everoze

Tilt the balance: how the UK can capture opportunities in floating wind

Floating Wind Taskforce
Final Report

experts | evolving | energy

RUK002-WP5-R-01-C
9th May 2024

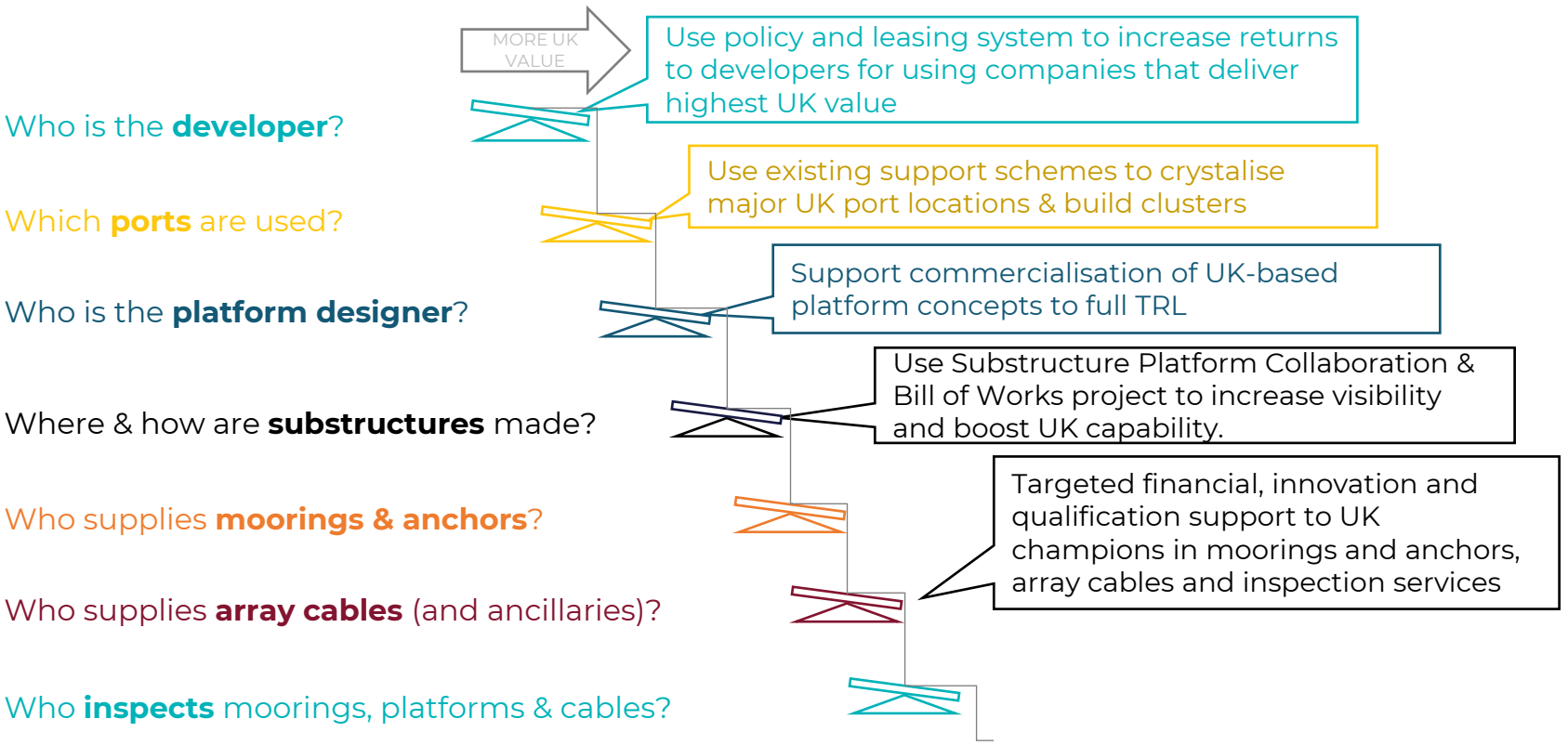
Headline messages

Tilt the balance on 7 key decisions to capture £38Bn of value and 27,000 jobs per year

7 Key Decisions: On each floating wind project, there are 7 key decisions that will largely drive how much value the UK will capture from floating wind*.

Tilt the balance: the UK needs to target these key decision point (on demo and large scale projects), 'tilting the balance' towards companies that deliver more economic value to the UK.

Economic growth: Through this, the UK can create £38Bn of GVA to 2050, of which £22Bn is from exports. This can sustain 27,000 jobs per year between 2030 – 2050.



£38Bn of value

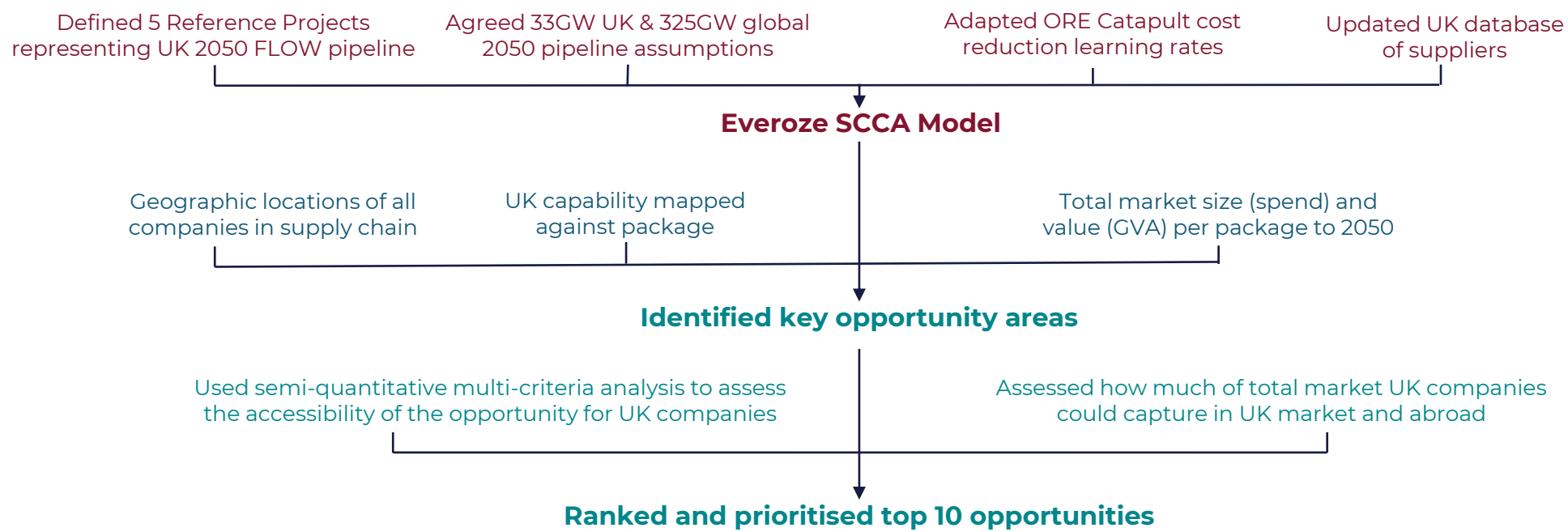
£22Bn in exports

27,000 jobs / year 2030 to 2050

*This report has looked specifically at floating-wind-specific elements and has not considered turbines, export systems, parts of O&M, etc. Inclusion of these elements would increase the number of decision points and the UK's GVA and jobs potential for floating wind.

Methodology

This project has mapped and assessed UK capability, opportunities and interventions



GVA and jobs per opportunity area

The table shows the UK and global market share and corresponding GVA and jobs figures for key opportunity areas.

Area	Details	UK market share	Global market share	UK Market GVA to 2050 (£Mn)	Export GVA to 2050 (£Mn)	Total GVA to 2050 (£Mn)	Years of person employment	Indicative jobs per year* (2030-2050)
Moorings and anchor supply elements	Design and engineering; synthetic rope; chain; connectors; anchors; jewellery; CMS; vessel equipment	Varies by sub-package i.e. 50% for mooring rope - 3% for chain	Varies by sub-package i.e. 25% for mooring rope - 1% for chain	1,424	4,879	6,303	131,345	6,567
Supply Array Cables	Static and dynamic	25%	10%	476	1,406	1,882	22,614	1,130
Concrete Substructures	Fabricate Concrete Substructures	75%	3%	3,803	1,186	4,989	109,580	5,479
Steel Substructures	Tier 1 contract to manage supply (lower tier elements including secondary steel would increase value)	10%	5%	1,067	3,269	4,336	53,805	2,690
Port Logistics	Tier 1 contract to manage Floater Assembly, Launch & Integration activities (including ports)	75%	3%	1,259	308	1,567	16,783	839
Installation	Installation of Floating Wind Turbine and Moorings	25%	10%	221	642	863	9,715	485
O&M	Inspections and maintenance - platforms, moorings, array cables; WTG spares; Major Component Repairs activity split between tow to shore and up tower crane solution	Varies by sub-package i.e. 75% for platform and mooring inspection - 10% for up tower crane	Varies by sub-package i.e. 25% for mooring inspection - 5% for up tower crane	5,770	9,007	14,776	235,125	5,878
Development services	Excludes procurement. Total value figure divided by 2 as much done in house by develoeprs	75%	25%	927	2,175	3,102	71,441	3,572
			Sub-total	14,947	22,872			
			Total			**37,819**		**26,640**

Years of employment is calculated by applying Spend / job ratios (classified by service line) and includes direct (i.e. the employment created to fulfil the demand for the product or service) and indirect employment (i.e. the jobs in the broader area that exist to produce the goods and services needed by the workers of the direct jobs). Jobs per year divides 'years of employment' by 20 (except for O&M where we assume 40 years) and assumes a relatively smooth deployment profile 2030-2050

CONTENTS

Version Control

Version	Purpose	Date
A	Draft report for client comment	21/03/24
B	Draft Final report	22/04/24
C	Final report	09/05/24

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Approver: Daniel Bacon

This project has been delivered by Everoze with the support of Lumen Energy & Environment and BiGGAR Economics.

Introduction

How the UK can create a globally competitive supply chain in floating wind

This project focuses on how the UK can capture opportunities in the floating wind supply chain for projects in the UK and abroad.

Floating offshore wind is roughly a £1 trillion global opportunity*. While it is a new industry, the UK needs to start with a realistic mindset and understanding of where its capabilities lie, as well as better understand what new opportunities will emerge due to differences between fixed and floating projects.

Through assessment of the types of project set to emerge (the reference projects), an analysis of existing capability across the UK and regionally, this project provides analysis of where in the UK there is existing capability that can be supported to grow.

The project has been delivered by Everoze, with the support from Lumen EE and BiGGAR Economics, with input from an expert Steering Group including senior Government and Industry representatives.

*Everoze estimate based on the analysis within this project. Put simply 325GW pipeline assumed with a cost of >£3Bn / GW

1

Inputs and Model

The SCCA Model

This project has used the SCCA Model, extending and deepening it for floating wind. The Model has four key elements.

1. Work Breakdown Structure

- 5 reference projects were defined, broadly representative of UK deployment out to 2050.
- All contract packages needed to deliver these reference projects were identified (incorporating the range of technology options included within the reference projects). This list of packages is the 'WBS'.
- These contracts are categorised at different 'Levels'. Level 1 being lifecycle stage, Level 2 being major contracts procured under multi-contract approach and Level 3 the primary components and services needed to deliver Level 2.

2. Cost analysis

- For each line item, cost drivers and cost assumptions were identified. The Everoze cost engine converts these drivers and assumptions into a cost breakdown for each reference project.
- The model provides cost estimates for all Level 3 items (and project breakdowns at this level). However, the model has many cost estimates at Level 4.
- For this project we introduced a cost reduction function, based on learning rate analysis undertaken by ORE Catapult.

3. Economics analysis

- BiGGAR Economics assigned Standard Industry Classification (SIC) codes to each WBS item.
- The cost value was then converted into a GVA figure and jobs using BiGGAR economic models.
- Future O&M and Decommissioning costs were discounted using a discount rate of 3.5% in the GVA calculation, aligned to UK Gov. good practice*.
- The process above was applied to the new cost items introduced in this project.

4. Supplier database

- The initial supplier SCCA database had 1406 companies, collated from Everoze experts, existing supply chain databases (including from Clusters) and checked against RUK Energy Pulse.
- The DataCity platform was used to identify company registration numbers and postcode locations for the companies.
- The platform was used to search for additional companies and others emerged through our review of specific floating wind elements. This resulted in a total of 1453 companies.

WBS		**Cost**			**GVA**			**UK Suppliers** (High or Medium UK footprint)				
WBS Code	Line Item	Driver	Assumption	Calculation	Direct	Indirect	jobs	Export champion	Domestic Champion	Foothold	Outsider	Unknown
2.1.2	Inter-array cables	Voltage, length	£/km	…	…			JDR	…			

Everoze cost engine

BIGGAR GVA formulas

Supply chain database

*Reference: HM Treasury (2022) The Green Book: Central Government Guidance on Appraisal and Evaluation. Available at: https://assets.publishing.service.gov.uk/media/623d99f5e90e075f14254676/Green_Book_2022.pdf

The five Reference Projects

The five reference projects selected are broadly representative of the UK pipeline out to 2050. They broadly represent the global pipeline, except for water depth, with other markets having deeper water sites.

The starting point for our modelling work was to finalise reference projects that broadly capture the UK floating wind pipeline out to 2050.

This was developed through review and categorising of the UK pipeline. This was then discussed and agreed with the project Working Group and aligned with Workstream 2 of the FLOW TF and IGP.

The high-level assumptions are shown here. The model also incorporates more detailed assumptions on how to cost different elements i.e. rotor diameter, spacing, primary steel weight of monopiles, etc.

	FLOW RP1	FLOW RP2	FLOW RP3	FLOW RP4	FLOW RP5
Description of project	Early commercial project from Scotwind.	Large commercial scale project which could either be from Scotwind or Celtic Sea. Project assumed is from Scotwind.	Large commercial scale project which could either be from Scotwind or Celtic Sea. Project assumed is from Celtic Sea.	Large project from a future leasing round, potential English North Sea	Very large project from a future leasing round, potentially Scotwind 2
Commercial operations	2030	2033	2038	2045	2050
Capacity (MW)	495	1008	1500	1804	2000
Design Lifetime (years)	25	25	25	30	30
Site Parameters					
Distance from shore (km)	40	50	80	125	160
Depth (m)	120	100	80	150	200
Soil type	Rocky/Sandy	Sandy	Sediment	Sandy	Sandy
Metocean (Hs (m))	2	1.9	2	2	2.1
Offshore cable (km)	50	100	90	200	250
Onshore Cable (km)	20	20	20	20	20
Distance to port (km)	52	65	104	163	208
Wind Turbines					
Wind Turbine Capacity (MW)	15	18	20	22	25
Qty WTGs	33	56	75	82	80
Foundation & moorings					
Principal Material	Steel	Steel	Concrete	Steel	Concrete
Mooring lines	Chain	Mix (chain and synthetic rope)	Mix (chain and synthetic rope)	Mix (chain and synthetic rope)	Mix (chain and synthetic rope)
No of mooring lines	6	6	3	3	3
Anchor type	Piled	DEA	DEA	Piled	Suction
Array Cables					
Array Voltage (kv)	66kV	66kV	132KV	132KV	132KV
Configuration	Static + Dynamic	Static + Dynamic	Static + Dynamic	Static + Dynamic	Static + Dynamic
Export System					
Concept	HVAC - 220kV	HVAC - 275kV	HVAC - 275kV	HVDC - 525kV	HVDC - 525kV
System Concept	HVAC	HVAC	HVAC	HVDC	HVDC
Qty. OSS	1	2	3	2	2
OSS Foundation Type	Jacket	Jacket	Jacket	Jacket	Jacket
Export Voltage (kV)	220kV	275kV	275kV	525kv	525kv
Other					
O&M strategy	Tow to port	Tow to port	Floating lift	Floating lift	Floating lift
Onshore cranes	Current	Current	Next gen	Next gen	Next gen

Reference project pipeline

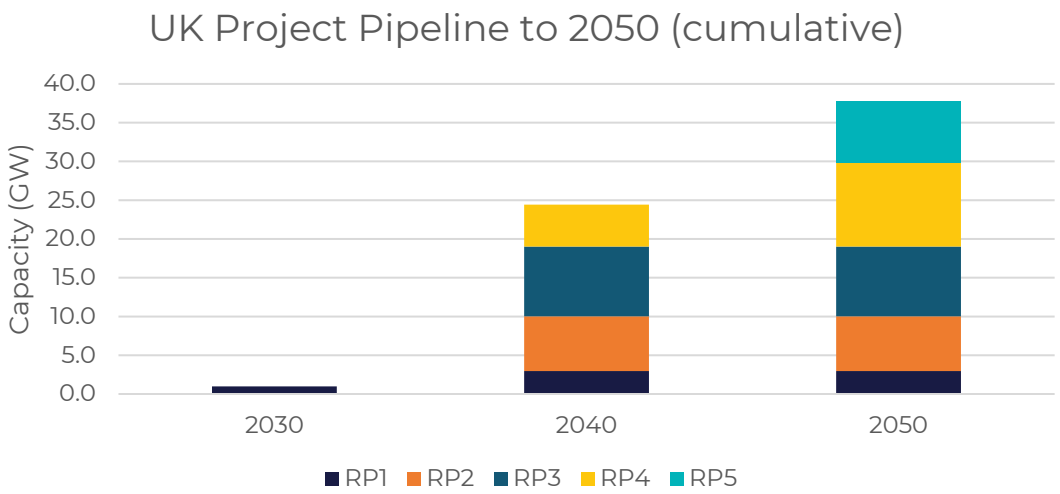
The assumptions driving the scaling from project to pipeline value

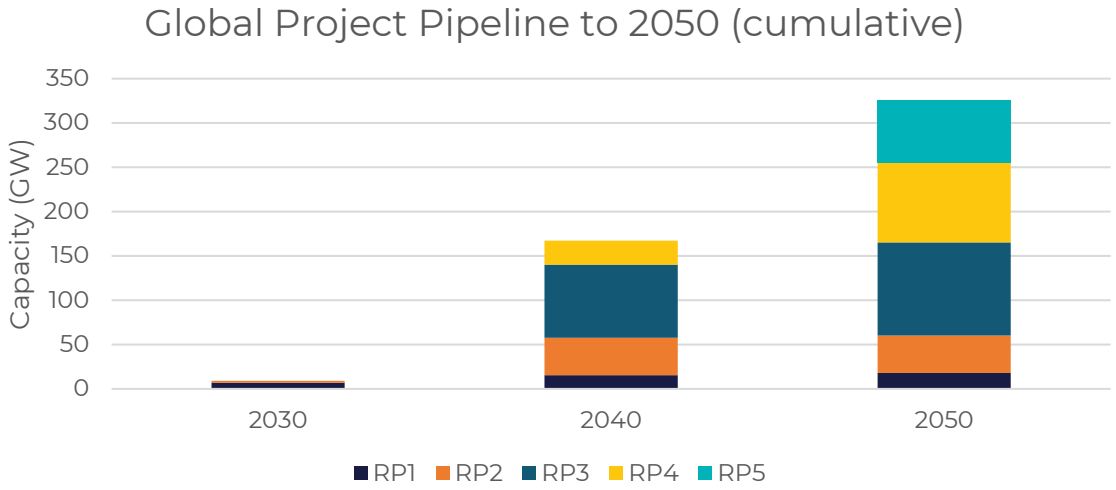
To provide a view on the 2050 pipeline projections, Everoze first aligned 2050 capacity assumptions with the Industrial Growth Plan assumptions. This was based on the following scenarios and assumptions:

- UK floating 2030 – 1.2GW UK fixed and floating 2030 – 45GW
- UK floating 2050 – 38.3GW** UK fixed and floating 2050 – 115GW (FES)

- Global floating 2030 – 9.1GW Global fixed & FOW 2030 – 328GW
- Global floating 2050 – 325GW Global fixed and FOW 2050 – 2000GW

Everoze then developed a cumulative pipeline of representative reference projects to meet these capacity targets.





*https://www.gov.uk/government/publications/british-energy-security-strategy/british-energy-security-strategy
** Figure agreed within FLOW TF / IGP team

2

Model outputs

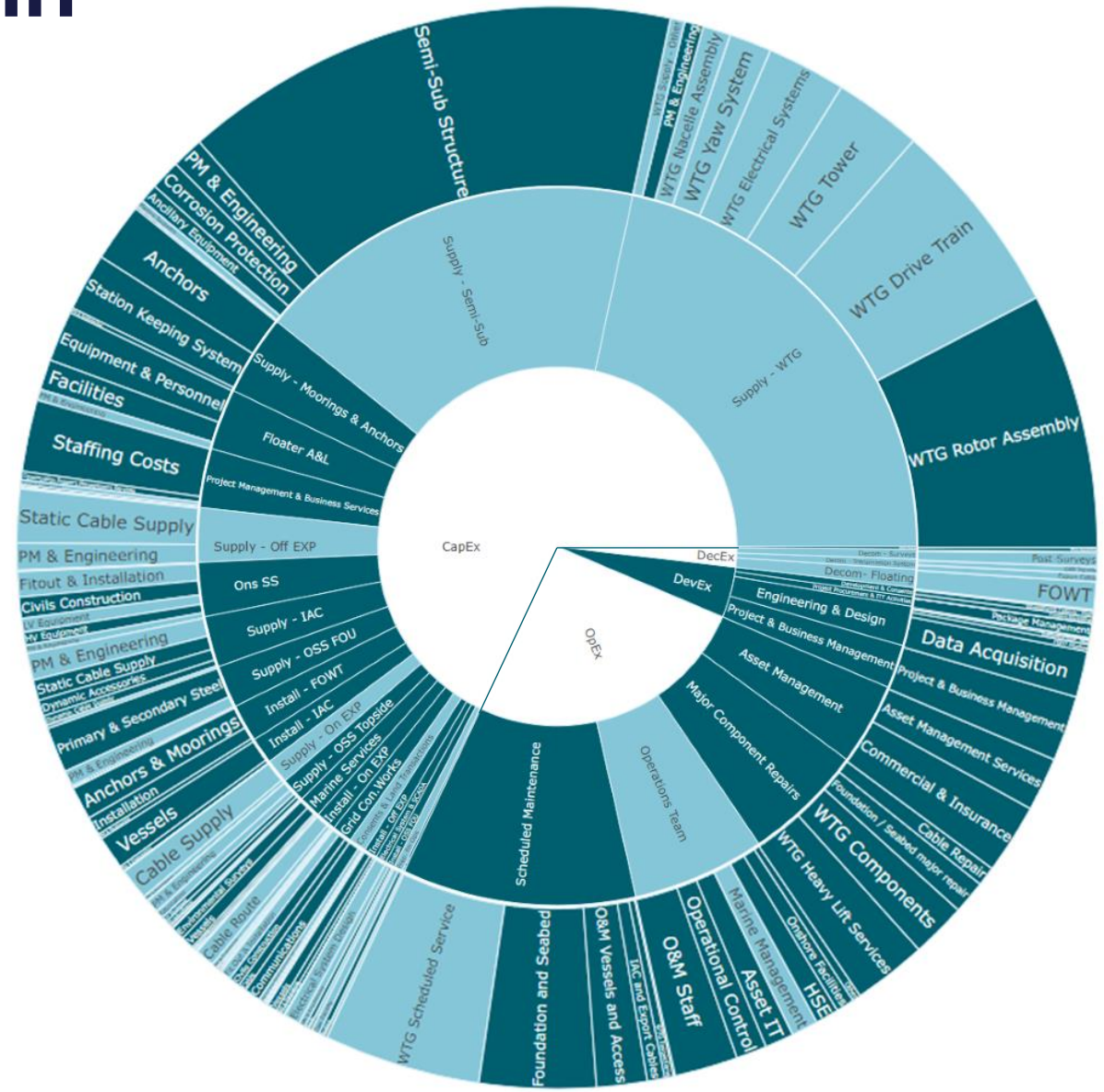
A Map of the UK supply chain

For floating wind with steel semi-subs

The sunburst chart to the right shows Level 2 and 3 of the WBS items for RP1 – a 450MW steel semi-submersible HVAC floating wind project commissioning in 2030. This is without any cost reductions applied.

How it works:

- The size of each segment shows the cost (£ million) of that line item
- The middle circle shows the lifecycle stage and covers Level 1 in the Work Breakdown Structure (WBS). The second circle shows Level 2 contracts, while the third circle shows Level 3 contracts.
- Segments coloured in **dark blue** show that there is a supplier who has a decent UK footprint and has won 3 or more contracts in offshore wind. Segments coloured in **light blue** imply that there is no UK-based supplier who has won more than 3 contracts. Each circle is coloured independently i.e. there may be high capability companies at Level 3 but not at the equivalent Level 2 (and visa versa)



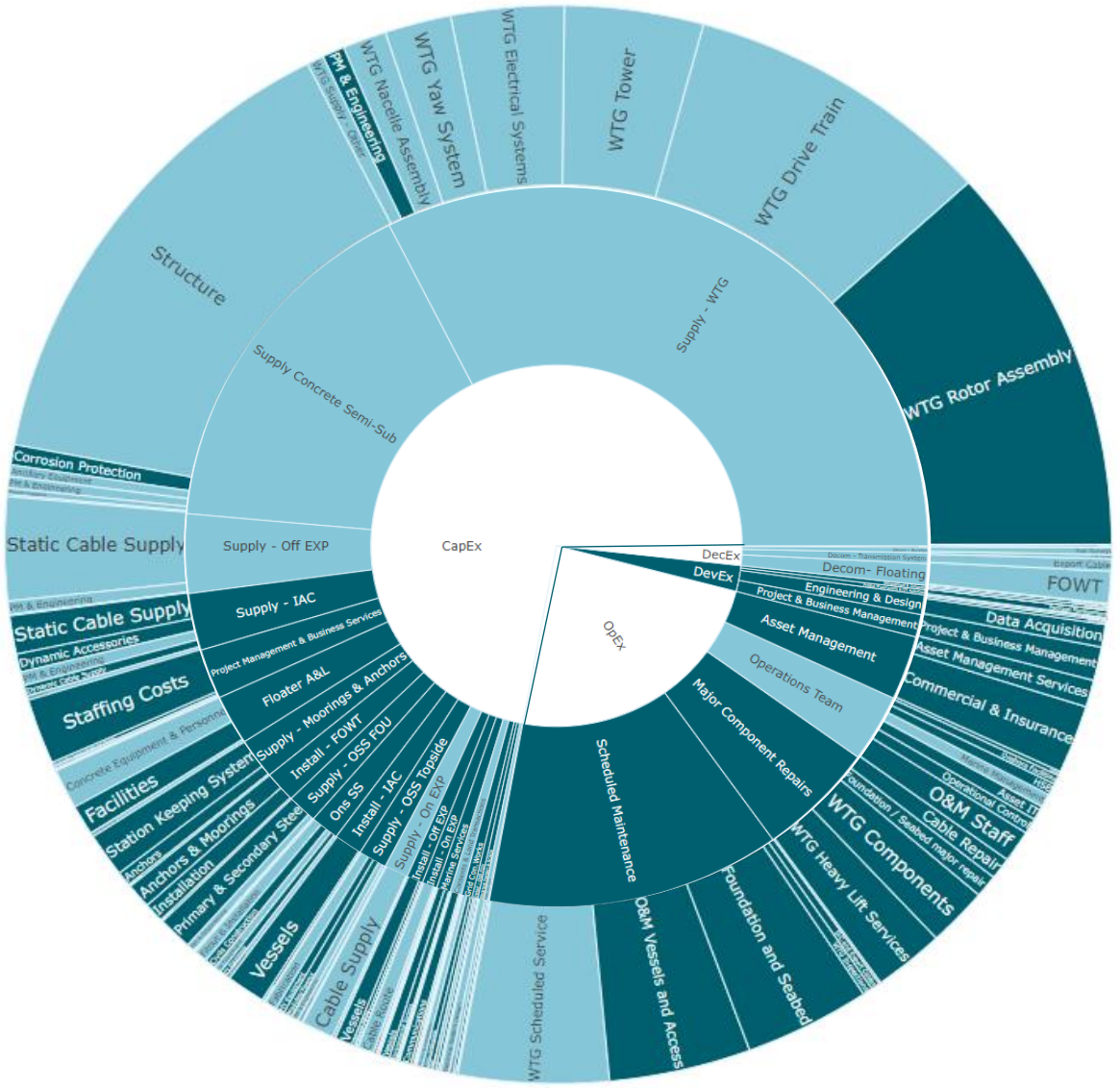
Insights:

- 'Supply' elements are far greater than 'install' elements – yet the installers often manage the supply packages.
- The chart highlights strong UK capability in the devex and opex phase. In the capex phase, the chart highlights strong UK capability in moorings and anchors, floater assembly and launch, electrical substations, array cable supply and blades.

A Map of the UK supply chain

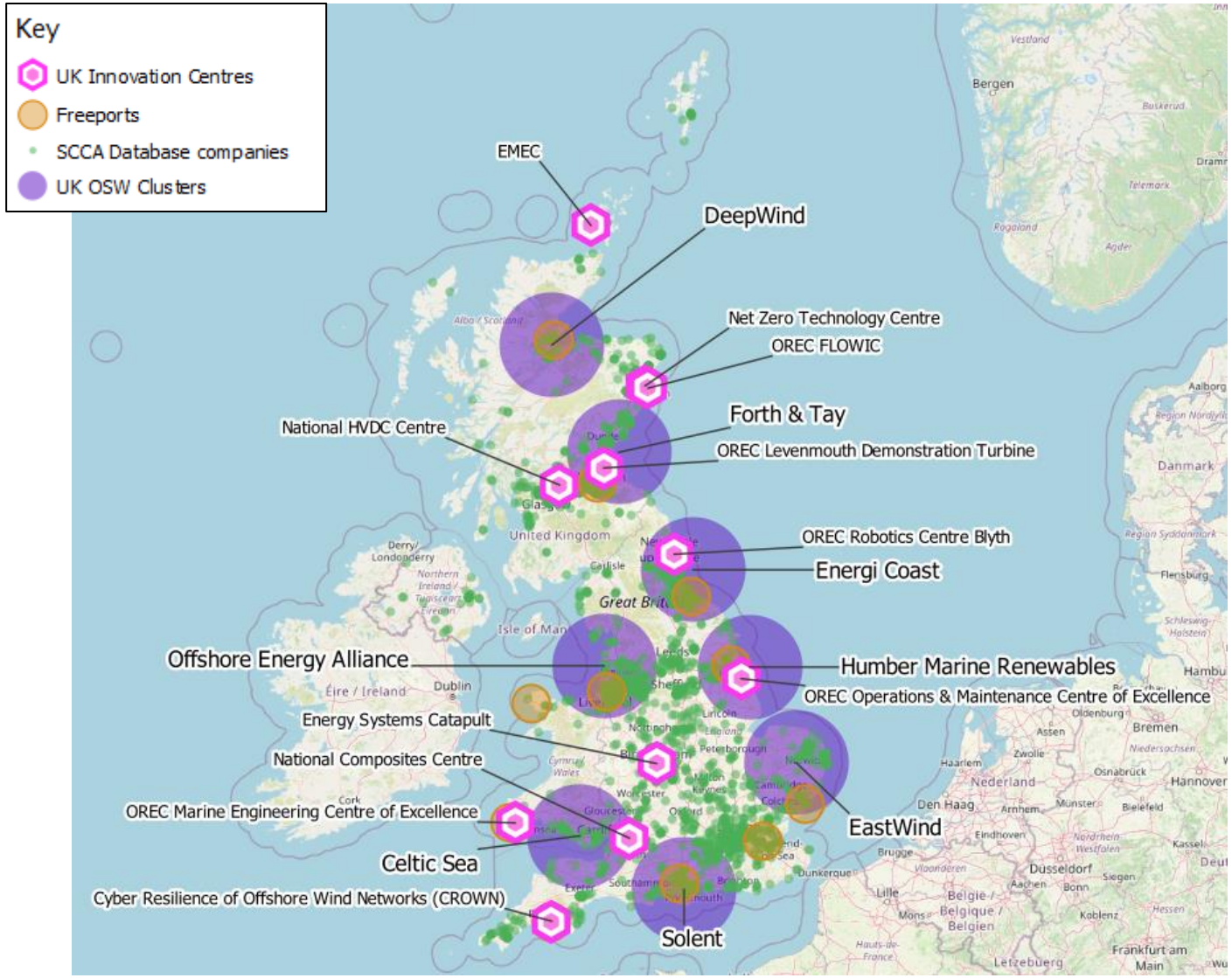
For floating wind with concrete semi-subs

This is the same sunburst chart for RP3, with larger turbines and concrete substructures.
The move to fewer, larger turbines increases the proportion of wind turbines in the overall cost share. It is a much larger project and so the proportion of devex is also much smaller.
There are no leading designers of concrete platforms in the UK, however the UK is well positioned to secure fabrication of the concrete structure at Level 3.



UK-wide picture

Mapping companies identifies a mix of clusters *and* wide UK coverage



Postcodes were identified for each company in the SCCA database and mapped using GIS with the overall results shown to the left. Existing clusters, freeports and innovation centres are also shown.

The summary of UK footprint highlights capability spread across the UK. This is shown by the large number of companies present away from coastal areas in locations such as the SE England, Midlands, North England and central belt of Scotland.

There are also significant coastal clusters located (listed clockwise from top) around Orkney & Caithness, Moray Firth, Aberdeenshire, Forth & Tay, NE England, Humber, East Anglia, Solent, SW England, South Wales, NW England & Northern Ireland.

The model provides geographic outputs by WBS line item (i.e. moorings and anchors) and these more detailed breakdowns are provided in the Annex B.

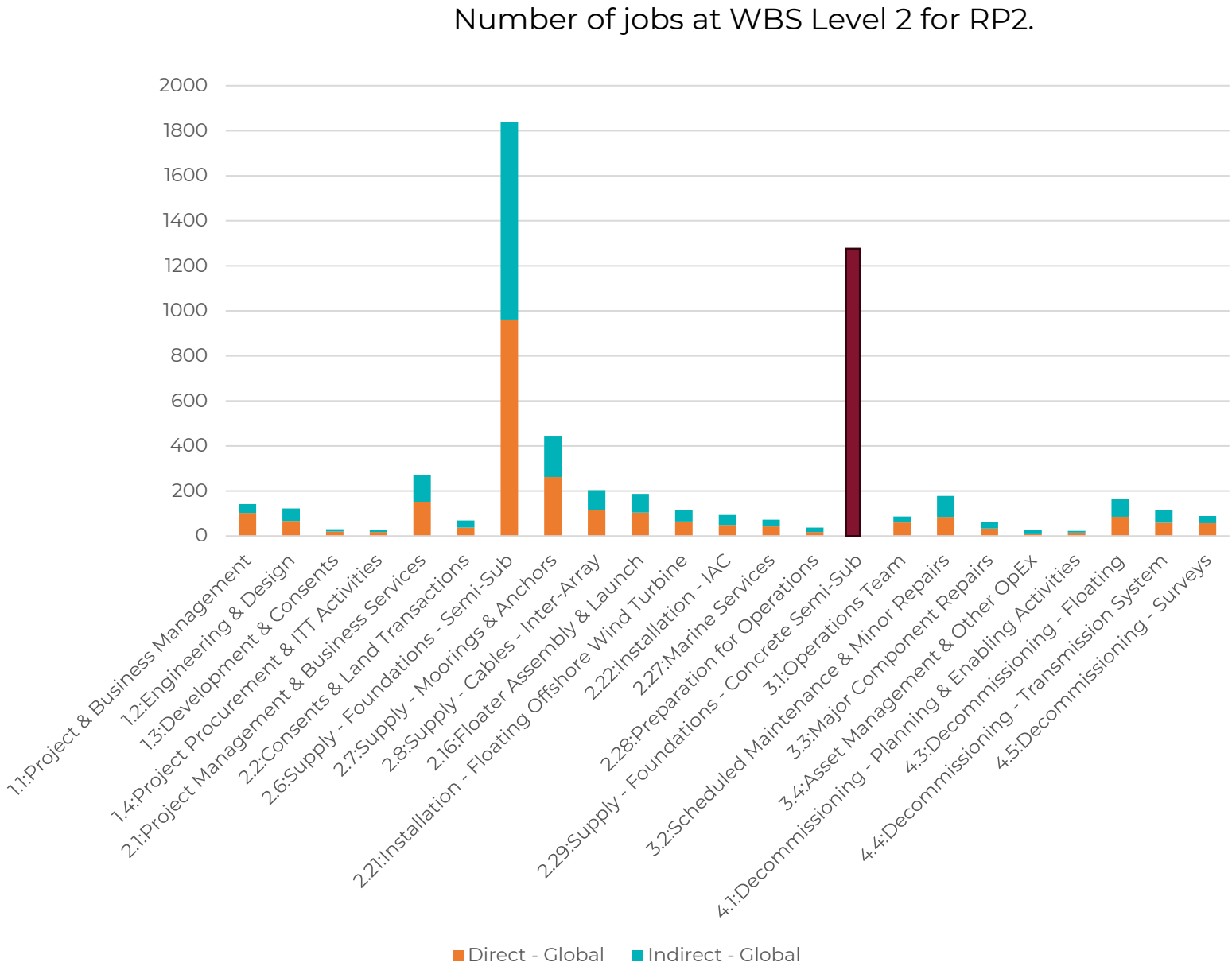
Jobs

Within floating wind specific line items, the floating foundation supply creates the most number of jobs.

The graph shows the number of jobs per Level 2 package. These jobs are per year of the relevant phase (i.e. capex is assumed to be 4 years). The figure (in red) for concrete is a rough estimate, calculated by reducing the RP3 figure by a third to reflect that RP3 is 1500MW and RP2 is 1000MW.

The results show that the supply of floating wind foundations provides the most number of jobs, with the analysis highlighting that steel foundations creates more jobs than concrete. This is driven by the SIC Codes used to derive Turnover / job ratios with primary steel fabrication having a £114,614 / job while concrete is assumed to have £218,439 / job.

Moorings and anchors provide the second most jobs on a project basis, followed by array cable supply.



3

Opportunity assessment

Comparative advantage

The UK has the widest range of expertise, but lacks comparative advantage in critical parts of the value chain

Unlikely to have domestic floating wind market

		UK	UK	FR	DEN	NO	NL	BE	GER	IRE	US	Asia	Other
		Domestic	Export										
Devex													
	Engineering												
	Commercial												
	Environmental												
	Survey												
Moorings													
	Package management												
	Ropes												
	Anchors												
	Jewellery												
Dynamic cables													
	Cable supply												
	Connectors												
	Jewellery												
Concrete Platforms													
	Designers												
	Fabrication												
	Raw materials												
Steel Platforms													
	Designers												
	Fabrication												
Assembly, integration and storage													
	Assembly												
	Intergration												
	Wet storage												
Installation	Design												
	AHVs												
O&M													
	Inspections (moorings & cables)												
	Monitoring												
	Repair												
	MCR - Heavy Lift												
	MCR - Tow to shore												
	MCR - up tower lift												
	Spares												

potential
good
strong

Left is a review of the UK's relative comparative advantages, compared to other major offshore wind markets and suppliers.

This review is qualitative and based on consultant experience of these different markets.

The review demonstrates that:

a) Other mature North Sea markets (Den, NL, BE and Ger) are unlikely to have their own floating market. The UK is unusual in that it is a mature fixed wind market, with very large floating potential

b) The UK has reasonably strong coverage across the different areas of floating offshore wind assessed in this report. Broadly the UK can demonstrate wider coverage across the offshore wind lifecycle than other markets. However, the UK does not necessarily have best capability except for areas such as Devex, Moorings (and anchors), cables & O&M.

c) For areas such as platforms and installation, the UK needs to recognise while it has capability, it lacks clear advantage, and seek to address this. This is particularly important given the high value of these opportunity areas.

GVA and jobs per opportunity area

The table shows the UK and global market share and corresponding GVA and jobs figures for key opportunity areas.

Area	Details	UK market share	Global market share	UK GVA to 2050 (£Mn)	Export GVA to 2050 (£Mn)	Total GVA to 2050 (£Mn)	Years of person employment	Indicative jobs per year* (2030-2050)
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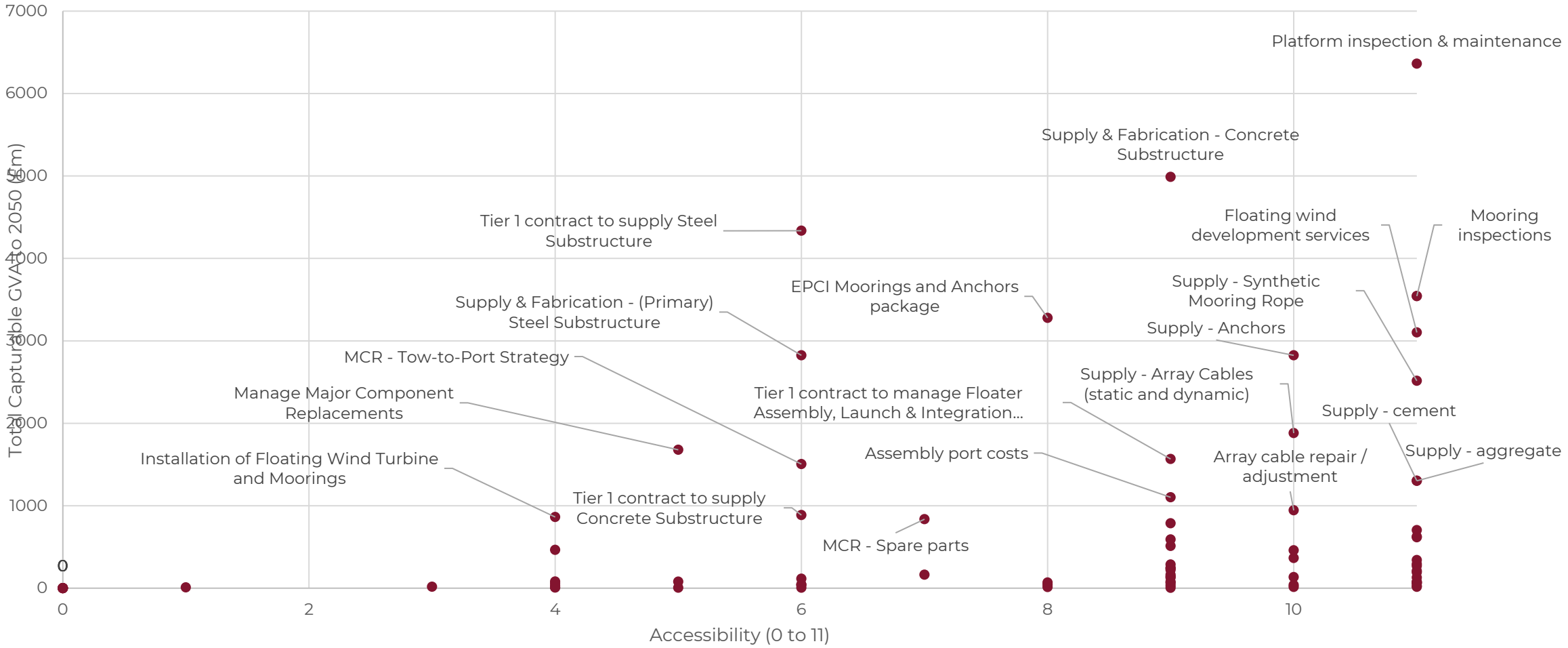
Summary chart

Highest value opportunities are in platform and mooring inspections, concrete substructures, steel substructures, moorings and anchors, development services, and array cables. There are multiple lower value but accessible opportunities that need to be understood by programmes such as OWGP. The top 20 of the full 38 opportunities are labelled.



Top 20 opportunities by value

No.	Package	Accessibility	Total Value (£Mn)	UK value (£Mn)	Global value (£Mn)	UK, export or mix focus	Key decision
1	Platform inspection & maintenance	11	6,362	3,212	3,149	Mix	Who inspects?
2	Supply & Fabrication - Concrete Substructure	9	4,989	3,803	1,186	UK	Where and how the substructure is made?
3	Tier 1 contract to supply Steel Substructure	6	4,336	1,067	3,269	Export	Who is the platform designer?
4	Mooring inspections	11	3,543	1,025	2,518	Export	Who inspects?
5	EPCI Moorings and Anchors package	8	3,278	865	2,413	Export	How is the mooring and anchor package contracted?
6	Floating wind development services	11	3,102	927	2,175	Export	Who is the developer?
7	Supply - Anchors	8	2,825	639	2,185	Export	Who suppliers anchors?
8	Supply & Fabrication - (Primary) Steel Substructure	6	2,824	1751	1,073	Mix	Where and how is the substructure made?
9	Supply - Synthetic Mooring Rope	11	2,516	543	1,973	Export	Who suppliers anchors?
10	Supply - Array Cables (static and dynamic)	10	1,882	476	1,406	Export	Who suppliers array cable?
11	Manage Major Component Replacements (MCR)	5	1,680	363	1,316	Export	Who manages major component replacements?
12	Tier 1 contract to manage Floater Assembly, Launch & Integration activities (including ports)	9	1,567	1,259	308	UK	Which port is used?
13	MCR - Tow-to-Port Strategy	6	1,506	620	886	Mix	Which port is used?
14	Supply - cement	11	1,303	1,158	145	UK	Where and how the substructure is made?
15	Supply - aggregate	11	1,303	1,158	145	UK	Where and how the substructure is made?
16	Assembly port costs	9	1,102	884	218	UK	Which port is used?
17	Array cable repair / adjustment	10	946	381	564	Export	Who inspects / repairs array cable?
18	Tier 1 contract to supply Concrete Substructure	6	888	309	579	Export	Who is the platform designer?
19	Installation of Floating Wind Turbine and Moorings	4	863	221	642	Export	Who installs?
20	MCR - Spare parts	7	837	179	658	Export	Who provides spares?

Key messages

This SWOT analysis summarises the key points relating to different the UK FLOW market

STRENGTHS
- Large potential floating wind market (25GW Scotwind & INTOG, Celtic Sea LR5, 12GW Celtic Sea future pipeline) with strong government support.
- Forms part of mature fixed wind market, with potentially attractive recent uplifts to strike prices. (It is easy to underestimate challenges for new entrant markets to build offshore wind sector).
- Stepping-stone demo projects under development, which if UK companies can deliver can help build track record and experience.
- The first GW scale FLOW projects worldwide are likely to be delivered in the UK.
- Strong offshore oil and gas capability, particularly in moorings, anchors and dynamic cables.
- Strong development services able to shape how sector develops.
- Collaborative investment mechanisms under discussion e.g. SIM, SIR.
- Innovation initiatives: OREC FLOW CoE, Carbon Trust JIPs etc.

WEAKNESSES
- No proven financial mechanisms for ports and supply chain to invest ahead of FID by developers. Single project interest by a developer is both too late and too small to trigger supply chain investment.
- Lack UK champions at the top tier i.e. i) lack major Tier 1 installation contractors (and Anchor Handler Vessels) ii) lack leading floating platform designers and iii) lack WTG OEM (apart from blades). UK capability mainly small companies at lower tiers.
- Lack overarching strategy and coordinated plan for developing UK capability. Lack alignment of incentives across lease, consent, grid and CfDs. Lots of organisations with overlapping responsibilities.
- High steel, labour and post BREXIT costs and barriers.
- Challenging 'supplier journey' with multiple procurement portals and difficult contractual terms.
- All Scotwind projects seeking to deliver over the same timeframes.
- Lack of UK focused equity investor able to take higher risk returns over long term for benefit of UK plc.

OPPORTUNITIES
- Supply moorings rope, anchors, connectors and jewellery.
- Secure IP around port fabrication, assembly, logistics, integration and storage.
- Fabricate concrete platforms, using UK based supply of rebar, aggregates and cement.
- Assemble and where possible fabricate steel platforms using cutting edge digital design and fabrication. As part of this support Marine Power Systems (MPS) to become leading steel platform designer.
- Cost effective inspection of platforms, moorings and anchors at scale.
- Supply of array cables and associated supply chain.
- Use UK expertise in development services to shape the contractual landscape for floating wind. Support UK developers to win floating wind leases globally.
- Capitalising on other strengths identified in the SCCA but not explicitly considered in this study (i.e. blades, surveying, electrical substations, etc).

THREATS
- A lack of timely investment in UK ports (particularly compared to ports in NL, DK, BE, DE and FR) mean other countries secure most of the value flow. UK projects therefore help other centres to gain scale and development.
- Other countries deploy stronger interventions to support their supply chain in early days of sector who then outcompete UK companies.
- Floating wind fails to move down cost curve quick enough, undermining political support.
- UK companies fail to win contracts on early projects and/or UK project timelines slip to the right meaning other countries deploy first projects at scale.
- Mooring and anchor integrators lack balance sheet to become Tier 1 contractor and play lower value consultancy role.
- UK remains at lower tiers with value squeezed over time.
- O&M centres with vessels / services / spares and capability will develop outside of the UK.
- Other sectors (defence, oil and gas) seen as more attractive, reducing appetite for companies to move across.

4

Conclusions

Conclusions

The UK needs to understand key decision points in how floating offshore wind is delivered. The UK can seek to tilt the balance by proactive positioning *and* ensuring its supply chain is ready.

The UK is the world's most significant floating offshore wind market by volume of projects and capacity. This, along with the presence of multiple early projects being delivered this decade, sets the UK up to gain competitive advantage in securing economic value from this domestic pipeline. **Early success at home will set up UK companies to supply the much larger global market set to emerge early in the 2030s.**

However, the UK needs to better understand how what key decisions will be made on a project-by-project basis. Across a portfolio of wind farms, these critical decisions will largely determine how much value flows to UK firms. **Tilting the balance on successive decisions will help grow UK content, with early successes increasing the likelihood of later success and overall growth in UK activity and success**.

At a policy level, **more can be done to encourage developers to adopt contracting strategies enabling UK suppliers to compete**. Industry and government must continue work together to enable the selection, design and construction of port facilities, as well as suitable logistics and associated manufacturing. Doing this will help secure UK value *and* over time ensure that it is UK expertise that is sought out by the global market. Programmes such as FLOWMIS, the SIM and the IGP are critical here.

The UK has advantages and strong potential already in existence. **The UK can develop its leading position in parts of the sector such as development, moorings & anchors, array cables and inspection**, through better coordination and contracting with these parts of the supply chain. The UK must defend and grow these UK success stories and progressively win more value through creating a positive business environment these firms can thrive in and export from.

While other parts of the floating value chain can be captured, **critical for maximising UK value is to capture floating platform assembly and manufacturing**. The UK must be the country that successfully demonstrates cost reduction through mass manufacturing, effective logistics and efficient installation. This report also advocates routes for collaboration so that the UK can fast track supply chain understanding of technical requirements. The UK can bring down its costs, embed expertise, attract inward investment and talent, and give UK suppliers competitive advantage from this knowledge and experience.

Finally, **the UK needs to be prioritise being the location for platform design teams and ideally the location for associated platform IP**. There is a critical and short- term need for the UK to support UK-players looking to commercialise steel platforms, and to investigate routes for attracting engineering and design teams into the UK for leading concrete platform concepts. Without embedding platform expertise within the UK, we will remain a market that others export to. An alternative outlook – that the UK has the companies able to export platform technology and know-how to the globe is possible. But delivering this requires proactive policy, plus ambition and long-term focus.

Annex

more detail on a) capability
and b) opportunity areas

Annex
a) Capability

Example companies – steel platforms

UK has strong engineering know-how, but only one UK platform design. UK firms share ambition to grow primary steel supply, as well as deepening existing secondary steel capability

Platform Design

e.g. Marine Power Systems

Significant control of supply chain (outside of developer/EPC roles) will rest with platform designers and contracted engineering teams. UK has only one platform designer at mid-late TRL readiness. MPS active in market building supply chain partnerships, and has engagement with a number of developers over utilisation of its Pelaflex platform design.

Primary Steel components:

e.g. Harland & Wolff; Global Energy Group; Wilton; SeAH; Smulders

UK has capability in bending, rolling and welding of large steel components of type needed for FLOW platforms. As detailed on the next slide, components required include columns, turrets, tanks, spars, box gantries. Challenges will lie in existing firms demonstrating cost effectiveness and volume production.

There are a larger number of steel fabrication companies in the UK able to provide plates, stiffeners etc but they are not focused on the offshore wind sector. If existing primary providers are to be able to focus on larger items, this wider UK fabricator supply chain will need to be developed.

Engineering Services

e.g. Kent; LMC; OWC

Significant UK engineering design and advisory services within UK – and leading design software provider in OrcaFlex

Platform internals:

Supply chain from O&G & UK MEP sector

Dependent on platform design, there will be requirements for cabling, pumps, control systems for installation at assembly sites. UK has existing mechanical, electrical, plumbing expertise, particularly around oil and gas and maritime sectors.

Secondary Steel components:

e.g. Harland & Wolff; Global Energy Group; Wilton; SeAH; Severfield; Hutchinson Engineering; Texo; Ledwood

Strong track record in secondary steel supply into fixed offshore wind, can be leveraged for FLOW. Sector needs to grow in size, and will need to work in partnership to secure volume tenders.

Temporary works & sea fastenings:

Local providers will need to be sought

Local activity within ports for assembly, fabrication, integration activities will bring demands for local steel fabrication expertise. Generally, is widespread availability of local fabrication expertise

Welding services:

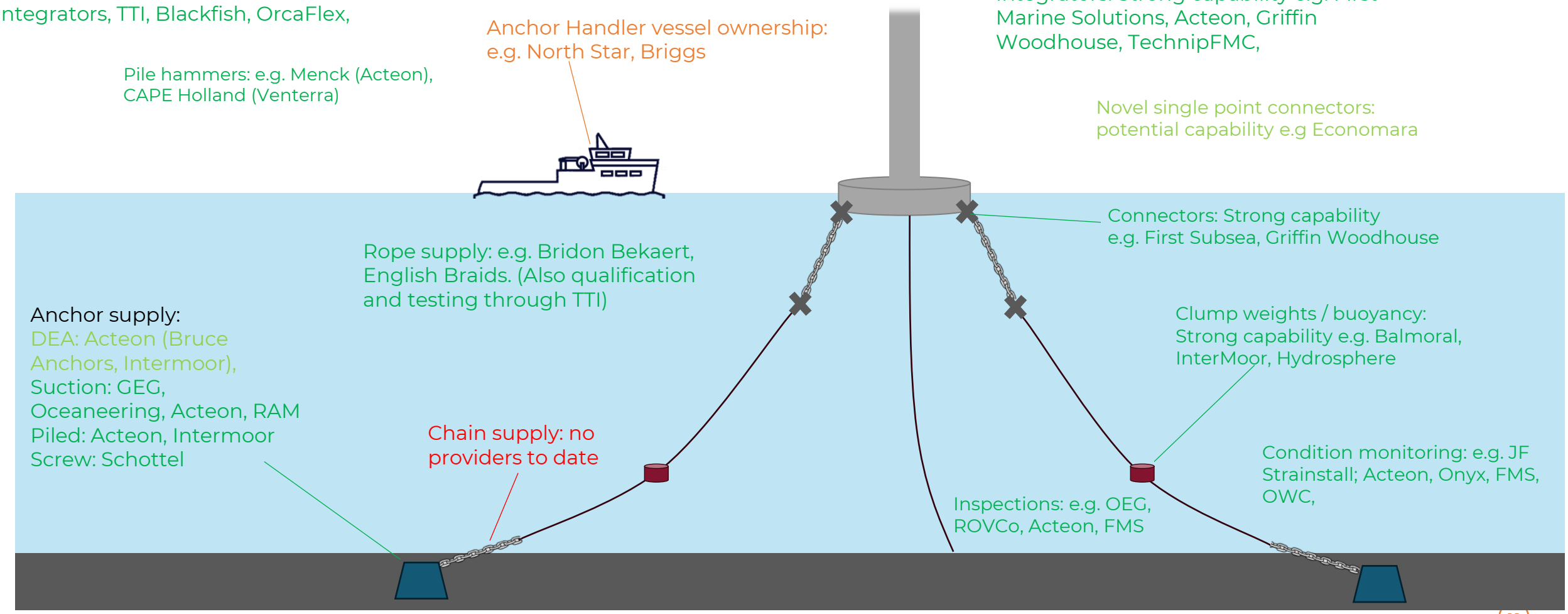
e.g. CRC Evans/Pipeline Technique, Cambridge Vacuum Engineering

Scaled up fabrication activities will require access welding & coating services from companies such as CRC Evans, and access to expertise on utilisation of advanced welding technologies.

Key:
Strong capability Good capability Some capability No capability

Example companies- mooring systems

UK has world leading integrators, rope manufacturers and ancillary providers. UK has good capability in anchors. UK has limited capability in anchor handler vessels – this presents a potential challenge as the owners of these vessels are likely well placed to 'own' the package.



Key: Strong capability Good capability Some capability No capability

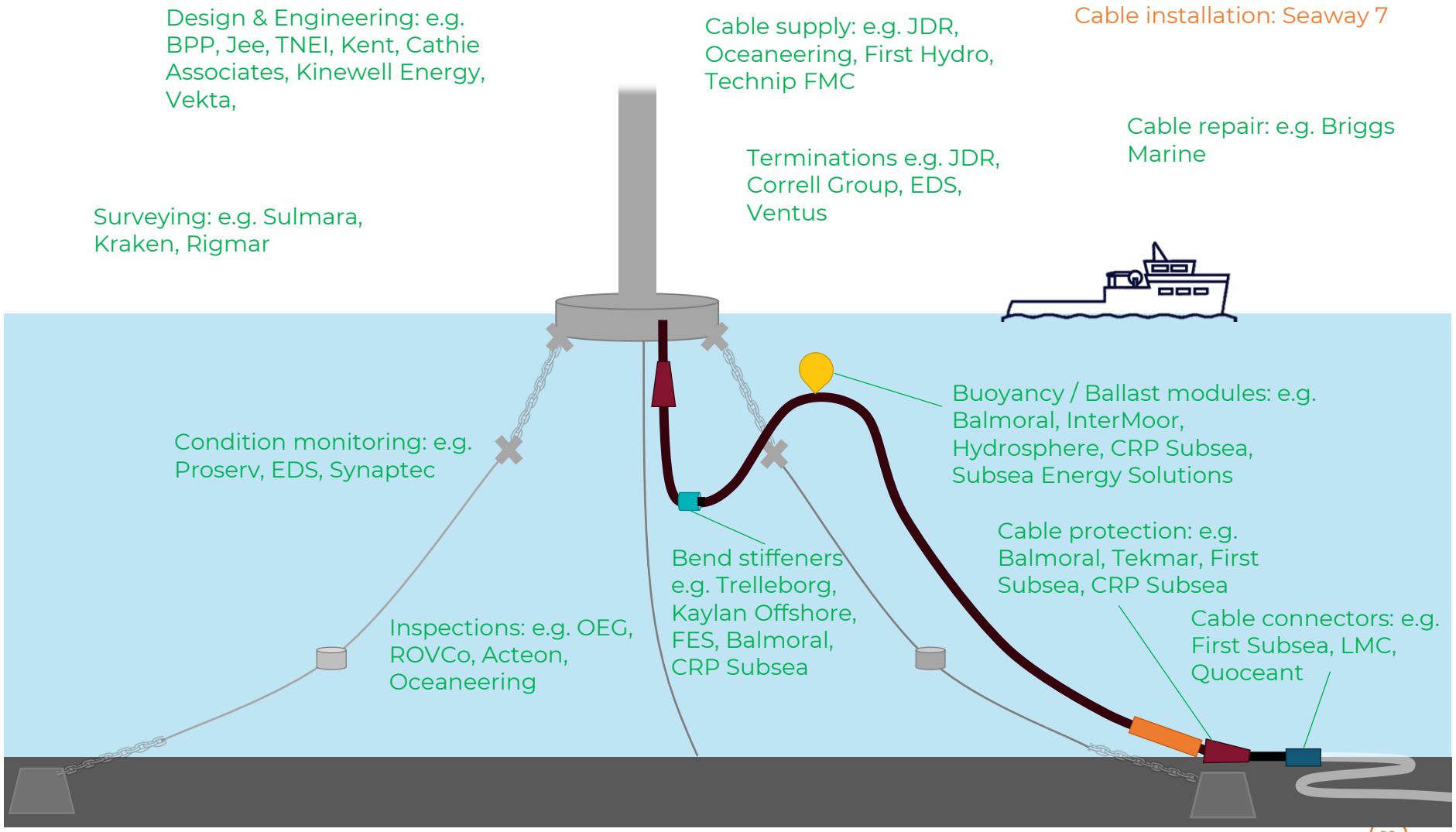
N.B. Shows simplified mooring design – there are various options

Example companies - array cables

The UK is very well placed for the dynamic cable market

The UK has a Level 2 supplier in JDR cables, supported by a strong supply chain across the lifecycle. This capability is arguably even stronger for the more complex floating wind sector and move to dynamic cables.

However, like fixed wind, the UK lacks a major installer with high UK footprint who could own the package for the UK.

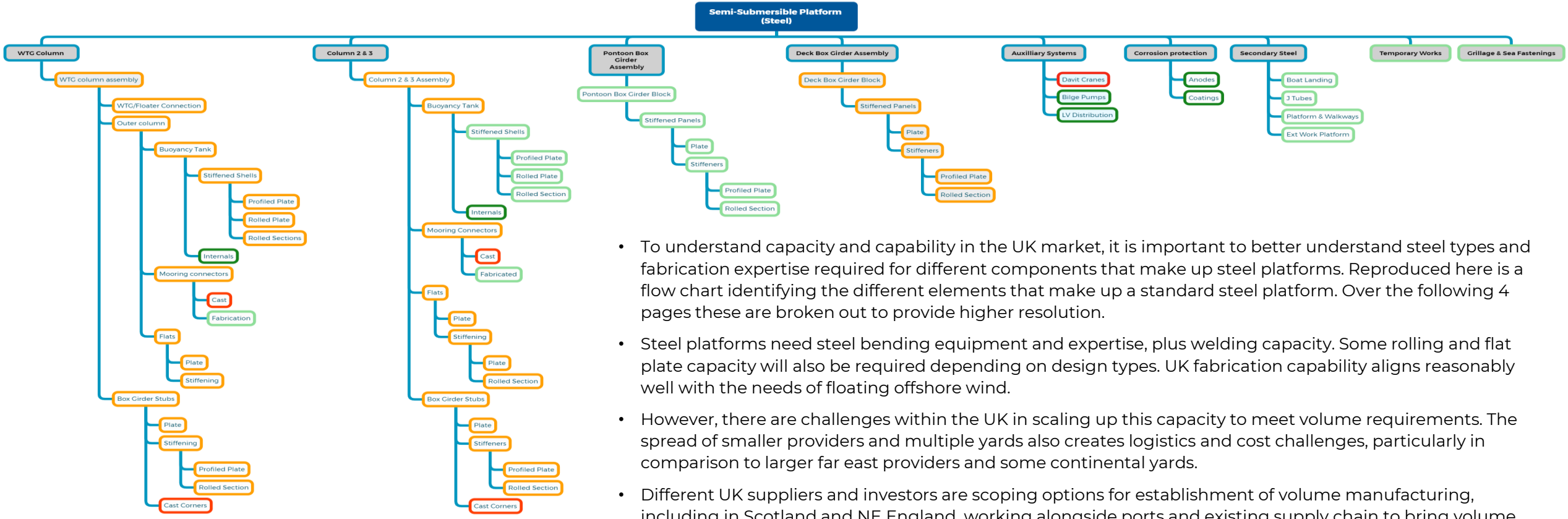


Key: Strong capability Good capability Some capability No capability

N.B. Assumes lazy wave design

Level 3 capability – steel platforms

UK fabrication capability aligns well with the needs of floating offshore wind but requires scaling up to deliver volume manufacture.



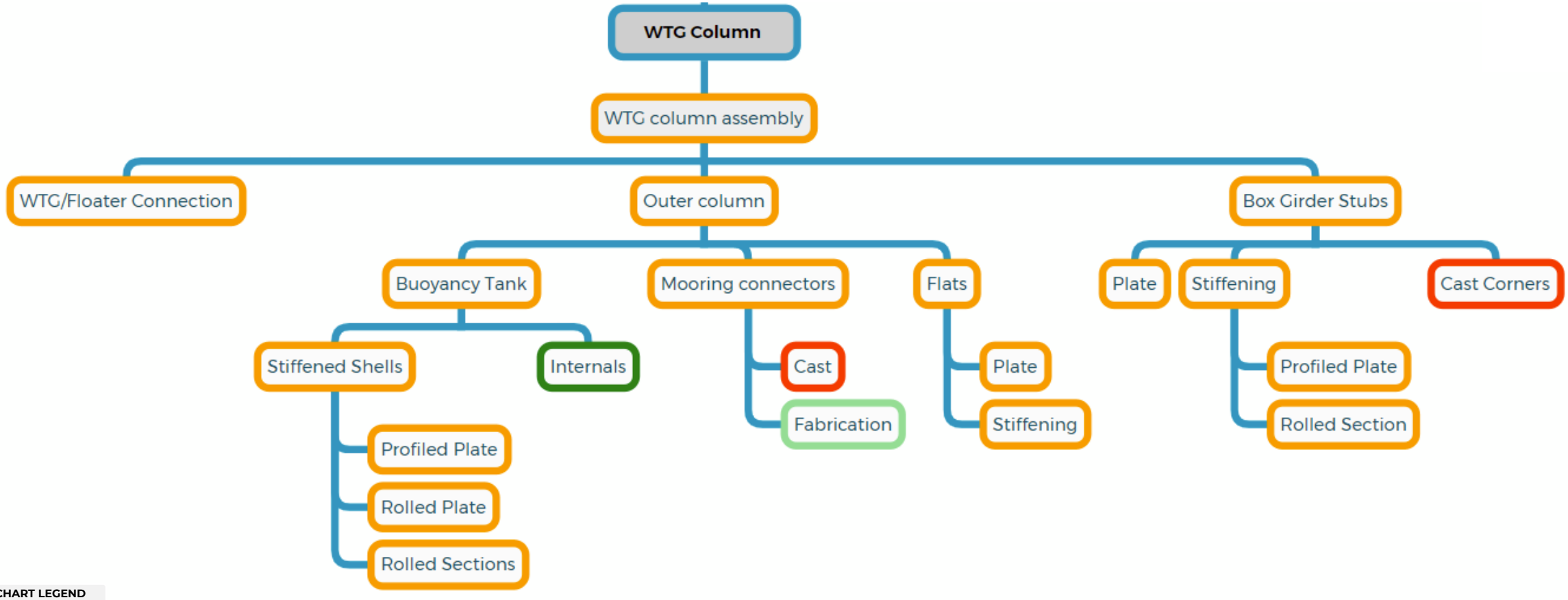
FLOW CHART LEGEND

No UK supplier	Up to 5 UK suppliers
Single UK supplier	Multiple UK suppliers
Up to 3 UK suppliers	

- To understand capacity and capability in the UK market, it is important to better understand steel types and fabrication expertise required for different components that make up steel platforms. Reproduced here is a flow chart identifying the different elements that make up a standard steel platform. Over the following 4 pages these are broken out to provide higher resolution.
- Steel platforms need steel bending equipment and expertise, plus welding capacity. Some rolling and flat plate capacity will also be required depending on design types. UK fabrication capability aligns reasonably well with the needs of floating offshore wind.
- However, there are challenges within the UK in scaling up this capacity to meet volume requirements. The spread of smaller providers and multiple yards also creates logistics and cost challenges, particularly in comparison to larger far east providers and some continental yards.
- Different UK suppliers and investors are scoping options for establishment of volume manufacturing, including in Scotland and NE England, working alongside ports and existing supply chain to bring volume manufacturing into UK. Successful realisation of these will be important in terms of addressing productivity, volume and cost issues. Not shown above but also important is wider expertise in welding provision.
- A recommendation for a *Bill of Works* plus platform collaboration to identify design requirements will enable this expertise and knowledge to be more widely shared by the UK supply chain.

Level 3 capability – steel platforms

Wind turbine column

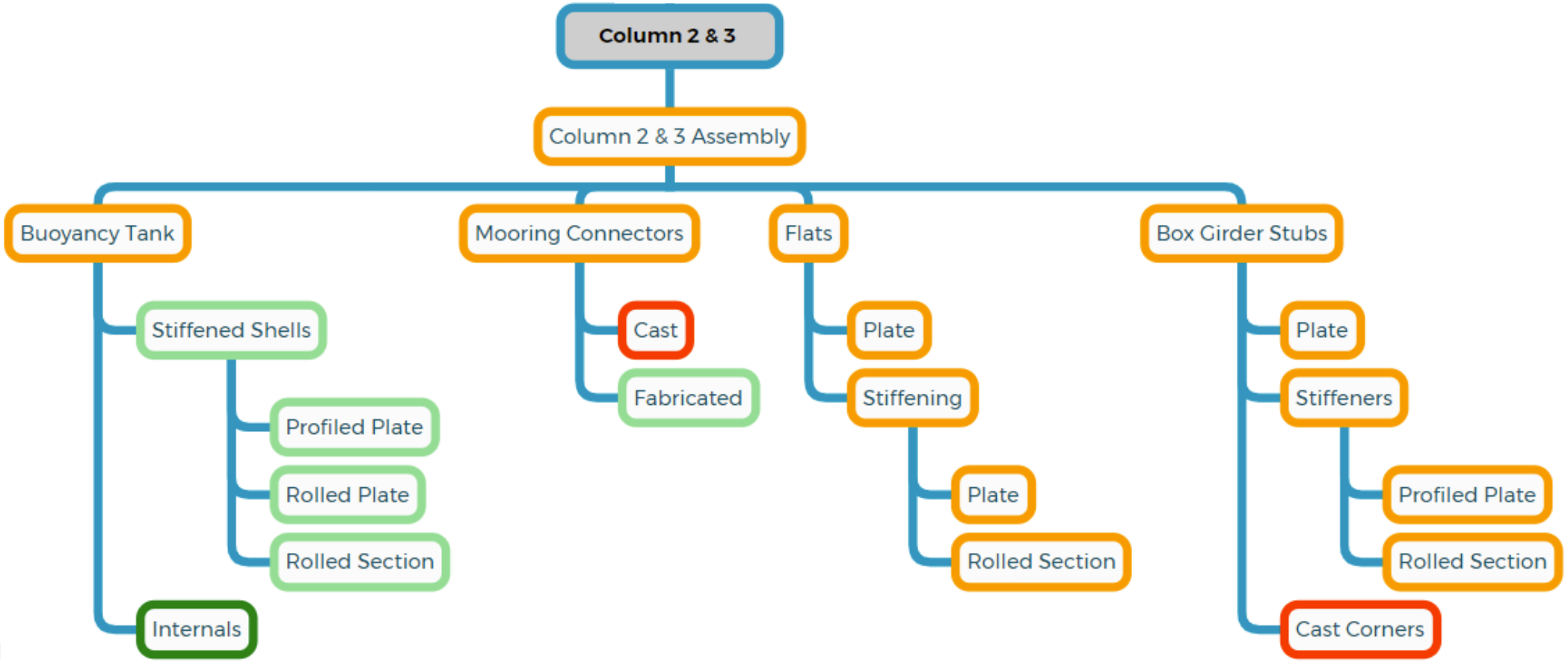


FLOW CHART LEGEND

No UK supplier	Up to 5 UK suppliers
Single UK supplier	Multiple UK suppliers
Up to 3 UK suppliers	

Level 3 capability – steel platforms

Columns 2 & 3

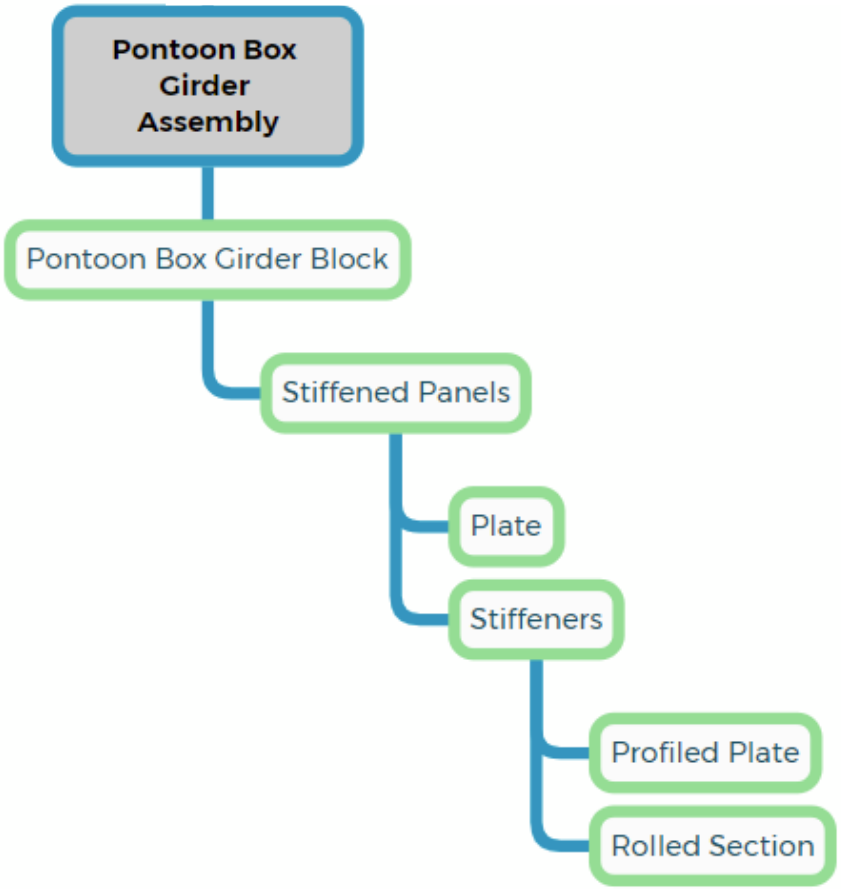


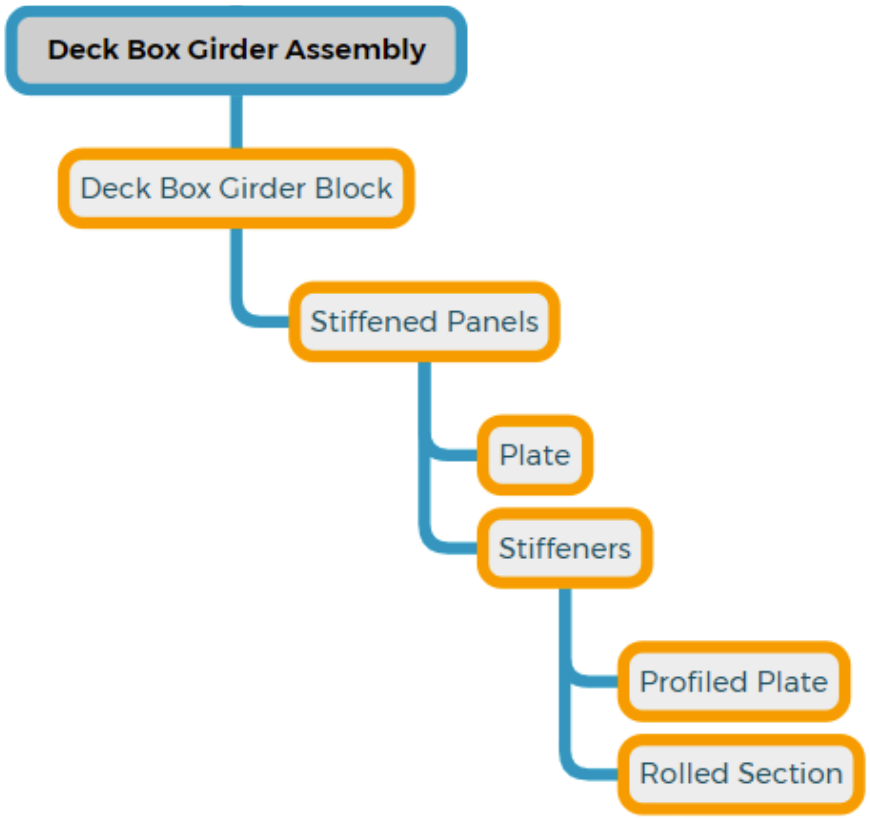
FLOW CHART LEGEND

No UK supplier	Up to 5 UK suppliers
Single UK supplier	Multiple UK suppliers
Up to 3 UK suppliers	

Level 3 capability – steel platforms

Box Girders



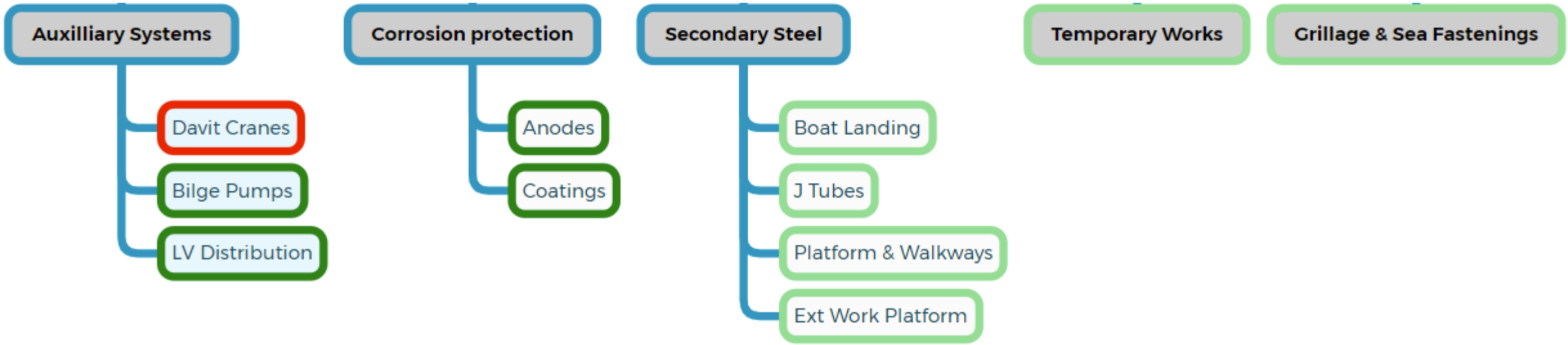


FLOW CHART LEGEND

No UK supplier	Up to 5 UK suppliers
Single UK supplier	Multiple UK suppliers
Up to 3 UK suppliers	

Level 3 capability – steel platforms

Auxiliary Systems, Corrosion Protection, Secondary Steel, Temporary Works, Grillage & Sea Fastenings



FLOW CHART LEGEND

No UK supplier	Up to 5 UK suppliers
Single UK supplier	Multiple UK suppliers
Up to 3 UK suppliers	

Example companies – concrete platforms

UK has strong engineering know-how, but no concrete platform design. UK has strong civil engineering expertise, but likely reliant on firms outside UK for slipforming, post-tensioning and other specialist manufacturing

Platform Design
No capability

Significant control of supply chain (outside of developer/EPC roles will rest with platform designers and contracted engineering teams. UK has no platform designers working on concrete platform production.

Engineering Services
e.g. Kent; LMC; OWC

Significant UK engineering design and advisory services within UK.

Raw materials:
Supply chain from civil engineering/construction - e.g. Celsa Steel

UK has existing supply chain within aggregate and cement supply. In Celtic Seas potential exists to use china clay wastes as source of aggregate.
The Celsa Steel Cardiff plant is the UK's biggest supplier of rebar, and UK has large volume of scrap steel as feedstock.

Formwork Slipforming:
Some civil engineering expertise

UK needs to invest in suitable rigs and equipment required for volume platform production. UK has formwork expertise to supply precast components. Slipforming expertise for volume FLOW platform production needs to be developed.

Post tensioning:
Some civil engineering expertise

UK has post tensioning expertise, plus some material supply (e.g. BBRG).

Steel components:
e.g. Harland & Wolff; Global Energy Group; Wilton; SeAH; Severfield; Hutchinson Engineering; Texo; Ledwood

Concrete platforms have some steel requirements, including mooring connections, flanges, auxiliary equipment. UK providers focused on offshore wind secondary steel work can potentially supply this equipment.

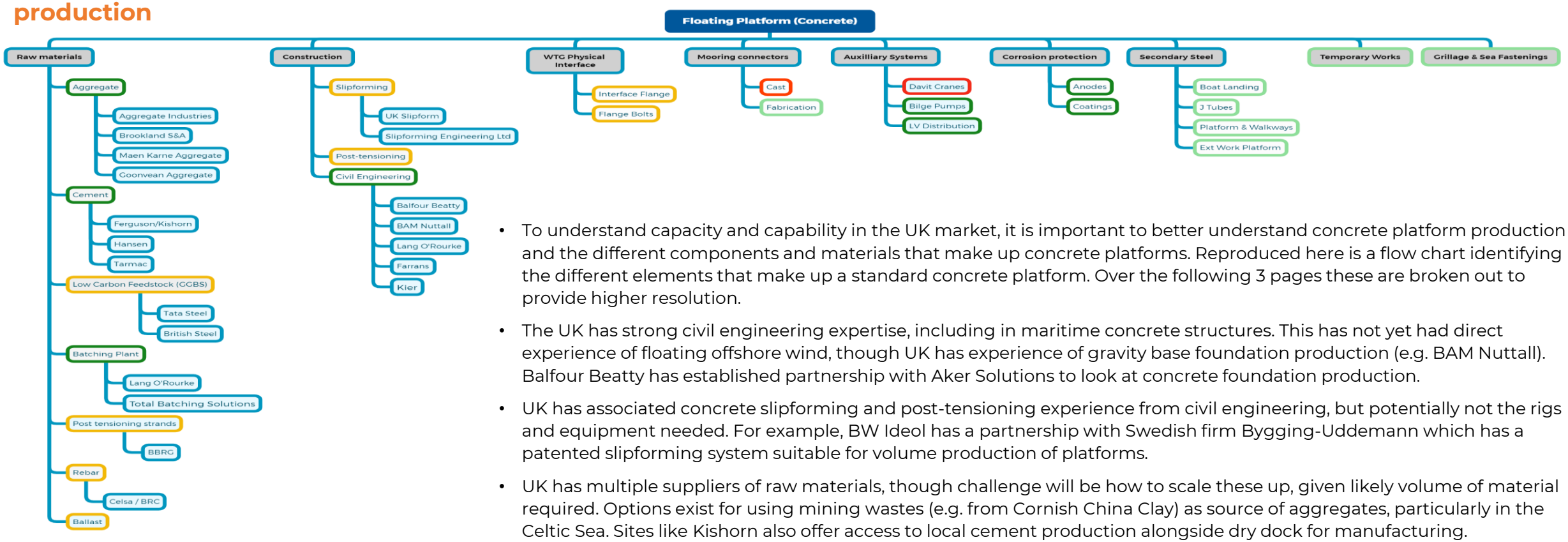
Temporary works & sea fastenings:
Local providers will need to be sought

Local activity within ports for assembly, fabrication, integration activities will bring demands for local steel fabrication expertise. Generally, is widespread availability of local fabrication expertise

Key:
Strong capability Good capability Some capability No capability

Level 3 capability – concrete platforms

To understand capacity and capability in the UK market, it is important to better understand the different components and elements required for concrete platform production



FLOW CHART LEGEND

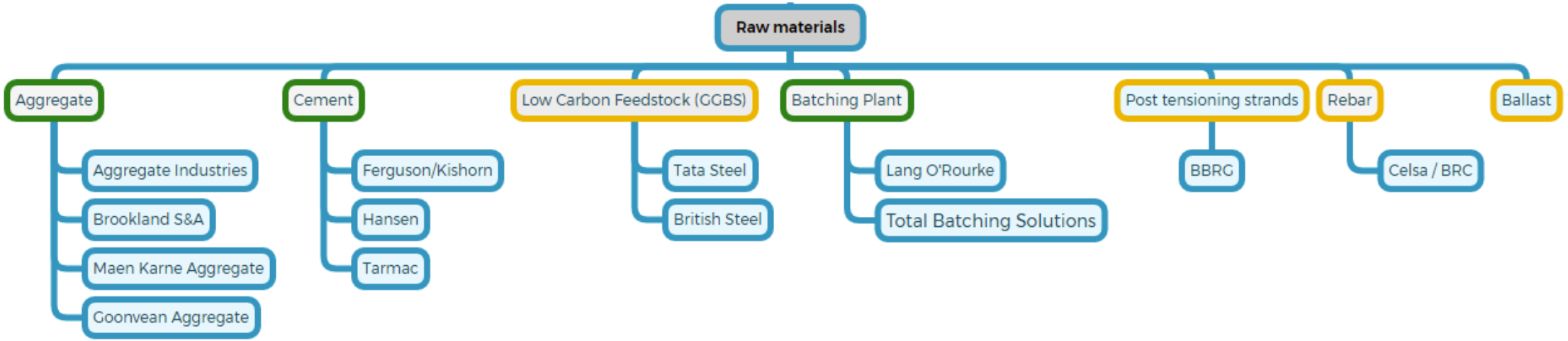
No UK supplier	Up to 5 UK suppliers
Single UK supplier	Multiple UK suppliers
Up to 3 UK suppliers	Example supplier

- To understand capacity and capability in the UK market, it is important to better understand concrete platform production and the different components and materials that make up concrete platforms. Reproduced here is a flow chart identifying the different elements that make up a standard concrete platform. Over the following 3 pages these are broken out to provide higher resolution.
- The UK has strong civil engineering expertise, including in maritime concrete structures. This has not yet had direct experience of floating offshore wind, though UK has experience of gravity base foundation production (e.g. BAM Nuttall). Balfour Beatty has established partnership with Aker Solutions to look at concrete foundation production.
- UK has associated concrete slipforming and post-tensioning experience from civil engineering, but potentially not the rigs and equipment needed. For example, BW Ideol has a partnership with Swedish firm Bygging-Uddemann which has a patented slipforming system suitable for volume production of platforms.
- UK has multiple suppliers of raw materials, though challenge will be how to scale these up, given likely volume of material required. Options exist for using mining wastes (e.g. from Cornish China Clay) as source of aggregates, particularly in the Celtic Sea. Sites like Kishorn also offer access to local cement production alongside dry dock for manufacturing.
- Concrete platforms will also have needs for mooring connectors, auxiliary systems, corrosion protection, secondary steel, temporary site works and sea fastenings that can all be supplied by UK companies, including fabricators local to site works..
- A recommendation for a *Bill of Works* plus platform collaboration to identify design requirements will enable this expertise and knowledge to be more widely shared by the UK supply chain.

Following slides show the breakdown in more detail

Level 3 capability – concrete platforms

Raw materials and examples of potential suppliers

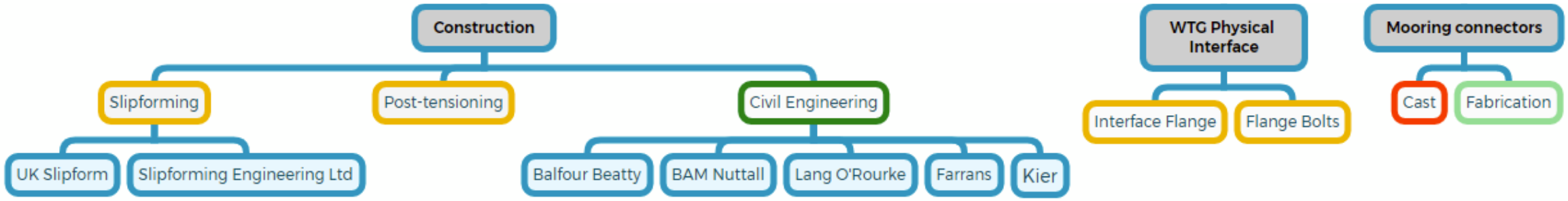


FLOW CHART LEGEND

No UK supplier	Up to 5 UK suppliers
Single UK supplier	Multiple UK suppliers
Up to 3 UK suppliers	Example supplier

Level 3 capability – concrete platforms

Construction, WTG Physical Interface & Mooring connectors and examples of potential suppliers

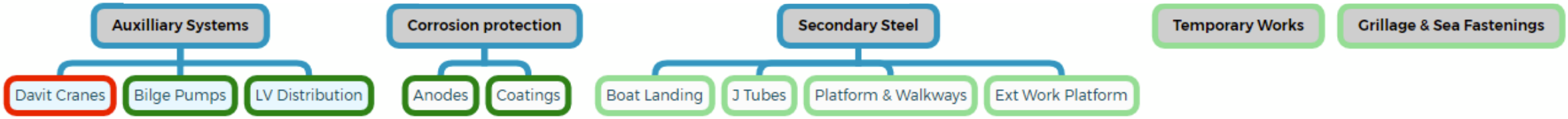


FLOW CHART LEGEND

No UK supplier	Up to 5 UK suppliers
Single UK supplier	Multiple UK suppliers
Up to 3 UK suppliers	Example supplier

Level 3 capability – concrete platforms

Auxiliary systems, corrosion protection, secondary steel, temporary works, grillage & sea fastenings and examples of potential suppliers



FLOW CHART LEGEND

No UK supplier	Up to 5 UK suppliers
Single UK supplier	Multiple UK suppliers
Up to 3 UK suppliers	Example supplier

Annex
b) Opportunity areas

Introduction

The study review 9 opportunity areas

The following slides provide the assessment of capturable GVA potential, accessibility, jobs and the location of companies for the UK across the following opportunity areas:

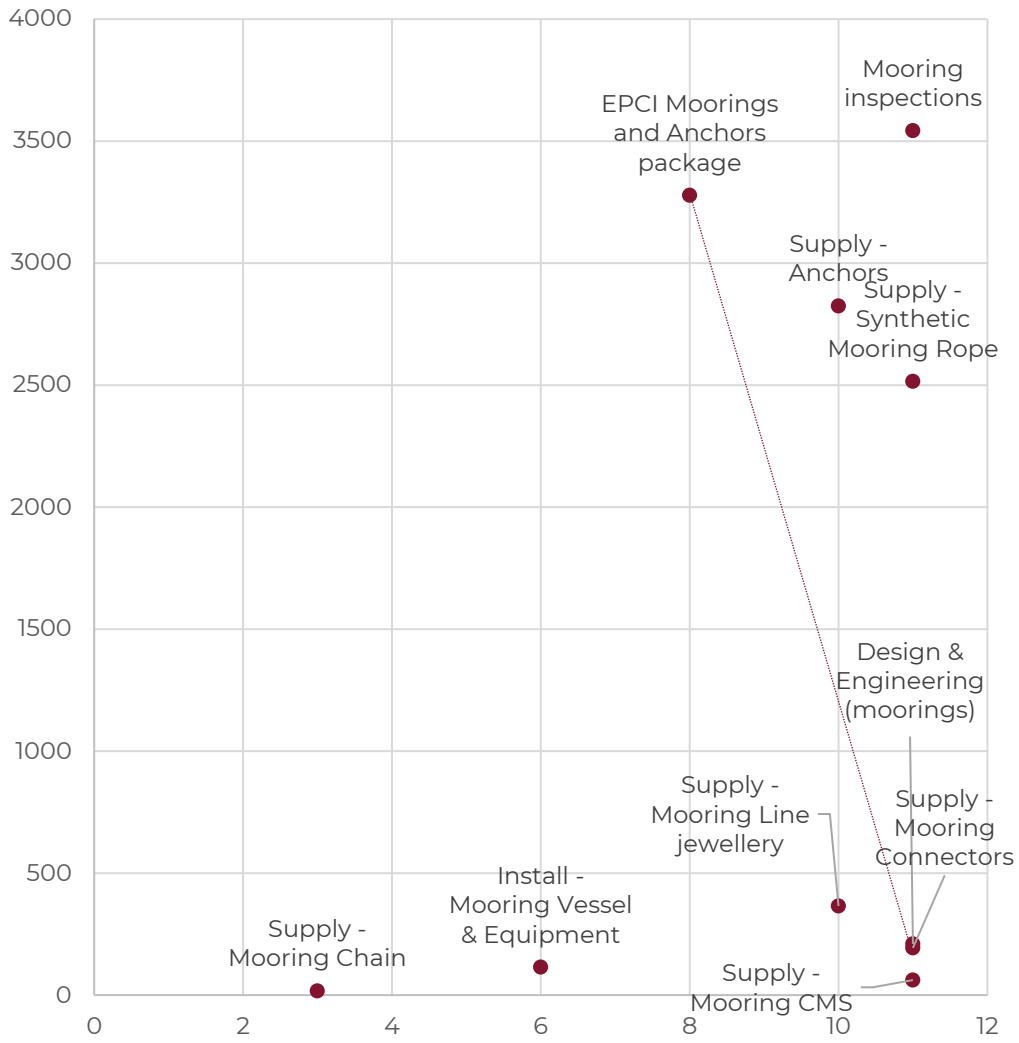
- Moorings and anchors;
- Dynamic cables;
- Concrete substructures;
- Steel substructures;
- Port logistics;
- Installation;
- Software;
- O&M; and
- Development services.

A slide is provided on the opportunities within each area and the locations of the companies.

Opportunities: Moorings & Anchors

Key points

- Results will be driven by mooring design assumed – this is based on semi-taut mooring configuration.
- Moorings and anchors represent a significant opportunity for the UK, because of established expertise from oil and gas. This expertise is important and if used correctly will have a disproportionate positive impact on overall project risk (and vice versa).The biggest prize is management of the overall package (supply and install), which is estimated to be a £28Bn opportunity globally to 2050. Of this we consider potential for UK companies to capture £3.5Bn of this (25% of UK projects, and 10% globally). This represents £3.5 Bn of value. However, there are challenges to accessing it:
  1. The appetite, balance sheet and competitiveness of the integrators to deliver this package, with purchasing of equipment potentially prohibitive. This represents areas to explore for interventions.
  2. How the package will be contracted and whether it will form part of a broader EPCI package, or contracted directly by developers.
  3. Whether those with vessels will be best placed to deliver the early projects, therefore building a track record, with the UK owning relatively few Anchor Handler Vessels.
- If the UK doesn't manage the package, instead playing more of a consultancy role in the design and engineering of mooring systems then the value is ~£250m. This will be a missed opportunity for the UK (shown in the red dotted line).
- The next largest opportunities are in the supply of synthetic mooring lines (£9Bn global opportunity) and anchors (£10Bn global opportunity). This is supply to either a developer or EPCI.
  - The UK is very well placed to supply mooring lines, with world leading rope suppliers at the forefront of floating wind, with existing UK factories and advanced plans to build more. Our view is that ropes will remain specialist enough to avoid commoditisation and provide long term comparative advantage for the UK.
  - Anchors: the UK has leading competence in the design and supply of Drag Embedment Anchors (DEA) and is at forefront of other anchor types (piled, suction, etc). However, to date industry has used DEA from Delmar-Vryhof (US-Dutch company) and there is a need to build UK track record.
  - Chain is a much smaller opportunity (£1.3Bn globally)– firstly because we assume that designs will primarily use synthetic rope, and secondly because the UK lacks a chain mill.
  - Mooring connectors are critical component impacting installation and operational approaches, with the UK have good capability and expertise.
- Inspections and repair are covered more fully in the O&M section but were included here to highlight the through-life opportunity for moorings and anchors – an opportunity more capturable if it is UK integrators own the overall package.



Locations & jobs

Capability is spread across Scotland and England with clear cluster in Aberdeen

The analysis highlights that £6.3 Bn of GVA in the Tier 2 opportunities would create 131,345 years of employment (i.e. the GVA provides value to support 131,345 people to be employed for one year). Spreading this equally between 2030 to 2050, implies around 6500 jobs per year. This includes direct (i.e. the employment created to fulfill the demand for the product or service) and indirect employment (i.e. the jobs in the broader area that exist to produce the goods and services needed by the workers of the direct jobs).

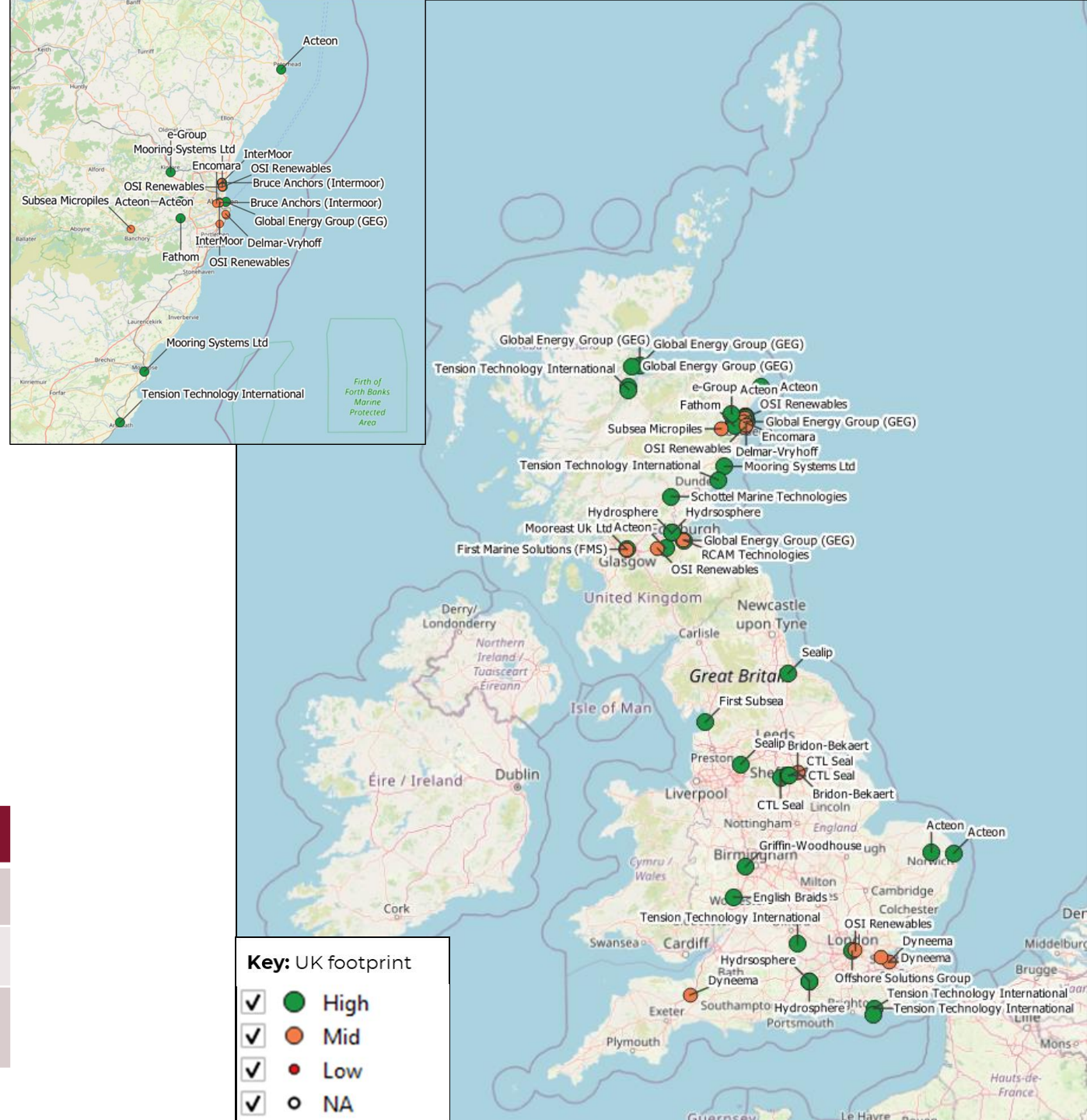
The map shows the location data for the companies in the SCCA database filtered for the moorings and anchors line items. It covers both headquarters and any operational sites that the DataCity portal picks up from scraping Company House and websites.

The map shows a clear cluster of competence around Aberdeen, with capability also spread around the Central Belt in Scotland and across England.

We therefore assume a regional split in jobs as follows. This does not account for any new investments.

	UK	England	Scotland	Wales	NI
Split	N/A	40%	60%	0%	0%
Years of employment	131,345	52538	78807	0	0
Indicative Jobs per year 2030-2050	6567	2626	3,940	0	0

Model outputs



Opportunities

Key points

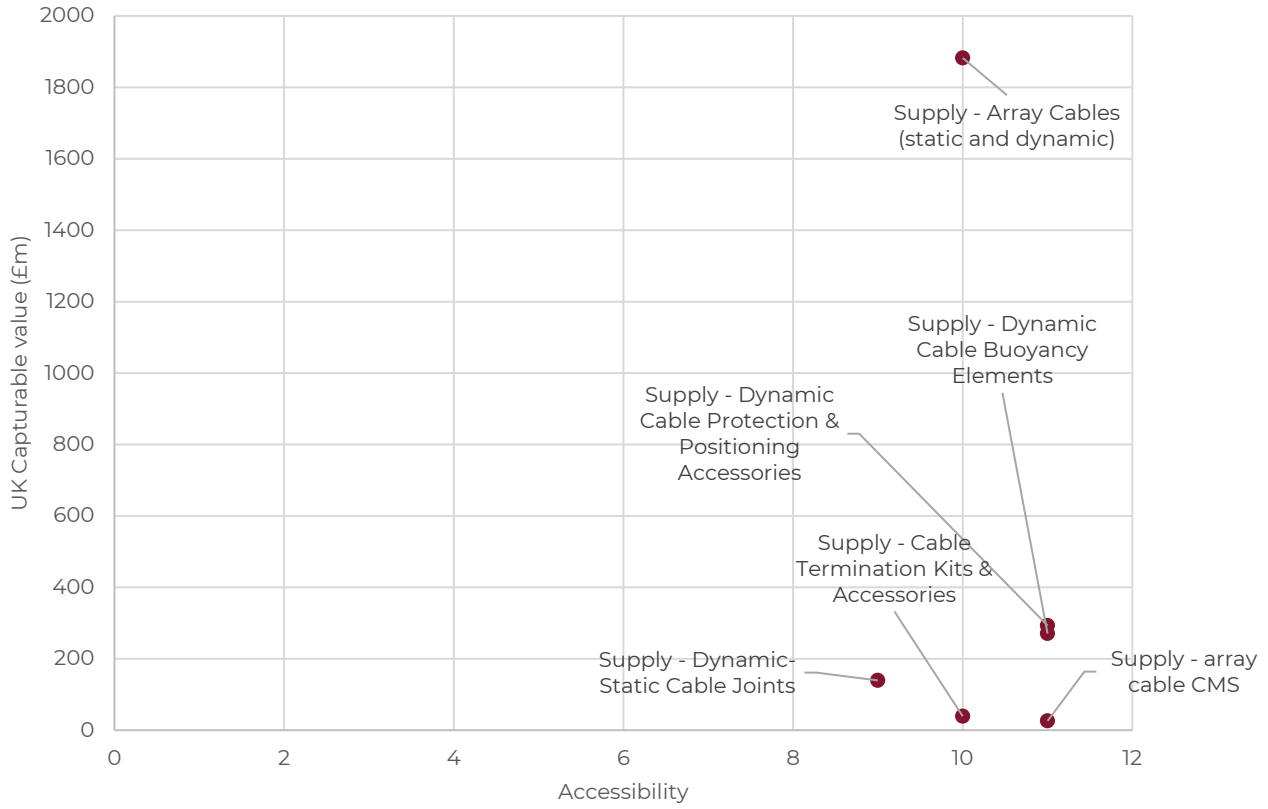
The array cable supply package is by far the most valuable opportunity and is very accessible to UK companies such as JDR. Overall this has a total market value of £16Bn to 2050. Of this total opportunity, we estimate UK companies could capture 25% of the UK market and 10% of the global market representing £1.9Bn of GVA. JDR are very well placed, actively pursuing this opportunity, building a new factory and developing dynamic 132kV cables. Key to success will be a project pipeline to build track record and continued cost competitiveness / value add. A potential barrier is the lack of an UK cable EPC to own the supply and install package at the top tier.

The UK also has good opportunities at the next tier down, **with leading suppliers of cable connectors, protection, positioning and buoyancy accessories (combined) able to capture £750m in GVA.** Electrical disconnection and connection is a challenge for floating wind under a 'tow-to-port O&M strategy and will likely see significant innovation.

To date in fixed wind condition monitoring of buried array cables, where used, has typically been limited to strain and thermal performance. With the dynamic nature of floating cables likely to drive higher failure rates and in turn enhanced benefit from condition monitoring systems, **the industry will likely see greater take up of array cable monitoring**, with the UK having strong capability in this area.

In terms of value add, there is scope for the **UK to develop an optimised through life UK-system solution for cables (and possibly moorings)**, bringing together JDR with designers, CPS providers, connectors, joints, jewellery providers, CMS and possible cable repair companies.

Given the importance of copper in cables and decarbonisation, UK needs to identify how to secure critical mineral over the long term.



Locations & jobs

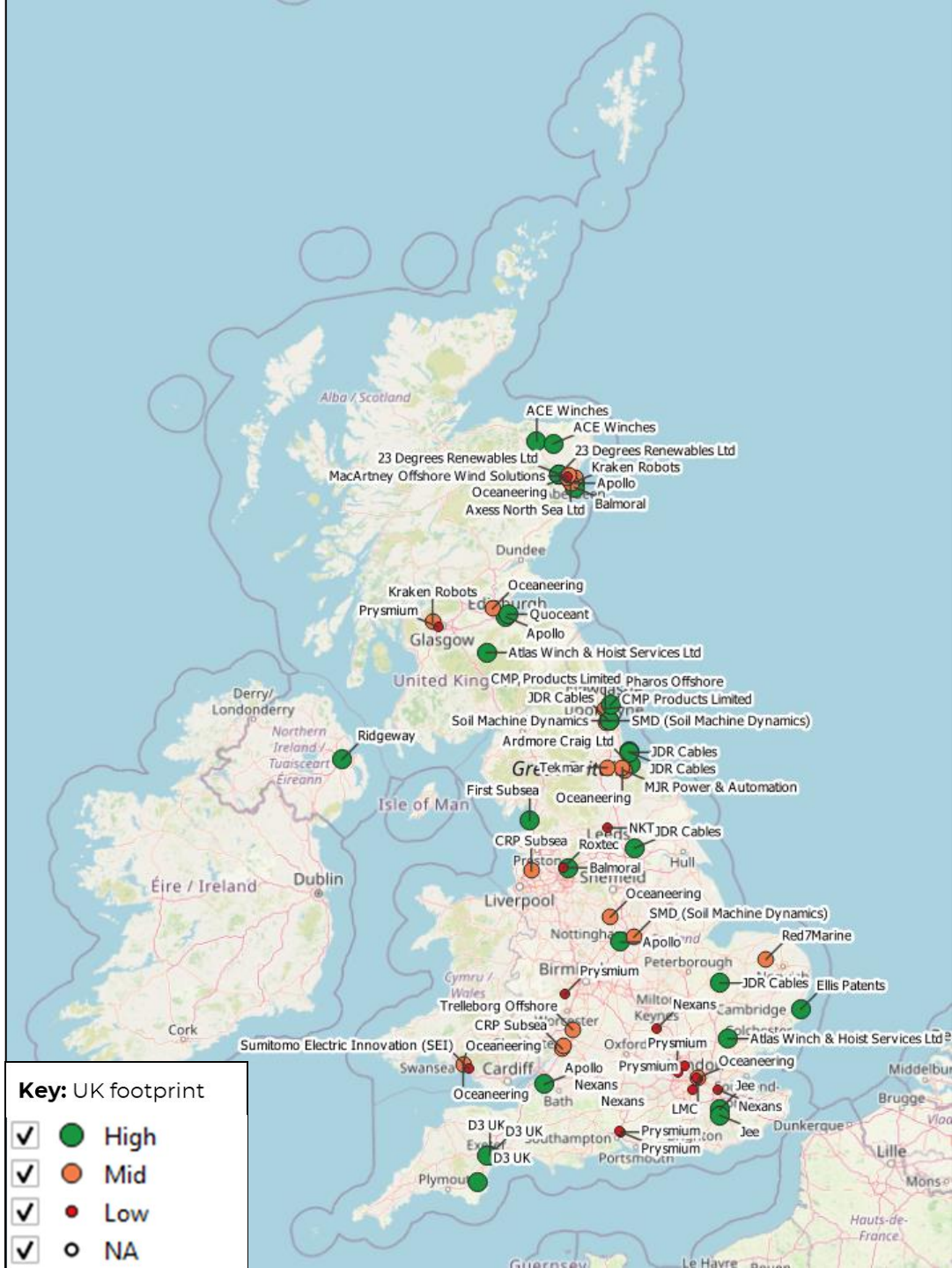
Array cables

The analysis highlights that £1.9 Bn of GVA in the array cable supply package would create 22,613 years of employment, whilst the £740m of GVA across cable accessories, joints, protection and buoyancy could create 2,305 years of employment. However we think there may be some overlap and duplication and so consider the top tier estimate to be reasonable. This implies around 1,130 jobs per year across the UK.

Array cable companies are reasonably spread out across the UK, with clusters in Aberdeen, Tyneside and Teeside.

We therefore assume a regional split in jobs as follows. This does not account for any new investments.

	UK	England	Scotland	Wales	NI
Split	N/A	60%	30%	5%	5%
Years of employment	22,614	13,568	6784	1131	1131
Indicative jobs per year	1130	678	339	57	57



Opportunities

Key points

Overall, **the UK has no UK-led platform designs coming to market and so Tier 1 value is assumed to be low** and challenging to access.

UK Projects

For UK projects, the **UK has a good opportunity to manufacture concrete fabrications** (on behalf of a non-UK designer). This requires the UK to establish suitable port infrastructure, tier two supply chain and skills base. Supply and fabrication of concrete substructures (to a Tier 1 designer) within the UK is a large £5Bn opportunity. This is by no means certain, with risks of import from France or other North Sea locations.

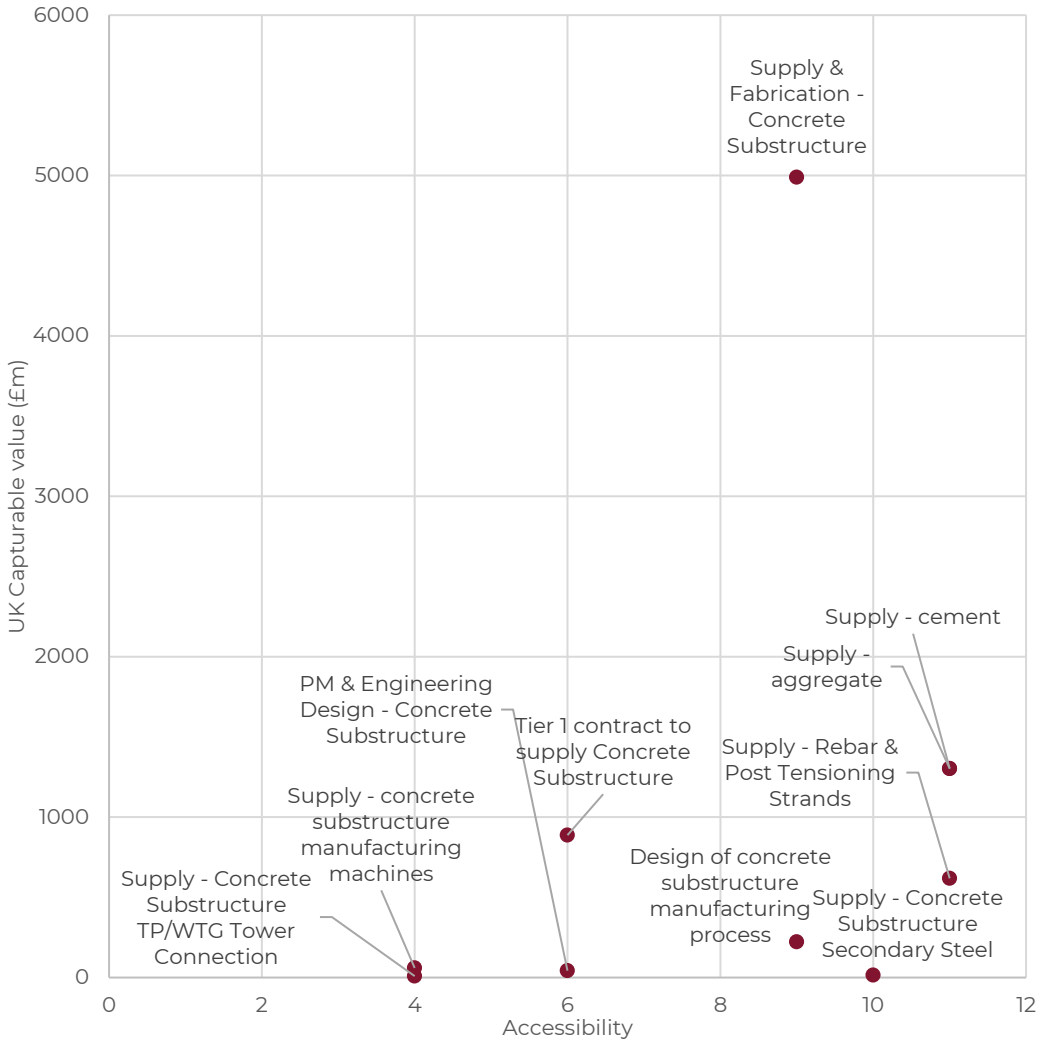
If UK manufacture is secured, then the **UK is well placed to secure value from the supply chain for raw materials,** particularly for rebar and post tensioning strands. Value to UK of rebar & post tensioning strands supply estimated at £3.45Bn. Celsa Steel clear market leader. UK can also supply aggregates and cement plus other green cement additives, delivering wider supply chain value. The UK's existing secondary steel providers are also well placed to provide into this market.

Export opportunities

The lack of UK-led platform designs in market means that critical decisions will be made outside of UK, with the **UK having little ability to capture the circa £58Bn global GVA from non-UK concrete fabrication activity.**

Strong civil engineering expertise means UK has opportunity to benefit from opportunities relating to design and construction. However, UK has not been a leader in applying concrete expertise into FLOW. **Immediate focus needs to be here**, so that UK civil engineering companies can secure value from design and engineering of platforms.

UK has opportunities to offer innovations such as alternative rebar materials, plus consideration of options for low carbon concrete supply. For low carbon concrete floating wind could be seen as helpful for growing multi-sector UK IP and competence



CONCRETE PLATFORMS

Locations & jobs

Concrete expertise is located across UK. Bulk of activities will be focused around chosen manufacturing ports (where indirect benefits will flow)

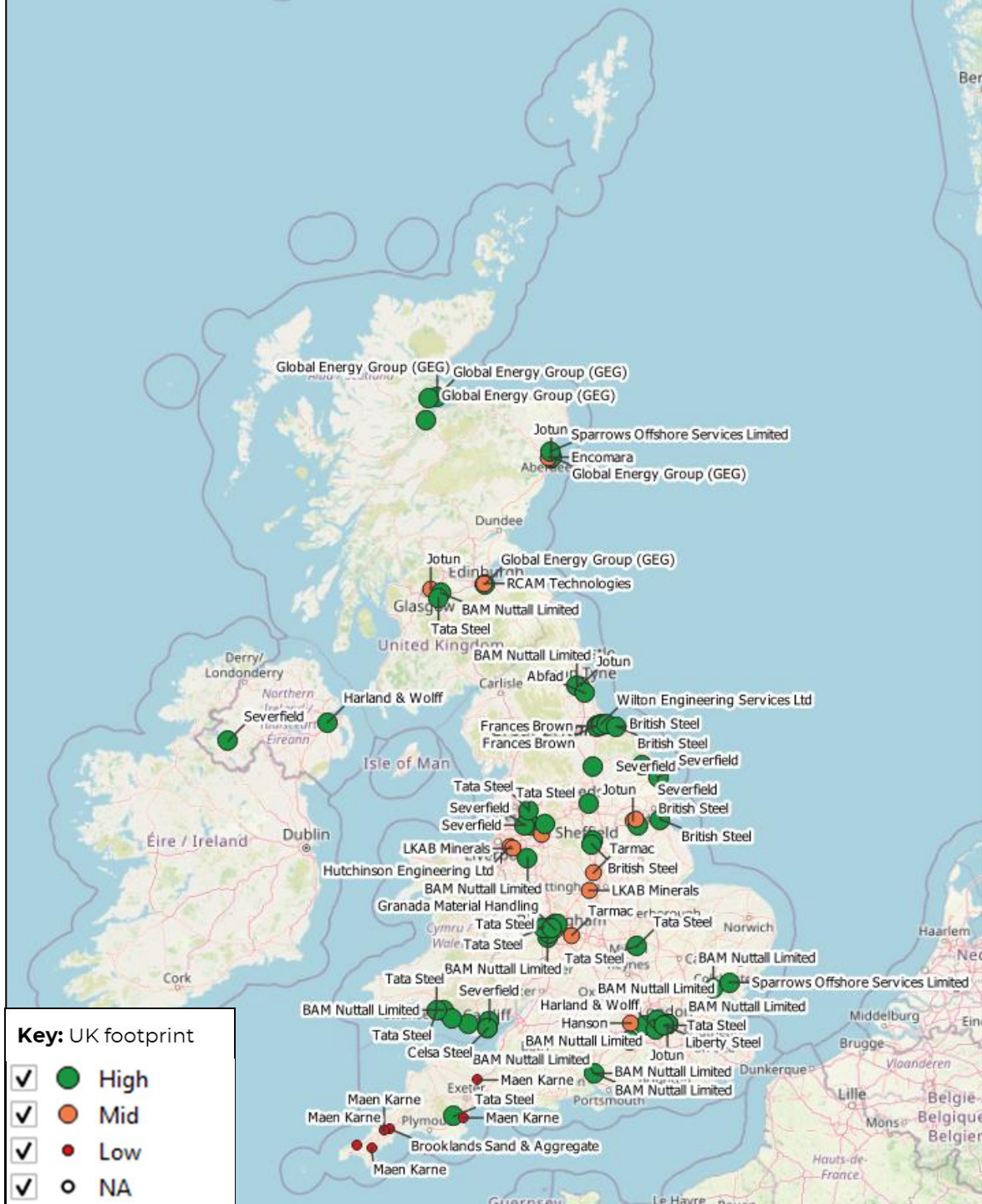
The analysis highlights that £5.0Bn of GVA in the concrete platform supply package would create 109,580 years of employment.

Companies able to provide materials, labour and expertise into this package are reasonably spread out across the UK, A significant focus of this activity will be the chosen platform manufacturing sites, but the supply chain will stretch across UK due to the high material requirements (e.g. rebar, cement & aggregates). For example Celtic Seas projects will be able to access a supply chain across South Wales and SW England.

Also shown on this map are secondary steel providers able to supply necessary components for concrete platforms.

We therefore assume a regional split in jobs as follows.

	UK	England	Scotland	Wales	NI
Split	N/A	45%	30%	20%	5%
Years of employment	109,580	49,311	32,874	21,916	5,479
Indicative jobs per year	5,479	2465	1643	1095	273



Opportunities: steel platform opportunities

Key points

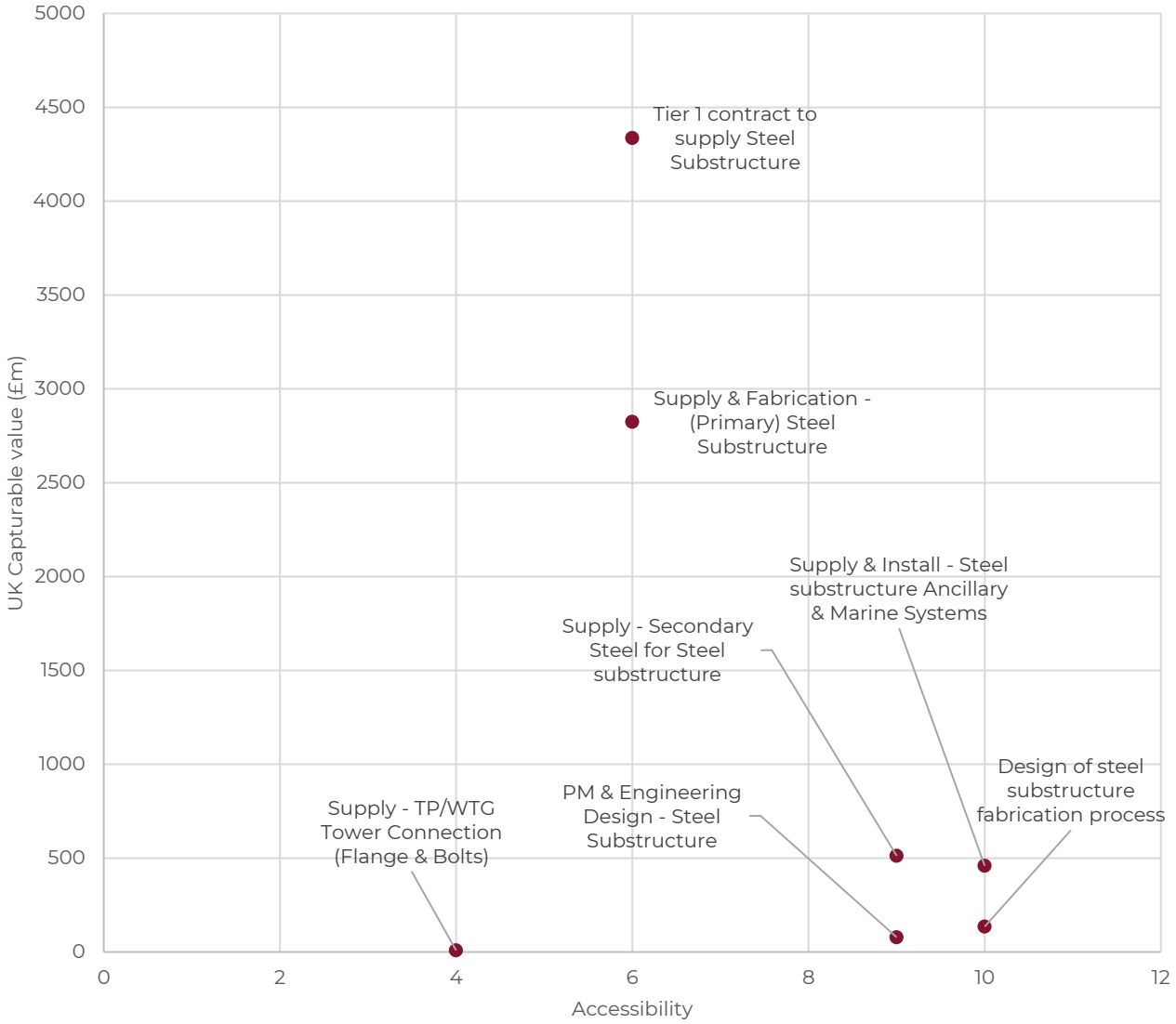
The supply and fabrication of floating steel substructures is the most significant opportunity in terms of value. However, UK has only one designer/supplier of platforms. UK may therefore struggle to capture top tier value from this activity. Value could grow with greater focus on fabrication rather than assembly. Current analysis estimates UK can capture 25% of value from primary steel within UK market and 50% in secondary market. This could grow, but support needed to build UK footprint. UK needs to look at which primary elements it can best build advantage in, and options to shift rapidly to volume manufacturing.

UK has existing network of UK fabricators able to supply primary and secondary steel items. Sector's current focus is mainly secondary steel supply, but there is growing appetite and capability to deliver higher proportion of primary steel items. Value of secondary steel items is also significant and seen as activity with reasonable value.

UK can secure competitive advantage through coordination between fabricators, prioritisation of which elements UK can best focus on and close alignment and involvement with platform providers. This includes whether to focus on tubular vs steel plates.

UK will be able to secure value from steel platform assembly. Challenges will relate to the level of additional fabrication and component manufacture it can also secure above this.

UK can benefit from early commercial application of innovative welding technologies and digital fabrication process innovation to help address productivity and cost challenges.



STEEL PLATFORMS

Locations & jobs

Capability is found across UK, though with focus in England and Scotland, with clear clusters around Aberdeen, NE & NW England

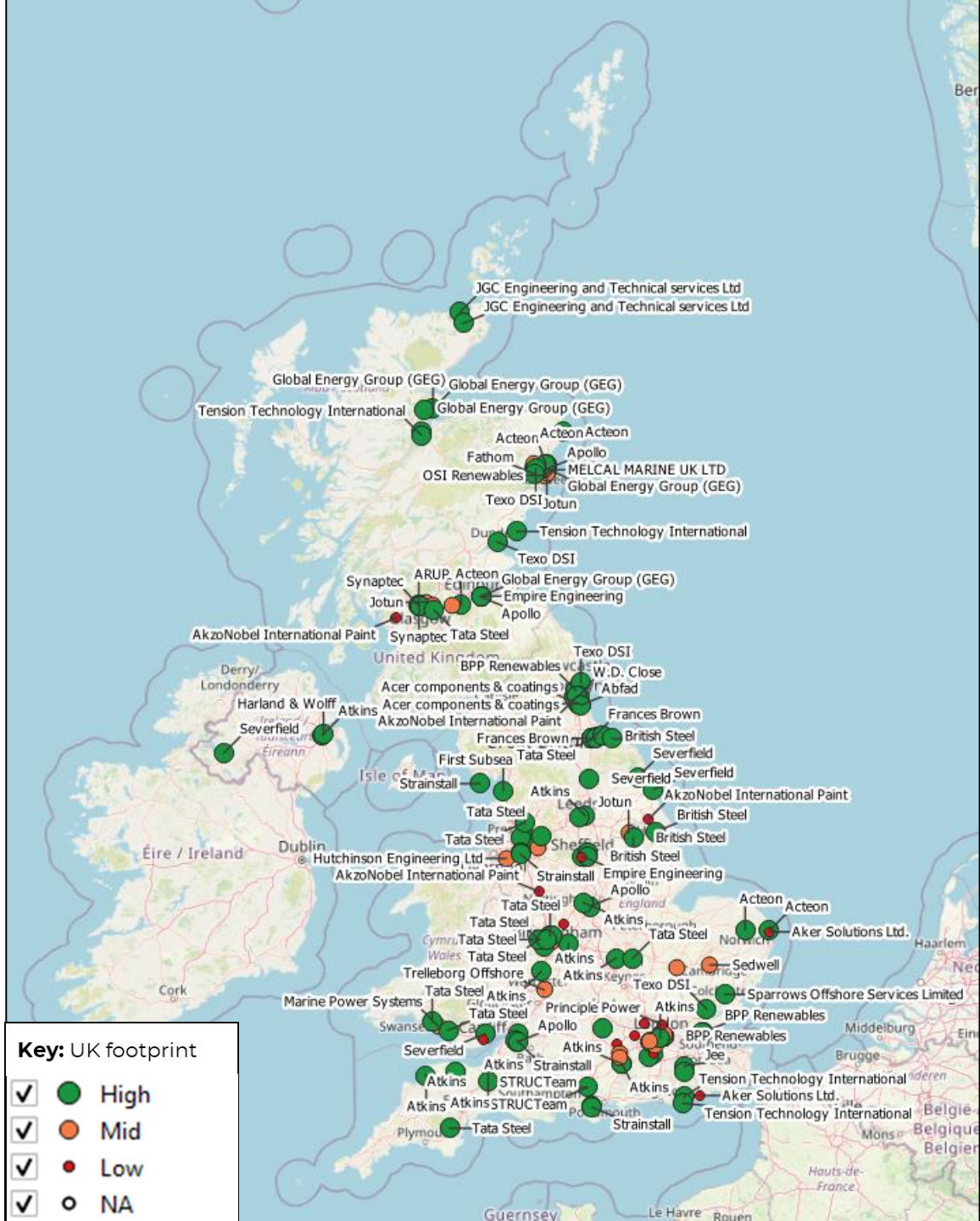
The analysis highlights that £4.3Bn of GVA in the steel platform supply package would create 53,805 years of employment.

UK fabrication expertise for potential supply into the steel platform market is distributed across UK, with some regional clusters of activity.

This map also includes UK secondary steel providers able to support steel platform deployment. In many cases UK has fabricators able to deliver both primary and secondary elements: if they are successful in securing primary items, may be a need to encourage tertiary providers to grow into provision of some secondary items.

UK steel expertise will also be needed for supplying secondary steel into concrete platform manufacturing processes.

	UK	England	Scotland	Wales	NI
Split	N/A	50%	35%	10%	5%
Years of employment	53,805	26,902	18,832	5,380	2,690
Indicative jobs per year	2690	1345	941	269	134



Port logistics

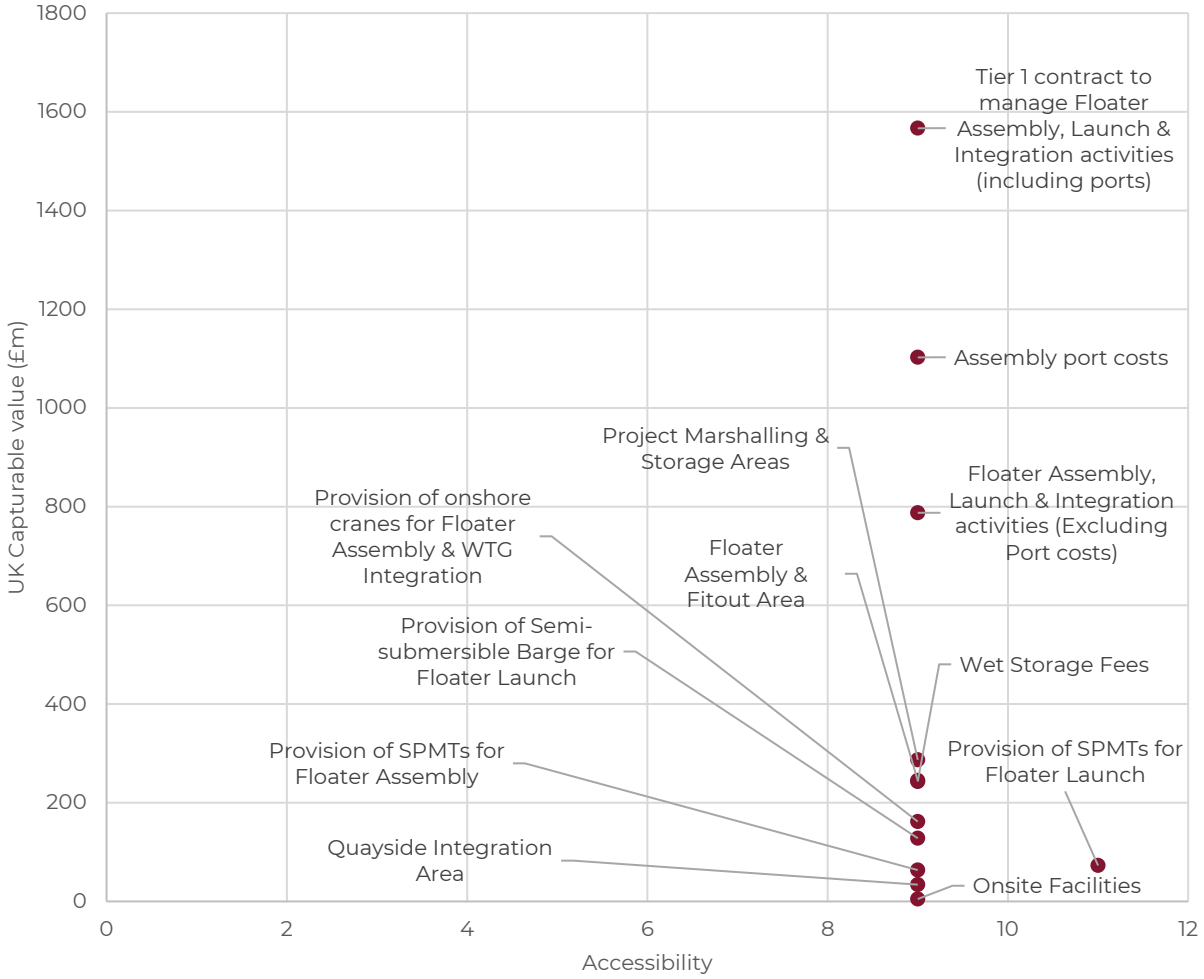
Key points

Item of most significant value is overall assembly, launch & integration contract. UK has specialist expertise in this area, though there are significant risks in market being controlled by contract decisions of non-UK players (specifically platform providers, EPCIs). The openness of the market at present means there is an opportunity for UK to secure this value item early.

Value to UK ports. There are a range of port activities and revenue streams for UK ports supporting UK projects. While these include provision of quayside, fit-out, storage and marshalling activities. the highest value port activity relating to floating offshore wind comes from **Platform Assembly**.

Floater assembly also offers up other important value items for heavy lift and civil engineering providers. Crane, logistics and civil engineering expertise will be required to support floater assembly and launch.

There are a range of logistics supply chain opportunities. These include supply of cranes, barges and SPMTs, which can be delivered by partnership of companies. Space dominated by large European providers – e.g. Sarens, Mammoet – which have UK operations, but UK also has domestic heavy lift and transport expertise of its own – e.g. Osprey Group.



Locations & jobs

Capability is spread primarily down east coast of Scotland and England and tends to be clustered around major ports

The analysis highlights that £1.57Bn of GVA in the ports logistics package would create 13,563 years of employment.

Our assessment is that this value is created primarily around the delivery of UK floating offshore wind projects, though there may be some opportunities to support non-UK projects (e.g. Ireland).

Port logistics providers are focused primarily around UK port locations, and often linked to port providers.

The map (right) identifies strong capability down the east coast of Scotland and England in particular, with small clusters of activity around Moray Firth, Forth & Tay, Tyneside and Teeside, plus a number of UK head offices based in or near London

We therefore assume a regional split in jobs as follows.

	UK	England	Scotland	Wales	NI
Split	N/A	30%	40%	25%	5%
Years of employment	16,783	5,035	6,713	4,196	839
Indicative jobs per year	839	251	335	209	41

Opportunities

Key points

The installation of floating wind turbines is much lower cost than in fixed wind, with much of the work transferred to quayside and less expensive vessels required. Installation also has quite a low GVA to cost ratio. This means installation of the floating wind turbine (including moorings and anchors) is assessed to be a **£7.3 Bn total global opportunity out to 2050.**

Within this, it is considered feasible for the **UK to capture 25% of this share for UK projects and 10% of global projects, representing ~£850m opportunity.** This scores quite low in terms of accessibility as i) the UK lacks major fixed wind installation contractors ii) the UK does not own many anchor handler vessels, with the first projects likely going to those who can sweat existing assets. Success will likely require i) a major UK oil and gas service provider to transition across and/or ii) a smaller scale player stepping up, possibly through partnership (like the one between First Marine Solutions and POSH).

The first floating wind specific installation vessels designs are now being published but are unlikely to be made in the UK.

Additional vessel opportunities around tugs and barges are considered more accessible, although much lower value, in part because the cost of a new vessel is deployed across multiple projects over the lifetime of the vessel.

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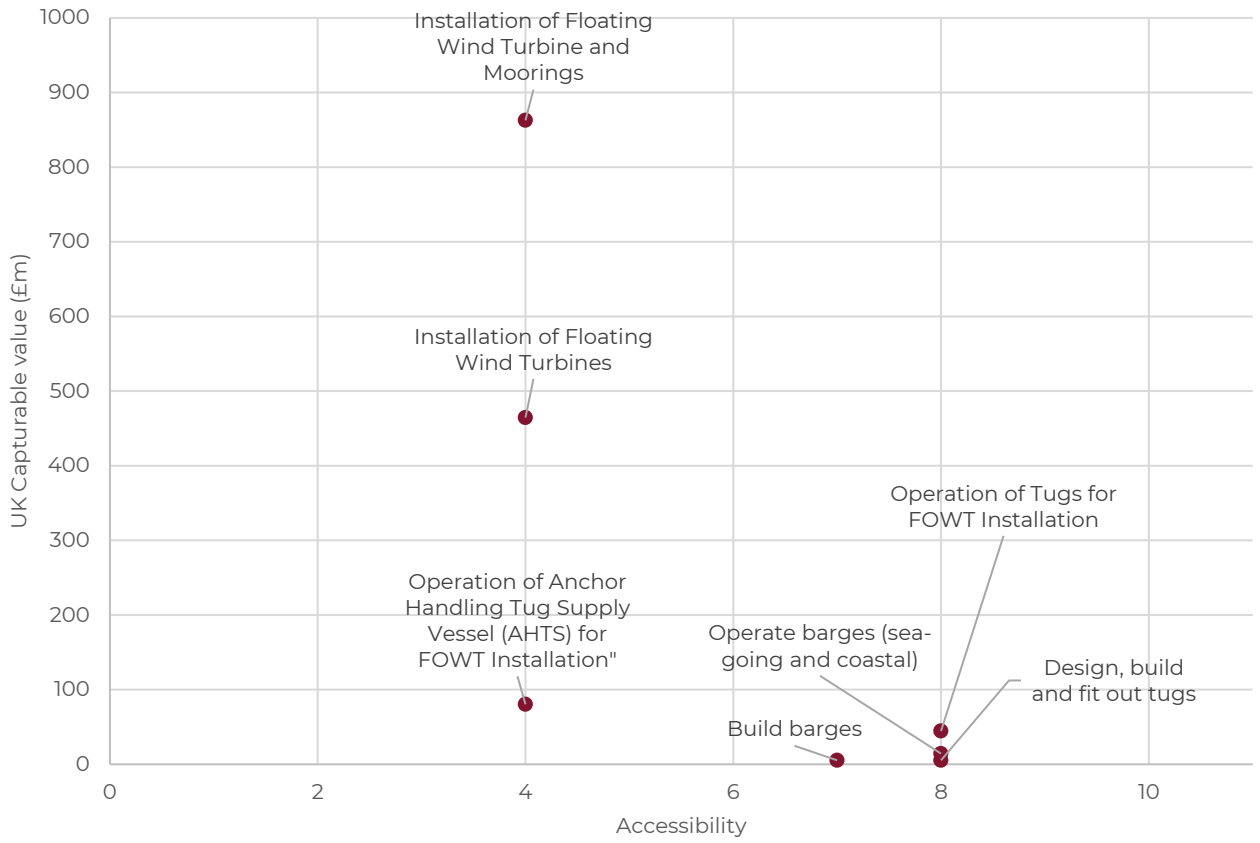


INSTALLATION

Locations & jobs

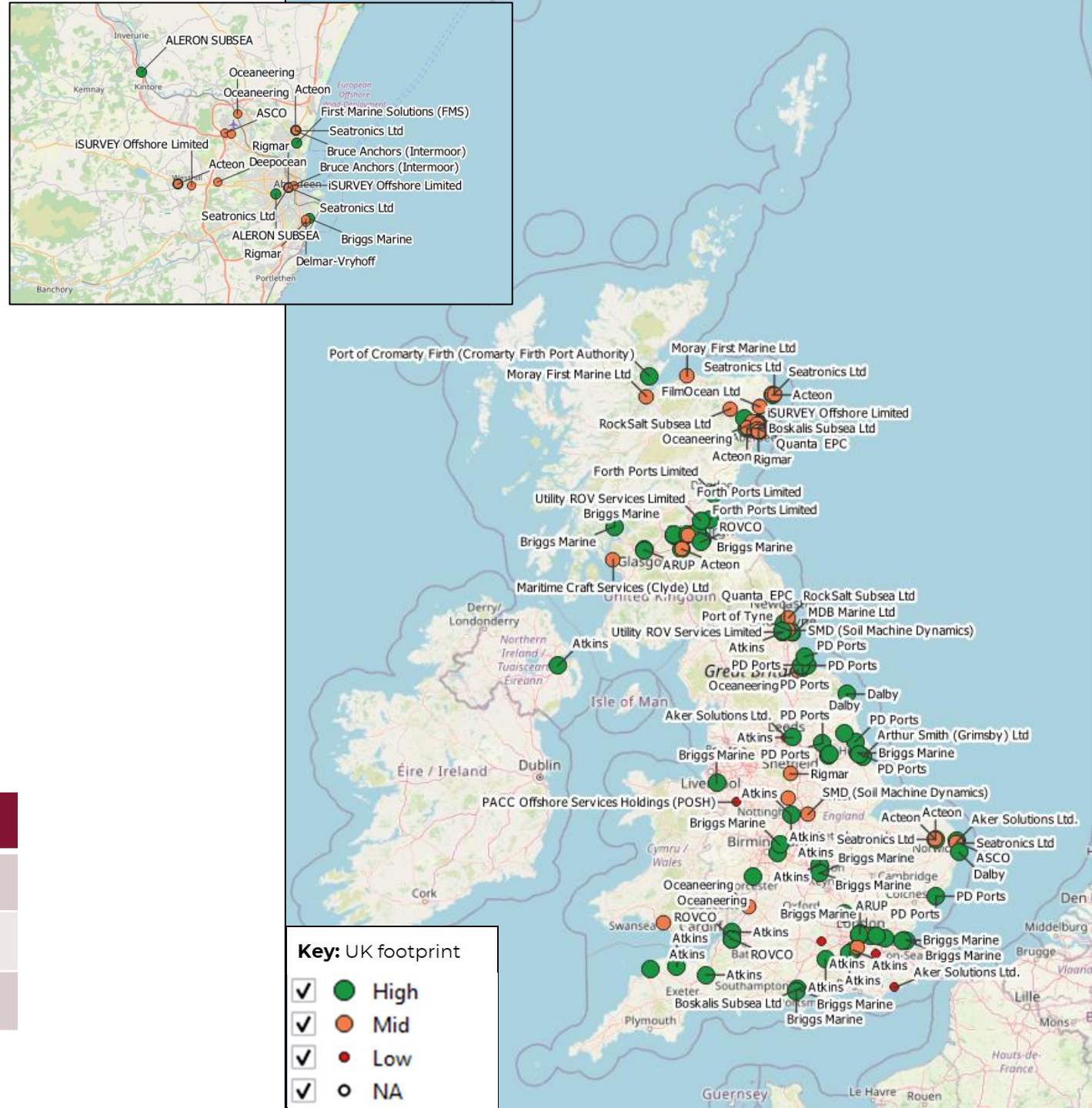
North sea clusters in Aberdeen, Leith and Tyneside.

Capturing 25% of the UK FOWT installation market and 10% of the global market would create 9715 years of employment out to 2050.

Companies involved with installation are shown on the map to the right, with the majority on the North Sea coast and clusters in Aberdeen, Leith and Tyneside.

The assumed regional split is shown below. This clearly does not account for any future developments created by the Celtic Seas leasing round.

	UK	England	Scotland	Wales	NI
Split	N/A	50%	50%	-	-
Years of employment	9715	4858	4858	-	-
Indicative jobs per year	485	242	242		



Opportunities

Key points

There are opportunities for software in floating wind, however they were harder to assess because:

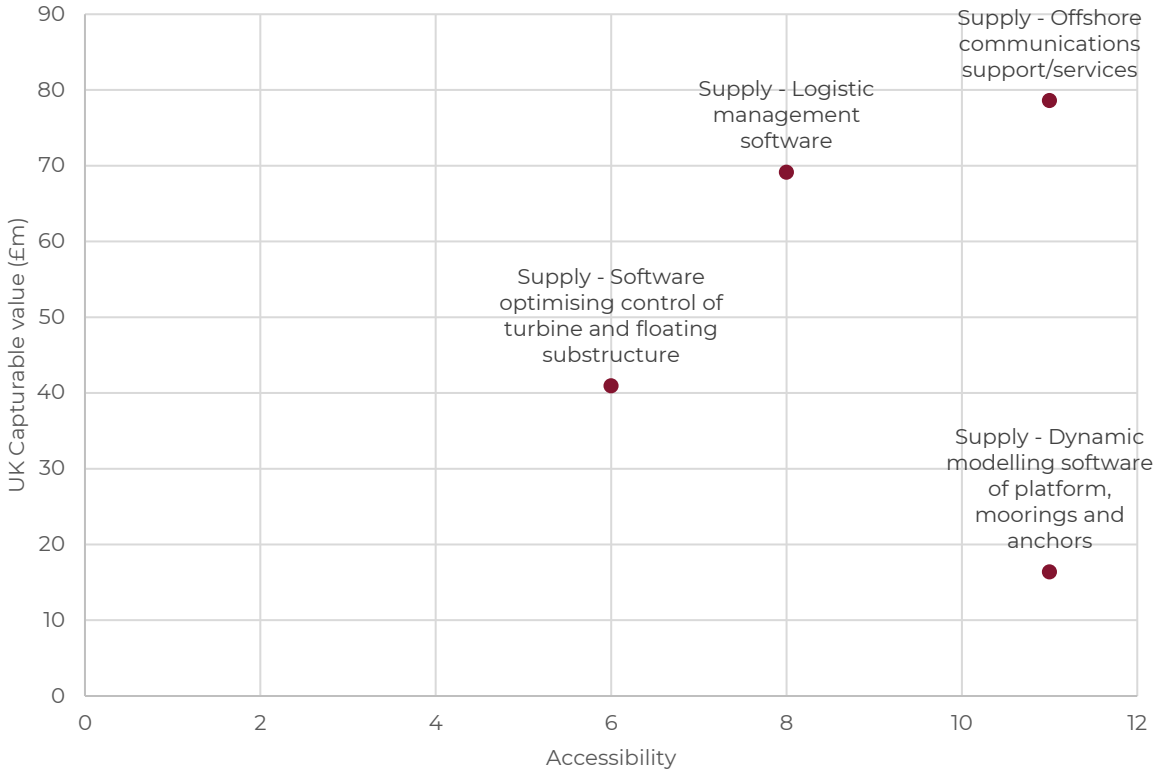
i) They did not fit the structure of the SCCA Model. For instance software products form part of the design and engineering line items, but are not separated out.
ii) They appear to be much lower value than the other areas.
iii) Everoze and associates have some knowledge of this element, but robust conclusions are more difficult to draw, particularly as software is not a stand-alone item, but is utilised across the value chain. We would therefore welcome recommendations on sector expertise to discuss with further.

There are however notable areas of UK competence, for instance OrcaFlex is the industry leading software platform for dynamic modelling of platforms, moorings and anchors.

The UK also appears to have a cluster of competence in offshore communication and positioning support services, with companies such as Sonadyne, Jet Engineering, OSIL, etc.

Optimising control of the turbine and floating structure is a really key area for floating wind, and the UK has companies with leading competence. The challenge is accessing this, with the turbine and platform OEM likely to keep this data close.

There is an opportunity in logistics management, with the number of moorings line, dynamic cables, anchors etc likely to be problematic for operations.



Note: Given challenges of aligning with WBS codes – including utilisation of software across lifecycle - we weren't able to provide a map for software.

Opportunities: O&M

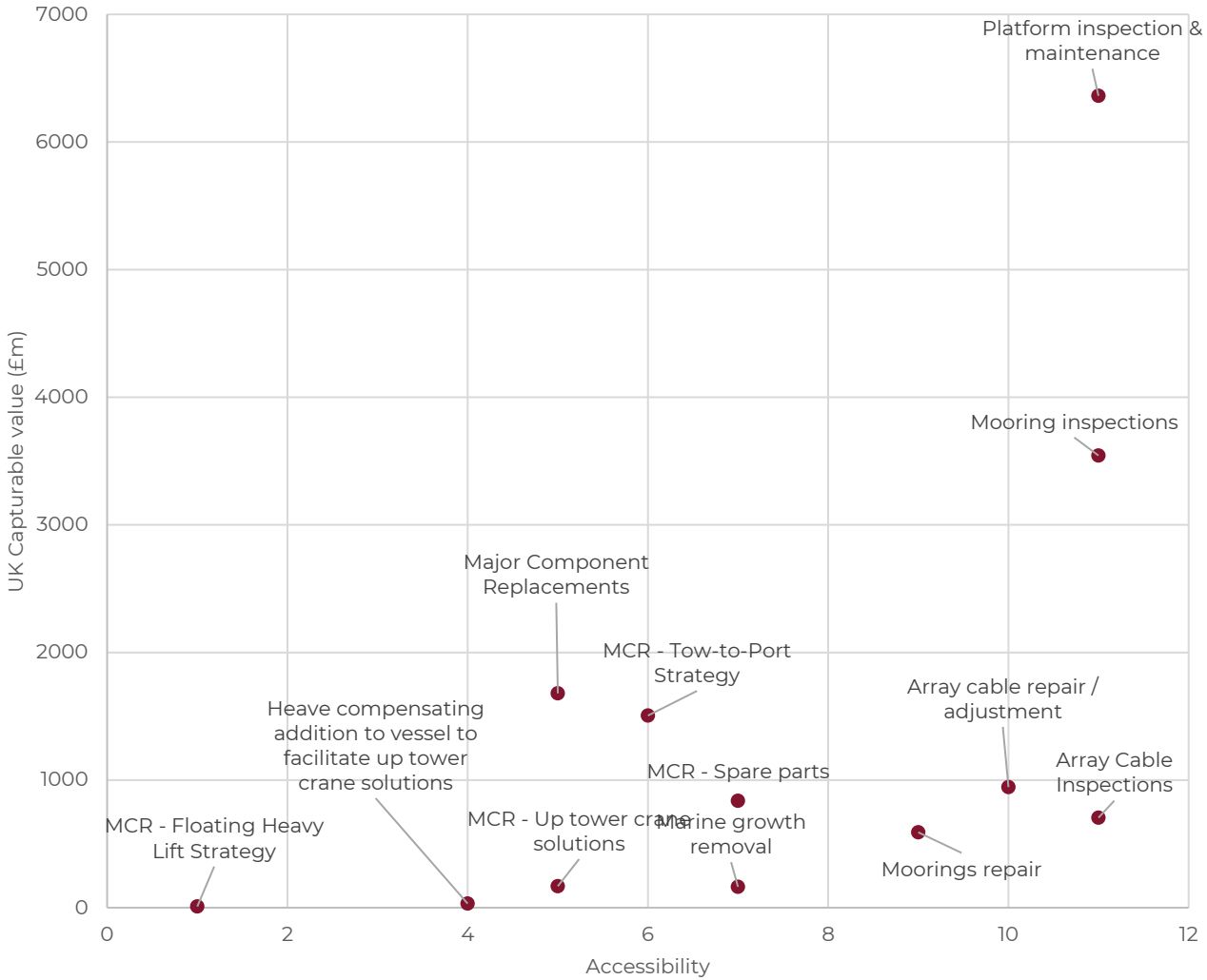
Key points

Platform, mooring and cable inspections represent a (perhaps surprisingly) large opportunity, albeit it over the lifetime of the project and potentially with relatively low margin. They are an area with strong UK capability (through the host of offshore service providers) and are an area ripe for autonomous and digital innovations. These innovations may reduce the total value shown to the right. The UK can use pipeline to build track record and innovative solutions that can then be exported.

Mooring repair and dynamic cable repair are interesting niche areas, highly accessible to the UK given cable repair competence and moorings expertise. We understand that with dynamic cables there may be a need to adjust the cable bends to mitigate fatigue loading.

Major component replacements are an area of significant uncertainty for the floating wind sector, with three broad options (tow to port, use Heavy Lift Vessel or use of novel up tower crane solution). The analysis concludes that:

- **Heavy Lift offers little opportunity for the UK**, with little chance of a UK operator procuring and operating such a vessel**.**
- **Tow-to-port offers more opportunity but requires significant intervention** Tow to port suits UK capability as it can be delivered through smaller vessels, involves greater use of portside infrastructure and plays to UK strengths in disconnection / connection. However, accessibility is relatively low, requiring either a major oil and gas service provider to transition across or a smaller tier player to step up. They would need to do so in the installation phase initially, with the organisations who deliver installation most likely to deliver O&M contracts. For this strategy there is potential value in heave compensation on vessels to provide greater stability for component change out.
- **Up tower cranes will likely be part of the mix although leading providers are not UK based** – this could be an FDI opportunity.



Locations & jobs

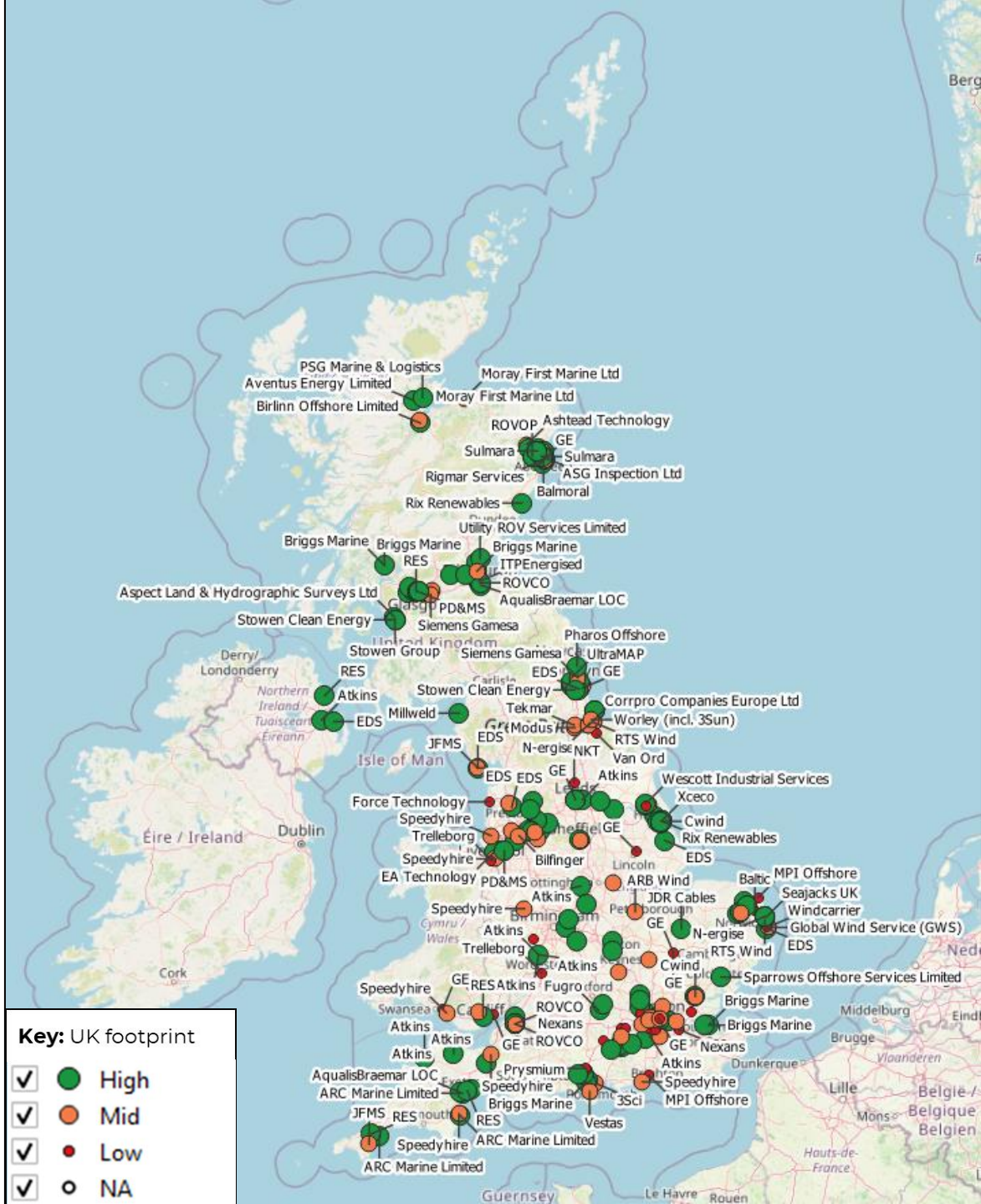
O&M providers are mainly distributed in coastal areas in England and Scotland.

The capturable Tier 2 value is £14Bn, albeit spread across the lifetime of the project. This offers potential to create 235,125 years of employment. If we spread this value across 40 years, representing the build out from 2030-2050 and then an operational life of 20 years beyond this then this means 9,405 jobs per year.

O&M providers are spread around coastal areas in primarily in England and Scotland. This gives the following years of employment breakdown.

This obviously does not account of future investments or the Celtic Sea leasing around which would change this picture significantly.

	UK	England	Scotland	Wales	NI
Split	N/A	60%	35%	5%	0%
Years of employment	235,125	141,075	82294	11756	-
Indicative jobs per year	5,878	3526	2,057	293	



Opportunities: Development services

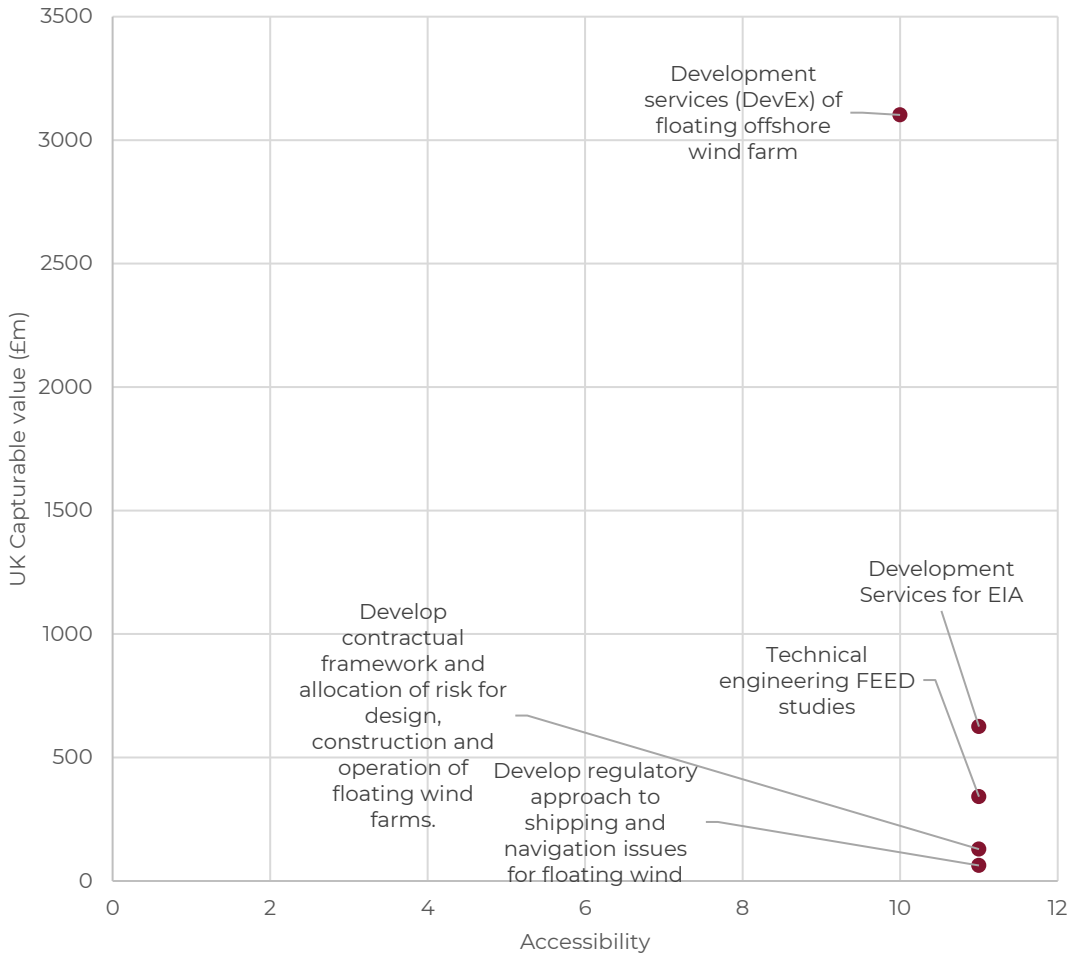
Key points

The developer of any floating wind farm is a powerful position in the supply chain, shaping the supply chain and contractual structure for the project. The value of developing a wind farm isn't shown on the chart to the right, but is high value and there is an opportunity for the UK to support UK developers to win floating wind leases globally, who may then be better placed to develop the UK supply chain.

Services provided to floating wind developers ('Development services') are a high value, highly accessible opportunity for the UK. This is because a) the UK is very strong in development services, with many export champions already active around the globe, and b) the development of floating wind farms is similar to fixed wind, albeit with differences in certain areas. Development services can also be seen as an important 'beachhead' into new markets, which can then pull through the rest of the UK supply chain. Development service opportunities are across engineering, environmental and commercial.

Two specific opportunities are:

1. **Developing the contractual framework for floating wind.** The SCCA flagged major concerns with the contracting structure typically used within the fixed wind sector, with developers and Tier 1s pushing risk down the supply chain. Floating wind will require new contracting structures, with much greater role of the platform OEM, moorings and anchors and evolving approach to major component replacements. The UK has an opportunity to develop the approach to contracting structures; this will not only benefit UK suppliers, but can also be exported globally, particularly if backed by UK developers, insurance and finance providers.
2. **Developing the regulatory approach to shipping and navigation issues.** Floating wind involves the quayside construction, wet storage and transportation of large numbers of giant floating structures. This is unprecedented, presenting issues for ports, mariners and welfare at sea. The UK can take a lead in developing solutions to these challenges, which can then be exported globally.



DEVELOPMENT SERVICES

Locations & jobs

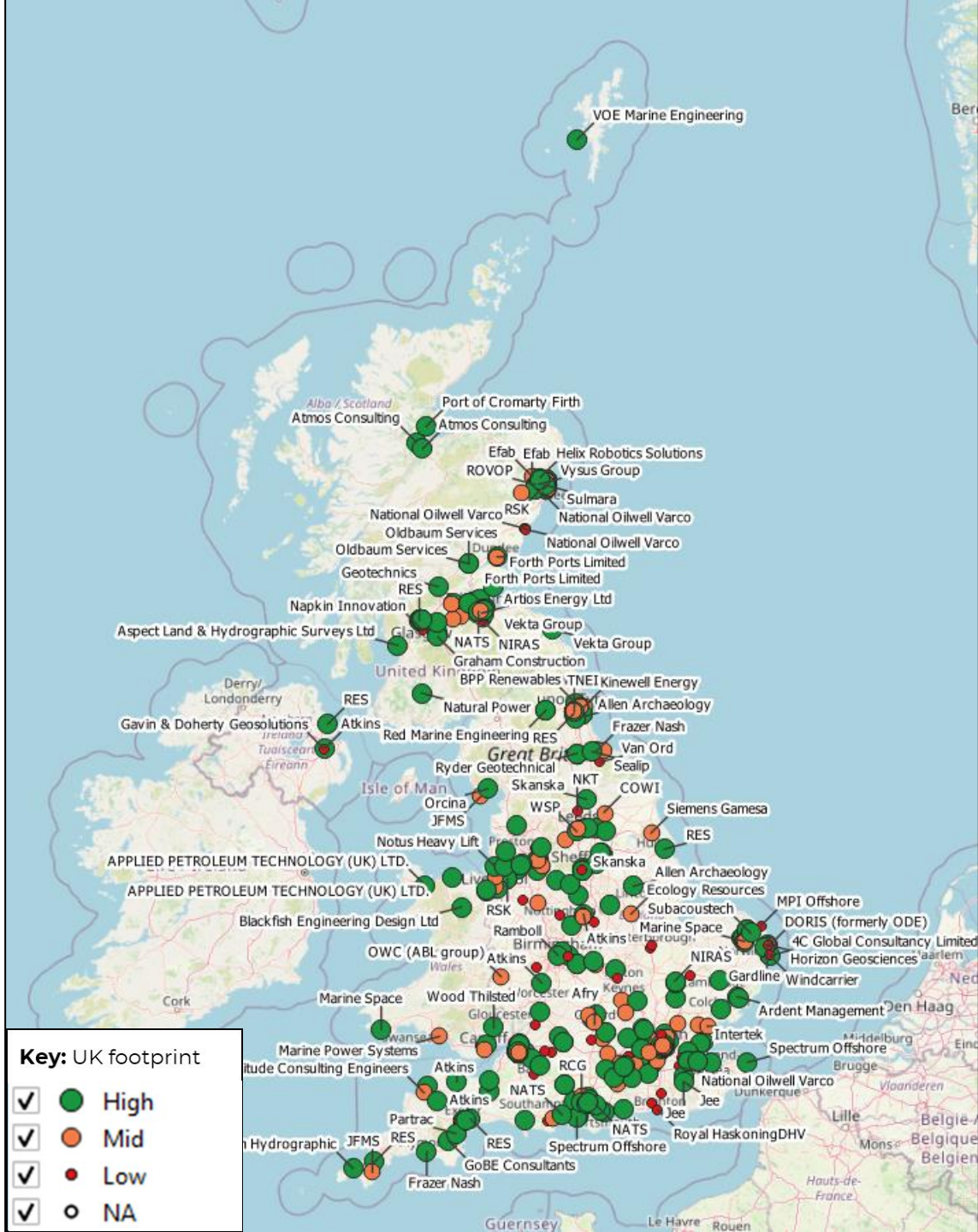
A broad spread across the UK

The UK has a huge number of development service providers, spread right across the UK.

Development services offer £3.1Bn of capturable value, with potential of creating 71,441 years of employment.

This is assumed to be split across the nations as follows.

	UK	England	Scotland	Wales	NI
Split	N/A	50%	40%	5%	5%
Years of employment	71,441	35721	28576	3572	3572
Jobs per year	3,572	1,786	1428	178	178



Annex
c) Platform Collaboration Framework

Platform specification clarity to support a successful supply chain

The UK can help its supply chain via a collaborative programme to build shared supply chain knowledge on volume, timescale, specification & delivery requirements. Focus needs to be on supporting supply chain success through assisting it to standardise and automate its work, and UK needs to avoid having pipeline of multiple designs, complex execution strategies and bespoke supply chain needs that prevent the UK from being locked in a high-cost inefficient state.

Overcoming sector weaknesses & market gaps

The UK has some top tier gaps in its FLOW supply chain, that prevent investment in the supply chain. Few top tier platform owners/ designers limits information shared with UK supply chain. Greater focus is needed on how to enable a common supply chain and match platforms against existing UK capability and have sufficient time to grow capability where needed.

Clarity over timescale of the pipeline, volume and specification requirements is important for the supply chain to enable the right investment at the right timescale.

UK supply chain can support LCOE reductions *if* sector focus recognises role of volume manufacturing & Lean processes & continuous improvement. Sector will not be able to deliver this if expected to deliver to wide range of non-aligned specifications. UK manufacturing needs support to deliver volume and standard processes (e.g. rapid die change systems in manufacturing, investment in welding technology & innovation).

Collaborative intelligence to build market confidence & plan investment

Working through the FLOW Taskforce, OWGP, FOWCEx, a future delivery body or via programmes such as the SIM, sector could build supply chain confidence through coordinated work to identify front-runner platforms.

This work can be used in an aggregated format to help protect project confidentiality.

This work can also be used to drive forward coordinated sector action on project execution strategies (particularly for platform assembly/manufacture).

Confidential processes can be developed to encourage information sharing between platform designers, developers and supply chain. While there are commercial sensitivities, there is overall benefit to sector from having shared information.

This proposal builds on the SCCA& IGP recommendation for a “bill of works” on platform & steel specification requirements, and sector experience of collaboration in JIPs, SIM process etc.

Anonymised but powerful sector intelligence

A Platform collaborative framework would involve identifying a trusted third party to collate and anonymise sector information re. platform design choices.

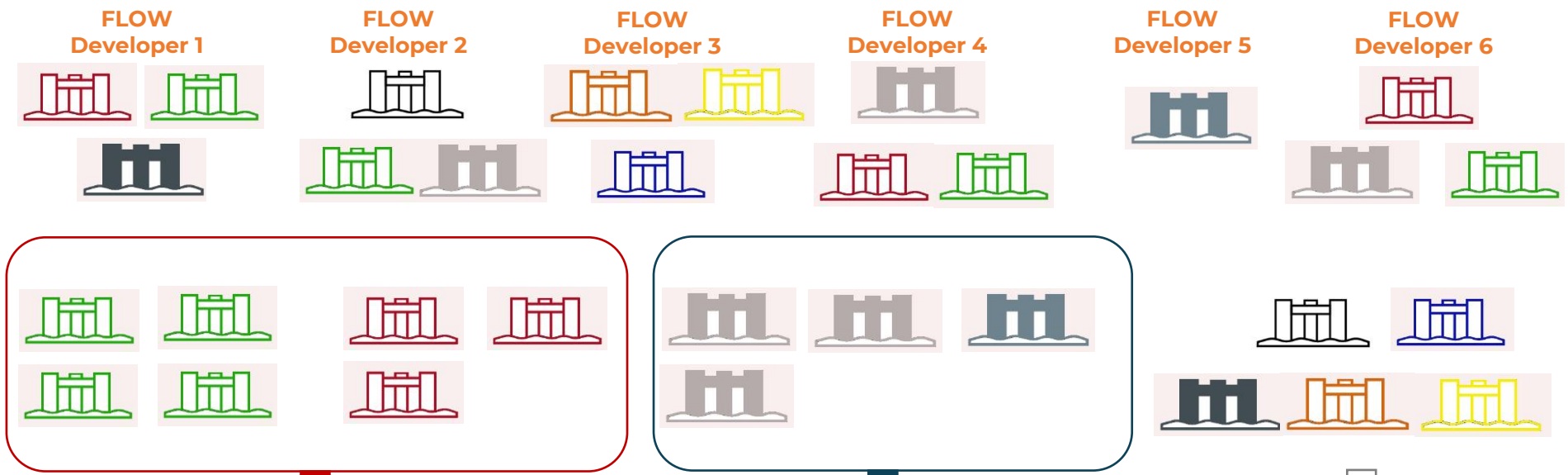
Participating developers would receive information back, as would identified partners (UK port groups and UK suppliers).

For example, if a developer shares information, they can receive anonymised information on wider market activity, with potential for agreement re. further collaboration (e.g. developers with common platform choices working together to establish UK supply chain to de-risk deployment).

Over time an increasingly accurate picture can then be painted as to volume and specification requirements for floating offshore wind platform component, assembly and manufacturing requirements and build confidence around a successful execution strategy across the UK.

How would platform collaboration work?

Collaborative processes can be used to provide market insights re. future infrastructure and supply chain requirements specifications to help drive sector confidence and give UK supply chain players advantage.



A shortlist of steel platforms can be identified, with prioritised engagement re. UK supply chain.

Anonymised sector information gathering re. different platform types can be used to help UK ports, supply chain, skills providers and steel sector prepare for required type and volume of work.

Over time as confidence grows re. platform selection, information can be updated.

A shortlist of concrete platforms can be identified, with prioritised engagement re. UK supply chain.

Focus can be on port manufacturing and civil engineering engagement, plus discussions re. opportunities for process engineering improvements.

A watching brief kept on longer list of platform choices, with updates provided as and when situation changes within market.

UK focused approach on volume manufacturing, LEAN, cost reduction etc. will make it a good home for emerging platform designs looking to improve market offer.

Note colours of platform icons are used to denote theoretical platform types. Solid colours represent concrete, outline colours steel.

At the current time, many UK project developers have yet to finalise platform choices.

Developers will seek to draw up a shortlist of platforms for consideration in Pre-FEED and FEED design prior to a final design competition and decision on final platform.

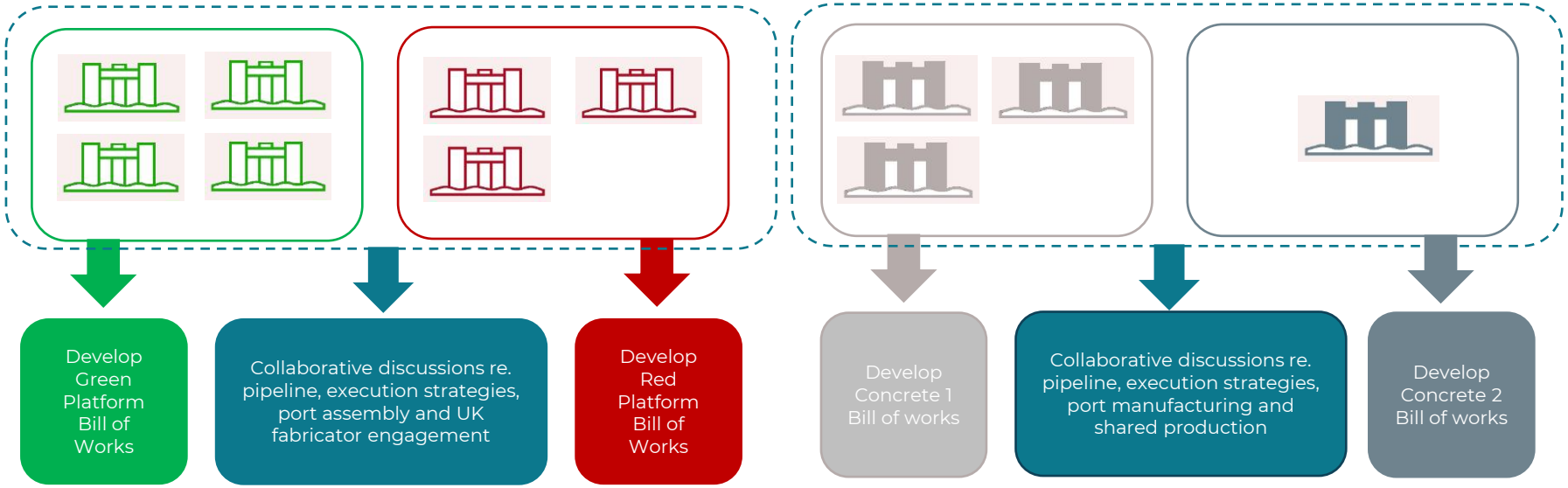
This need to keep options open delays clarity on market requirement and also potentially impacts ability of ports and supply chain to plan ahead. Different platforms have different supply chain and infrastructure requirements (with common overlaps but also outliers).

In this example, 5 of 6 developers have yet to move beyond a shortlist of 3 potential platforms. Only developer 5 has chosen a (concrete) platform at this stage.

Collaborative work would help show the market likely interest, and allow more confident planning based on likelihood of demand/type.

Creating a sector 'bill of works' and enabling agnostic assembly and installation

Collaborative processes can help the UK supply chain and steel producers to prepare for future demand, and "platform proof" UK assembly and installation investments.



A shortlist of steel platforms can be identified, with prioritised engagement re. UK supply chain.

Action to set out a “Bill of Works” will help focus UK sector effort on supply chain requirements and specification, enabling them to invest ahead of demand and ensure technical capability.

The process can then be used to review execution strategies within ports to ensure platform agnostic delivery systems in place and prioritise automated, lean processes.

Shared intelligence re. concrete design types will be useable by UK ports and suppliers.

It could be used to help build market confidence in UK civil engineering sector, as well as to ensure sufficient investment in future supply (e.g. rebar, aggregate).

The process can then be used to review execution strategies with focused effort on ensuring dedicated concrete ports are built capable of agnostic platform delivery.

A first step in work would be the delivery of a **Bill of Works** programme. This can be developed either from generic designs, or more accurately from individual platform concepts.

The UK supply chain (plus steel sector) would benefit from clarity on platform technical requirements (e.g. steel grade) of the multiple different components within each steel platform.

Such a bill of works would help UK suppliers invest and prepare and potentially highlight areas for UK collaboration between suppliers.

The UK can also better map capability and look at options for supply from different UK locations, underpinned by shared logistics.

This knowledge can be used to help ports and installers manage agnostic platform assembly processes that maximise space and minimise production time, enabling multi-port deployment and shared use of facilities (and/or rapid redeployment).