from Oil & Gas should not be underestimated and as such the FOW sector should embrace the cross-energy sector actions currently in draft and being rolled out as part of the North Sea Transition Sector Deal People & Skills plan in Q2 2022.**

   These actions include:
   - Deliver alignment and remove duplication in offshore safety standards by creating a coalition of standards bodies to lead, develop and implement change;
   - Develop an integrated framework of common safety and survival standards which is simple, flexible, visible, equitable and avoids duplication of training wherever possible;
   - Define clear career pathways across each sector of the industry, making visible the careers opportunities across the offshore energy sector;
   - Identify and prioritise future skills requirements across technical, digital, safety, and business disciplines and create alignment across industry, government, and academia;

- Adopt a digital-first approach to delivering training, development, and life-long learning to enable the workforce to develop cross-industry skills and careers;
- With cross-industry commitment, map and align standards for relevant technical and professional roles to create mutually recognised Offshore Energy Training Standards identifying short-term opportunities to make cross-sector standards mapping visible;
- Implement a digital mechanism that allows skilled workers to move easily across sectors, creating a more mobile and flexible workforce;
- Build on existing activities within each sector to establish an offshore energy diversity and leadership forum to promote cross-industry leadership, alignment, and action;
- Create a baseline of data across characteristic groups – cross-sector or cross-industry – and benchmark against other sectors;
- Create an Offshore Energy D&I roadmap highlighting areas where action needs to be focused with required resources, advice, and support mechanisms for industry to lead the change;
- Develop an offshore energy vocational education framework covering apprenticeships, T-Levels, National Vocational Qualifications, and Scottish Vocational Qualifications;
- Mapping and supporting a more integrated approach to graduate and post-graduate attraction, including internships, and work experience placements;
- Further develop and promote the My Energy Future STEM programme, including the creation of an employee value proposition for the offshore energy industry;
- Map and develop transition pathways to support the attraction and mobility of people from other engineering and technology sectors, including the transition of ex-military personnel and other routes to enter the sector;
- Agree an integrated approach to people and skills data collection, including common skills and job classifications to support forecasting;
- Develop and agree a common taxonomy for job roles, and job families to improve sector analysis, and support mobility of skills across sectors;
- Deliver an annual offshore energy workforce people and skills survey, providing robust data, intelligence and analysis of offshore energy people and skills.

3. The FOW industry should ensure that it works alongside the existing fixed offshore wind sector to attract the highly skilled workforce coming available from the military

The current offshore wind sector has had some degree of success in attracting and utilising some highly trained, motivated and highly professional ex-military staff that are available. The sector should begin the process of aligning with those that can provide a bridge to these skills, which could deliver a range a highly skilled and experienced personnel over the coming years, especially in Engineering, Mechanical, Electrical, Planning and Logistics disciplines.

10 OBSERVATIONS

During the process of building the Model Project and the dialogue this generated with contributors to the work, several interesting observations where made related to the scale of the challenge from a construction perspective. Whilst this report focusses on people and skills the authors did not want to lose that work and so have captured them in 1-5 below.

1. **The scale of the challenge, and accordingly the opportunity, that the growth in floating wind sets from an onshore fabrication perspective (floating foundations, towers, substations, and pile anchors) is unprecedented and must be factored into future planning.**

   Using the base case growth scenario of 18GW of FOW by 2040, and **assuming no concrete is used** in foundations, means that the industry will need to fabricate in the region of:

   - **1,227** x 4,000 tonne floating foundations with a combined weight of **4.9 million** tonnes of steel;
   - **1,227** x 1,700 tonne turbine towers with a combined weight of **2.1 million** tonnes of steel;
   - **36** x 2,500 tonne substation topsides with a combined weight of **4.9 million** tonnes of steel;
   - **36** x 4,000 tonne substation foundations with a combined weight of **90 thousand** tonnes of steel;
   - **3,824** x 80 tonne pile anchors with a combined weight of **305 thousand** tonnes of steel.**

   **Note – assumes pile anchors rather than drag anchors are used in all scenario's

2. **The overall combine weight of the steel required by 2040 under the base case growth scenario used in this report is circa 7.5 million tonnes, by 2050 this becomes 20 million tonnes and must be factored into future planning.**

   The significant requirement suggests that there could be a case for stimulating a UK based "Green Steel" manufacturing capability, fuelled by clean energy, and located strategically close to fabrication and assembly port facilities.

3. **The scale and number of FOW assets to be towed from the onshore fabrication and assembly port to the installation site suggests that minimising the sailing distance of these towing journeys will play an increasingly important cost effectiveness role in the FOW sector and must be factored into future planning.**

   This will drive the need for these facilities to be in the UK and located as close to the offshore development zones as is practical and will provide an opportunity and incentive to UK industry and government to stimulate and enable several UK ports to be able to deliver the fabrication, marshalling and assembly services needed for these global scale FOW assets.

4. **The scale and number of FOW assets to be marshalled, fabricated, and assembled suggests that carrying out these activities in a single sheltered deep-water port (for each individual project) will play an increasingly important cost effectiveness role in the FOW sector and must be factored into future planning.**

This will drive the need for these facilities to be in the UK and located as close to the offshore development zones as is practical and will provide an opportunity and incentive to UK industry and government to stimulate and enable several UK ports to be able to deliver the fabrication, marshalling and assembly services needed for these global scale FOW assets.

5. **The scale and number of FOW assets to be marshalled, fabricated, and assembled suggests that standardising as much as possible will play an increasingly important cost effectiveness role in the FOW sector and must be factored into future planning.**

As part of the dialogue with stakeholders and suppliers to the FOW sector carried out in the preparation of the desk-based model, it became clear that the more that could be standardised across the sector, the less pressure that will be put onto the supply chain and its people, skills, and vocations

Most often quoted during these conversations where anchors, types and sizes, cable types and sizes, mooring chain and rope types and sizes, safety standards and workforce training requirements.

11 NEXT STEPS

FOW offers the UK a huge future opportunity to develop a clean energy foundation for the UK and to develop and grow the people, skills and vocations employed in the sector, as well as providing significant opportunities to develop young people through training schemes, apprenticeships, and graduate roles.

The ORE Catapult FOW CoE and the report authors Opergy Limited hope that this report has provided a useful view of the future of people, skills, and vocational requirements in the UK's FOW sector and that it has set the scene for further debate.

We also hope that it will stimulate further dialogue and further action to help support the opportunity that presents itself to the UK economy.

There are further steps that should be taken to further our understanding of the people, skills and vocational challenges that face the industry to ensure the UK takes advantage of this enormous potential energy sector.

1. **The UK has the potential to lead the world in FOW, but this report also highlights that there are potential shortage of the People, Skills and Vocations required to deliver this goal, these People, Skills, and Vocations will come from several sources including cross sector transfer from Oil & Gas, however there is no clear cross energy sector data available on People, Skills, and Vocations**

   This report recommends that an annual cross energy sector workforce survey and report in line with what is already done by OWIC and RUK be put in place covering Offshore Wind, Oil & Gas, Hydrogen Production and CCUS

2. **The data gathered and built to produce this report has given us an insight into the future but has not provided a full picture.**

   This report recommends that a more detailed study be undertaken focussing on providing more granularity on the specific People, Skills and Vocations shortages that the growth outlined in this report will create.

3. **The model built was produced around a single set of assumptions, and only provides a monochromatic view of the methodology to build out the sector.**

   This report recommends that further modelling around other floating scenario's, foundation types etc would produce a rounded view of the people, skills and vocations needed and further granularity.

4. **Communicating the findings, conclusions and recommendations associated with this report is essential to ensuring its usefulness**

   This report recommends that a structured and scheduled series of roll out roadshows would ensure real value was gained from its production.

APPENDICIES

APPENDIX 1 - GROWTH OF FLOATING OFFSHORE WIND – A LITERATURE REVIEW

Development of Floating Offshore Wind

Over 91% of offshore wind capacity is installed in European waters, albeit at an average depth of 27 metres, with shallow waters becoming scarce and limited space, according to the Catalonia Institute for Energy Research (IREC) (*Floating offshore wind turbines: Challenges and opportunities*). Higher wind speeds can be found further offshore.

However, bottom-fixed turbines have depth limitations (ECN: *Cost Modelling of Floating Wind Farms*) which means a different solution is needed to extract vast quantities of offshore wind resource from deeper waters – enter, FOW.

The National Renewable Laboratory (*Overview of Floating Offshore Wind*) highlights how 80% of global offshore wind resources are suited for FOW. IREC further highlights the respective market potentials for floating turbines, including 4,000GW for Europe, 2,450GW for the USA, and 500GW in Japan. ETIP Wind (*Floating Offshore Wind, Delivering Climate Neutrality*) also cites a technical potential of 4,000GW for Europe, as well as more than 14,000GW for the rest of the world.

Wind Europe (*Floating Offshore Wind Energy – A Policy Blueprint for Europe*) highlights FOW as an opportunity to cement Europe's leadership in renewables globally, while ETIP Wind says the continent will need 150GW of it by 2050 to successfully become climate neutral.

The UK government has already signalled its support to FOW through the *10-Point Plan*, *Energy White Paper*, and *Net Zero Strategy*, with 1GW of capacity targeted for 2030. This, it says, will be a "steppingstone" to further growth in the UK, helping to develop jobs and opportunities in the associated industrial supply chain and place the UK at the forefront of FOW, which will use both the North and Celtic Seas, the English Channel, and the Atlantic Ocean.

The Crown Estate has a *Celtic Sea Floating Wind Programme*, where it suggests that with the UK a global leader in offshore wind deployment, floating wind is the "next frontier in this green growth strategy" and sets a target for 4GW of new capacity in the Celtic Sea alone by 2035. The Carbon Trust, meanwhile, in the summary report for its *Floating Wind Joint Industry Project Phase I*, predicts the UK can have 5GW of capacity by 2030, albeit with low certainty, as well as forecasting 29.2GW worldwide.

The other potential impacts of achieving such capacity are a little harder to come by, however, such as job creation and economic benefits – at least in the documents reviewed. The UK government forecasts that its of offshore wind as a whole – 40GW by 2030, which includes 1GW of FOW – will support 60,000 jobs in 2030.

As for FOW on its own, in *Industrial Leadership – Unlocking the UK's Floating Wind Potential*, ORE Catapult, Renewable UK and Scottish Renewables do offer a specific estimate, suggesting it can create more than 29,000 jobs and deliver £43.6bn in GVA by 2050. In terms of how much capacity this would likely be from, it notes the UK will require almost 100GW of offshore wind to deliver net zero, with up to 50% coming from floating wind by 2050, rising to 60% if the aggregate installed capacity target rises above 150GW.

In that same report, ORE Catapult, Renewable UK and Scottish Renewables acknowledge the UK has world leading skills and experience in fixed bottom offshore wind, oil and gas and subsea engineering, leaving it well placed to develop a FOW industry. On oil and gas, it says floating wind will support a transition of highly skilled jobs from that industry into offshore wind renewable energy. It identifies floating wind and oil and gas having crossover in key technology areas, namely substructures, mooring and anchoring systems, and dynamic cable systems.

ETIP Wind (*Floating Offshore Wind, Delivering Climate Neutrality*) also says FOW is an opportunity to repurpose Europe's oil and gas infrastructure and provide sustainable alternatives for Europe's offshore workforce.

The Carbon Trust (*Floating Offshore Wind: Market and Technology Review*) highlights floating wind as an "obvious candidate" for the North Sea oil and gas industry to safeguard local jobs in Scotland, while Policy Exchange (*The Future of the North Sea*) details how the skills of the oil and gas industry have a crucial role in delivering net zero, referencing CCUS, hydrogen and floating wind, with their experience in designing and operating floating platforms in offshore environments needed for the latter.

As well as oil and gas, there is crossover with the fishing industry. ORE Catapult (*Floating Offshore Wind and Fishing Interaction Roadmap*) notes a requirement for guard or support vessels during the construction of a FOW farm as a potential economic opportunity for fishing vessels or their crew, either permanently or seasonally, as well as in pre-construction and operational work.

Obviously established onshore and offshore wind project developers also have a role to play with transferable skills (ORE Catapult – *Supply Chain Report: Benefits of Floating Offshore Wind to Wales and the South West*), while ETIP Wind (*Floating Offshore Wind, Delivering Climate Neutrality*) suggests industrialised coastal regions impacted by a decline in shipbuilding have the most to gain from reorienting their infrastructure to FOW, perhaps suggesting another potential labour source.

This is echoed by Wind Europe (*Floating Offshore Wind – A Policy Blueprint for Europe*), which, while highlighting the positive impact FOW will have on local marine infrastructure, increasing local economic activities in ports and supporting job growth in all marine industries at local, regional and national levels, also says industrialised coastal regions affected by a decline in shipbuilding have the most to gain from investing in floating wind and can convert their existing infrastructure.

Potential jobs sparked from a development of floating wind include more jobs in the wind turbine industry and subindustries related to offshore, including ports, shipyards, transportation, construction, and operations and maintenance (Wind Europe – *Floating Offshore Wind Vision Statement*).

Other documents look at some of the risks and challenges likely to be encountered when trying to develop FOW. ORE Catapult (*Floating Offshore Wind Technology and Operations Review*) warns of significant gaps between the current number of supply chain companies with capabilities required to support the FOW industry and the number needed to deliver anticipated deployment in the 2030s and beyond. This is especially so in relation to the manufacture of key FOW subsystems, such as substructures, mooring systems, and dynamic cables.

The issue of Brexit on FOW is discussed by the University of Strathclyde and others (*Offshore wind, ready to float?*), namely the fact that leaving the single market and customs union could result in tariffs, supply chain disruption and a lack of access to skilled labour. It notes the UK is very reliant on overseas products and services to deliver FOW projects.

Several documents also assess regional impacts, looking into where the best opportunities for FOW are. IREC (*Floating Offshore Wind Turbines: Challenges and Opportunities*) cites France, Norway, Portugal, Spain, Scotland, the USA, Japan, and Taiwan among the markets where floating wind turbines are an opportunity, while Shannon Foynes Port and GDG (*Offshore Wind Potential Study*) make the case for FOW in Ireland.

They state a "major appetite and confidence" in the future of floating wind in Ireland. The Irish West has some of the best wind resources in the world, with consistent wind speeds greater than 14m/s and the area available for floating wind being larger than the entire island of Ireland.

ORE Catapult (*Floating Offshore Wind Technology and Operations Review*) suggests for the UK, a substantial proportion of its future commercial FOW farms will be in the Scottish waters. In *Floating Offshore Wind: Cost Reduction Pathways to Subsidy Free*, it cites the most effective FOW project areas in England and Wales as specifically being North East England and the Celtic Sea.

It also looks at the "significant opportunity" for FOW for industries surrounding the Celtic Sea in its *Supply Chain Report: Benefits of Floating Offshore Wind to Wales and the South West*. It says between 15-50GW of floating wind capacity could be developed in the Celtic Sea between the UK and Ireland, and notes of the opportunity to develop a local supply chain for Wales and the Greater South West region.

It refers to the target of 60% of local content in offshore wind projects and explains how the majority of pilot FOW projects deployed in Scotland so far have had a limited contribution from the UK supply chain. The major fabrication and installation works have been undertaken in Spain and Norway.

Therefore, for Wales and the South West of England, it maps out how things can be different, noting its several established onshore and offshore wind project developers that can play a role, and how they can use local professional services. These include accounting, legal, HR, IT roles and direct project development roles, both during construction and operation of the project.

It also finds an opportunity for companies in the region to produce secondary steel for projects, highlighting companies clustered in the South West and several in Cornwall that have potential expertise in serial manufacturing parts, such as boat landings, external access ladders, external and internal work platforms, and corrosion protection systems.

Then there's the Crown Estate's *Celtic Sea Floating Wind Programme*, where it notes that "significant early investment" is needed for the sector to reach its potential, given how delivering FOW at scale will place substantial demands on infrastructure and the supply chain across the UK.

It cites integration of turbines with the substructure and its tow to site as a significant opportunity for regional ports. It further says that full-scale commercial scale projects will likely drive this activity into regional ports close to project locations, with facilities supporting this activity likely suitable for supporting long-term operation and maintenance services.

People and Skills Context

With shallow waters becoming scarce and limited in space (IREC – *Floating offshore wind turbines: Challenges and opportunities*), FOW can serve as a solution and make the most of deeper waters with higher wind speeds.

The UK government has signalled its support to FOW through its *10-Point Plan*, *Energy White Paper,* and the *Net Zero Strategy*. It has set a goal for 1GW of capacity by 2030, describing this target as a "steppingstone" to further growth in the UK, helping to develop jobs and opportunities in the associated industrial supply chain and place the UK at the forefront of FOW.

The Crown Estate (*Celtic Sea Floating Wind Programme*), meanwhile, is targeting 4GW of new capacity in the Celtic Sea alone by 2035, while The Carbon Trust (*Floating Wind Joint Industry Project Phase I Summary*) which finds the UK can have 5GW of capacity by 2030, albeit with low certainty. It also forecasts 29.2GW of capacity worldwide.

In terms of the impact on jobs, estimations are a little harder to come by. The UK government has forecast that its growth of offshore wind as a whole – 40GW by 2030, which includes 1GW of FOW – will support 60,000 jobs in 2030. As for FOW alone, ORE Catapult, Renewable UK, and Scottish Renewables (*Unlocking the UK's Floating Wind Potential*) suggest the UK will need close to 100GW of offshore wind to deliver net zero by 2050, with up to 50% of this floating wind – 60% if aggregate installed capacity exceeds 150GW. It estimates this would create more than 29,000 jobs in FOW and deliver £43.6bn in GVA by 2050.

The report cites the UK's world leading skills and experience in fixed bottom offshore wind, oil and gas, and subsea engineering as leaving it well placed to develop a FOW industry. On oil and gas, it says it will support a transition of highly skilled jobs from that industry into offshore wind.

The role of oil and gas in floating wind is repeated by ETIP Wind (*Floating Offshore Wind, Delivering Climate Neutrality*) – an opportunity to provide sustainable alternatives for Europe's offshore workforce – and Policy Exchange (*The Future of the North Sea*), which highlights the transferable skills of oil and gas workers in designing and operating floating platforms in offshore environments for FOW.

There is also crossover with the fishing industry, with a role for guard or support vessels during construction of a FOW farm, one that could be filled by fishing vessels or their crew (ORE Catapult – *Floating Offshore Wind and Fishing Interaction Roadmap*), as well as an opportunity for industrialised coastal regions impacted by a decline in shipbuilding to repurpose their infrastructure for FOW (Wind Europe – *Floating Offshore Wind – A Policy Blueprint for Europe*).

Other documents speak of challenges with regards to an insufficient supply chain (ORE Catapult – *Floating Offshore Wind Technology and Operations Review*) and the impact of Brexit, as UK floating wind demonstration projects have so far relied on overseas products and services (University of Strathclyde – *Offshore wind, ready to float?*).

What is the government saying?

Various government publications over the last few years have addressed the issue of skills gaps, including the most recently released, *Levelling Up White Paper*.

As one of its "levelling up missions," it pledges that by 2030, the number of people successfully completing high-quality skills training will have "significantly increased" in every area of the UK, with 200,000 more people successfully completing high-quality skills training annually in England. There will be 80,000 more completing courses in the lowest skilled areas to drive this progress.

The *Energy White Paper,* meanwhile, proposes developing a strategy for upskilling through the Green Jobs Taskforce and a National Skills Fund. It homes in on analysis from the London School of Economics, which estimates over 6M people have skills that will be affected by the transition to clean energy, representing 21% of current jobs.

It highlights this as an opportunity to develop new skills across a range of career pathways and ensure key sectors, such as construction (2.2M people employed) are fit for a clean energy future. It notes the need for more installers to retrofit existing buildings with energy efficiency and clean heat measures, or to ensure new-build homes are zero carbon ready. It further notes the Green Jobs Taskforce was tasked with producing an action plan for net zero skills across a range of sectors, targeting 2M net zero jobs by 2030, pinpointing the skills needed now, as well as those required long-term.

So, onto the *Green Jobs Taskforce Report*, which sets out a series of recommendations built around three key themes of driving investment in net zero to support excellent quality green jobs in the UK; building pathways into good green careers; and a just transition for workers in a high carbon economy.

It is under the second theme where the greatest reference to skills gaps is made. It notes how there will be significant increases in demand for green skills, with all levels of government, the education sector, industry, and unions needing to collaborate to address longer-term skills gaps and ensure lifelong pathways into good green careers are built.

To specifically address future and current skills gaps, it calls for the skills, knowledge and behaviours required for people to move into green jobs should be embedded into the curricula of relevant subjects at all stages in the learning cycle.

Sticking with education, it identifies a need for further education colleges that can provide regional and national hubs of expertise in zero carbon skills, saying these should build on the role of College Business Centres and the expansion of Institutes of Technology, to play a key role in levelling up the skills base, supporting regions' to overcome persistent employment and productivity challenges and, ensuring high-quality delivery of training, which can plug both skills gaps and skills shortages.

It also references the need to diversify the workforce, noting the sector is not accessing talent from the widest possible pool.

The *Heat and Buildings Strategy*, meanwhile, identifies potential skills gaps when it comes to improving energy efficiency of building fabric, citing 105,000 energy efficiency installers, levels 2-4; 15,000 energy efficiency assessors, levels 2-4; and 10,000 retrofit coordinators, level 5. Citing the CITB, it puts the estimated training demand timeline at 1-4 years for training facilities and courses to 12,000 people per year, before after 5-10 years, 30,000 people are being trained per year. The government pledges to support training and new routes of entry in key skills shortage areas.

Elsewhere, the *Net Zero Strategy* warns of how skills gaps could hamper the net zero transition, if left unaddressed, and pledges to work alongside industry to build evidence on them, assess how far existing interventions are on course to address them, and where appropriate, identify further opportunities to flex key skills programmes to support green sectors and occupations. It specifically cites the risk of skills shortages in the decarbonisation of buildings – e.g. A lack of heat pump installer numbers.

General Onshore Construction Workers

The Engineering Construction Industry Training Board (ECITB), in its *Towards net zero* report, found that of over 20 decarbonisation technologies assessed, while none of the nine main ones anticipated to be rolled out over the next 10 years are expected to bring about a major skills disruption, caution is needed as skills will have to be transferred from other sectors, raising the possibility of significant workforce shortages.

This will be particularly problematic for technologies adopted in the short-term, with a limited timeframe to retrain and/or recruit personnel and highly disruptive technologies expected to be deployed in the medium and long-term. The decarbonisation of industrial clusters will bring about added complexity, with tight deployment timeframes and the wide variety of technologies set to be rolled out potentially exploiting current skills shortages. This makes industry collaboration key to bring multi-sector expertise together.

A 2021 article for Construction News cites ONS statistics, which revealed 33,000 vacancies between April and June (2021) – the second highest in the past 20 years, with the first coming in the preceding period of March to May (35,000). Commentators link it to high demand, with a catch up in work following Covid restrictions in 2020, as well as a lack of skilled labour, exacerbated by a loss of a substantial amount of EU workers and the industry losing people to outside of the construction sector.

The CITB's Construction Skills Network, meanwhile, forecasts that output will grow at an average rate of 4.4% between 2021 and 2025. It says the industry will reach 2019 levels of output in 2022 as it recovers, post-Covid. Overall, an additional 217,000 workers are needed, working out at 43,000 a year, up to 2025. Infrastructure and home building will see the fastest growth. It warns the industry will have to plug skills gaps for bricklayers and dry liners, as well as investing in leadership and management, digital skills, and skills related to energy efficiency to boost productivity, while addressing growing challenges – namely net zero and building safety. It also identifies Brexit as having made things such as attracting talented people to the industry, making it easy to join, and retaining existing skills as a "more acute challenge."

Offshore Workers

In its report, *Net Zero North Sea*, IPPR looks at how to ensure a managed transition for oil and gas in Scotland and the UK following Covid-19.

It draws on how the skills system is ill-equipped to support a just transition. It specifically cites the Open University's annual Business Barometer which finds 85% of respondents in mining and energy sectors reporting skills shortages. Issues include insufficient funding for adult retraining, especially in England; insufficient devolved powers for skills, meaning local governments with the best understanding of local skills are unable to sufficiently tailor locations to their local areas; a lack of foresight over future skills needs, owed to policy uncertainty at the national level and a lack of comprehensive skills audits; a lack of commonly recognised accreditation across the industry, creating administrative and cost barriers to workers with transferable skills but facing having to retrain unnecessarily; poaching within the energy sector, reducing the incentive for smaller companies to train workers and pay into levies; and competition from other sectors.

In Offshore Magazine, Mike McKinley of Subsea Innovations warns of the subsea engineering market standing at a crossroads – it should be noted this was 2020. McKinley outlines how between 2015 and 2017, over 80% of subsea field development engineers in the US were laid off. Many senior and principal subsea engineers were among these. Further engineers opted not to wait for the downcycle to end, either retiring or exiting the industry. This left the industry losing a significant amount of knowledge and expertise "without warning or preparation."

A younger, smaller workforce was left in its place. Upstream engineering, procurement, installation, and commissioning (EPICs) firms were hit especially hard. Covid-19 then exacerbated problems further.

Looking to the post Covid-19 environment, McKinley expects the first issue for a subsea engineer not currently employed to be decide whether to stay in the market or not, noting it is a "given" demand will continue falling. Deciding factors on who gets a job will include A) can they get it done? B) how fast? And C) how cheap? This is leading operators and EPICs to turn to contractors, with this ratio of contract to permanent subsea engineers set to continue rising. McKinley recommends those who opt to stay in the industry to consider contracting their services, adding operators and EPICs will have "significant interest" in small consulting firms, comprised of two to three reputable engineers for the near future. This is where unemployed engineers should focus.

The University of Manchester warns of the skills shortage being the biggest threat to offshore wind, not just in relation to immediate technical specialists, such as divers for subsea inspections, but also the need to develop skills to support long-term innovation in a bid to persuade companies to relocate their high value manufacturing to the UK.

It says the current workforce is just about managing to cope with the 10GW in place, but bottlenecks are occurring that could put the UK's 2030 target of 40GW at risk. It sets out seven areas to prioritise action and address skills shortages: investing in R&D; developing specialist doctoral colleges; creating conversion programmes for graduates; scaling local training programmes; retaining existing skills from oil and gas industries; driving industry collaboration; and using best practices in existing agencies.

Chair of AFBE-UK Scotland, Ollie Folayan, writes in Energy Voice on how any increase in activity for the oil and gas sector as it recovers from the 2020 slump will be short-lived if services offered do not tie in with the energy transition. Many major oil and gas operators recognise this, with many embarking on a process of restructuring for a world beyond oil. This has seen a significant reduction in staff. For the mid-term, Folayan warns of a risk of not so much of increased unemployment but more, underemployment, with some skills becoming obsolete and the demand for skills relevant to the transition coming into a sharper focus.

In its 2018 report, *Skills and Labour Requirements of the UK Offshore Wind Industry*, Energy & Utility Skills finds total power output from offshore wind could rise to 35GW by 2032, with employment estimates suggesting the workforce could grow from 10,000 in 2017 to 36,000 in 2032.

Employment levels will increase in all phases of the project lifecycle, especially in Construction and Installation (+6,700) and Operations and Maintenance (+6,900). Employment demand is tipped to be strongest for technicians and engineers, with an estimated additional requirement for 10,200 by 2032. This represents almost half of new job creation, reflecting the highly skilled, technical nature of many of the tasks undertaken by the workforce.

Challenges include competition for skills among the energy and infrastructure sectors. Availability of new talent could be an issue with the labour market extremely tight (record high employment, low unemployment) and shows little sign of easing. It tips post-Brexit immigration policies to further exacerbate challenges and notes the UK is already short of around 20,000 engineering graduates per year. This was also written before Covid-19.

It also discusses skills supply and demand. Many of the base skillsets needed for offshore electricity generation and transmission are like those already demanded across the wider energy sector, both onshore and in oil and gas, where workforce reductions have slowed. Business, commercial, stakeholder/supply chain management and advanced first aid and rescue skills are also all central to a successful future.

Another aspect of the report is how it warns of the issue of the availability of locally source higher-level skills. This is due to the number of UK graduates with degrees relevant to the offshore wind industry. There were 9,185 in 2015-16, with universities in the North East (595) and East of England (185) struggling compared to those in East Midlands and Yorkshire & Humber (1,900).

In 2017, Windpower Monthly looked at the findings of the Made Smarter Review. This found the potential for digitalisation in the UK's offshore wind industry to be significant, but a skills shortage being a barrier, along with the need for greater stability in the government's approval system and more collaboration with other, relevant technological sectors – including aerospace or nuclear.

With the industry set to support 60,000 direct and indirect jobs in the UK by 2032, it is key the sector ensures the right skills are developed today and continues field deployment, in the face of the skills shortage, the need to industrialise modern technology and tensions over UK content. Skills required in the sector are like those existing within other sectors, such as general manufacturing and the offshore oil and gas sector. It notes the sector's strong tradition of delivering engineering skills at all levels – from apprenticeships all the way through to post graduates.

OGV Energy Magazine cites analysis from Rystad Energy, which forecasts a hiring wave of offshore wind staff by 2030.

It says demand will triple to 868,000 full-time jobs by 2030 – rising from around 297,000 in 2020. Jobs will hit 589,000 by 2025. Direct jobs include development manufacturing, construction, installation and operation, and maintenance of offshore windfarms. Indirect roles relate to materials and services consumed, such as workers in steel plants supporting turbines, electronics workers supplying nacelle components, and staff at renewable energy regulatory institutions.

As global offshore wind capacity rises to 110GW by 2025 and 250GW by 2050, a lot of skilled employees will be needed. Construction and Development jobs are set to account for most of the employment over the next decade. Operation and maintenance roles, driven by the capacity of wind farms, will make up 12% by 2025, growing as capacity increases at a rapid pace.

Alexander Fløtre – Rystad Energy Product Manager for Offshore Wind – adds that oil and gas workers could benefit from this growth in offshore wind employment, with areas such as foundation manufacturing, offshore construction, project development and O&M "highly relevant" to oil and gas operations. There is also the fact they have similar safety standards, with workers requiring basic offshore emergency training and, often, helicopter underwater escape training before deploying to offshore projects. This ranks as a fantastic opportunity to recover some of the talent lost during the oil and gas industry downturn, especially in O&M, project development and engineering jobs.

The Global Energy Talent Index (2021), which encapsulates the views of 16,000 energy professionals spanning 166 countries, highlights a looming talent crisis as being the biggest threat to the energy industry, with no sector immune.

It warns of plenty of red flags around the energy industry's ability to build a pipeline of qualified young people willing to join and remain in the industry. It explores both oil and gas and the renewables sector. In the former, its findings – indicative of a potential skills gap – include 56% of those entering the workforce would pursue a career in oil and gas now, down 67% from two years ago; 73% of young respondents (up to 24 years old) would enter the sector now, down 18%; and just 46% of older respondents (55 and above) would enter the sector now.

In the renewables sector, 57% of those surveyed are worried about a potential skills gap, while 78% currently working in the sector would consider leaving it in the next three years. Still, 77% said they would still pursue a career in the renewables sector if entering the industry today. To build a stronger employment brand for renewables in future, recommendations included a greater emphasis being placed on the innovative nature of the work; the role of automation and digitalisation; and the potential for individual career advancement.

The Marine Sector

BIMCO and the International Chamber of Shipping warn of how the aftermath of the Covid-19 pandemic will exacerbate anticipated labour supply problems in the marine sector over the next few years.

It notes how the Delta coronavirus variant has hit parts of Asia hard. This has seen many nations cut off land access for sailors, leaving captains unable to rotate tired crews and around 100,000 seafarers stranded at sea past their stints. At the height of lockdowns in 2020, over 200,000 merchant sailors were stuck on their ships.

Overall, it estimates that there are 1.89M seafarers, operating over 74,000 vessels in the global merchant fleet. An extra 89,510 will be needed by 2026, based on projects for growth in shipping traded. It notes a shortfall of around 26,240 certified officers, with demand for seafarers outpacing supply during 2021.

The Aviation Sectors

Oliver Wyman explores the pilot shortage facing aviation. Reasons for this range from an aging workforce facing mandatory requirement, fewer pilots existing the military and barriers to entry in the US, such as costs of training, whereas in other regions – like China – have seen a burgeoning middle class demanding more air travel. The challenge has been to expand capacity fast enough to keep pace.

Covid-19 has also seen ways to enter the industry cut off, such as cadet programs and banks supporting financing, with the attraction of what was once more a stable and lucrative career path, now looking a lot less secure. Pilots furloughed during the pandemic may also opt to pursue other opportunities as well.

The article forecasts between 25,000 and 35,000 current and future pilots could choose alternative career paths over the next decade. A global pilot shortage is expected to emerge in certain regions no later than 2023, but probably before. A global gap of 34,00 is forecast by 2025. Extreme scenarios could see this as high as 50,000. The impact of furloughs, retirements and defections is set to impact even the biggest carriers.

It recommends several remedies, such as reducing pilot demand; reinforcing the workforce pipeline; and engaging with the workforce.

To shift focus to the UK specifically, Unite the Union says between February 2020 and March 2021 – the date of the publication of its article – 5,164 jobs in aviation were being lost, on average, each month. It criticises the government's lack of support for the industry, outlining how the UK has suffered twice the job losses in aviation and related industries than France and Germany over the past year, with the French and German governments giving more than twice the level of financial support for every aviation and aerospace job than the UK.

APPENDIX 2 - FLOATING OFFSHORE WIND LITERATURE REVIEWED

- Shannon Estuary – Offshore Wind Potential Study (Shannon Foynes Port & GDG)
- Incite – Floating Offshore Wind Turbines: Challenges and Opportunities (IREC)
- Floating Offshore Wind Technology and Operations Review (ORE Catapult) – November 2021
- An Overview of Scottish Fisheries Prepared for the Floating Offshore Wind Industry (ORE Catapult) – November 2021
- Floating Offshore Wind and Fishing Interaction Roadmap (ORE Catapult)
- Industrial Leadership – Unlocking the UK's Floating Wind Potential (ORE Catapult, Renewable UK, and Scottish Renewables) – September 2021
- Bureau of Ocean Energy Management: An overview of floating offshore wind and the use of spatial data on the West Coast
- Supply Chain Report: Benefits of Floating Offshore Wind to Wales and the South West (ORE Catapult)
- Celtic Sea Floating Wind Programme (The Crown Estate)
- NREL: Cost of Floating Offshore Wind Energy Using New England Aqua Ventus Concrete Semisubmersible Technology
- ECN: Cost Modelling of Floating Wind Farms (2016)
- University of Exeter: Installation Innovation for floating offshore wind (2021)
- Pentland Floating Offshore Wind Farm (CIP) (2021)
- Floating Offshore Wind Delivering Climate Neutrality (ETIP Wind)
- Carbon Trust: Floating Offshore Wind: Market and Technology Review (2015)
- Wind Europe: Floating Offshore Wind Vision Statement
- Floating Offshore Wind Energy - A Policy Blueprint for Europe
- Floating Offshore Wind Development and Consenting Process – Risks and Opportunities (ORE Catapult)
- Floating Offshore Wind: Cost Reduction Pathways to Subsidy Free (ORE Catapult)
- Floating Offshore Wind Demonstration Programme – Guidance Notes (BEIS) (2021)
- Floating Wind Joint Industry Project (Carbon Trust) Phase I summary report (2018)
- Floating Wind Joint Industry Project (Carbon Trust) Phase II summary report (2020)
- Floating Wind Joint Industry Project (Carbon Trust) Phase III summary report (2021)
- Offshore wind, ready to float? Global and UK trends in the floating offshore wind market (Uni of Strathclyde and others) (2019)
- NREL: status of Floating Offshore Wind Technology (2020)
- NREL: Overview of Floating Offshore Wind (2021)
- Floating Offshore Wind – Application of Standards, Regulations, Project certification and classification – risks and opportunities (ORE Catapult) (2021)
- Energy White Paper – UK Government (2020)
- Net Zero Strategy – UK Government (2021)
- Offshore Wind Sector Deal – UK Government (2021)
- The Future of the North Sea – Policy Exchange (2020)

Offshore Renewable Energy

FLOATING OFFSHORE WIND CENTRE OF EXCELLENCE

ORE Catapult
Inovo
121 George Street
Glasgow, G1 1RD

+44 (0)333 004 1400