Supergen Offshore Renewable Energy

Disruptive Innovation and Industrial Modernisation: Pathways to Securing Offshore Renewable Energy Supply Chain Competitiveness

A Supergen Offshore Renewable Energy Hub Policy Paper prepared by the Policy and Innovation Group at the University of Edinburgh

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Disruptive Innovation and Industrial Modernisation: Pathways to Securing Offshore Renewable Energy Supply Chain Competitiveness

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Supergen Offshore Renewable Energy Hub

The Supergen programme was set up in 2001 by the Engineering and Physical Sciences Research Council (EPSRC) to deliver sustained and coordinated research on sustainable power generation and supply. For phase four of the programme, the Supergen Wind and Supergen Marine Hubs were combined into the Offshore Renewable Energy Hub. The Supergen Offshore Renewable Energy (ORE) Hub builds on the work of the former Hubs, and looks at synergies between offshore wind, wave and tidal technologies as well as building on current research in each area. Led by the University of Plymouth, Supergen ORE provides research leadership to connect stakeholders, inspire innovation and maximise societal value in offshore renewable energy.

Find out more about Supergen ORE at **https://supergen-ore.net/**

Policy and Innovation Group

The Policy and Innovation Group is part of the Institute for Energy Systems (IES), which is one of the seven research institutes within the School of Engineering at the University of Edinburgh. The Policy and Innovation Group combines expertise in offshore energy technology, energy system organisations and institutions, and the wider policy and regulatory landscape. They apply a range of quantitative and qualitative research tools and methods including energy system modelling, future transition scenarios, techno-economic analysis and innovation pathways. This leads to the development of policy guidance reports, energy system roadmaps and economic and energy system analysis for technology developers, public and private investment and government departments.

Find out more about the Policy and Innovation Group at **https://www.policyandinnovationedinburgh.org**

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Designed by Martin Budd Design Consultant

Cover: Robotic arm in operation at offshore wind turbine production site
Credit: Lin Shanchuan/Xinhua/Alamy Live News

CONTENTS

INTRODUCTION	04
1 THE UK'S ECONOMIC GROWTH AND CLEAN ENERGY AMBITIONS	05
2 MAPPING ECONOMIC GROWTH AND CLEAN ENERGY POLICIES	08
3 THE ROLE OF ORE TECHNOLOGIES IN DELIVERING UK CLEAN GROWTH	12
4 BALANCING NET ZERO TIMELINES AND ORE SUPPLY CHAIN DEVELOPMENT	20
5 WHAT & WHO? THE BUILDING BLOCKS OF A DISRUPT AND MODERNISE SUPPLY CHAIN	24
6 HOW? DEVELOPING COMPETITIVENESS WITHIN A DISRUPT AND MODERNISE SUPPLY CHAIN	30
7 FACTORS IMPACTING DISRUPTIVE INNOVATION AND INDUSTRIAL MODERNISATION	36
8 THE DISRUPT & MODERNISE INNOVATION ECOSYSTEM	38
OVERTAKING, NOT JUST CATCHING UP	48
REFERENCES	50

DISRUPTIVE INNOVATION AND INDUSTRIAL MODERNISATION: PATHWAYS TO SECURING OFFSHORE RENEWABLE ENERGY SUPPLY CHAIN COMPETITIVENESS

INDUSTRY FOREWORD

The Offshore Wind Growth Partnership (OWGP) is leading efforts to grow globally competitive UK capacity across priority areas of the offshore wind supply chain. Delivering that capacity could create thousands of skilled jobs and tens of billions in GVA across engineering and manufacturing industries while ensuring resilience in our energy supply. Industrial opportunity has never been greater, with Allocation Round 7 adding 8.4GW to the project pipeline and supply chain businesses hungry to scale up to meet that demand.

The Prize on Offer

A once-in-a-generation opportunity is there for the taking so we must be bold enough to reach for it. To succeed on this scale the industry cannot choose adequacy, and I don't believe that our industry would. We need audacity to aim for tremendous success, balanced with diligence to build it out. The UK wind industry struck that balance to lead the world in offshore wind deployment, we can do it again as we grow the UK supply chains that engineer more of the equipment we deploy.

Government intent has been set clearly by the Modern Industrial Strategy and the Clean Power 2030 Action Plan – building out offshore renewable energy supply chains delivers against both of these ambitions. OWGP is proud to work together with colleagues from Great British Energy, The Crown Estate, Offshore Wind Industry Council and many other commercial and research institutions to grow the enduring supply chains that will form the legacy of aligning industrial ambition with policy intent.

The Role of Research and Innovation

This underpinning research and policy guidance report by the Supergen ORE Hub offers valuable perspectives on how policy measures could combine modernising of supply chains with support for disruptive innovation to create market-opening products and services. In areas where UK companies are already succeeding, it is vital to develop excellence in modern cost-competitive manufacturing to stay at the forefront of these sectors. However, in areas where we aim to break into new markets, the UK needs not just a step, but a leap forward in capability in order to win and secure its place. Those leaps forward are created by sustained disruptive innovation that are in turn supported along the road to commercialisation.

In my role at OWGP I'm fortunate to work with colleagues from across the sector to support both the research and commercialisation of the technologies and business models needed for UK supply chain growth. This report's framing of the collaborating organisation as forming an ecosystem of support provides a helpful perspective to make the complex landscape more accessible and easier to navigate for companies and policymakers.

Looking Forward

This report's recognition that disruptive innovation is also required for the UK to succeed in markets where it currently lacks traction is timely. As OWGP and its partners plan to access new markets highlighted in the Offshore Wind Industrial Growth Plan, research of this quality is invaluable to informing those debates. Experience from successful high-value engineering sectors also shows that continual innovation supporting established supply chains is key to sustaining economic growth and high value employment.

I strongly support this report's clear identification of the need for modernised supply chains as essential to winning contracts amidst global competition and maintaining that competitiveness for the long-term. Enabling success in manufacturing is exactly the purpose of supply chain growth funds like our own Industrial Growth Fund, Great British Energy's Supply Chain Fund and the Crown Estate's Supply Chain Investment Programme.

We hope this latest work by the Supergen ORE Hub inspires bold, coordinated action to grasp the opportunities we have in front of us, alongside proactive industrial and innovation policies which further strengthen support for supply chain growth.

Dr Peter Giddings

IGP Implementation Manager, Offshore Wind Growth Partnership

INTRODUCTION

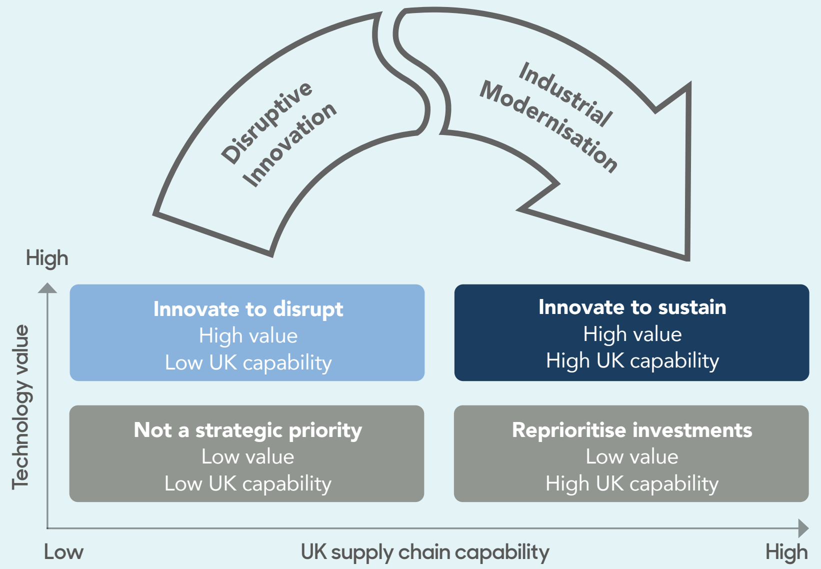
A decade ago, the scale of the opportunity for offshore renewable energy (ORE) technologies in transforming the UK's energy system was still a matter of debate. **That is no longer the case**. Today, there is strong agreement within UK energy policymaking of the defining role that innovative ORE technologies – and their underpinning supply chains – will play in delivering a secure, resilient, and sustainable energy future.

The question facing today's policymakers is how to revitalise the UK's industrial capabilities and ensure that the UK supply chain can lead on the development and manufacture of the disruptive and highly innovative ORE technologies, subsystems and components that represent the future of this sector. To assume a truly market leading position, **the UK must prioritise proactive, coordinated, and innovation-focussed policies** that can strengthen both technological development and supply chain capabilities. This dual approach is vital to unlocking and retaining the long-term socioeconomic value, Just Transition and carbon reductions associated with the ORE sector.

This opportunity and challenge coincides with wider effort to re-establish the UK as a strategic industrial nation within global clean energy supply chains. International competition is intensifying, with multiple countries aiming to lead across the same critical segments of the ORE value chain. In this context, enhancing UK supply chain competitiveness is of critical importance. **The UK must work to establish itself as a leading location for ORE innovation**, where advances in technology, materials, and manufacturing processes are matched by the ability to convert innovation into scalable, competitive industrial production. This challenge is further intensified by the compressed timelines imposed by the climate crisis, which demand rapid delivery while still allowing time to build industrial capability and meaningfully embed domestic supply chains.

Delivering this outcome will **require more than just the expansion of existing capabilities**. Incremental growth alone will not secure a long-term competitive advantage for the UK in the face of fast-moving and capital-intensive global markets. Instead, the UK must embrace a ***Disrupt and Modernise supply chain strategy***, where both **disruptive innovation** and **industrial modernisation** are able to create the conditions for new technologies and sophisticated production methods to emerge and scale. This approach supports the leapfrogging of incumbent technologies, **allowing the UK to focus on overtaking, rather than just catching up**, and achieve globally competitive positions across ORE supply chain.

The Leapfrogging Transition



This report argues that disruptive innovation and industrial modernisation are central to the UK achieving strategic leadership in a select number of high-value offshore renewable energy technologies and components. It therefore sets out a policy framework model to translate innovation leadership into scalable industrial capability, securing the UK's long-term competitiveness and strategic position within global offshore renewable energy supply chains.

1 THE UK'S ECONOMIC GROWTH AND CLEAN ENERGY AMBITIONS

The next decade represents a critical window in which the UK must take decisive action to deliver on two important national ambitions:

- First, the UK must take urgent steps to **lower its greenhouse gas emissions**, adhering to its legally mandated goal to achieve Net-Zero by 2050 [1] and the shorter-term aim of a clean power system by 2030 [2]. The realisation of these ambitions, which are vital to mitigating the worst extremes of the ongoing climate crisis, will rely heavily on the accelerated delivery of a national decarbonised energy system.
- At the same time, the UK must also actively **seek new sources of clean and competitive economic growth**. In doing so it must focus on strategic sectors that are capable of translating their value into tangible benefits, realised through improved socioeconomic returns and high-value job creation across the country [3].

These objectives should not be pursued in isolation, but understood as mutually reinforcing national missions, as shown in Figure 1. Their most important point of alignment lies in the development of an innovative and competitive domestic supply chain that underpins the delivery of the Net Zero transition.

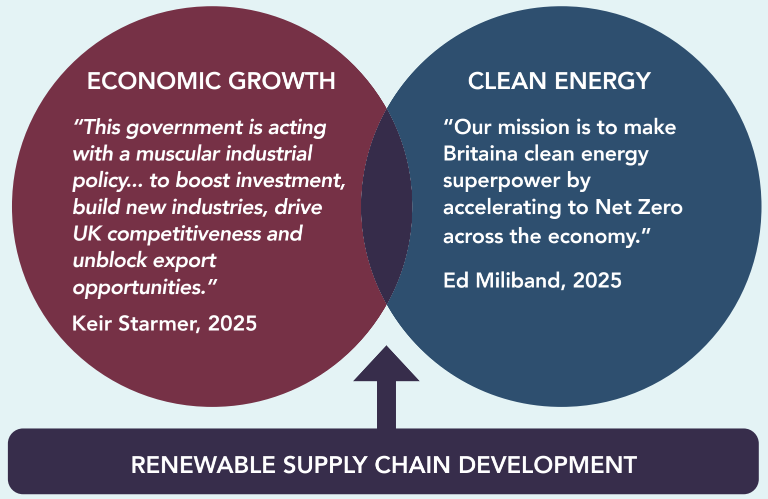


Figure 1. The overlapping ambitions of economic growth and clean energy

Economic Growth

Prime Minister Keir Starmer has articulated a clear priority, stating that *"This Government is acting with a muscular industrial policy… to boost investment, build new industries, drive UK competitiveness and unlock export opportunities"* [4]. This statement reflects not only the Government's commitment to partnership with business but also an understanding that long-term economic growth requires active state involvement in shaping the conditions for success. For decades, the UK economy has grappled with stagnation, regional inequality, and underinvestment in infrastructure and industry. Renewed emphasis on growth therefore relies on ensuring that industry support is positioned strategically in sectors where the UK has a comparative advantage.

In practice, this ambition requires building industries that are globally competitive, resilient to external shocks, and capable of generating high-value jobs across the country. The ORE sector has the potential to provide precisely such an opportunity. These industries draw on the UK's natural resources, engineering strengths, and existing leadership position in the deployment and operation of both offshore renewables and legacy oil and gas facilities. Yet, to realise the sector's full economic potential, the UK must move beyond importing critical components and instead develop its own sophisticated, innovative, and globally competitive supply chains

Clean Energy

The second ambition, outlined by Ed Miliband, Secretary of State for Energy Security and Net Zero, is to *"make Britain a clean energy superpower by accelerating to Net Zero across the economy"*[5]. This ambition acknowledges that climate goals and energy security must be pursued in tandem. This will ensure that Net Zero is not only seen as a commitment towards creating a sustainable and responsible climate, but also as a way to reduce reliance on imported fossil fuels.

The UK's world-leading targets for offshore wind capacity and its growing commitments to emerging technologies, such as tidal stream and wave energy, demonstrate a clear pathway for ORE technologies to dominate future energy systems. But such a pathway depends on the UK developing the capabilities to deploy these technologies at scale, reduce costs, and secure the infrastructure required for rapid expansion. A clean energy superpower cannot be built on fragile or imported supply chains; it requires high levels of domestic innovation and manufacturing capabilities.

The Intersection: Renewable Energy Supply Chains

Taken together, the dual ambition of economic growth and clean energy represent a once-in-a-generation opportunity to transform the composition of the UK's energy infrastructure and radically re-imagine our relationship with the deployment of clean energy technologies. By concentrating innovation capability on a range of technologies with a high-innovation ceiling, the UK has the potential to establish itself as a world-leader in the development and manufacture of disruptive ORE technologies that will underpin global energy systems for years to come. Simultaneously, by developing a modern and sophisticated domestic supply chain, capable of manufacturing these high-value technologies at scale and at globally competitive prices, the UK has the potential to return significant benefits in terms of economic growth, energy security and the Just Transition, across the country. However, meeting this demand through imports alone would undermine both objectives. The UK must instead catalyse domestic production and technological leadership to build competitive supply chains that deliver skilled jobs and regional regeneration, create export opportunities, reduce import dependence, and secure a credible position in the global clean energy economy.

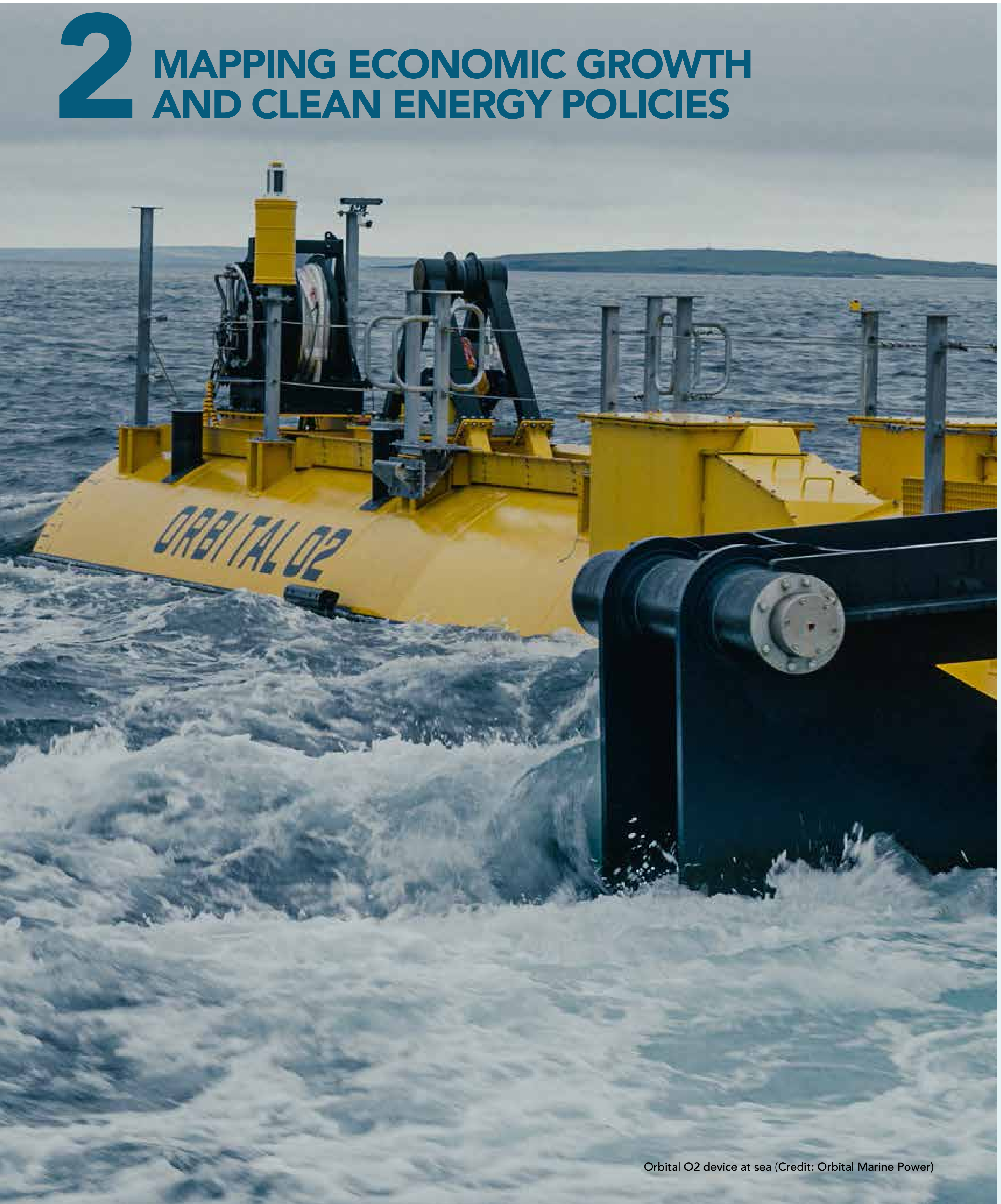
The Dual Ambitions of Economic Growth and Net Zero

The UK has clearly stated ambitions to accelerate both economic growth and the delivery of the Net Zero transition. At the intersection of these high-level goals lies the **development of competitive domestic supply chains for the clean energy sector.** The realisation of this goal is key to advancing and mutually reinforcing these national priorities, while retaining long-term socioeconomic value within the UK.

DISRUPTIVE INNOVATION AND INDUSTRIAL MODERNISATION: PATHWAYS TO SECURING OFFSHORE RENEWABLE ENERGY SUPPLY CHAIN COMPETITIVENESS

Offshore wind transition pieces (Credit: Adobe Stock)

2 MAPPING ECONOMIC GROWTH AND CLEAN ENERGY POLICIES



Orbital O2 device at sea (Credit: Orbital Marine Power)

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The UK's Energy Policy Landscape

Having established the connection between UK Government ambitions on economic growth and clean energy, it is important to map these within the UK's existing national policy landscape. Three frameworks in particular, shown in Figure 2, provide the clearest connection: the UK's Modern Industrial Strategy [3], linking to economic growth; the Clean Power 2030 Action Plan [2], linking to clean energy development; and the Clean Energy Industries Sector Plan [6], intersecting these two ambitions. Together, **these documents articulate the high-level vision, but not the practical and actionable pathways**, that will be required to position the UK as a global leader in the competitive production of a range of clean energy technologies.

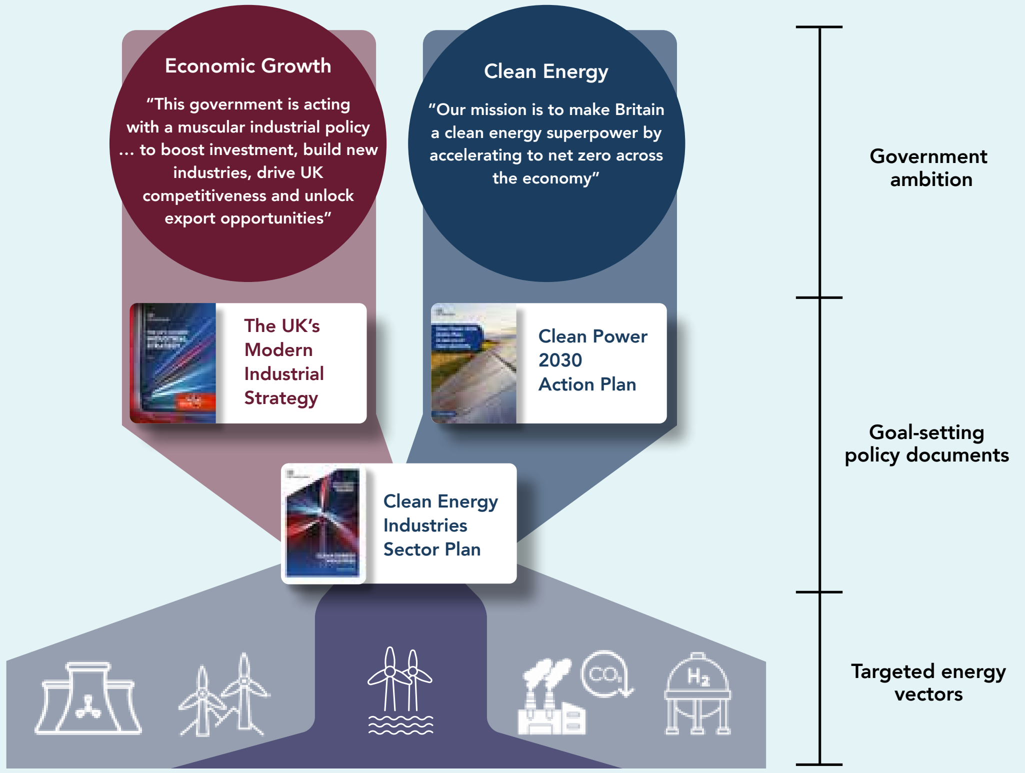


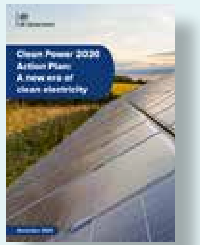
Figure 2. Policy frameworks driving the delivery of economic growth and clean energy

Goal-setting Policy Documents:

The UK's Modern Industrial Strategy

The UK's Modern Industrial Strategy is a comprehensive 10-year plan to boost long-term economic growth by making it easier, faster and more attractive for businesses to invest in the UK, while fostering more competitive and resilient domestic supply chains. Central to this strategy is the concentration of government support on eight sectors with especially high growth potential (the IS-8). Clean Energy Industries is one of these, recognised for its potential to serve as both an engine of growth and the foundation of a sustainable economic future – provided that domestic production of clean energy technologies can keep pace with their deployment.

The IS-8 prioritisation has been reinforced by the provision of hardwired departmental budgets and R&D allocations for the next decade. This approach aims to put private business, entrepreneurship, and innovation at the heart of the UK's economic renewal. This has been reinforced by clear choices to reduce electricity costs while decarbonising industry, strengthening trade and security, and supporting innovation through £86bn of R&D investment for the IS-8. Despite these aims, practical detail is still required to coordinate the funding and deliver necessary effort across the IS-8.



Clean Power 2030 Action Plan

Running in parallel to the Industrial Strategy, the Clean Power 2030 Action Plan sets out the UK Government's aim to fully decarbonise the power system by 2030. It is framed as both a climate commitment and an industrial mission: to secure energy independence, lower costs for households and businesses, and position the UK as a global clean energy leader. Alongside deployment targets for solar, nuclear, and onshore wind, the Action Plan calls for an unprecedented expansion of offshore wind capacity of up to 51 GW by 2030 – roughly three times currently installed capacity – while acknowledging the potential for emerging technologies, such as tidal stream, to contribute to a diversified and resilient power system.

The Action Plan is clear that deployment alone will not be sufficient to meet UK targets; progress depends on embedding innovation across technology, industry, and governance. It supports early-stage innovation and commercial scale-up while directing investment into domestic supply chains to strengthen UK capability. Reforms to planning, grid connections, and auction processes aim to reduce delays and investor risk, with clear capacity targets providing long-term demand signals. Overall, the Action Plan positions innovation as foundational, requiring both rapid deployment and the accelerated development of home-grown capabilities to ensure future energy technologies are designed, manufactured, and deployed through a modernised and competitive UK supply chain.

Clean Energy Industries Sector Plan

The Clean Energy Industries Sector Plan (CEISP) represents the point of intersection between the UK's Modern Industrial Strategy and the Clean Power 2030 Action Plan, setting out how clean energy industries can simultaneously drive long-term economic growth and deliver Net Zero. Distinct from the broader Industrial Strategy and the near-term Clean Power 2030 framework, the CEISP positions clean energy industries as the link between national missions on growth and decarbonisation.

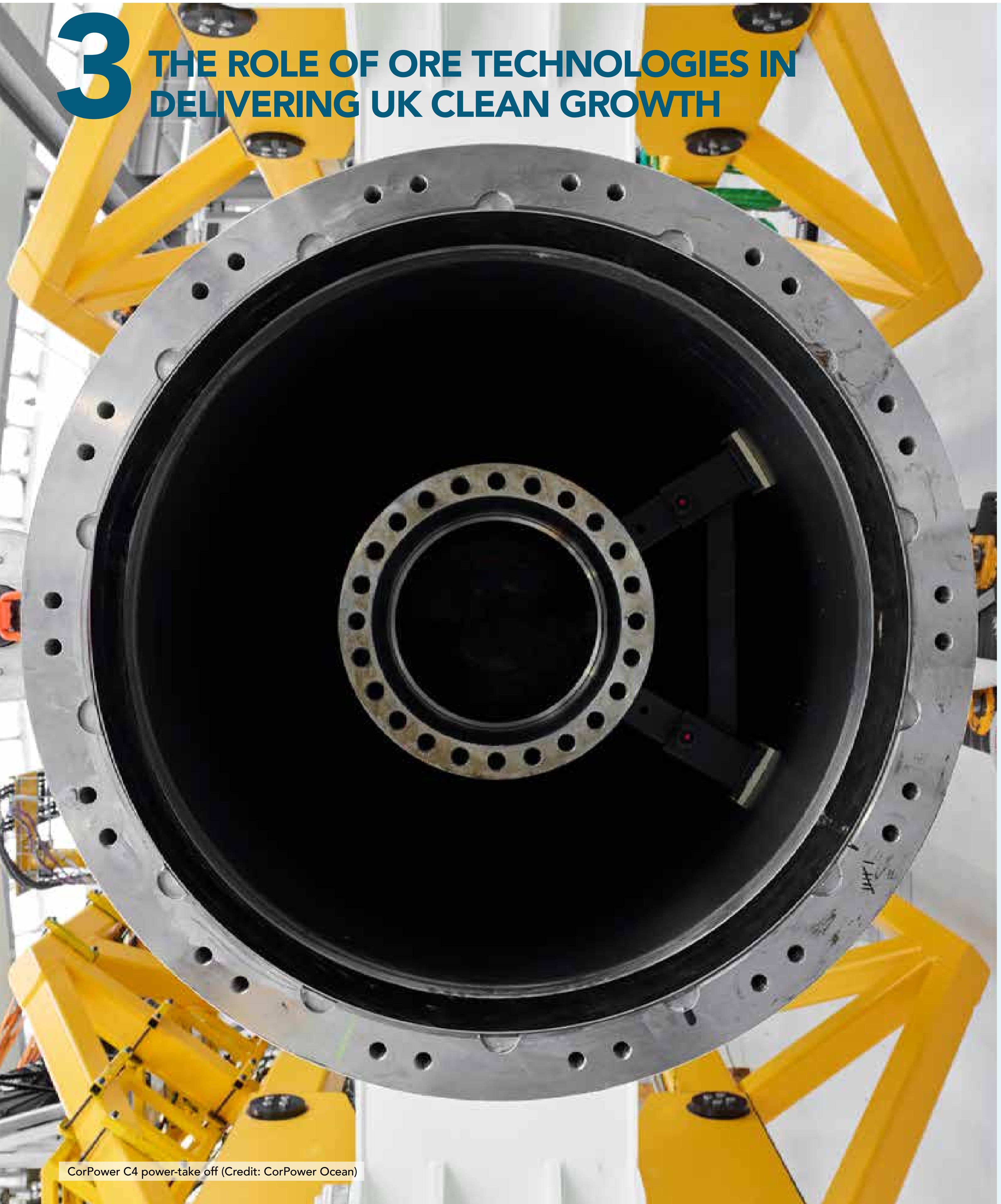
The CEISP makes clear that UK clean energy leadership will depend not only on capacity deployment, but on embedding innovation and industrial modernisation across the supply chain – scaling manufacturing, accelerating technology demonstration, and strengthening regional clusters to retain long-term value. Reducing import dependence, supporting domestic manufacturers, and capturing a greater share of future value are identified as priorities, alongside export opportunities in rapidly expanding global markets. Given the pace of planned deployment, the CEISP underlines the need for the UK to act now if it is to fully capitalise on the opportunities of the Net Zero transition.

The intersection of Economic Growth and Net Zero

Together, the UK's Modern Industrial Strategy, Clean Power 2030 Action Plan, and Clean Energy Industries Sector Plan set out a clear vision for delivering economic growth, clean energy, and more competitive domestic supply chains. However, while these frameworks provide strong strategic direction, they offer limited practical guidance on how technology development and supply chain capability should be prioritised and coordinated. As a result, policymakers and supply chain actors lack the detail needed to turn ambition into delivery at the pace and scale required.

CorPower C4 composite hull in mobile factory (Credit: CorPower Ocean)

3 THE ROLE OF ORE TECHNOLOGIES IN DELIVERING UK CLEAN GROWTH



CorPower C4 power-take off (Credit: CorPower Ocean)

DISRUPTIVE INNOVATION AND INDUSTRIAL MODERNISATION: PATHWAYS TO SECURING OFFSHORE RENEWABLE ENERGY SUPPLY CHAIN COMPETITIVENESS

Supergen Offshore Renewable Energy

The Deployment Potential of the UK's ORE Sector

The UK's electricity demand is expected to double by 2050, creating an urgent need for the large-scale deployment of a diverse portfolio of clean energy technologies to meet future energy system needs [7]. In response to this need, the UK is exceptionally well-placed to harness its extensive offshore renewable energy (ORE) resources. Existing reports estimate that there **is the market potential for over 115GW of offshore wind**, **of which up to 45GW could be deep-water offshore wind**†,to be deployed in the UK by 2050 [9, 10]. Additionally, there is also potential for up to **6GW of tidal stream** and **6GW of wave energy** to be deployed in a UK energy system by 2050 [11]. While these various technologies are currently at different stages of commercialisation, they are united by a shared need for ongoing technological innovation and subsequent cost reduction, albeit at different rates, to become established features of the UK's national energy system [12].

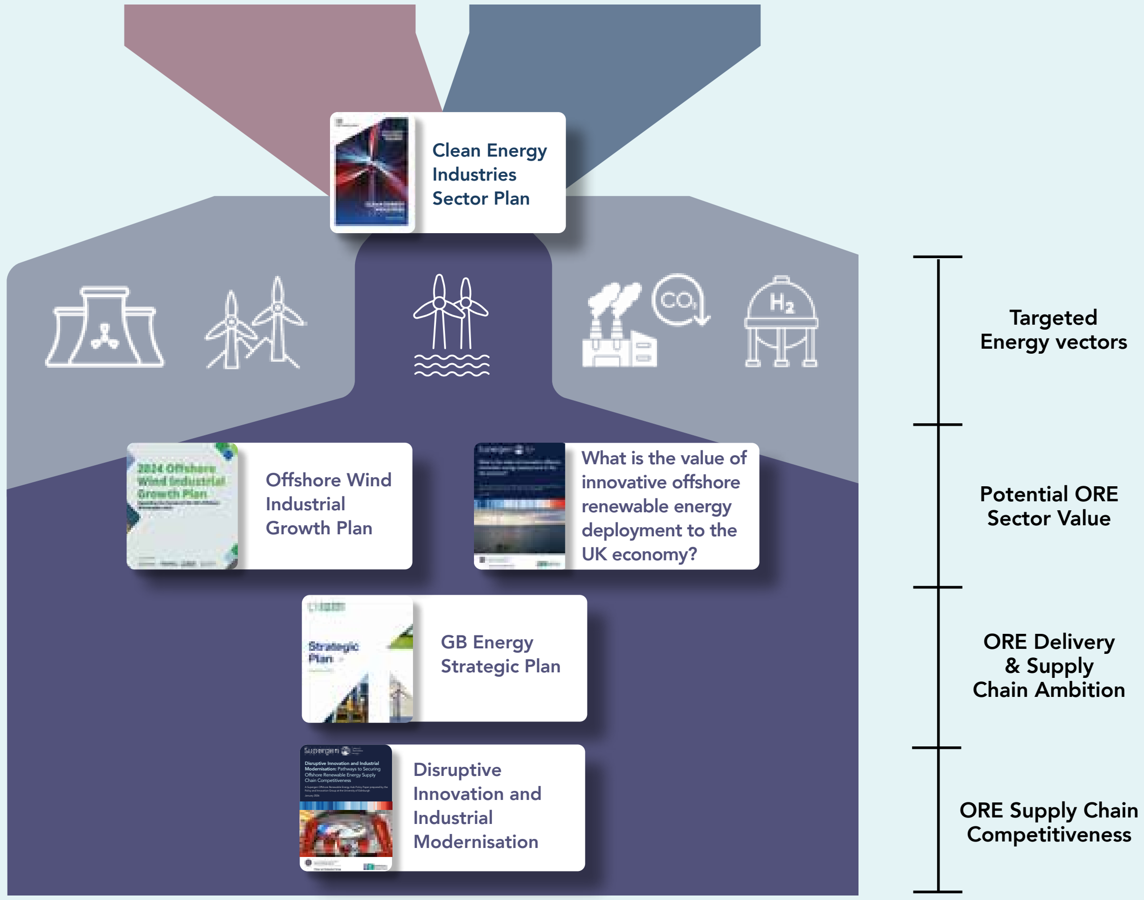


Figure 3. The UK ORE policy landscape

Looking ahead, it is clear that as the predicted expansion in deployment of offshore wind, tidal stream and wave energy devices occurs over the coming decades, the sector's underpinning supply chains will need to expand rapidly. This will be vital to both avoid delays in energy transition timelines and to secure the socioeconomic benefits associated with the deployment of ORE devices. In order to encourage this development, establishing clear estimates of the socioeconomic prize associated with the ORE sector has become increasingly important. The following sections will now provide summaries of the policy frameworks shown in Figure 3, outlining how the UK policy landscape has evolved to capture and integrate these estimates.

† Deep-water wind refers to offshore wind deployment in water depths beyond the limits of fixed foundations, primarily enabled by floating technologies and emerging hybrid substructures that bridge fixed and floating concepts to access deeper-water wind resources [8].

Potential ORE Sector Value:

The Offshore Wind Industrial Growth Plan

The Offshore Wind Industrial Growth Plan (IGP) sets out a strategic framework to maximise the economic, industrial, and supply chain benefits of offshore wind deployment in the UK. It assesses the current strength of the sector, identifies actions needed to secure long-term growth in both domestic and export markets, and quantifies the socioeconomic prize on offer. To that end, the IGP outlines that the UK currently has the second highest deployed capacity of offshore wind globally, with each gigawatt installed contributing roughly **£2–3bn of gross value added (GVA)** to the UK economy. Additionally, investments made in the offshore wind sector have supported **over 30,000 jobs** across the country to date. By 2035, the IGP expects that the UK market size for offshore wind will reach around **£270bn**, with an export market in the region of **£1,000bn**.

Figure 4. Strategic position and economic impact of the UK offshore wind sector *(adapted from* [13])

However, the IGP highlights that these benefits will not materialise without concerted action. Global competition is intensifying, with over 100 countries committed to tripling renewable energy capacity by 2030, increasing pressure on shared supply chains for materials, components, and skills. Early bottlenecks in European offshore renewable energy supply chains underscore the need for timely strategic intervention. While the UK has strong foundations and established capabilities in parts of the offshore renewable energy sector, maintaining competitiveness will require a long-term strategic approach. Without sustained investment in device innovation and supply chain modernisation, the UK risks missing the next generation of disruptive technologies that will shape the sector's future.

What is the value of innovative ORE deployment to the UK economy?

Looking beyond the shorter-term timelines associated with the IGP and the Clean Power 2030 Action Plan, it becomes clear that there is a potential energy system role to be played by a range of innovative ORE technologies, all of which are currently at different stages of commercial maturity. However, what is common across these various technologies is that without providing the required innovation support to ensure that the UK is well-positioned to sustain their development and lead the sector should they reach commercial deployment, there is a real danger of losing out on significant socioeconomic benefits.

These socioeconomic benefits are quantified in a report by the Supergen ORE Hub focussing solely on highly-innovative ORE technologies, such as floating offshore wind, wave and tidal stream. This report predicts that, dependant on domestic supply chain strength, the deployment of **45GW of floating offshore wind, 6GW of tidal stream** and **6GW of wave energy** in UK waters **could generate between £18bn and £41bn of GVA by 2050** [10]. It also states that domestic exports, enabled by the UK establishing a leading position in this global market, **could generate an additional £3.3bn** to **£45bn**, also by 2050.

In a scenario where there are high levels of domestic content in future ORE projects, this report predicts **that the sector could support over 166,000 full time equivalent jobs in 2050**. Breaking these jobs down by project cost centre, the report shows how manufacture of the device, including floating offshore wind foundations, accounts for the largest share of employment opportunity, and by extension GVA. Capturing these significant socioeconomic benefits are explicitly reliant on the development of a UK supply chain that can consistently compete with overseas competitors in the long-term.

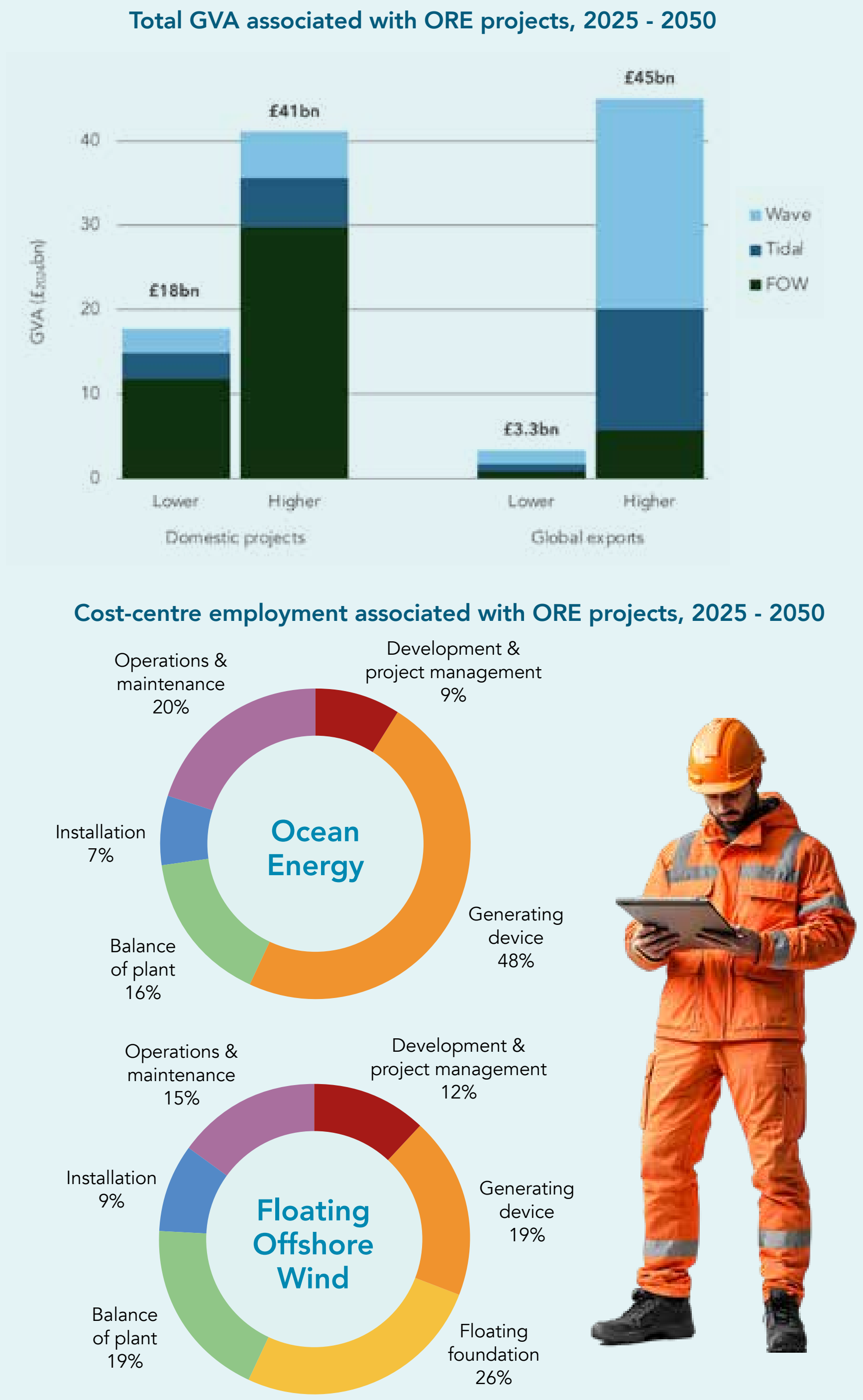


Figure 6. Socioeconomic potential of UK ORE development [9]

ORE Delivery and Supply Chain Ambition:

Great British Energy Strategic Plan

The Great British Energy (GBE) Strategic Plan represents the UK government's most deliberate intervention to capture the value on offer from the Net Zero transition through de facto supply chain delivery support [14]. Central to the Strategic Plan is the principle that accelerating domestic development and deployment of clean energy technologies should deliver materially greater long-term value to the UK than reliance on imported technologies, through jobs, industrial capability, and energy security.

To this end, the Strategic Plan focuses public investment on priority areas which maximise long-term socioeconomic returns. It identifies three such priorities, of which ORE, with a particular emphasis on the commercialisation of deep-water offshore wind, is one. Offshore wind is expected to be a cornerstone of the UK's Net Zero transition. Yet, analysis underpinning the Strategic Plan indicates that, based on current deployment trajectories, **the UK faces a potential shortfall of 20–38 GW of offshore wind capacity by 2035**. GBE positions itself as a developer and strategic investor with a mandate to de-risk the existing pipeline and catalyse new projects to help close this gap.

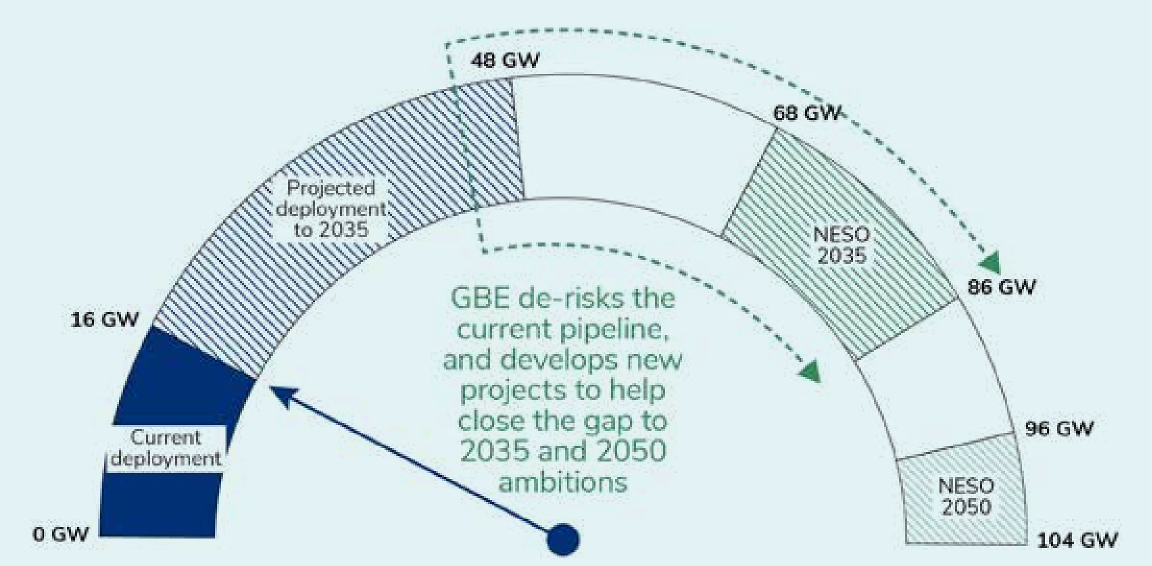
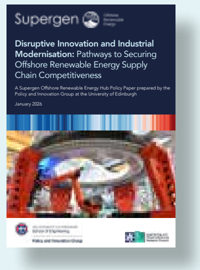


Figure 6. Projected deployment timeline for offshore wind, including gap to 2035 NESO target [14]

Furthermore, seizing the early-mover advantage in commercial deep-water wind could enable total UK offshore wind capacity to **exceed 100GW by 2050**, making the nascent technology an integral contributor to meeting decarbonisation targets – while anchoring industrial value domestically. Although references to the wave and tidal stream sectors in the Strategic Plan are limited, GBE indicates that these are the types of technologies that could be supported by GBE Ventures, particularly where minority equity positions can accelerate high-growth technologies with a strong UK innovation footprint.

The Strategic Plan also considers the importance of coordinating investment into these sectors in parallel with GBE's newly announced Energy, Engineered in the UK (EEUK) programme [15]. EEUK is a **£1bn funding programme** designed to unlock industrial opportunities from the energy transition and to ensure the UK develops enduring capabilities in the clean energy technologies of the future. The programme will support technologies across the energy sector, and we will make bold, deliberate choices to invest in building long-lasting technology sovereignty, positioning the UK to lead globally.

ORE Supply Chain Competitiveness:



Disruptive Innovation and Industrial Modernisation

The preceding overview of the UK's fast-evolving clean energy policy landscape has underlined the clear role for both established and more innovative ORE technologies in a future UK energy system. It has also indicated the growing awareness within UK policymaking that in order for the full socioeconomic value of these technologies to be recognised, substantial action is required with regards to immediate supply chain development and commercial build-out.

However, capturing the value on offer from the ORE sector is not simply a matter of scaling existing capabilities. In a globally competitive marketplace, securing domestic and international demand requires UK-made products to outperform international alternatives on quality, performance, reliability and, perhaps most importantly, value for money. While the three documents outlined above articulate the ambition and rationale for investing in UK supply chain capability, they stop short of clearly defining how ORE supply chain competitiveness can be developed in practice – from innovating disruptive products and processes, to skills, infrastructure and investment coordination. Clearly defining strategy, funding priorities, enabling factors, and cross-cutting opportunities will be critical to ensuring public and private capital is deployed effectively, maximising the likelihood that UK ORE companies develop globally competitive offerings and assume positions of international leadership within the ORE sector.

Looking ahead, there is a significant opportunity for the UK to adopt a more strategic and selective approach by identifying high-value areas of the ORE supply chain where existing domestic innovation can be leveraged to establish clear technological leadership compared to international competitors. The remainder of this report will outline how the UK, **by investing in disruptive technologies alongside cutting-edge manufacturing processes**, has the potential to not only secure its own energy future but also capture global market share in both nascent and established ORE sectors. Conversely, it makes clear that by failing to develop a robust, sophisticated and, above all, competitive domestic supply chain the UK stands to potentially cede the lucrative prize of a fully commercialised ORE sector to overseas competitors.

Highlighting the Role of ORE Technologies in a UK Energy System

By 2050, ORE technologies will be deployed at scale and will form an indispensable feature of the UK's Net Zero energy system, as detailed in several ORE specific policy documents, including:

- *'The Offshore Wind Industrial Growth Plan'*
- *'What is the value of innovative ORE deployment to the UK economy?'*
- *'Great British Energy Strategic Plan'*

While these policy documents make clear that ORE technologies can help to fulfil the UK Governments ambition on clean energy deployment, ensuring that it also delivers on ambitions concerning economic growth will require the proactive development of underpinning supply chain capabilities. The remainder of this report will look to bridge this gap and clarify how the UK can establish a globally competitive ORE sector and retain the associated socioeconomic benefits.

The Overall UK ORE Policy Landscape

The preceding sections of this report have mapped out how the UK's ambitions for economic growth and expanded deployment of clean energy technologies can, in part, be realised and delivered through the development of a competitive offshore renewable energy sector and underpinning supply chain. This overall policy landscape can now be visualised in full in Figure 7.

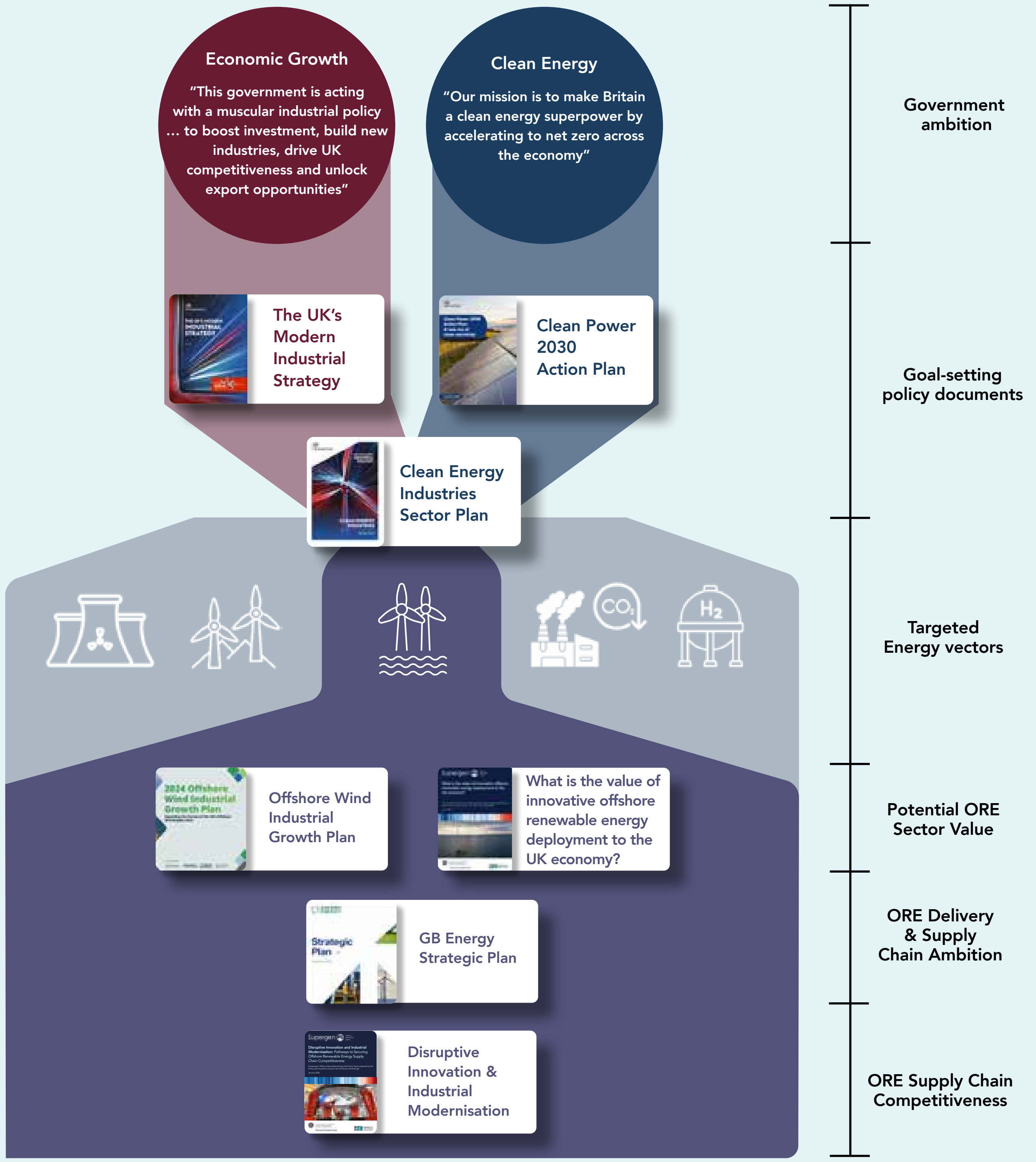


Figure 7. The overall policy landscape to translate ambitions for economic growth and clean energy into competitive ORE development and deployment

Orbital O2 at the Fall of Warness (Credit: Orbital Marine Power)

4 BALANCING NET ZERO TIMELINES AND ORE SUPPLY CHAIN DEVELOPMENT

Operations and maintenance of offshore wind farm (Credit: ORE Catapult)

DISRUPTIVE INNOVATION AND INDUSTRIAL MODERNISATION: PATHWAYS TO SECURING OFFSHORE RENEWABLE ENERGY SUPPLY CHAIN COMPETITIVENESS

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The Tension Within the Net Zero Transition

Having identified the potential significant socioeconomic value that is associated with a commercialised ORE sector, it is essential to consider the options available to the UK for developing domestic supply chains capable of translating ambition into delivery with increased supply chain content.

In doing so, the UK must seek to optimise the two overarching goals that exist in tension at the heart of the UK's clean energy transition.

While the Net Zero transition must be delivered at an accelerated rate, the transition must be matched by the equally rapid growth of innovative UK manufacturing and supply chain capabilities. This is vital to ensuring that the jobs, skills, and value created by the transition are retained within the UK.

These goals create a dual – and at times competing – set of policy expectations. The UK must scale clean energy infrastructure at unprecedented speed, but it must also ensure this expansion acts as a catalyst for producing tangible socioeconomic return within the national economy, rather than offshoring value to international suppliers.

The challenge for policymakers, therefore, is not to treat these objectives as separate problems to be solved in isolation, but rather to resolve this tension through the development of a coherent policy environment in which both goals reinforce one another. Achieving this outcome will demand proactive policy interventions, strategic investment and close coordination between government, industry and research stakeholders.

Figure 8. Balancing the speed of UK ORE deployments against supply chain capability development

To explore the potential trade-offs between these dual objectives and inform more balanced, strategic policymaking, this report outlines three scenarios, each of which illustrates an alternative approach to addressing these tensions.

DISRUPTIVE INNOVATION AND INDUSTRIAL MODERNISATION: PATHWAYS TO SECURING OFFSHORE RENEWABLE ENERGY SUPPLY CHAIN COMPETITIVENESS

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Scenario 1: 'Buy and Regret'

The UK prioritises the rapid deployment of ORE devices by relying heavily on the long-term import of high-value, high complexity components from more mature supply chains belonging to overseas competitors.

Pro's

+ Enables rapid deployment of ORE capacity in the short term by relying on mature international supply chains.
+ Provides immediate access to proven technologies, reducing near-term delivery risk.
+ Helps meet deployment milestones without upfront investment in domestic manufacturing capability.

Con's

- Creates long-term dependence on international suppliers for critical ORE components and subsystems.
- Limits the development of domestic high-value manufacturing capability and innovation capacity.
- Results in missed opportunities for skilled job creation, GVA retention, and export growth within the UK.
- Reduces national energy security and industrial resilience by increasing exposure to global supply disruptions.
- Weakens the UK's ability to influence future technology trajectories and global market development.

Scenario 2: 'Slow Down to Catch Up'

The UK opts to delay the established 2030 Clean Power milestones to allow more time for the domestic ORE supply chain to develop both development capabilities and manufacturing capacities.

Pro's

+ Allows additional time for domestic supply chains to develop manufacturing capability and capacity.
+ Increases UK content in ORE projects over the long term.
+ Supports the growth of a stronger domestic industrial base in selected areas.

Con's

- Delays progress towards Clean Power 2030 and Net Zero targets, undermining climate ambition.
- Introduces uncertainty into project pipelines, reducing market visibility and investor confidence.
- Risks falling behind global competitors who continue sustained R&D and deployment in parallel.
- Misses opportunities for learning by doing, operational refinement, and institutional capability building.
- Weakens policy credibility and the UK's international leadership position in offshore renewables.

Scenario 3: 'Disrupt and Modernise'

The UK pursues an ORE deployment strategy designed to meet its Net Zero targets, strategically importing critical components and subsystems in the short term where domestic supply is currently constrained.

However, this approach is explicitly transitional. Simultaneously, the UK prioritises investment in disruptive innovation and industrial modernisation to establish a leading position.

Pro's

+ Maintains momentum towards Clean Power 2030 targets while recognising near-term supply chain constraints.
+ Uses short-term imports strategically while building domestic capability in parallel.
+ Targets investment towards high-value technologies and subsystems where the UK can achieve competitive advantage.
+ Strengthens innovation infrastructure, workforce capability, and supply chain readiness simultaneously.
+ Improves long-term GVA retention, skilled job creation, and energy security.
+ Positions the UK as an export-oriented hub for Tier 1 ORE suppliers with access to global markets.

Con's

- Requires strong coordination across government departments, agencies, and industry.
- Demands sustained public investment and clear strategic prioritisation.
- Involves managing transitional reliance on imports while domestic capability is developed.

Choosing a Direction

Rather than accepting an assumed trade-off between rapid deployment and domestic supply chain development, the Disrupt and Modernise scenario sets out a pathway in which both objectives are pursued in parallel and mutually reinforced. It recognises that the pace required to meet the UK's net zero commitments cannot be achieved by slowing deployment, nor can long-term industrial value be secured by relying indefinitely on imported high-value components.

By deliberately fostering innovation alongside deployment, the Disrupt and Modernise scenario enables the UK to avoid incremental, catch-up pathways and instead focus on next-generation technologies, manufacturing processes, and system integration approaches. Short-term imports are treated as transitional enablers rather than permanent dependencies, providing space for domestic capability to be built in parallel through sustained investment in innovation infrastructure, manufacturing scale-up, and workforce development. Crucially, this approach embeds learning-by-doing within the deployment pathway itself, ensuring that process knowledge and experience directly inform innovation priorities and supply chain development.

In doing so, the Disrupt and Modernise scenario offers the only credible route to reconciling the UK's twin imperatives: delivering large-scale offshore renewable energy deployment at the speed required for net zero, while simultaneously capturing long-term economic, industrial, and strategic value from the ORE sector. As such, this scenario provides the most robust foundation for a resilient, competitive, and future-proof ORE supply chain and is therefore selected for further development.

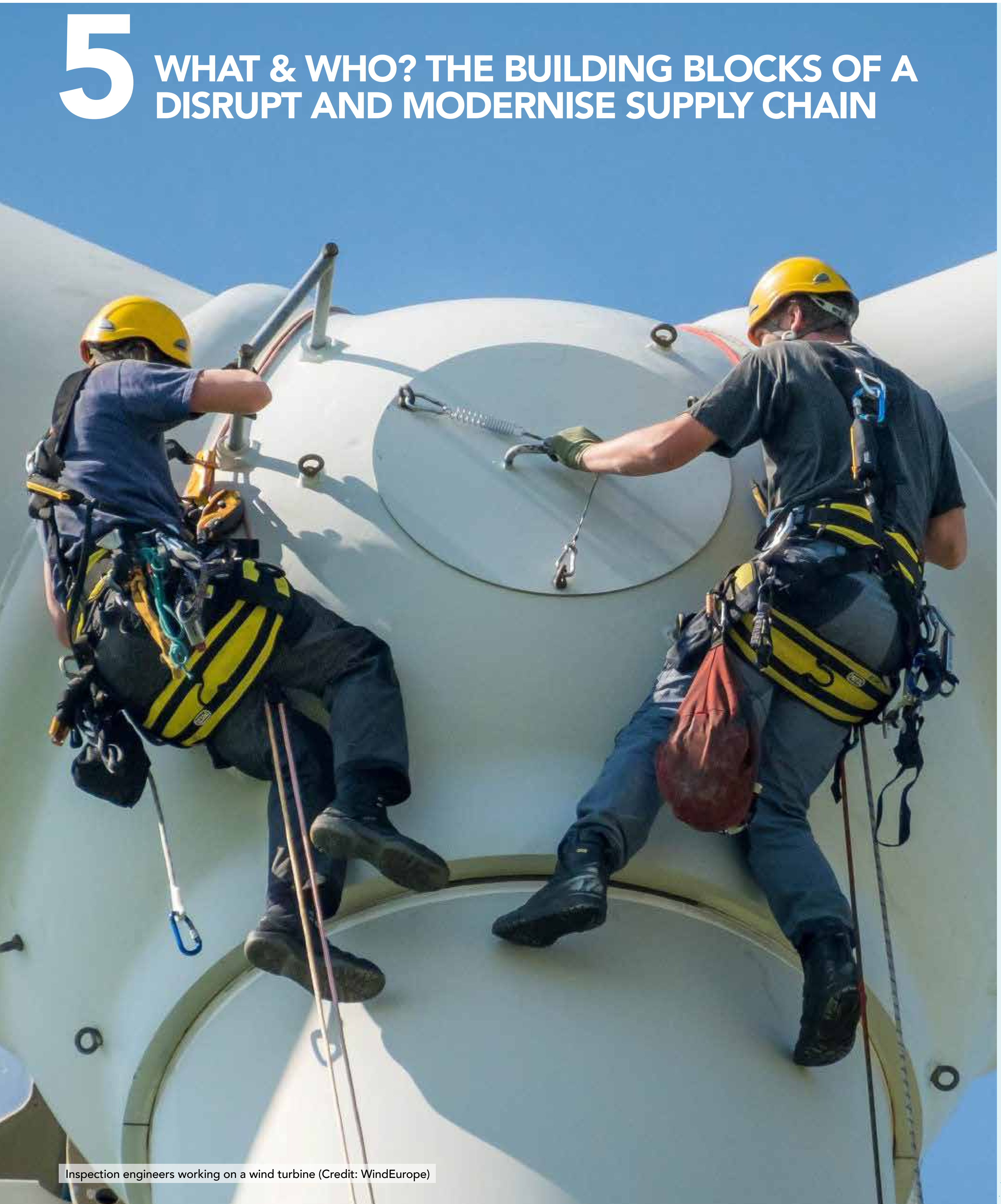
Resolving the Tension Between Net Zero Delivery and Supply Chain Development

To realise the full benefits of a commercial ORE sector, UK policymakers must navigate the core tension at the heart of the clean energy transition: advancing rapidly towards Net Zero while ensuring the simultaneous development of a modern and competitive domestic supply chain.

There are several potential trade-offs that could be made to resolve this tension, some of which involve compromising either the speed of the Net Zero transition or the ambition to build a competitive domestic supply chain.

This report argues that the UK should instead prioritise a Disrupt and Modernise approach. This approach is one that explicitly limits short-term reliance on imported technologies by simultaneously developing domestic innovation capabilities and manufacturing capacity.

5 WHAT & WHO? THE BUILDING BLOCKS OF A DISRUPT AND MODERNISE SUPPLY CHAIN



Inspection engineers working on a wind turbine (Credit: WindEurope)

DISRUPTIVE INNOVATION AND INDUSTRIAL MODERNISATION: PATHWAYS TO SECURING OFFSHORE RENEWABLE ENERGY SUPPLY CHAIN COMPETITIVENESS

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What Subsystem Areas Could a Disrupt and Modernise Supply Chain Focus On?

The UK ORE Sector already benefits from several strategic studies that highlight priority areas for industrial growth and innovation, such as the *Offshore Wind Industrial Growth Plan* [13] (IGP) and *Future Economic Potential of Tidal Stream & Wave Energy in Scotland* [16] (FEP). Underpinning both is the idea that supply chain competitiveness is one of the ORE industry's primary levers on regional and national economic growth, stemming from the ORE device manufacturing segment's prominence in terms of long-term GVA generation and job creation. However, both reports also stress the significance of strategic specialisation in future support for UK ORE supply chains to drive maximum impact. Given the maturity and globalised nature of the offshore wind sector, the IGP introduces a comprehensive 'Make or Buy' methodology, which provides a systematic framework for evaluating how the UK can most effectively develop and source critical components and services, shown in Figure 9, within the offshore wind value chain [13]. In contrast to the offshore wind sector, wave and tidal stream are more nascent industries. As a result, their supply chains are not yet globally competitive marketplaces, but rather informal networks of manufacturers and developers co-innovating bespoke, pilot-scale solutions. With industrial frontrunners or a clear competitive manufacturing landscape yet to emerge, the evidence-base to conduct an IGP-styled 'Make or Buy' analysis remains limited.

Figure 9. Priority areas identified within the IGP framework *(adapted from [13])*

By analysing the strategic priorities of both the IGP and the FEP, it becomes evident that the offshore wind, tidal stream and wave energy sectors share a number of common device and subsystem categories. These include drivetrain components, subsea cables, blades, floating substructures, anchoring and mooring systems, as well as several operational and deployment-related services.

These overlaps between IGP priority areas and core ocean energy components point to shared opportunities across the offshore wind, tidal stream and wave energy industries. In particular, they highlight the potential to leverage common underpinning research, engineering capabilities and manufacturing processes across the sectors. Subsequently, this report identifies seven strategic categories as cross-cutting areas with strong potential to drive disruptive innovation across the wider ORE sector, shown in Figure 10. Collectively, these categories represent a range of potential areas for strategic specialisation within a future UK Disrupt and Modernise supply chain.

1 **Recyclable Blades**

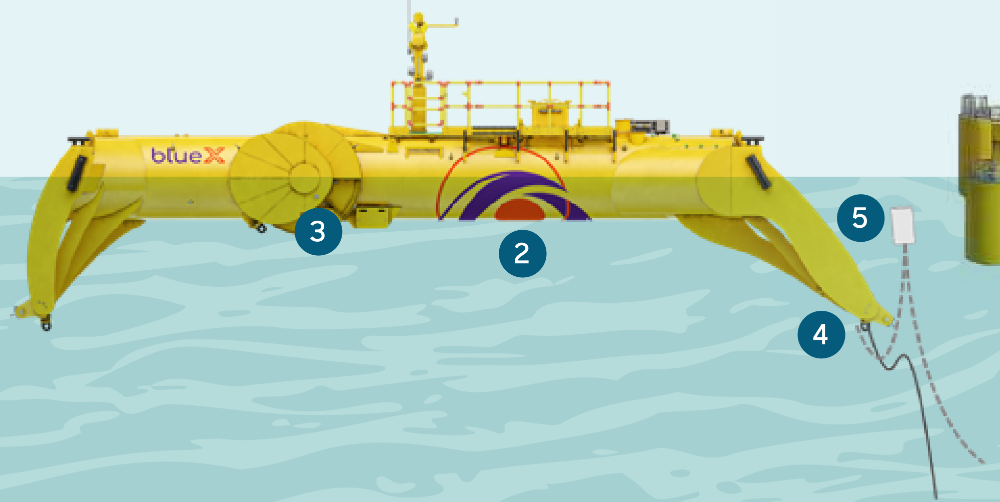
Investing in development pathways for recyclable wind and tidal turbine blades supports sustainability while reducing lifecycle costs, enabling the UK to lead in environmentally responsible technology.

2 **Next-Generation Composite Structures**

Advanced composite structures have use-cases across offshore wind towers, wave and tidal turbine hulls, and floating substructures. Breakthroughs in the segment have potential to reduce material use, improve structural efficiency, and lower installation costs, offering opportunities for industrial modernisation and global competitiveness.

3 **Next-Generation Power Take-Offs (PTOs)**

Ensuring capability in the design, testing and implementation of innovative PTO systems would allow capture of a high value segment that has historically eluded the UK. All electromechanical renewable energy systems rely on PTOs to convert movement to electrical power – breakthroughs here would have far-reaching impacts extending well beyond the ORE sector.



4 **Deep Water and Floating Foundations**

Floating and deep-water foundations open access to previously inaccessible offshore wind deployment sites, while, while advancement in mooring and anchoring technology would simultaneously benefit the wave and tidal sectors.

5 **Array and Export Cables**

Tools and processes to improve cable reliability and grid interconnection, develop interoperable HVDC systems, as well as deployment of novel materials and designs have the potential to safeguard the UK's position as a European segment leader. More specifically, further breakthroughs in dynamic inter-array cabling would support the roll out of floating generation devices across wind, tidal and wave.

6 **Next-Generation Installation, Operations and Maintenance (IOM)**

Enhanced IOM strategies – including predictive maintenance, specialised vessels, and autonomous solutions – secure long-term performance and cost-efficiency for all types of offshore assets.

7 **Smart Environmental Services**

Environmental monitoring, digital survey tools, and ecological intelligence systems support sustainable deployment, regulatory compliance, and informed operational decision-making.

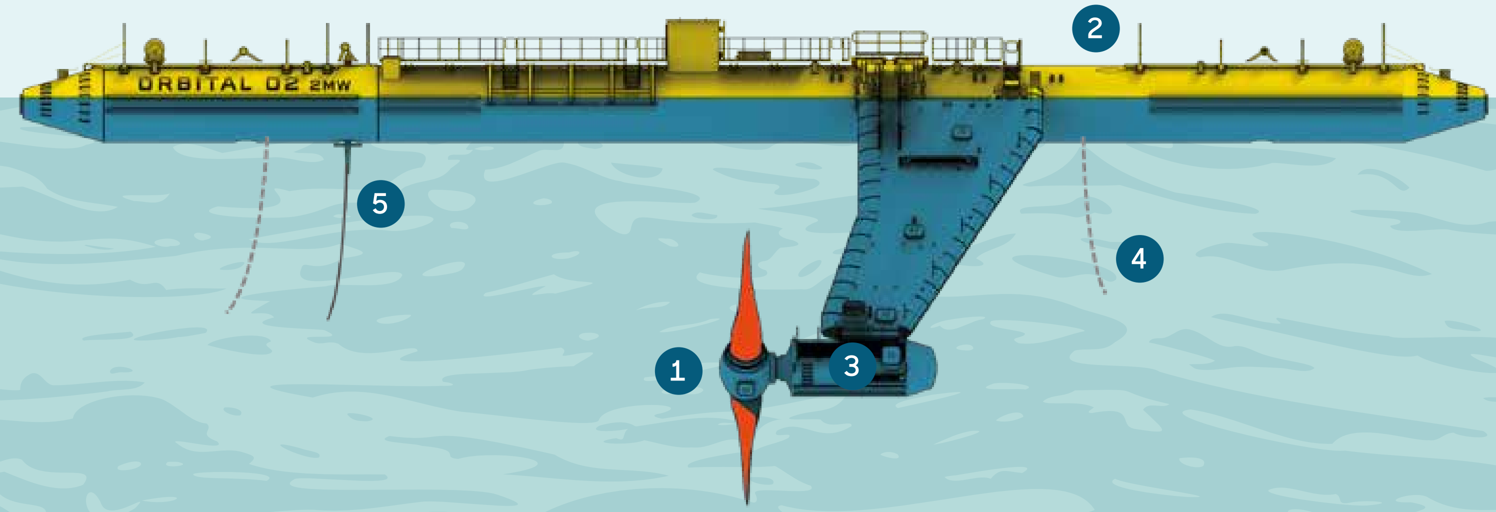


Figure 10. The seven strategic cross-cutting areas of an integrated ORE supply chain

Who Constitutes a Future Disrupt and Modernise Supply Chain?

Developing a competitive ORE supply chain requires coordinated action from a diverse set of actors. While government can provide the enabling environment through policy, investment, and strategic oversight, the responsibility for translating ORE potential into domestic capability lies with the companies and organisations directly involved in **device and subsystem development, manufacture, and underpinning innovation**, as shown in Figure 11.

Figure 11. The actors that constitute a UK Disrupt and Modernise supply chain

Device and Subsystem Developers

These technology developers play a vital role in deploying innovative ORE devices, subsystems and solutions, driving the commercialisation of new technologies across the sector. They are responsible for advancing concepts from prototype through to full-scale deployment and for identifying viable routes to market for next-generation solutions. Their capacity to demonstrate high-performance, low-risk technologies is essential both for securing domestic project opportunities and for strengthening the UK's position as an export leader. As global demand for ORE technologies expands, sustaining a strong and competitive technology development base will be critical to ensuring that the UK remains at the forefront of the sector.

Manufacturers

The UK's manufacturing base, from specialised SMEs with niche production skillsets to large-scale industrial fabricators, will be central to realising the economic benefits of ORE sector growth. UK ORE manufacturers must be able to deliver high-quality components and subsystems at competitive costs and commercial scale, including structural elements, drivetrain assemblies, power electronics, blades, anchoring solutions, and other critical components of ORE devices. To build and sustain competitive advantage, UK manufacturers must be prepared to adopt advanced production techniques, digital tools, and low-carbon processes, ensuring that their supply chains are ready to integrate process-based innovations that accompany the development of new ORE subcomponents. The success of manufacturers will depend on the reliability and visibility of demand pipelines and their ability to align with the specifications and innovation cycles of technology developers.

Innovation Organisations

Innovation organisations – including universities, research institutes, and test centres – form the foundation of the UK's offshore renewable energy (ORE) research and innovation landscape. They play a critical enabling role in accelerating innovation, supporting technology pull-through, and maintaining the competitiveness of the UK supply chain. As domestic supply chains are required to adapt rapidly to evolving technologies while scaling production, the contribution of these organisations becomes increasingly vital. Innovation organisations support ORE development by advancing new materials, manufacturing techniques, and design optimisation methods that feed into commercial products. They help de-risk and scale technologies through modelling, testing, and performance validation, accelerating the transition from research to manufacturing. By acting as neutral conveners, they strengthen collaboration between developers and manufacturers and support skills development through training researchers, engineers, and technicians. The UK's leadership in ORE technologies is underpinned by the strength of these organisations and their close links to industry, making sustained investment and alignment with industrial needs essential for long-term competitiveness.

The Role of Government-based Actors

It is important to note that these actors are not delivering a competitive Disrupt and Modernise supply chain in isolation, rather they must engage with a wide range of government-based actors on policy, funding and regulation. Within UK government a central challenge is that the policy levers relevant to ORE supply chain competitiveness are distributed across several departments with distinct mandates. The Department for Energy Security & Net Zero (DESNZ) leads on deployment, consenting and the policy frameworks governing offshore renewable energy. The Department for Business & Trade (DBT) retains responsibility for industrial capability, export strategy and wider sectoral competitiveness. The Department for Science, Innovation & Technology (DSIT) oversees research, innovation funding and advanced technology development pathways.

In addition to UK Government, policy intent is partially translated into action through a range of regional and delivery-level actors, including devolved governments, enterprise agencies, and other place-based institutions, as well as purpose-built delivery and funding bodies such as Great British Energy and UKRI. These actors play critical intermediary roles, linking national strategy with the operational realities of the UK ORE supply chain.

What and Who: Building Out a Disrupt and Modernise Supply Chain

The development of a *Disrupt and Modernise* supply chain should seek to combine disruptive innovation with forward-looking options for supply chain modernisation, leading to the establishment of the UK as a market-leader in ORE development and deployment.

While the sector, through commercial manufacturers, technology developers and innovation organisations, holds the ultimate responsibility to develop competitiveness, it must also engage and work with a wide range of UK Government actors, including DESNZ, DSIT and DBT, as well as regional governments and enterprise agencies.

These actors must collaboratively target a limited number of strategic, high-value, cross-cutting technology areas, whose development has the potential to benefit the entire ORE sector, across offshore wind, tidal stream and wave energy.

6 HOW? DEVELOPING COMPETITIVENESS WITHIN A DISRUPT AND MODERNISE SUPPLY CHAIN

Acoustic surveys conducted at EMEC (Credit: EMEC/Colin Keldie)

DISRUPTIVE INNOVATION AND INDUSTRIAL MODERNISATION: PATHWAYS TO SECURING OFFSHORE RENEWABLE ENERGY SUPPLY CHAIN COMPETITIVENESS

The ORE Supply Chain Competitiveness Classification System

Building on the established ***What*** and ***Who*** analysis, this section sets out a practical framework for ***How*** competitiveness can be developed within a Disrupt and Modernise supply chain. This process begins by introducing a **supply chain competitiveness classification system**, whereby the supply chain opportunity presented by any one subsystem can be ranked. Assessing supply chain competitiveness across the ORE supply chain is a necessary precursor to presenting potential policy mechanisms to increase both supply chain capabilities and capacities. Furthermore, given the range of established competitors and the growing presence of ORE technologies in energy systems worldwide, it is unrealistic to expect the UK to establish leading positions in all areas of the ORE supply chain.

The four classifications used in this report are described are shown in Figure 12 below:

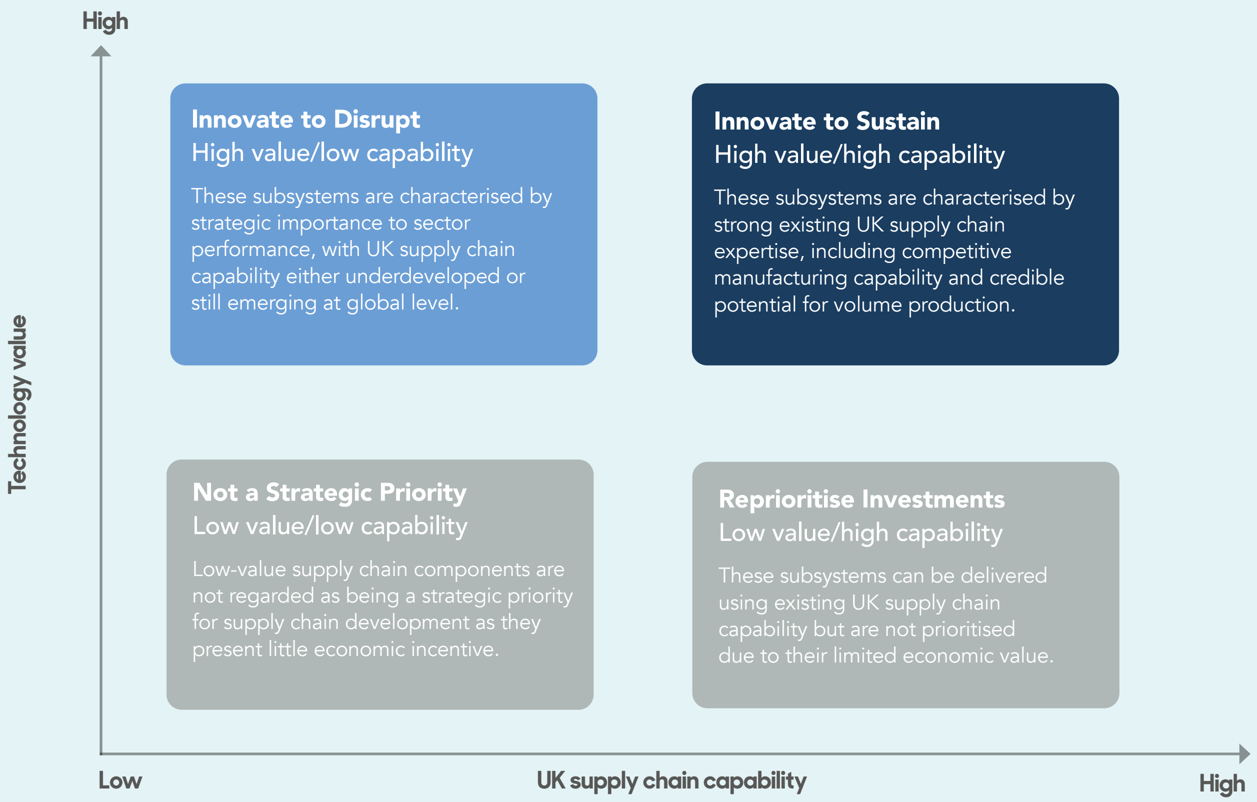


Figure 12. The ORE supply chain competitiveness classification system

This report will only focus on high-value ORE supply chain components, ensuring a strategic approach that will help to maximise long-term economic return while also potentially strengthening existing instances of UK ORE technological leadership.

Therefore, the challenge becomes how the UK can increase its ability to produce high-value subsystems competitively at volume and move towards the upper-right corner of Figure 12. The classifications established in this report are not rigid, with any one ORE component having the potential to move from one classification to another in response to applied innovation and policy support mechanisms. However, to develop a truly competitive supply chain within the timeline set by the UK's Net Zero agenda, there is a pressing need for a step-change in both the ways and speed with which the UK can move high-value subsystems from a position of low UK supply chain capability to a position of high UK supply chain capability. This ambition is as challenging as it is valuable to deliver due to the UK's relatively weak position as a manufacturer of innovative products. Hurdles to overcome include a high-cost base, historic underinvestment in industrial and manufacturing capability, and fragmented policy support.

How? The Role of the Leapfrogging Transition

Having established a system for assessing the high-value cross-cutting ORE subsystem areas the UK should focus on, and identified a need to increase supply chain capabilities, attention must now turn to identifying a process through which this outcome can be achieved.

In the limited number of areas of the ORE sector where the UK already possesses the beginnings of a competitive supply chain, it may be possible to move towards or even solidify a market leading position through incremental innovation. However, for the majority of high-value ORE technologies, this is not reflective of the UK's current competitive position. For the UK's largely underdeveloped supply chain to competitively produce at scale the high-value technologies required to turn the ORE market into a source of impactful socioeconomic value for the country, an alternative technology development pathway must be found.

Therefore, this report has developed the novel concept of **the Leapfrogging Transition**, shown in Figure 13, as a pathway that enables ORE product developers to bypass the slower route of incremental innovation – **allowing the UK to overtake international competitors, rather than just catch up**.

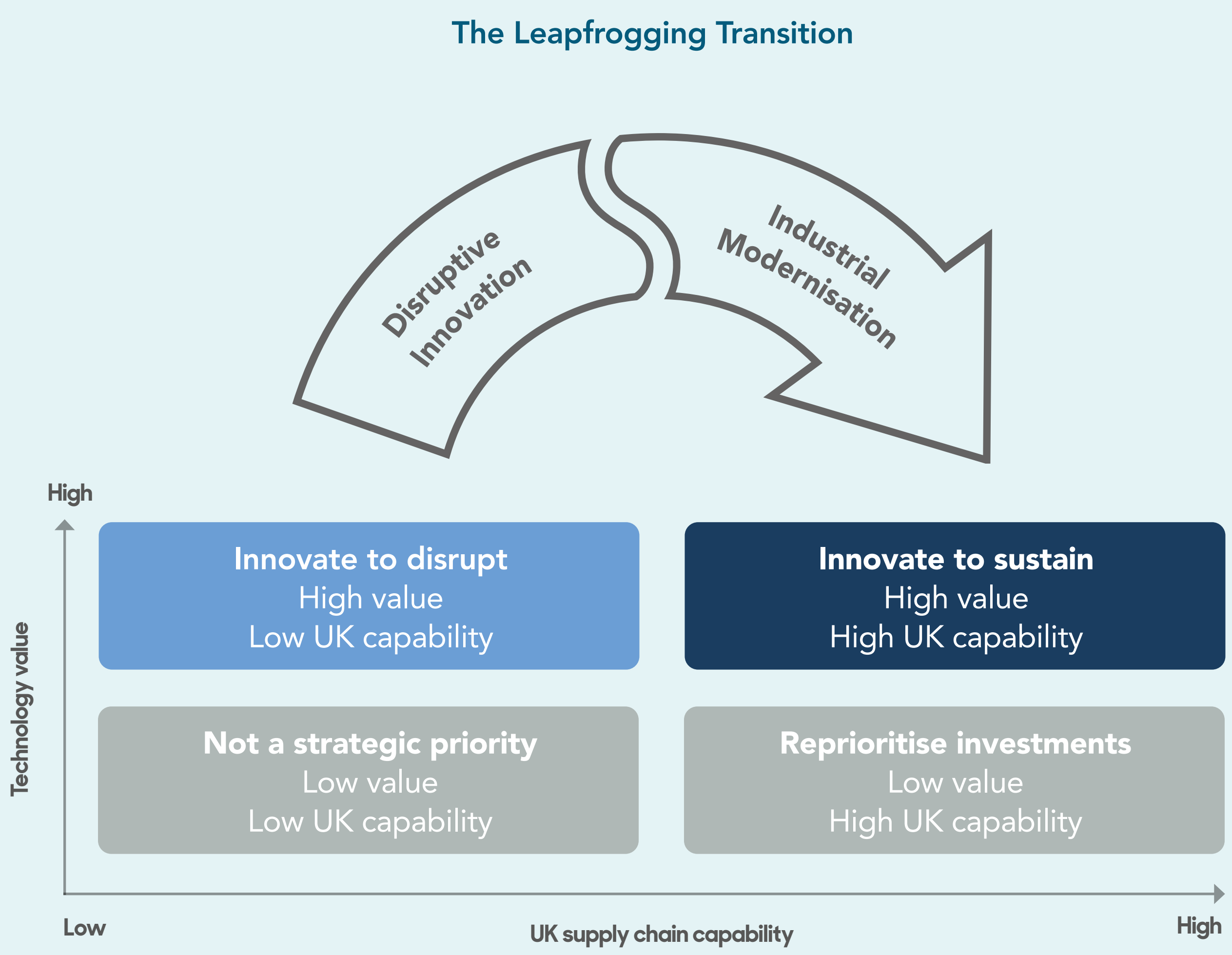


Figure 13. The Leapfrogging Transition

By identifying strategic opportunities within the wider ORE technology landscape, the UK can take a proactive and future-oriented approach to building a modern, process-driven supply chain. While these low-capability areas currently represent potential vulnerabilities, they also highlight a chance for the UK to establish targeted technological leadership. By focusing innovation efforts on breakthrough technologies capable of capturing these opportunities, the UK can harness its strong innovation and engineering base to deliver transformative solutions that strengthen overall industrial competitiveness.

If this innovation-led approach is coupled with coordinated investment in supply chain modernisation – including automation, digitalisation, and skills development – the UK can secure the domestic capability to design and manufacture next-generation renewable technologies at scale. Taken together, this approach has the potential to lock in long-term economic value across the ORE sector, creating sustained GVA growth, high-quality employment and export potential.

Finally, in a sector as fast evolving as the ORE sector, this approach should be sustained in the long-term. By placing the emphasis on an ongoing reciprocal relationship between the development of innovation capabilities and overall supply chain modernisation, the UK has a very real possibility of sustaining this competitive position well into the future.

In this overall context, the **Leapfrogging Transition** should be understood as a dual ambition: to accelerate technological innovation at the device and subsystem level, while simultaneously advancing the sophistication and competitiveness of the underpinning supply chain. Together, these efforts could position the UK to move strategic, high-value segments of the ORE sector into globally competitive, future-proofed positions, reinforcing the country's industrial base and leadership in the global clean energy transition.

The Leapfrogging Transition is driven by two underpinning concepts:

Disruptive Innovation: In technology areas where the UK has identified that it is unlikely to develop a market-leading position through incremental innovation, it should instead utilise its domestic innovation capabilities to aggressively develop disruptive, high value ORE technologies. This approach should specifically target ORE technologies with the potential to reshape the existing ORE market and with a high suitability to be manufactured economically and at scale in a modernised supply chain.

Industrial Modernisation: The UK must rapidly modernise its ORE supply chain, whether the goal is to strengthen existing manufacturing capabilities or to create a landing pad for disruptive new technologies. Industrial modernisation through advanced manufacturing, automation, and digitalisation is essential for long-term competitiveness. It is also critical to coordinate the co-design of the future supply chain. This ensures that it can competitively manufacture the innovative technologies that will shape the ORE sector in the coming decades.

Optimising Disruptive Innovation and Industrial Modernisation

Importantly, any successful leapfrogging transition within the *Disrupt and Modernise* supply chain cannot rely exclusively on either disruptive innovation or industrial modernisation. Instead, achieving long-term supply chain competitiveness will require a balanced application of both objectives, ensuring that both product and process are developed in close alignment.

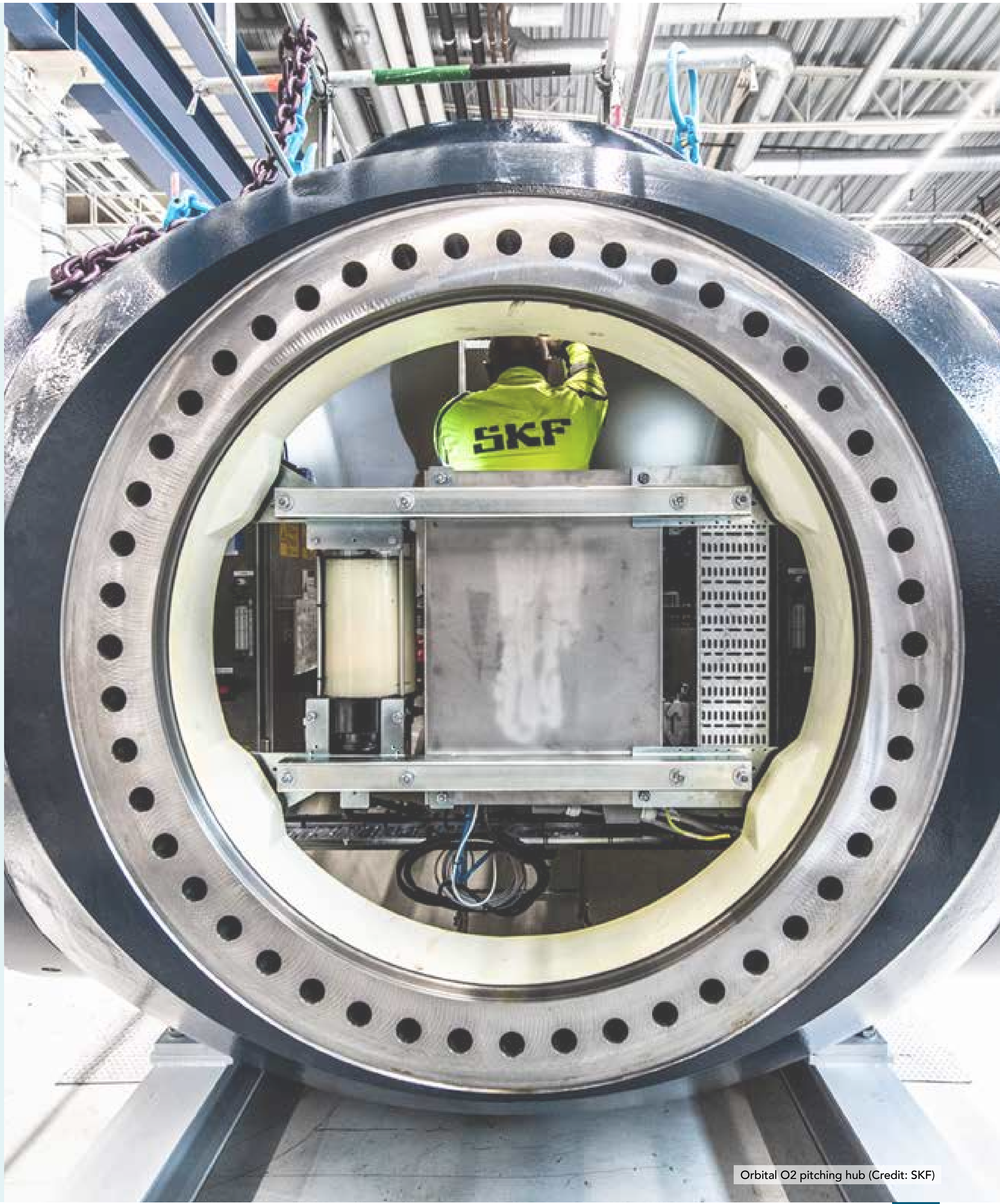
For policymakers, the implications are clear. The most effective strategy is to combine the supply chain preparations of industrial modernisation with the leapfrogging potential offered by disruptive innovation. However, this blended approach must be guided by well-developed and comprehensive policy programmes, that target the specific factors that drive and influence supply chain competitiveness. Pursuing a leapfrogging strategy requires deliberate alignment of research funding, industrial capacity, workforce development, and regulatory frameworks with the most promising high-value component areas. Done well, this approach can accelerate the deployment of disruptive ORE technologies while establishing the foundations of a modernised and globally competitive supply chain.

Overtaking, Not Just Catching Up – Establishing the Leapfrogging Transition

The **Leapfrogging Transition** presents an opportunity to accelerate the delivery of the UK government's stated ambitions of increased economic growth and the establishment of the UK as a clean energy superpower. By identifying strategic gaps within the wider ORE technology landscape, the UK can take a proactive, future-oriented approach to innovation support. Coupling this approach with coordinated investment in supply chain modernisation would secure domestic manufacturing capability and lock in long-term economic value, high-quality employment, and export potential

The **Leapfrogging Transition** is driven by two underpinning concepts:

- **Disruptive Innovation:** In technology areas where the UK has identified that it is unlikely to develop a market-leading position through incremental innovation, it should instead utilise its domestic innovation capabilities to aggressively develop disruptive, high value ORE technologies. This approach should specifically target ORE technologies with the potential to disrupt the existing ORE market and with a high suitability to be manufactured economically and at scale in a modernised supply chain.
- **Industrial Modernisation:** The UK must rapidly modernise its ORE supply chain, whether the goal is to strengthen existing manufacturing capabilities or to create a landing pad for disruptive new technologies. Industrial modernisation through advanced manufacturing, automation, and digitalisation is essential for long-term competitiveness. It is also critical to coordinate the co-design of the future supply chain. This ensures that it can competitively manufacture the innovative technologies that will shape the ORE sector in the coming decades.

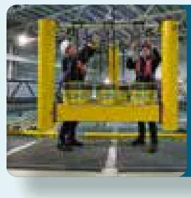


Orbital O2 pitching hub (Credit: SKF)

7 FACTORS IMPACTING DISRUPTIVE INNOVATION AND INDUSTRIAL MODERNISATION

Strengthening the UK ORE supply chain, whether through industrial modernisation or disruptive innovation, requires a clear understanding of the factors that enable supply chain capabilities and competitiveness. Developing the capability to produce high-value ORE subsystems will require a shift away from business-as-usual policy design towards a more systematic view of what underpins supply chain resilience, innovation and growth. Without such clarity, policy interventions risk becoming fragmented or misaligned with industrial and technological realities. Identifying and targeting these enabling factors is therefore essential to guiding effective investment and policy support.

Research, Innovation and Development (R,I&D) investment is vital for driving technological breakthroughs, reducing costs, and overcoming engineering challenges specific to offshore environments. R,I&D not only supports the development of next-generation device subsystems but also facilitates productivity improvements across supply chain processes. Targeted R,I&D efforts enable developers and manufacturers to move up the value chain, differentiate their capabilities and capacities, as well as establish and maintain technological leadership.


Research, Innovation & Development

Clustering supports industrial and innovation ecosystems where supply chain firms, researchers, skills providers, and infrastructure co-locate to enable knowledge exchange and shared capability. UK regional clusters such as the Humber, South Wales, and Scotland's North East strengthen resilience through local skills and facilities, attracting inward investment. The UK can also act as a national cluster, coordinating local authorities and national agencies to link regional strengths into a more cohesive innovation system.


Clustering

Collaboration between research organisations, technology developers and manufacturers is critical for accelerating innovation and translating ideas into commercial practice. Collaborative programmes reduce duplication, manage risk and keep research aligned with market needs. Public–private partnerships and cross-sector working groups help align innovation priorities, co-develop standards and unlock funding to progress pre-commercial technologies.

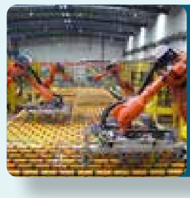

Collaboration

Market Visibility, through a clear and credible long-term pipeline of offshore renewable energy projects, across both domestic and addressable markets, provides the demand signals required for companies to invest in skills, capacity, and innovation. Clarity regarding future deployment volumes, timelines, technology requirements, and local content incentives allows technology developers, supply chain actors, and investors to plan with confidence, reduce investment risk, and encourages new entrants to commit to building capability within the UK.

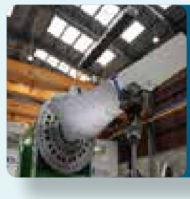

Market Visibility

DISRUPTIVE INNOVATION AND INDUSTRIAL MODERNISATION: PATHWAYS TO SECURING OFFSHORE RENEWABLE ENERGY SUPPLY CHAIN COMPETITIVENESS
Supergen Offshore Renewable Energy

The eight factors below define the enabling conditions for competitive ORE supply chain development, enabling both Disruptive Innovation and Industrial Modernisation. They are informed by the World Economic Forum's Global Competitiveness Index (GCI), an annual assessment of national competitiveness structured around 12 pillars and over 100 indicators [17]. Although the GCI spans economy-wide determinants from public health and institutions to macroeconomic stability, its most relevant themes are distilled into the composite factors presented here. Together, they form a set of supply chain-focused drivers which underpin the Leapfrogging Transition.


Supply Chain Automation & Digitalisation

Supply Chain Automation and Digitalisation is key to producing high-quality components at volume and globally competitive prices. Integrating advanced manufacturing techniques, digital technologies, and adaptive logistics enables the supply chain to manage complexity, improve efficiency, and reduce costs. This can be supported through a range of solutions, such as robotics, additive manufacturing, and automated quality assurance, which improve precision, consistency, and scalability.


Innovation Infrastructure

Innovation Infrastructure comprises the physical and institutional assets that enable the development, testing and validation of new technologies across the supply chain, including test facilities, data-sharing platforms, innovation hubs and demonstration sites. Providing a connected pathway from invention to deployment reduces barriers and accelerates commercialisation, enabling supply chain actors to refine processes, reduce costs and maintain competitiveness.


Future Workforce Development

Future Workforce Development underpins the sector's long-term competitiveness by ensuring a talent pool capable of operating in increasingly digital and multidisciplinary offshore environments. Strategic workforce planning, informed by clear identification of future skills needs and supported by targeted education, upskilling, and apprenticeships, enables effective knowledge transfer, productivity gains, and adaptation to emerging technologies and practices.


Regulation & Consenting

Regulation and Consenting provide investment certainty, standardise practices and support timely project delivery. Clear, consistent and forward-looking regulation reduces supply chain risk and aligns incentives with strategic industrial objectives, while international alignment with global standards lowers export barriers and supports cross-border market access. In parallel, efficient consenting reduces non-technical risk, shortens timelines and enables innovative technologies to progress from demonstration to deployment without disproportionate cost or delay.

Figure 14. Factors driving the competitive performance of a Disrupt and Modernise supply chain

8 THE DISRUPT & MODERNISE INNOVATION ECOSYSTEM

The dual challenge of advancing the technological performance of ORE devices and subsystems while building a supply chain capable of delivering competitively at pace and scale requires more than isolated policy support mechanisms. As such, the eight factors identified in the previous chapter can be structured into a coherent framework to provide targeted and coordinated support, enabling both disruptive innovation and industrial modernisation, as shown in Figure 15. The ***Disrupt and Modernise Innovation Ecosystem*** is designed to deliver strategic sequences of technological and industrial development, aligning device, subsystem and process level breakthroughs with parallel advancements in supply chain capability.

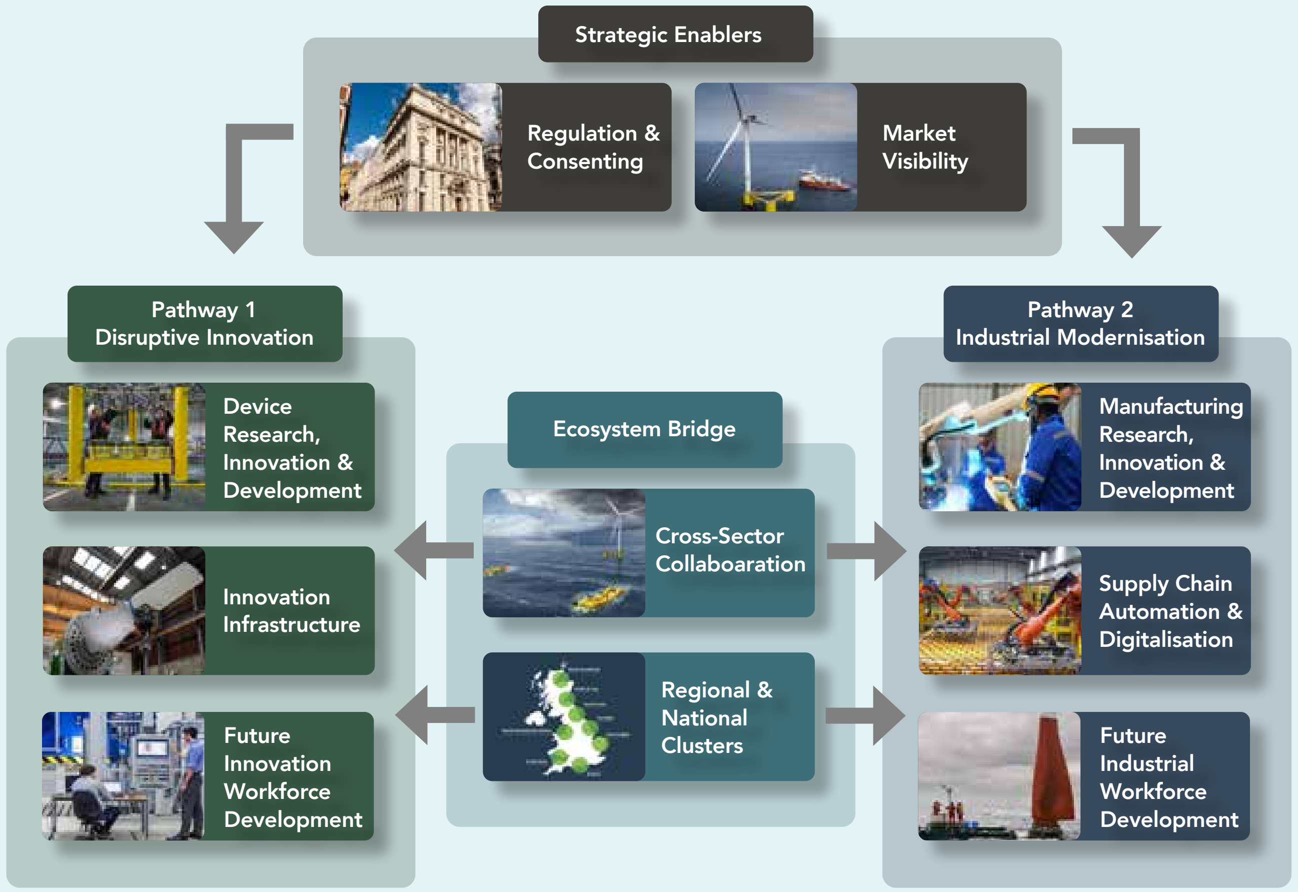


Figure 15. The Disrupt and Modernise Innovation Ecosystem

The final sections of this report will now expand each of the four constituent parts of the Disrupt and Modernise Innovation Ecosystem. In doing so these sections will provide high-level examples of the types of policy interventions that could be considered to enable the progression and increased competitiveness of the UK ORE sector.

Strategic Enablers

Strategic Enablers occupy the top level of the Disrupt and Modernise Innovation Ecosystem, reflecting their overarching role in shaping the conditions under which innovation and industrial development can occur. For the development of ORE devices and high-value subsystems, the availability of innovation funding alone is insufficient to stimulate sustained investment. Instead, long-term progress depends on the presence of credible market signals that reduce sector uncertainty and a regulatory environment that provides clarity and predictability across the full project lifecycle.

These strategic enablers are intended to operate across the Disrupt and Modernise Innovation Ecosystem and as such policies designed within this area are intended to benefit the wider ORE sector.

Market Visibility is delivered through clear deployment ambitions, transparent project pipelines and mechanisms that signal sustained future demand. Collectively, these elements can help to reduce the overall uncertainty and risk for technology developers, supply chain actors and investors by providing confidence that innovations will have a viable route to market. Long-term market pull mechanism visibility, complete with transparency on timelines and local content incentives, in addition to legally mandated deployment targets, sustained demand-side support and policy alignment are critical in providing this confidence.

In the absence of such visibility, promising technologies can often become trapped at the demonstration stage, with private and public investment deterred and ultimately constrained by uncertainty around deployment scale, timing and location. There is a clear role for high-level UK Government intervention in this area, given its ability to provide durable, sector-wide commitment, improve overall project bankability and assist in the crowding-in of private capital.

Regulation & Consenting closely complement market visibility, playing a critical enabling role by determining the speed, cost and risk profile of technology development and deployment. Predictable regulatory frameworks which are proportionate to project scale and risk, alongside efficient and adaptive consenting processes, are particularly important for novel ORE devices and subsystems, where regulatory uncertainty can present a greater barrier than technical feasibility.

Regulatory and consenting frameworks that are designed to evolve over time could support staged deployment, allowing projects to progress from demonstration to commercialisation efficiently. Under such approaches, consent conditions, monitoring requirements and evidence thresholds are reviewed and refined as empirical data is gathered through testing and early deployment. When effectively aligned with market signals, adaptive regulation and consenting frameworks can actively support learning and iteration, accelerate deployment, and reduce project risk, rather than constrain innovation.

Pathway 1: Disruptive Innovation

The Disruptive Innovation Pathway represents the long-term strategic approach of the innovation organisations and technology developers in the ORE supply chain, who are focused on utilising the UK's innovation capabilities to help access new markets and **seize global leadership in novel technologies, processes and materials.**

Pathway 1 is crucial to ensuring that the UK not merely follows the dominant technological trends established by sector incumbents, but instead targets technological leapfrogging. This enables the UK to skip intermediary stages of industrial development and move directly to frontier technologies.

The three foundational factors underpinning this pathway are outlined below:

Device/Subsystem Research, Innovation & Development

At the core of any technological leapfrogging strategy is the use of long-term and sustained investment into fundamental and applied R,I&D, essential to fostering breakthrough technologies, new materials, and novel processes to support design, planning and manufacturing. Organisations such as EPSRC, Innovate UK and the Supergen ORE Hub play a central role in supporting device-and subsystem-level innovation, nurturing breakthroughs across the ORE sector. This work is vital to maintain a steady pipeline of technological innovations capable of being integrated and adapted by a domestic supply chain. The familiarity with the live research landscape that these organisations possess also uniquely positions them to respond flexibly to changing research priorities.

Yet, global competitiveness will require a more structured and integrated approach to device-and subsystem-level research, development, and demonstration, bridging the gap between early-stage research and commercial deployment. Crucially, innovation at the subsystem level must be guided by design for manufacture and assembly principles, ensuring that novel technologies are not only technically advanced but also scalable, reliable, and cost-effective to produce at volume. Targeted programmes that support technologies across multiple TRLs linking fundamental research with applied development and offshore validation are particularly important for high-risk, high-impact subsystems where innovation can unlock significant performance, reliability, and cost reductions at system level.

DISRUPTIVE INNOVATION AND INDUSTRIAL MODERNISATION: PATHWAYS TO SECURING OFFSHORE RENEWABLE ENERGY SUPPLY CHAIN COMPETITIVENESS

Future Innovation Workforce Development

The future offshore renewable energy workforce must be equipped with the advanced skills needed to drive technology development and disruptive innovation. This includes expertise in systems engineering, data science, artificial intelligence, materials science, hydrodynamics, and control systems, alongside strong capabilities in design, simulation, and iterative testing. As technologies become more complex and digitally integrated, interdisciplinary thinking and the ability to work across physical and digital domains will be critical.

Expanding this workforce requires targeted support across the innovation skills pipeline. This includes supporting early career researchers and professionals through specialised training, placements, and collaborative R&D programmes, alongside structured apprenticeship pathways for technical specialists and lab-based roles. The continuation and expansion of industry-based doctoral training centres, such as IDCORE, can play a particularly important role in this pipeline by producing highly skilled graduates with deep technical expertise and sector-relevant, industry-embedded experience. In parallel, the transition of relevant expertise from adjacent sectors should be enabled through targeted upskilling of technicians, engineers, and mid-career professionals in the practical competencies required for disruptive ORE development. Together, these measures are essential to building the talent pipeline needed to deliver the next generation of offshore renewable energy devices, systems, and components.

Innovation Infrastructure

Physical and digital innovation infrastructure, including open access testing facilities, real sea demonstrators, shared data platforms, and advanced simulation tools, is critical to accelerating iterative innovation, de-risking development, and validating the performance of devices and subsystems. By bridging the gap between lab scale research and market deployment, innovation infrastructure enables learning-by-doing and iterative refinement of materials, components, and manufacturing processes, providing developers and researchers with a low-risk environment to test, validate, and refine disruptive solutions.

Existing national assets, such as the ORE Catapult's open access research turbine in Levenmouth and drivetrain test centre in Blyth, as well as the National Composites Centre and Supergen-linked university testbeds, should be leveraged and expanded. In parallel, innovation organisations such as UKRI, through EPSRC and Innovate UK, alongside the Supergen ORE Hub, should lead a coordinated national effort to ensure that the innovation infrastructure required to support all priority high-value offshore renewable energy devices and subsystems is in place. Access to testbeds for small and medium sized enterprises is particularly important and should be encouraged through targeted funding mechanisms, building on the EPSRC infrastructure model used for facilities such as FASTBLADE at the University of Edinburgh. Sustained investment in specialist testing staff and facilities is essential to maintaining relevant capability over time. Together, these elements enable rapid, iterative testing and validation, accelerating learning cycles and significantly reducing the time required to move new technologies from development to deployment.

Pathway 2: Industrial Modernisation

The Industrial Modernisation Pathway represents the short-to-medium-term approach aimed at **rapidly improving domestic capability and scaling production** in areas where the UK has existing expertise or can realistically catch up with competitors.

While there will be an initial need to import key technologies and components to meet ORE deployment trajectories, the Industrial Modernisation Pathway aims to ensure that the high-value ORE components identified as having the potential for innovation leapfrogging through Pathway 1 are able to land into a prepared plug-and-play supply chain.

The three enabling factors which support this pathway are outlined below:

Manufacturing Research, Innovation & Development

Research, innovation and development are as critical to the progression of novel manufacturing processes and capabilities as they are to ORE subsystem development. A competitive and scalable supply chain must be equipped to absorb, adapt, and manufacture new innovations efficiently and at the volumes required to meet future demand. This requires R,I&D efforts focused on developing the tools, processes and systems that will support emerging advanced manufacturing techniques, automation, digitalisation, and materials processing. By involving ORE subsystem developers, innovation organisations and UK-based supply chain firms at an early-stage, it is possible to support design-for-manufacture adaptation, prototyping, process validation and component testing. This early supply chain integration can ultimately enable manufacturers to absorb, de-risk, and scale novel ORE subsystems rapidly, ensuring that emerging technologies have credible industrial landing points within the UK.

As seen in other high-value sectors such as defence and aerospace, effective use of High Value Manufacturing Catapult centres will be crucial to achieving supply chain modernisation. Without parallel innovation efforts within the supply chain, combined with effective coordination between technology developers and commercial manufacturers, even the most promising technologies risk being manufactured elsewhere or remaining uncommercialised. Delivering this transition will require a clear evolution programme, with funding made available to support larger-scale collaborative industrialisation projects involving OEMs, specialist component suppliers, and universities, all focused on scaling high-potential ORE subsystems. Funding should target advanced manufacturing, integration testing, and supply-chain process optimisation, while also supporting the development of supply-chain R&I needed to enable greater automation and digitalisation across the ORE manufacturing base.

DISRUPTIVE INNOVATION AND INDUSTRIAL MODERNISATION: PATHWAYS TO SECURING OFFSHORE RENEWABLE ENERGY SUPPLY CHAIN COMPETITIVENESS

Supply Chain Automation & Digitalisation

While innovation efforts outlined in the Manufacturing Research, Innovation & Development section are designed to bring forward innovations within the tools and manufacturing processes that will be utilised in a future supply chain, Supply Chain Automation and Digitalisation focuses on supporting their uptake in the supply chain. Modernising and consolidating the UK's industrial manufacturing is an essential step towards meeting future demand from accelerated ORE deployment targets. Capital investment programmes will be required to support the modernisation of existing manufacturing sites and the development of new regional facilities across key ORE clusters. Coordinated with public finance institutions, regional authorities, and strategic industry partners these funds have the potential to strengthen supply chain resilience and ensure the UK's industrial base is prepared to absorb and scale emerging technologies. However, a sophisticated supply chain is not just about more factories to scale production. It also involves the integration of digitalisation, automation, quality assurance, materials traceability, and smart logistics across all tiers of the production network.

Action should therefore focus on three priorities: modernising strategic manufacturing infrastructure through automation and digitalisation; building flexible manufacturing capacity in growth regions such as the Celtic Sea and northern Scotland; and enabling cross-sector compatibility to future-proof investment. Early coordination with sector bodies including the Offshore Wind Industrial Council, the Marine Energy Council, and the ORE Catapult will be critical to ensure facilities can adapt as markets evolve. Without strategic investment in upgrading production capabilities, the UK risks being locked out of high-value manufacturing and potentially forfeiting the opportunity to become a strategic leader in the competitive volume manufacture of ORE technologies.

Future Industrial Workforce

A sophisticated and competitive supply chain depends on a workforce trained not just to build, but to adapt, scale, and continuously refine emerging technologies and the manufacturing processes that support them. This includes technical skills in advanced manufacturing, robotics, automation, quality control, and materials processing, as well as digital competencies in data management, predictive maintenance, artificial intelligence, and production optimisation. Equally important are project management, health and safety, and logistics capabilities to support efficient and reliable large-scale delivery across complex supply chains.

Building this skill base requires strong industry-led training pathways, apprenticeships, and reskilling programmes that align with the evolving needs of the ORE sector. Clear communication of future skills demand, supported by sector-led roadmaps outlining how these capabilities can be developed and applied, would align training provision with technological change. An Offshore Renewable Energy Skills Passport approach could support accredited manufacturing pathways, embed digital and advanced manufacturing competencies, and enable the transfer of relevant skills from adjacent sectors. By providing clearer signals to workers, employers, and training providers, such an approach would support workforce mobility and help ensure the talent pipeline evolves in step with innovation across the supply chain.

Ecosystem Bridge

At the centre of the Disrupt and Modernise Innovation Ecosystem is the Ecosystem Bridge, highlighting the foundational role of cross-sector collaboration, regional and national clustering, and regulatory and legislative support in strengthening the UK ORE sector. By acting as a conduit between innovation organisations, technology developers, test centres, and commercial manufacturers, the **Ecosystem Bridge ensures that innovations from either pathway are not developed in isolation.**

The bridge links Pathway 1 and Pathway 2, reinforcing the importance of collaboration between innovation organisations, commercial manufacturers and technology developers, as well as the strategic value of regional innovation clusters that align with the development goals of the UK Government.

The two factors underpinning the Ecosystem Bridge are detailed below.

Cross-Sector Collaboration

By facilitating regular interaction across different parts of the ORE supply chain, connecting actors primarily focused on disruptive innovation with those focused on Industrial Modernisation, collaboration aligns R,I&D activities with market needs and project requirements, enabling efficient knowledge transfer. From an industrial perspective, structured collaboration frameworks support joint problem solving by bringing together partners from research, manufacturing, and technology development to address shared challenges and leverage existing capabilities across both the ORE and adjacent sectors.

At a strategic level, collaboration platforms can provide sector steering and coordination. For instance, the European Energy Technology and Innovation Platforms (ETIP) demonstrates how bringing together industry, policymakers, financiers, and academia can support shared roadmapping, identify priority innovation gaps, and align technology development with long term policy and market signals. By contrast, collaboration across the UK ORE landscape is characterised by a diverse set of organisations, informal networks, and project-based touchpoints. Establishing a clearer, more visible, and centrally structured collaboration framework would strengthen strategic oversight, improve coordination, and enhance innovation outcomes, while reinforcing supply chain cohesion and competitiveness.

DISRUPTIVE INNOVATION AND INDUSTRIAL MODERNISATION: PATHWAYS TO SECURING OFFSHORE RENEWABLE ENERGY SUPPLY CHAIN COMPETITIVENESS

Regional & National Clusters

At a regional level, clusters bring together co-located expertise and infrastructure for manufacturing, component testing, workforce development, and innovation support. By building on geographically concentrated capabilities, clusters can enable faster response times, reduce reliance on distant suppliers, and support the transfer of knowledge across firms. They also act as a magnet for inward investment, as companies are more likely to locate where skills, infrastructure, and capabilities are already established. Co-locating these activities alongside the offshore wind regional clusters identified by the Offshore Wind Industry Council creates opportunities to maximise the shared use of prototyping and validation facilities, including laboratories and pre-commercial test rigs, while also benefiting from existing industrial and academic infrastructure.

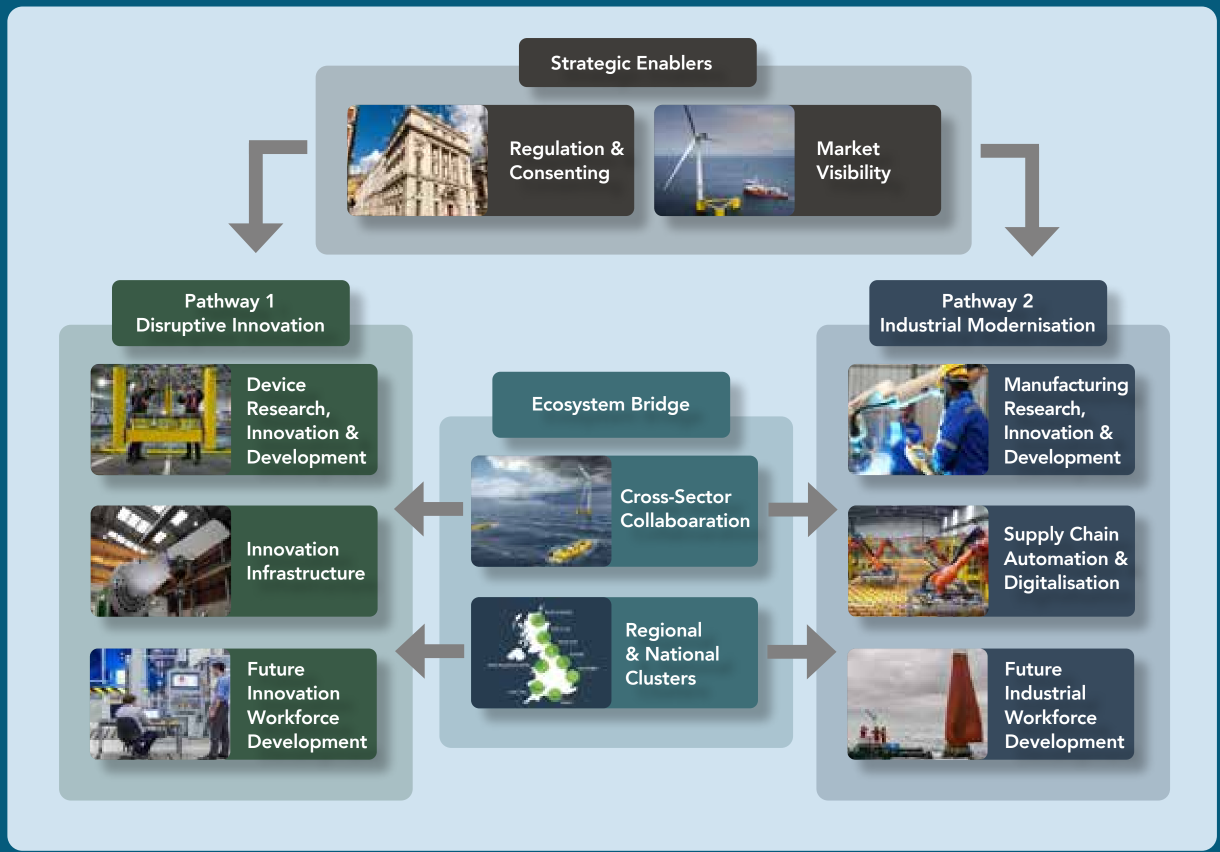
While many of these outcomes can be realised through innovation clusters focused on high-value, cross-cutting ORE technology subsystems, care must be taken to ensure that clustering is pursued only where it delivers clear strategic and economic value. Regional clustering should therefore be selective and purpose-driven, avoiding fragmentation of the UK's ability to function as a coherent national ecosystem.

The UK is particularly well placed to operate as a national cluster, given its high levels of interconnectivity and infrastructure capable of supporting and drawing together innovation, skills, and industrial activity across multiple regions. This national connectivity enables capabilities developed in one geography to be effectively integrated with those elsewhere, supporting efficient scaling of supply chains while reducing duplication and inefficiency. Aligning regional clusters with existing growth strategies and skills provision can further strengthen supply chains, attract inward investment, and position the UK as a globally competitive hub for next-generation ORE devices and subsystems. In doing so, there is also clear value in learning from international exemplars – such as the Basque Country and Germany's Fraunhofer model – where strong regional specialisation is combined with national coordination to deliver sustained industrial competitiveness.

CorPower Ocean dry testing (Credit: CorPower Ocean)

Establishing a Disrupt and Modernise Innovation Ecosystem

As shown above, the identified supply chain competitiveness factors can be structured into a **Disrupt and Modernise Innovation Ecosystem** to allow for targeted policy support across ORE supply chains: strategic sequences of technological and industrial development, aligning device, subsystem and process level breakthroughs with parallel advancements in supply chain capability.



At the top of the ecosystem sit the **Strategic Enablers of market visibility** and **regulation & consenting**, which operate across both pathways and shape the conditions under which innovation and industrial development can occur. Together, these enablers reduce uncertainty, provide long term signals to industry, and create a stable environment for investment, innovation, and deployment.

Pathway 1: Disruptive Innovation, is designed to provide tailored policy recommendations to overcome the innovation challenges facing each **specific ORE subsystem**. It is comprised of **device/subsystem research, innovation and development; a future innovation workforce** and **the provision of innovation infrastructure.**

Pathway 2: Industrial Modernisation, operates in a **technology-agnostic** manner and focus on the **preparation of the wider ORE supply chain.** It encompasses **manufacturing research, innovation and development; a future industrial workforce** and the **implementation of supply chain automation and digitalisation.**

The Ecosystem Bridge, comprised of **cross-sector collaboration and regional & national clustering,** links both pathways and ensures that neither one develops in isolation.

DISRUPTIVE INNOVATION AND INDUSTRIAL MODERNISATION: PATHWAYS TO SECURING OFFSHORE RENEWABLE ENERGY SUPPLY CHAIN COMPETITIVENESS

Automation in factory-setting (Credit: Adobe Stock)

OVERTAKING, NOT JUST CATCHING UP

The transition to a Net Zero energy system represents a defining test of the UK's industrial ambition. The need to deploy clean energy technologies at speed sits in tension with the time required to build competitive domestic supply chains capable of retaining long-term socio-economic value. **This tension poses a difficult dilemma for UK Government and policymakers to resolve:** whether to remain largely a consumer of clean energy technologies developed and manufactured elsewhere – or to prioritise the coordination and investment required to drive sustained innovation, modernise domestic supply chains, and increase home-grown deployment. Choosing the latter positions the UK not only as a deployer of clean energy, but as a creator of the industries that will shape the global energy transition.

Nowhere is this opportunity clearer than in the ORE sector. With just four years remaining to meet the Government's Clean Power 2030 ambition, installed offshore wind capacity is predicted to increase from over 16GW today to as much as 51GW by the turn of the decade. Alongside this, at least 130MW of tidal stream capacity is expected to be delivered via the CfD programme by 2029, while wave energy technologies continue to move steadily towards commercial readiness. Together, these ORE technologies offer the potential to deliver significant economic value, support a Just Transition, strengthen energy security, and reduce emissions at a time of accelerating climate impacts. However, without deliberate action to build competitive domestic supply chains, the majority of this value will be captured elsewhere. Deployment success alone will not deliver industrial leadership.

The value of the ORE sector therefore lies not only in the clean power it generates, but in the industrial capability its commercialisation can unlock. Securing this outcome will require a decisive break from business-as-usual industrial policy. Incremental progress alone will be insufficient. **It requires a clear shift in approach:** prioritising high-value subsystems and components, accelerating breakthrough innovation, and investing in advanced manufacturing models capable of scaling at speed. In doing so, the UK can reinforce its position in offshore wind while seizing leadership opportunities in emerging tidal stream and wave energy markets, embedding itself across critical segments of the ORE value chain. Achieving these outcomes requires a framework that explicitly connects innovation with industrial capability, and that accelerates the emergence of new technologies and manufacturing processes.

BladeBUG non-destructive testing (Credit: ORE Catapult)

DISRUPTIVE INNOVATION AND INDUSTRIAL MODERNISATION: PATHWAYS TO SECURING OFFSHORE RENEWABLE ENERGY SUPPLY CHAIN COMPETITIVENESS

Support for sustained innovation cannot, therefore, be confined to laboratories, research centres or university campuses alone. It must extend across the full value chain: to how components are designed, manufactured, assembled, and delivered; to how developers collaborate and share risk; to how manufacturers adopt advanced digital and automated processes; and to how policy and finance mechanisms enable transformation at pace. **The objective is not merely to keep pace with international competitors, but to move ahead, to anticipate disruption and position UK ORE supply chains to lead it**.

This report has argued that a Disrupt and Modernise approach provides an attractive alternative to gradual, incremental industrial development. Through the Leapfrogging Transition – **enabled by the combined application of disruptive innovation and industrial modernisation** – the UK has the opportunity to bypass established pathways and move directly toward more advanced, globally competitive positions in strategic ORE subsystems and components. **However, such a transition cannot be delivered through any single policy lever**. Supply chain competitiveness is shaped by an interdependent set of factors, and progress in isolation risks creating bottlenecks that constrain scale-up and dilute impact.

Coordinated and sustained support across the full innovation ecosystem is therefore essential. Innovation funding must align with market mechanisms that provide clear and visible routes to deployment; industrial modernisation and disruptive innovation must be supported in parallel; and regulatory and consenting frameworks must evolve to enable new technologies and manufacturing models to reach commercial scale. **Only through this joined-up approach can risk be reduced, learning accelerated, and leapfrogging technologies successfully landed**.

Disruptive Innovation and Industrial Modernisation – The Pathway to ORE Supply Chain Competitiveness

Taken together, these findings point to an unavoidable conclusion. If the UK is serious about shifting from reliance on imported critical ORE technologies toward a more self-reliant future with high levels of domestic supply chain content, it must act now to build the capabilities required to innovate, manufacture, and export at scale. The pathway to achieving this lies in treating disruptive innovation and industrial modernisation as inseparable objectives, delivered through a coherent and strategically aligned Disrupt and Modernise Innovation Ecosystem that enables the UK to leapfrog established technological and industrial pathways.

By doing so, the UK can secure a competitive and resilient domestic supply chain embedded within the highest-value segments of global ORE markets, enabling clean energy commitments to be met in a timely manner while securing long-term industrial capability at home. The window to act is closing and the challenges are significant, but with clear intent and coordinated action the UK can proactively shape its energy system and industrial base in ways that deliver lasting benefits for its economy, society and the environment for generations to come.

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DISRUPTIVE INNOVATION AND INDUSTRIAL MODERNISATION: PATHWAYS TO SECURING OFFSHORE RENEWABLE ENERGY SUPPLY CHAIN COMPETITIVENESS

Construction of new wind turbine farm (Credit: Adobe Stock)

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