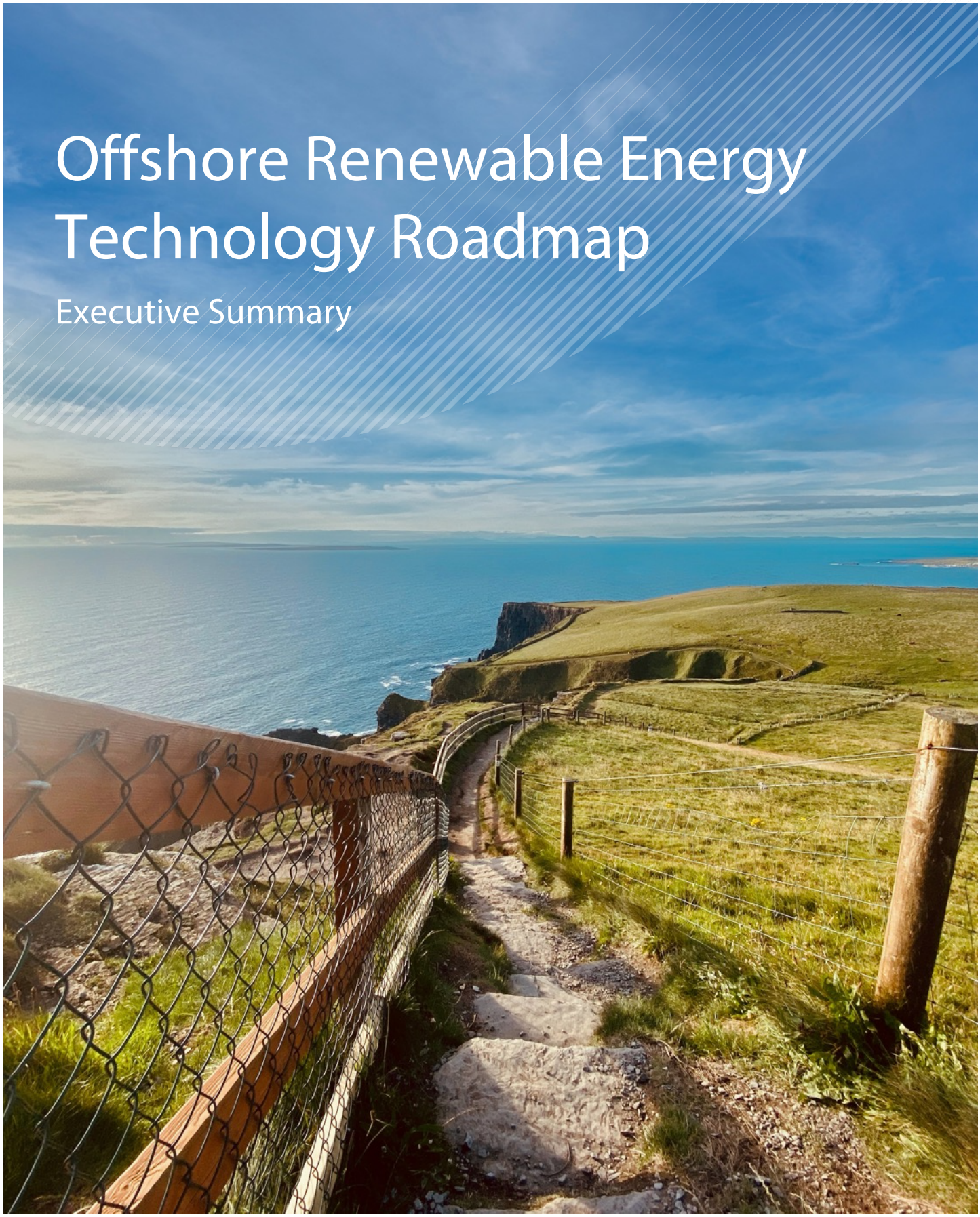
SUSTAINABLE ENERGY AUTHORITY OF IRELAND

Rialtas na hÉireann
Government of Ireland

# Offshore Renewable Energy Technology Roadmap

## Executive Summary



# Offshore Renewable Energy Technology Roadmap: Executive Summary

March 2024

**Report prepared for SEAI by:**
BVG Associates, supported by Beauchamps



**Sustainable Energy Authority of Ireland**
SEAI is Ireland's national energy authority investing in, and delivering, appropriate, effective and sustainable solutions to help Ireland's transition to a clean energy future. We work with the public, businesses, communities and the Government to achieve this, through expertise, funding, educational programmes, policy advice, research and the development of new technologies.

SEAI is funded by the Government of Ireland through the Department of Communications, Climate Action and Environment.

# Executive summary

With a seabed area seven times its landmass and excellent wind and wave conditions, Ireland has access to a huge offshore renewable energy (ORE) resource to help decarbonise the economy. Indeed, Ireland's ample scope for ORE deployment means that ORE can potentially provide far more energy than is needed by the people and businesses of Ireland, and Ireland has the potential to export significant low-carbon power to consumers across Europe.

This roadmap maps the pathway to harnessing Ireland's ORE potential. ORE deployment has a crucial role to play in driving the decarbonisation of the Irish electricity system whilst also unlocking economic and societal benefits for Ireland.

It supports a coordinated Government approach to realising the potential of each key ORE technology. This is achieved by assessing the readiness of technologies and considering both the latest relevant technology innovations, and key future innovations, for ORE technologies relevant to the Irish context.

Technology trajectories are examined through techno-economic modelling scenarios where metrics such as annual deployment rates, technology performance and costs are utilised to produce projections of technology performance in the Irish market up to 2050. Techno-economic projections provide a basis for comparing the impact of different deployment pathways which vary the mixture of technologies utilised and the volumes of offshore renewable energy being delivered. In turn, the scenario analysis elucidates the critical decision points and options mapping, for successful implementation in Ireland for offshore renewable energy targets.

By reviewing the Irish policy and regulatory landscape in addition to international best practices, the roadmap process examines the required policies, regulatory frameworks, Government supports, standards and skills for delivery, that need to be established, and when, to achieve the technology's decarbonisation potential. It also highlights the research opportunities for Ireland and identifies the skills needed to deliver this.

This roadmap is an advisory report to inform strategic planning and policy development. It is not a statement of Government policy. This roadmap will remain under review and will be updated as required by the Department of Environment, Climate and Communications (DECC) as and when significant technology or market developments demand it. It considers generating technologies only, and does not examine the development of wider enabling technologies such as interconnection, hydrogen, efuels and other grid flexibility technologies.

## Technology

This report concludes that fixed and floating offshore wind should play the dominant role in providing energy from our ocean.

Fixed offshore wind is already playing a significant role in many markets, with 61 GW operating globally across about 250 projects by the start of 2024. This technology has a high degree of commercial readiness, and is considered fully bankable, enabling access to significant volumes of finance. Cost of energy has reduced significantly since early projects, with more room for further reductions as wind turbines, project sizes and the global market continues to increase in scale. Ireland has capacity to develop at least 10 GW of fixed offshore wind.

Floating offshore wind, which can be deployed in deeper water than fixed, has a lower degree of commercial readiness than fixed offshore wind, but efforts to deploy the technology at scale are gathering pace globally, with many countries setting ambitious multi-Gigawatt deployment targets. Although cost of energy is higher than fixed offshore wind in shallower water, there is significant room for innovation to drive this down, and the technology can also benefit from many technology developments in fixed offshore wind. Ireland has capacity to deploy significant quantities of floating offshore wind in its extensive exclusive economic zone off the Atlantic coast in the west and south, where mean wind speeds are higher than in shallower areas suitable for fixed offshore wind. Constraints to deployment of floating offshore wind in Ireland are much more likely to be driven by constraints on Ireland's capability to economically export excess generation than its capability to deploy additional turbines.

Wave energy is the next ORE technology that could impact. Current cost of energy is higher than floating offshore wind and the path to potential commercial viability is less certain, but Ireland has the potential to have a greater influence on the market than in offshore wind, hence securing a larger fraction of that market for local suppliers. This is because there is much less focus on wave energy technology, globally.

## Deployment

Ireland has 25 MW of fixed offshore wind capacity installed to date in one small project of 7 turbines, installed in 2004. A further 3.1 GW has been awarded an offtake agreement in the Offshore Renewable Energy Support Scheme (ORESS) round 1 auction of 2023, and is expected to be constructed in the coming years.

Four ORE deployment scenarios to 2050 are considered in this report:

1. **Decarbonising with offshore wind.** This scenario sees domestic demand progress according to the National Energy Projections 2022. Offshore wind is deployed to meet Ireland's domestic energy needs and there is little net export of energy.
2. **Delivery of 37 GW ambition.** In this scenario, Ireland delivers its stated ambition of 37 GW offshore wind by 2050, which sees Ireland become a significant net exporter of energy.
3. **Stretch wind target.** In this scenario, Ireland goes beyond its currently stated offshore wind ambition, delivering 50 GW by 2050, which sees Ireland export an even larger share of its energy.
4. **Meeting 37 GW ambition with wind and wave.** In this scenario, wave technology progresses sufficiently to make a significant contribution to ORE deployment targets, adding 4 GW generating capacity by 2050.

These scenarios represent indicative deployment pathways only, based upon Government ambition statements, observed deployment growth trajectories in other markets, and domestic demand projections from National Energy Projections 2022. They are not intended to represent a forecast, and pace and scale of deployment may differ in practice. *Table A* shows the total operating capacity of each ORE technology and key sources of additional offtake under each of the four scenarios.

**Table A: 2050 operating capacity of key ORE and offtake technologies under each scenario**

| Scenario | Fixed offshore wind (GW) | Floating offshore wind (GW) | Wave (GW) | Other ORE technologies (GW) | Interconnection (GW) | Hydrogen electrolysis (GW) |
|---|---|---|---|---|---|---|
| Scenario 1: Decarbonising with offshore wind | 6 | 3.3 | 0.15 | 0 | 3.1 | 0 |
| Scenario 2: Delivery of 37 GW ambition | 10 | 27 | 0.15 | 0 | 13 | 11 |
| Scenario 3: Stretch wind target | 10 | 40 | 0.15 | 0 | 18 | 16 |
| Scenario 4: Meeting 37 GW ambition with wind and wave | 10 | 24 | 4 | 0.1 | 13 | 11 |

The report concludes that, due to a high level of technical and commercial readiness, there can be confidence that offshore wind can deliver the pathways set out in scenarios 1-3. This assumes the right policies and frameworks in place, as discussed in Sections 4.3 to 4.12.

There is less certainty about the wave energy contribution that turns scenario 2 into 4. The cost reduction pathway mapped for wave energy consistent with a scenario 4 pathway represents a target rather than a predicted progression. On current evidence, a cost reduction pathway for wave consistent with scenario 4 may not be possible to achieve.

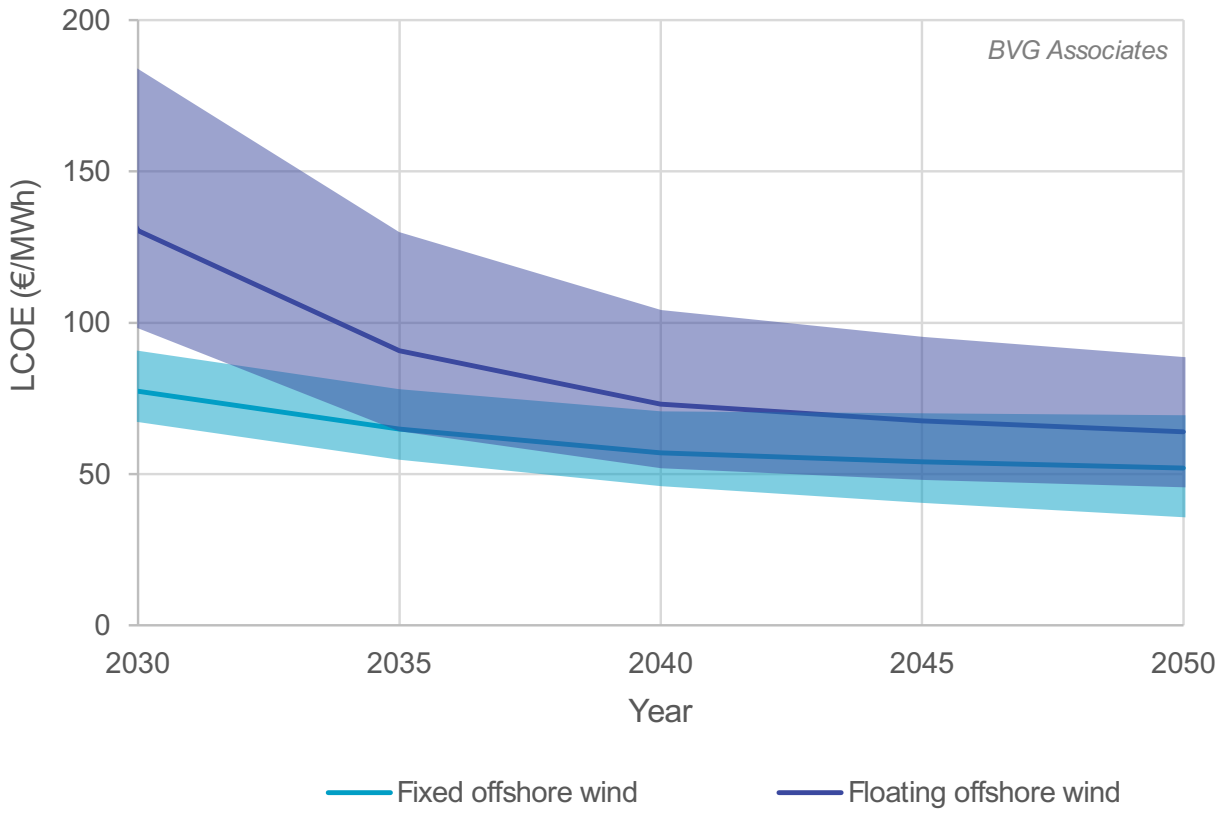
## Levelized cost of energy

Levelized cost of energy (LCOE) for fixed offshore wind is anticipated to fall by just under one third, and for floating to fall by just over 50% for projects installed during the period 2030 to 2050. LCOEs (in real terms) are expected to fall on the back of high volumes of global activity and further technological development, which drive cost savings through drivers including increasing turbine size, economies of scale, improved manufacturing processes and O&M techniques. LCOE trajectories for fixed and floating offshore wind change little with increased Irish deployment, though a small saving is likely in higher deployment scenarios. Ireland's status as a high-wage economy located in

close proximity to a well-established supply chain in Europe means that local facilities will not in general offer a substantial cost saving versus non-Irish competitors.

*Figure A* shows LCOE trajectories for fixed and floating offshore wind. Uncertainty bands represent the range within which the LCOE could fall, assuming consistent macroeconomic conditions. Wider bands are indicative of greater uncertainty over the progression of the technology.

**Figure A: Levelized cost of energy trajectories for fixed and floating offshore wind in Ireland**




It is currently uncertain whether wave energy has the potential to compete on price with fixed and floating offshore wind in the future, or offer sufficient additional benefits to the energy system to warrant much of a price premium. It is likely that significant investment in R&D will be required if this potential is to be realised, without certainty of success at this stage.

## Policy and frameworks

The Government has stated its ambition to deliver 5 GW of offshore wind by 2030, and 20 GW by 2040, with a view to delivering on a long term target of 37 GW by 2050. Ireland has frameworks in place to support first deployment of fixed offshore wind. 3.1 GW of additional fixed offshore wind capacity was brought forward in the ORESS round 1 auction.

Ireland is moving from a developer-led approach to a plan-led approach, with project locations chosen by Government and the establishment of The Maritime Regulatory Authority (MARA) to oversee the award of Maritime Area Consents (MACs) and other licenses for maritime activities. Many details of how this new approach will operate remain subject to consultation. It is important for Ireland to solidify frameworks soon to reduce uncertainty.

There are opportunities to strengthen Ireland's policies and frameworks to build investor confidence and facilitate rapid deployment, based on a wealth of good practice examples from other markets. Key considerations are:

- Delivering a clear industrial policy for ORE, and methodologies for measuring and reporting on local content to maximise local economic benefit.
- Delivering clear, predictable and timely end-to-end frameworks for ORE deployment, which deliver for both investors and Irish citizens.
- Enabling timely investment in grid infrastructure, renewable hydrogen and interconnection to facilitate ambitious ORE deployment plans.

## Supply chain and local economic benefit

Ireland has the opportunity to benefit significantly from the rollout of ORE. This report finds a gross value add (GVA) of between €8.8 billion and €53 billion to the Irish economy associated with domestic rollout of ORE, depending on the scenario. This equates to between 96,000 and 610,000 FTE years of employment for Irish workers. *Figure B* shows a comparison of overall GVA benefits associated with Irish deployment in each of the four scenarios. Employment benefits follow a similar trend.

Local content levels in fixed and floating offshore wind and wave projects are between 15 and 25%, depending on year, technology and deployment scenario.

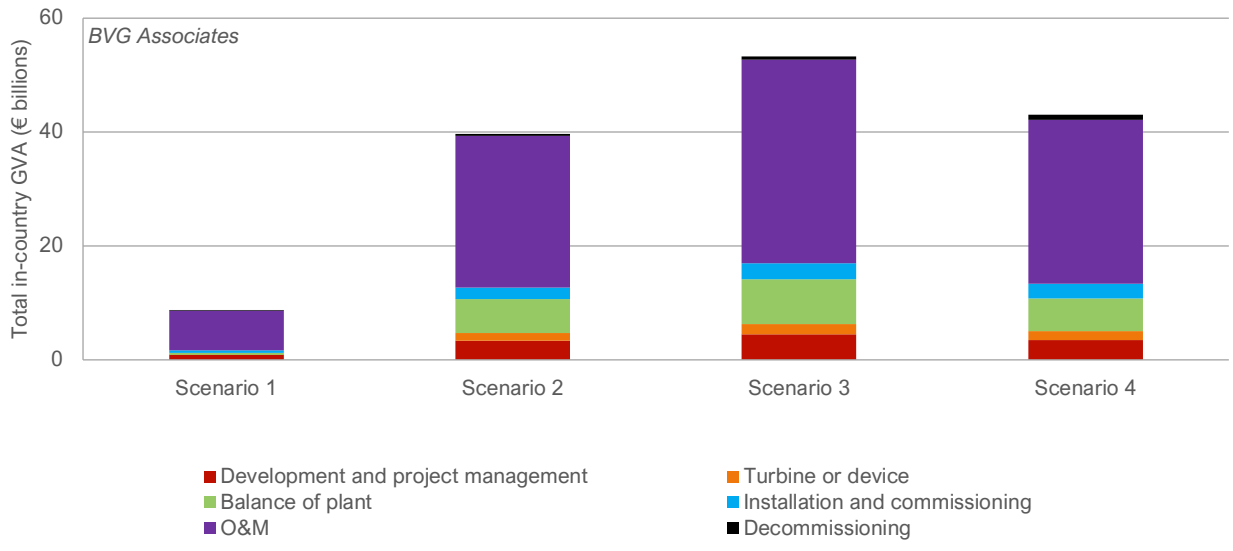
This means that GVA and job opportunities are driven to a large extent by volume of deployment, rather than by increased local content levels.

Nevertheless, this report identifies a number of supply chain areas in which Ireland has the opportunity to capture inward investment, and therefore jobs and economic benefit. These include:

- Construction and marshalling ports (both fixed and floating).
- Tower manufacturing.
- Synthetic cable manufacturing.

With the expansion of its domestic offshore wind industry, Ireland has the potential to benefit significantly from export opportunities, especially if the above investments are captured. When export benefits are taken into account, GVA benefits to 2050 are between 16 and 36% higher than those delivered by the domestic pipeline alone. These benefits cover the export of goods and services associated with ORE deployment. They do not include the economic benefits of the export of hydrogen or electricity via interconnection, which have not been modelled. It is important to continue to evaluate the competitiveness of Irish electricity and hydrogen export within export markets, as the rollout of ORE progresses.

**Figure B: Comparison of Irish GVA benefits of domestic deployment across scenarios, broken down by spend category**



Key considerations in maximising local benefit are:

- Setting out ambitious long-term deployment targets.
- Establishing appropriate and targeted industrial strategy to identify and exploit investment opportunities.
- Providing investment incentives to build investor confidence and attract foreign direct investment within a competitive international context.
- Putting in place and continue to refine clear, timely and predictable frameworks to support deployment, including for leasing, permitting, offtake and grid connection.
- Confirming the timing of future deployment opportunities, including clarifying a regular future pipeline of auctions with multi-year visibility.
- Ensuring appropriate mechanisms for community engagement and participation are built into frameworks, including, where proportionate, community benefit mechanisms to foster strong public support.
- Supporting research in areas of Irish opportunity and strength to derive a competitive advantage.

## Research and research skills

Ireland already has a strong research base in ORE, in which a wide variety of Government agencies, academic institutions and research funding bodies participate. Strengthening this research ecosystem in line with ORE market growth helps ensure deployment and maximises local benefit within the supply chain.

Areas of specific focus should be:

- Generation technologies that are most likely to impact Ireland's future energy mix, so fixed and floating offshore wind and the best wave energy concepts.
- Greatest focus on floating offshore wind as it offers the best opportunity for the Irish research community to reduce consumer bills.
- Areas within these technologies where:
  - Skilled Irish research can provide additionality – there is little point following others who are further ahead
  - Significant benefit is available, regarding LCOE or market delivery (volume and / or speed) or enabling competitive local supply to Irish projects (and potentially exports), hence providing a route to market.
- A high degree of international awareness, industry engagement and where relevant, collaboration.
- A long-term framework for research support, but with flexibility to adapt to evolving market needs and research landscape.

The body of best practice examples from other markets shows that:

- Shared investment between industry and Government increases research value for money. This may involve strategic partnerships and co-funding.
- Prioritization is important, based on potential for impact and relevance to national needs.
- Continuity of funding in the route to market for worthwhile innovations is vital.
- Collaboration between industry and research institutions is key, leveraging existing knowledge and resources.
- International collaboration is often valuable, combining strengths to address key shared challenges.
- Data sharing repositories and standardization can be helpful to facilitate informed research and innovation.
- Long-term research visions and tangible goals are helpful in building areas of excellence.
- Coordination between funding bodies and streamlining of programmes helps bring clarity, but research, by nature, has an element of uncertainty and some overlap is inevitable.
- Rigorous stage-gate processes to limit later-stage funding only to viable solutions increases value for money.
- Signposting funding opportunities, providing challenges and business coaching helps innovators to achieve commercial success

## Recommendations

On the basis of the above assessment, this report includes 50 recommendations for Ireland to drive forward deployment of ORE in line with the scenarios envisaged, maximising the domestic economic benefit of this effort and ensuring ORE deployment is supported by the Irish research and development sector.

Recommendations apply to all scenarios unless otherwise stated.

### *Energy strategy*

1. DECC builds an ORE deployment strategy for Ireland primarily around fixed and floating offshore wind. These technologies offer the greatest certainty and return on investment for Ireland.
2. SEAI and DECC review on an ongoing basis whether other technologies, especially wave energy, should play a significant role in Ireland's energy mix, and monitor developments in most relevant technologies. Public support for technology development may be appropriate in some cases.
3. DECC delivers (and updates every 3 years) a decarbonised electricity system pathway, setting out Ireland's long-term ambitions for ORE technologies and their place within the wider energy system and addressing security of energy supply, cost-effective energy for consumers, local jobs and economic benefits, climate and environmental benefits and attracting foreign investment.
4. DECC integrates a firm vision for interconnection and alternative offtake solutions such as hydrogen or efuels into future pathway documents. This should include consideration of the international competitiveness of Irish interconnection, or alternative offtake, accounting for generation, production, storage and transmission costs, as well as optimisation of domestic usage.

### *Policy*

5. DECC ensures that industry participation and stakeholder consultation is built into future policy development, establishing a strong forum for ongoing dialogue with industry during policy and framework development and implementation.
6. DECC delivers timely clarity on the future framework for ORE and a policy statement outlining details of the future framework beyond ORESS 2 to provide forward certainty for developers.
7. If Ireland wishes to pursue significant deployment of other ORE technologies, DECC should consider setting a corresponding ambition. (Applies only to scenario 4.)

### *Frameworks to enable ORE delivery*

8. DECC focusses on accelerating delivery through effective frameworks and by promoting the attractiveness of Ireland as a market for offshore wind.
9. DECC and The Department of Enterprise, Trade and Employment (DETE) consider how an appropriate balance can be achieved between delivering low cost deployment and driving investment in local supply chain, ensuring alignment between statements of policy and content of frameworks.
10. DECC ensures that frameworks allow sufficient time for necessary activities such as collection of site data, transmission network planning, supply chain planning and bid development between stages to minimise risk to investors and generate efficient outcomes for consumers.

### *Framework for marine spatial planning*

11. DECC draws on developer feedback and industry expertise to ensure that state-run site surveys, assessments and selection activities meet the requirements of developers, whose preferences for data specification may vary.
12. DECC makes the data used to inform designated maritime area plan (DMAP) development available to industry to improve transparency and efficiency of the leasing and permitting process.
13. DECC sets out a long term plan for marine spatial planning on a national basis, including a plan for future DMAPs.

### *Framework for seabed leasing and offtake*

14. DECC establishes a regular pattern of ORESS auctions or any successor schemes (for example every two years) with multi-round forward visibility for the market.
15. DECC fully describes the framework for upcoming offshore renewable offtake auctions at the earliest opportunity. If in future schemes the auction comes before MAC award and permitting, as in ORESS 2.1, bidders should have reasonable certainty they will receive a MAC and necessary permits, should they be successful, to reduce delivery risk and increase the attractiveness of the offshore renewable energy market.
16. MARA grants exclusive development rights under MACs moving forward and maintains the 45-year rights period to give developers long-term certainty when participating in offtake auctions.
17. MARA issues guidelines on how projects coming to market under alternative offtake arrangements, such as corporate power purchase agreements (CPPAs), may secure a MAC.
18. DECC maintains a suitable longstop date in future auction terms to ensure timely project delivery is incentivised while minimising risk to developers.
19. DECC considers whether to pursue auctions for other ORE technologies. (Applies to scenario 4 only.)

*Framework for permitting*

20. DECC and the Department of Housing, Local Government and Heritage (DHLGH) ensure both MARA and An Bord Pleanála respectively are appropriately resourced to deliver the volume of timely permitting decisions desired. The resourcing required will depend on the scale of Ireland's deployment plans.
21. DECC defines a full single point of contact (SPC) function to streamline the permitting process in line with RED III requirements and implements the monitoring and enforcement elements of the SPC function.

*Framework for export system and grid connection*

22. The CRU and EirGrid introduce measures to give early clarity of grid charging costs, grid connection dates and locations to reduce risk and cost to developers participating in future offtake auctions. Compensation measures for late delivery should also be introduced.
23. DECC, DETE and EirGrid consider adopting an integrated offshore hub model to reduce the number of connection assets required. The centralisation of responsibility for export system and grid connection under EirGrid in the plan-led model facilitates this type of strategic planning.
24. DECC clarifies EirGrid's long term role in design and build of transmission infrastructure beyond ORESS 2.1 and ensures that EirGrid is properly resourced to discharge its expanded responsibilities. The resourcing required will depend on the scale of Ireland's ORE deployment plans.
25. EirGrid develops a strategic roadmap for transmission network development to 2050, providing forward visibility of reinforcement plans and a commitment to updating it on a regular basis, informed by forthcoming marine spatial planning documents. This will increase investor certainty and facilitate future proofing of transmission network investments.
26. DHLGH considers how the planning regime could be changed to more easily facilitate delivery of new onshore export system and transmission network infrastructure.

*Framework supporting wider energy system*

27. DECC brings forward an updated regulatory regime for hydrogen, aligned with efforts at an European Union (EU) level to facilitate seamless trade. (Applies to scenarios 2, 3 and 4 only.)
28. DECC and DETE explore opportunities for Ireland to benefit from the development of local supply chains for renewable hydrogen. This should include consideration of Ireland's international competitiveness as a supplier of hydrogen. (Applies to scenarios 2, 3 and 4 only.)
29. EirGrid explores innovative technologies to support grid access for ORE.

*Framework for health and safety*

30. DETE brings forward updated offshore health and safety legislation which contains specific provision for the ORE industry and its working practices.
31. DETE and the Health and Safety Authority (HSA) develop Irish ORE wind health and safety guidance and legislation with reference to best practice from global training bodies such as the Global Wind Organisation, G+ Offshore Wind Health and Safety Association, as well as examples of best practice in established markets.
32. SOLAS develops offshore-specific content for the Safepass qualification.

*Framework for technology development and certification*

33. The National Standards Authority of Ireland (NSAI) ensures that the Irish certification regime remains aligned with International Electrotechnical Commission (IEC) standards to ensure harmonisation and facilitate confidence in financing Irish projects, and that industry and investors have a strong voice in the development of new standards and certifications.
34. NSAI focusses where Irish site conditions are beyond the standard definition of site conditions, to ensure Ireland-specific risks are managed.
35. DECC and DETE undertake a feasibility assessment of regulatory sandboxes for ocean renewable technologies, allowing regulatory requirements to be altered on a limited basis for trial projects to test the effectiveness of new approaches.

*ORE supply chain and skills development*

36. DETE, the Department of Further and Higher Education, Research, Innovation and Science (DFHERIS), SEAI and Skillnet Ireland seek to maximise benefit in key areas of Irish advantage, including project development and operations and maintenance (O&M), through skills funding initiatives and support for

research and development in adjacent subjects such as seabed surveying, LiDAR and remote monitoring technologies.

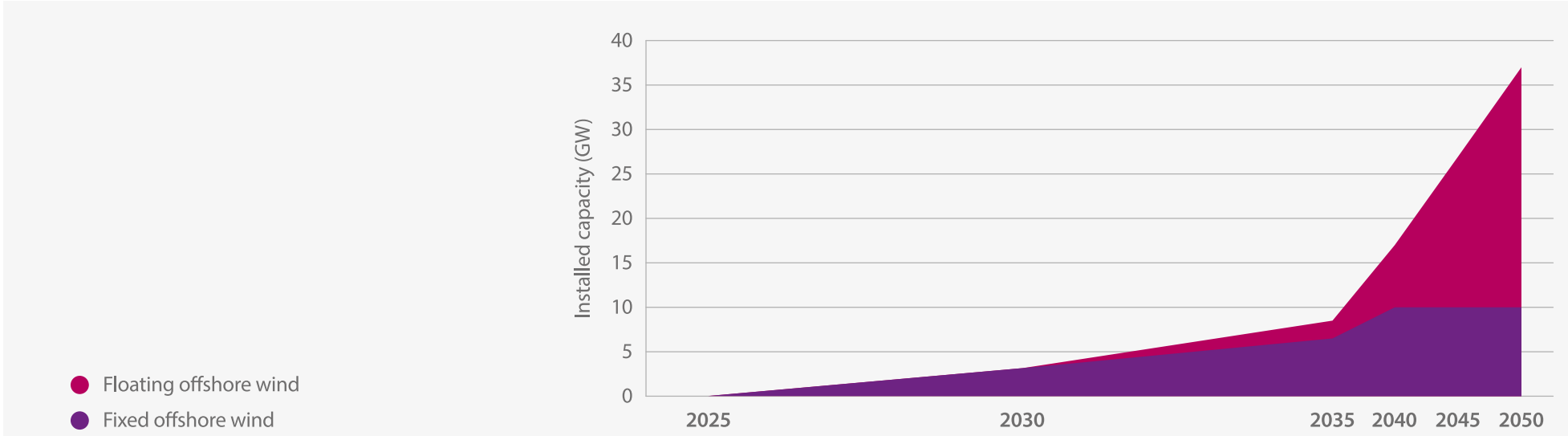
37. DECC adjusts the methodology for calculating Irish content within project delivery plan questionnaires to ensure calculated local content percentages reflect actual Irish value capture, in line with international best practice examples.
38. DETE establishes a clear and targeted industrial strategy for offshore wind which targets investment in specific manufacturing facilities as outlined in this report. (Applies to scenarios 2, 3 and 4 only.)
39. DETE, with collaboration from the Department of Finance, puts in place investment incentives specifically targeted at larger-scale manufacturing and infrastructure investments. Such incentives could include investment grants, tax incentives or preferential financing arrangements. (Applies to scenarios 2, 3 and 4 only.)
40. DoT establishes mechanisms to provide investment support for port infrastructure upgrades. (Applies to scenarios 2, 3 and 4 only.)
41. DETE facilitates the development of industrial clusters through supportive policies, funding for business networks, and other initiatives to encourage industry collaboration and investment, including regional development initiatives like the Shannon Estuary Economic Taskforce. (Applies to scenarios 2, 3 and 4 only.)
42. DFHERIS and SEAI support industrial clusters through targeted skills funding initiatives and support for research and development in areas relevant to targeted areas for Irish participation. This could include, for example, support for synthetic materials research to build Irish capability. (Applies to scenarios 2, 3 and 4 only.)
43. DETE considers whether an industrial strategy may be appropriate for wave energy, at a suitable time in the technology development pathway.
44. DECC and DETE continue to evaluate the competitiveness of Irish electricity and hydrogen export within export markets, as the rollout of ORE progresses, and use this to inform future deployment plans.

### *Research and development*

45. SEAI develops a focussed ORE research & innovation strategy for Ireland with clear objectives, which builds on the content of this report, addresses any gaps in support and monitors ongoing technology developments and innovations.
46. DETE, SEAI and SFI focus offshore wind activity on:
    - Addressing the specific (often extreme) conditions seen in Irish waters:
    - For fixed offshore wind, project development and O&M, including robotics, AI and sensing technologies to enable cost reduction in O&M
    - For floating offshore wind, foundations, including advanced manufacturing processes to enable cost reduction.
47. SEAI and SFI focus wave energy research on lower-cost, lower-TRL activity, with robust stage gate in place before significant-scale sea trials. This will allow Ireland to support a wider array of innovations and assess which are likely to impact the market before progressing to more costly, large scale research.
48. DETE, SEAI and SFI maximise the value of research and innovation activities, where relevant, through business coaching, facilitating collaboration and wider enabling support.
49. DETE, SEAI and SFI collaborate in ensuring that the Government provides joined-up leadership in research and innovation in ORE.
50. DFHERIS works with research funding agencies to create a targeted research and development fund to support commercialisation of wave technology, including financial support for demonstrator-scale projects to support the development of Irish supply chain expertise. (Applies to scenario 4 only)

*Figure C* presents a timed roadmap of recommendations to deliver Scenario 2: Delivery of 37 GW ambition. This scenario is consistent with current Government policy, representing delivery of the target set by Ireland under North Seas Energy Cooperations (NSECs) and Policy Statement on the Framework for Phase Two Offshore Wind. Some recommendations that are timed for implementation in a given period require ongoing action after this.

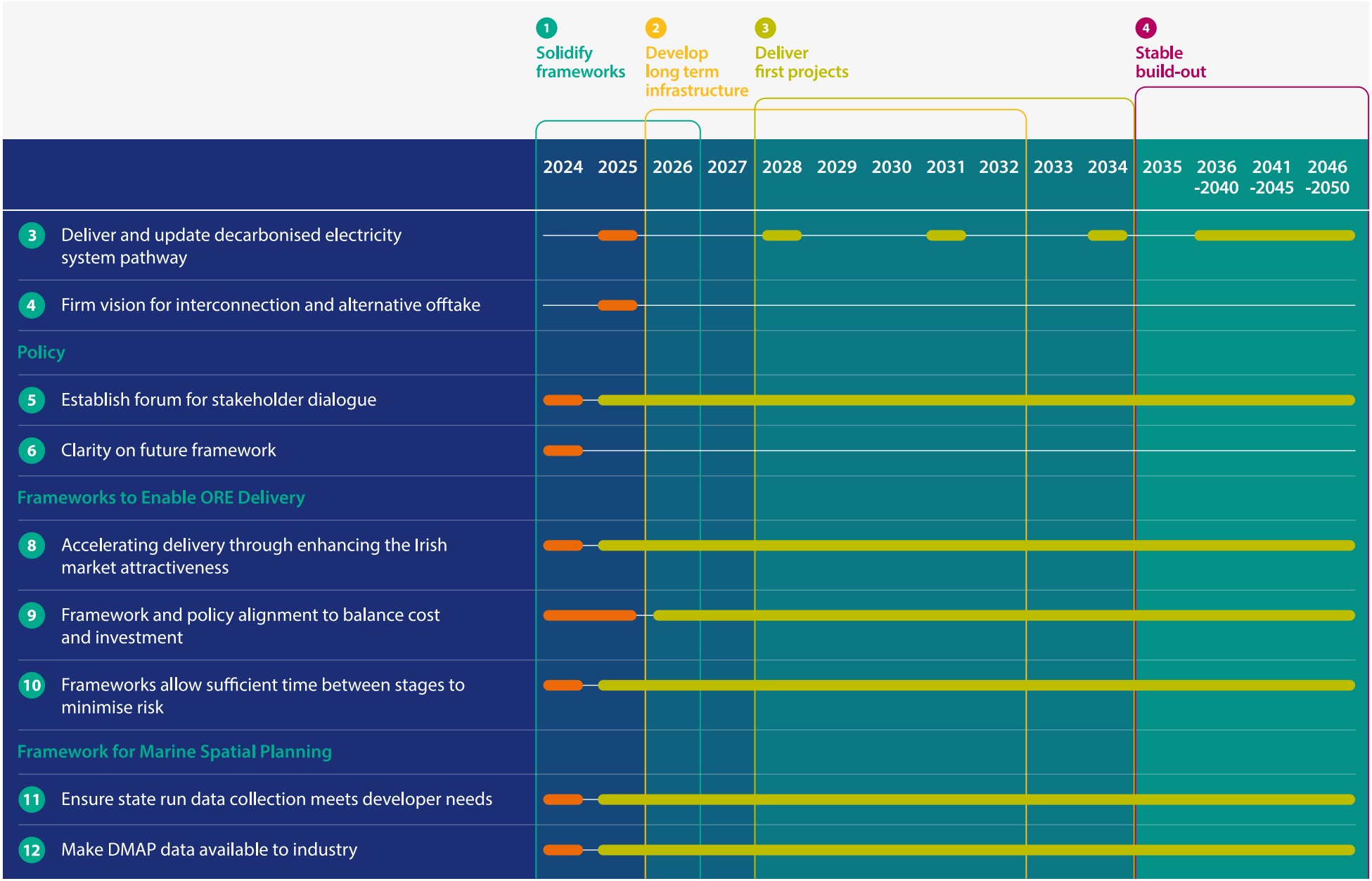
**Figure C: Timed roadmap of recommendations to deliver the Government's current offshore wind ambitions (Scenario 2)**

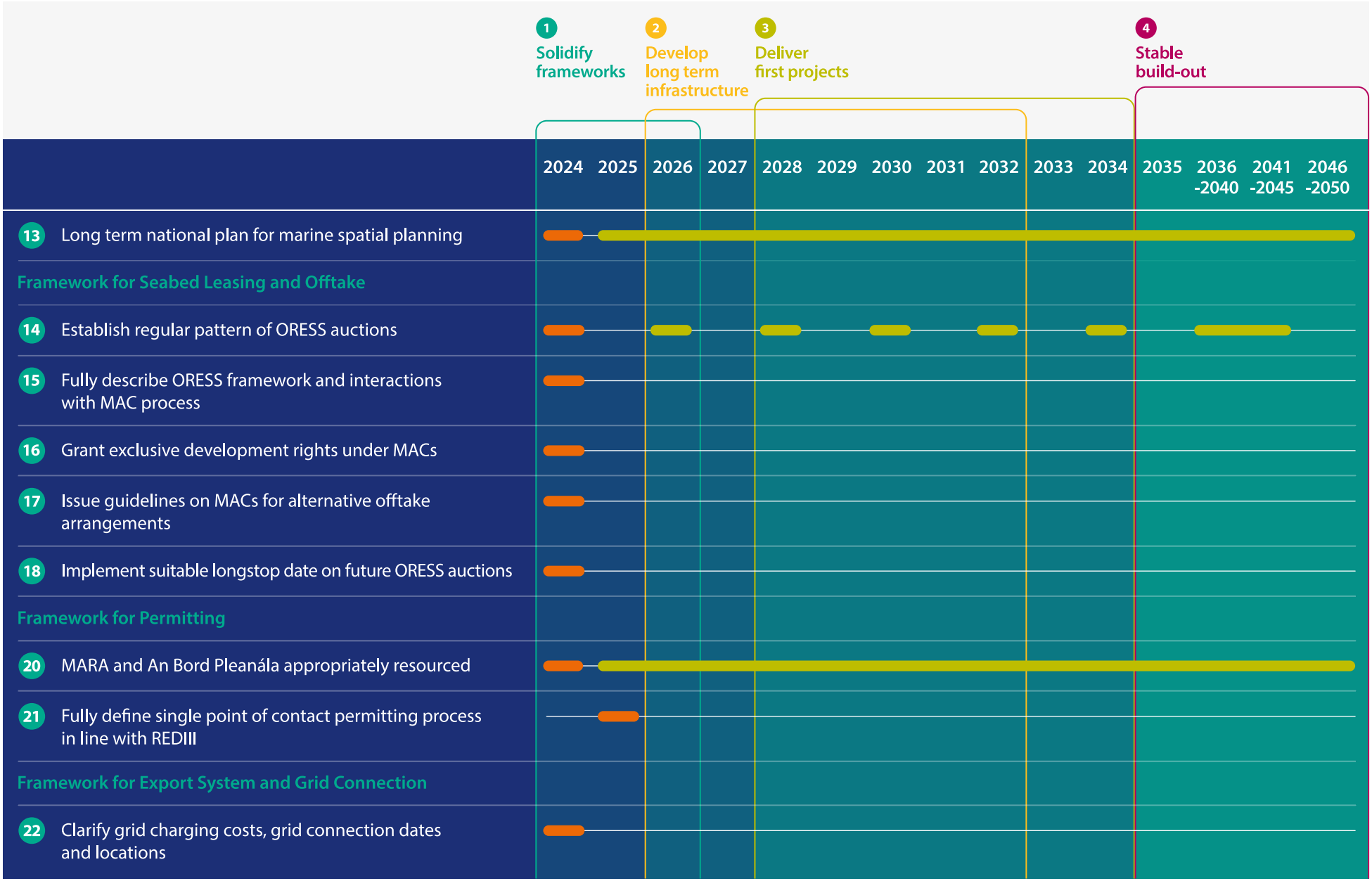


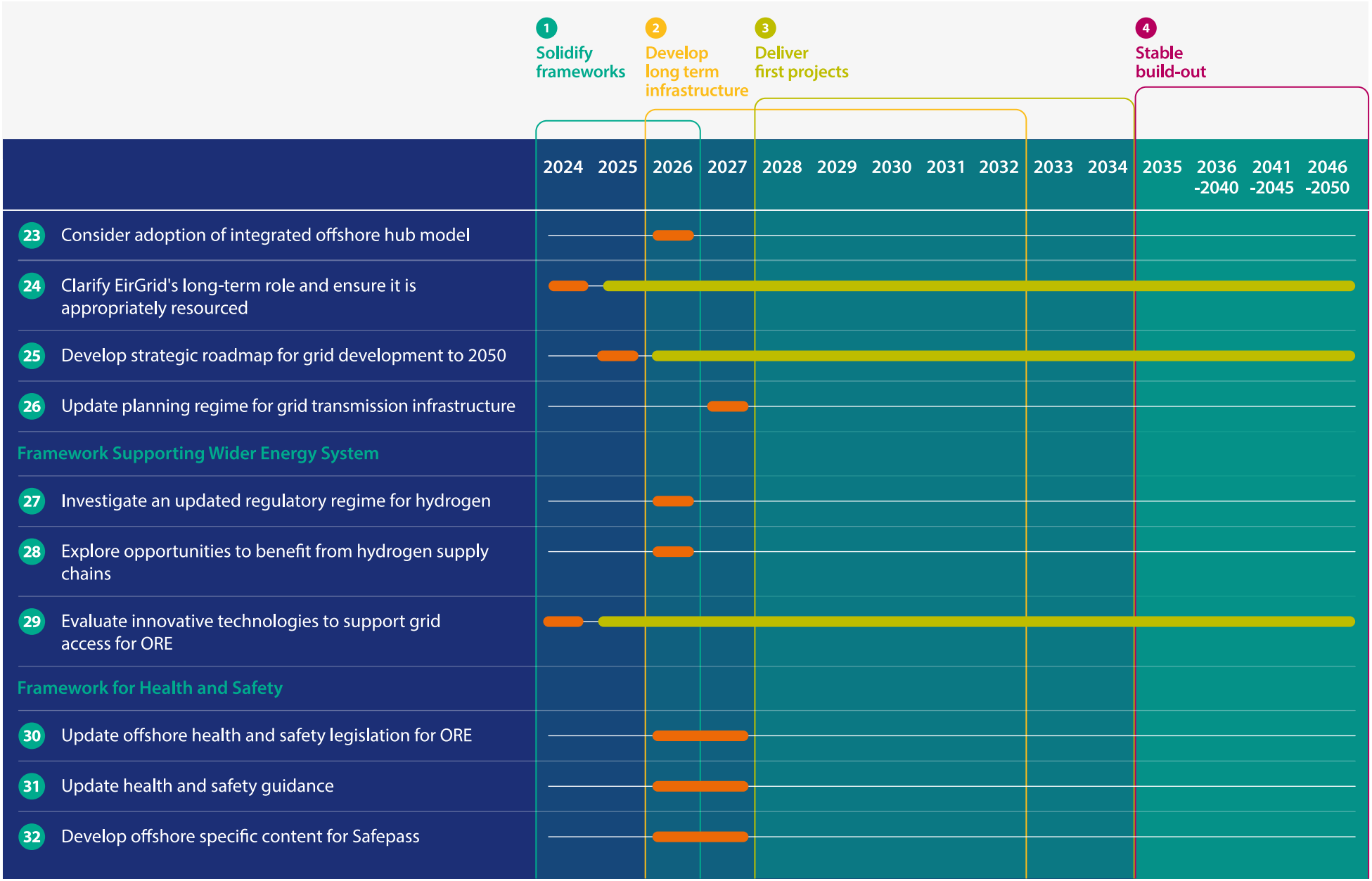

Initial Deliverable
Ongoing Delivery

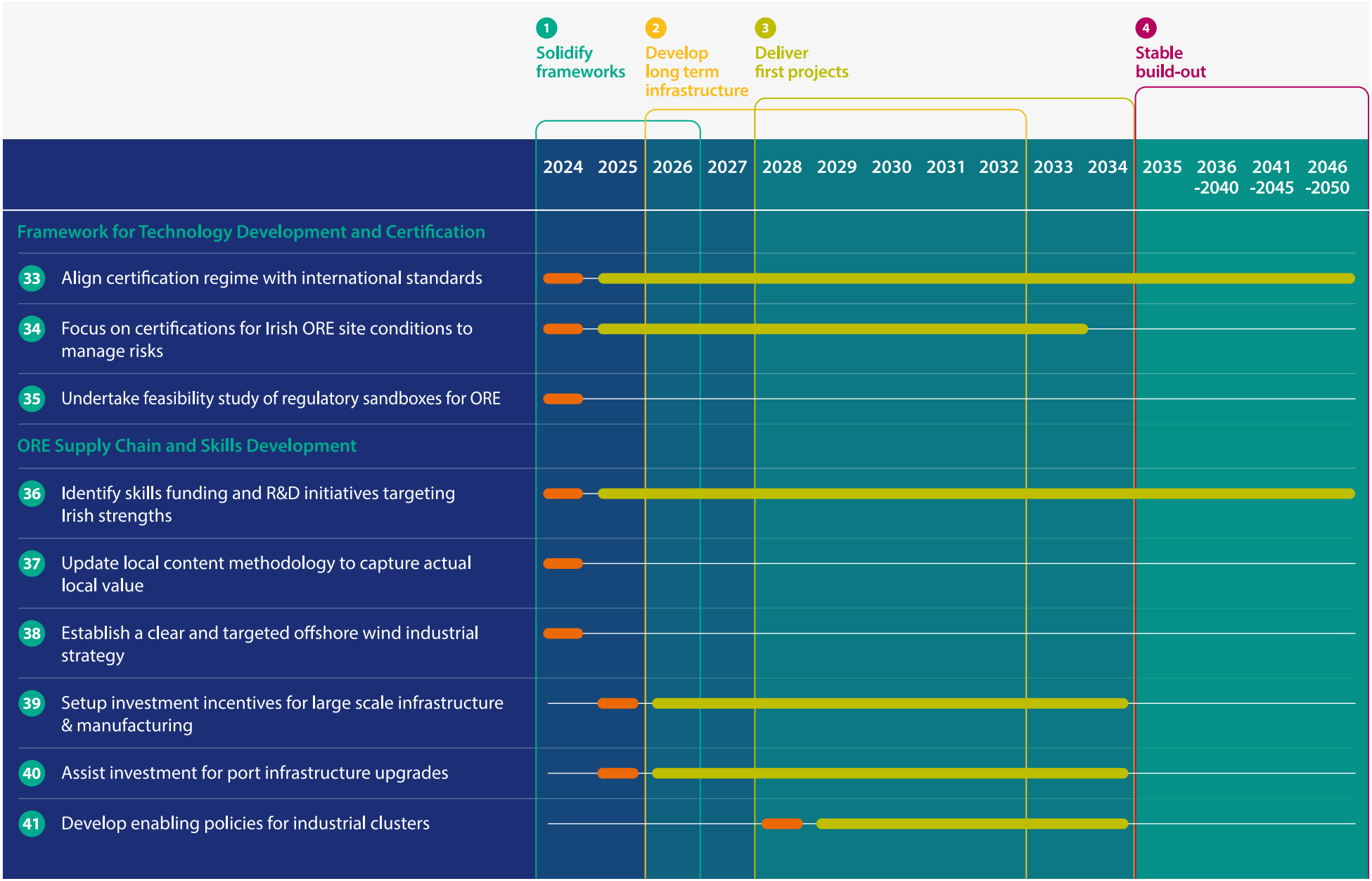
1 Solidify frameworks
2 Develop long term infrastructure
3 Deliver first projects
4 Stable build-out

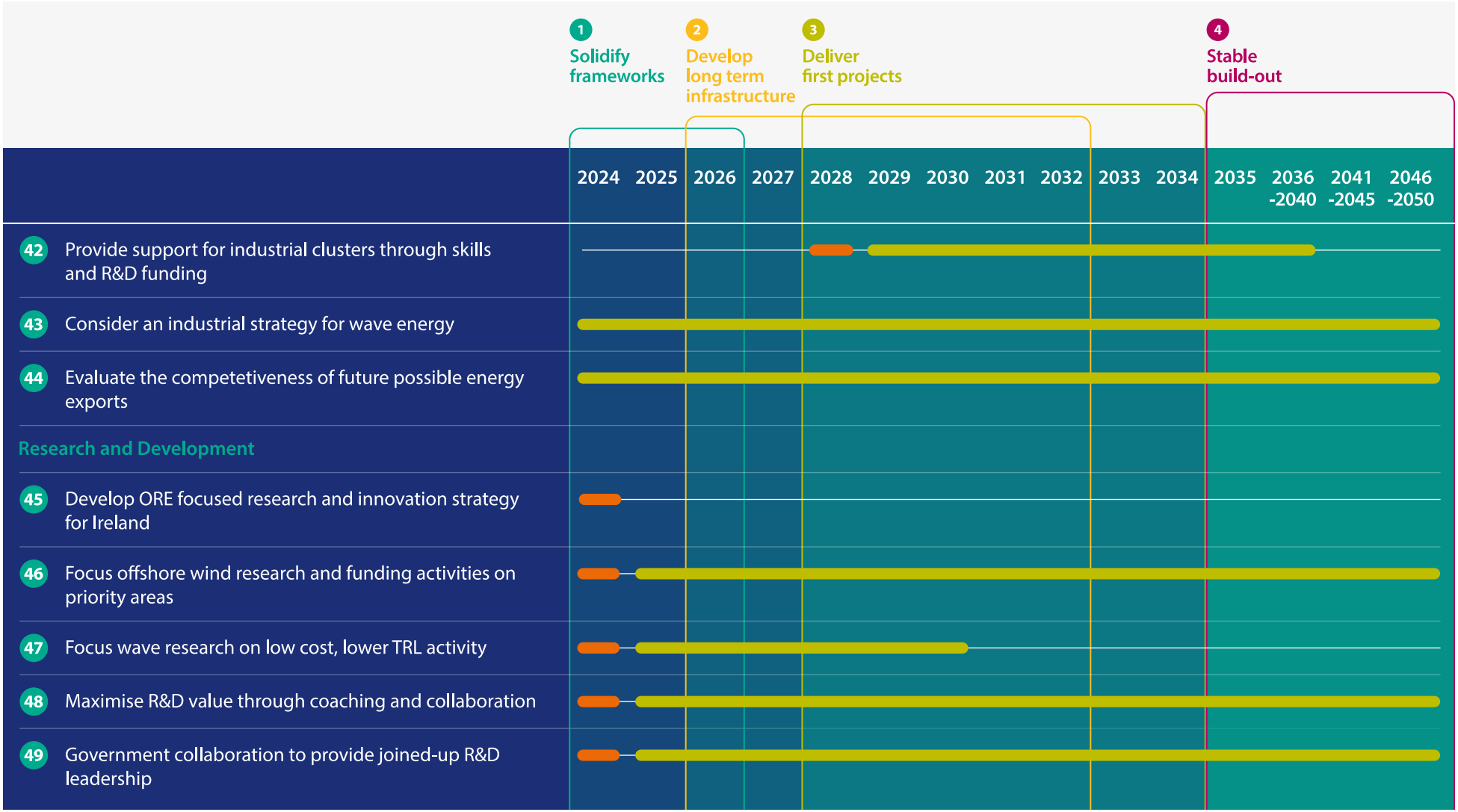
| | 2024 | 2025 | 2026 | 2027 | 2028 | 2029 | 2030 | 2031 | 2032 | 2033 | 2034 | 2035 | 2036 -2040 | 2041 -2045 | 2046 -2050 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Annual fixed and floating offshore wind installation rate (GW/yr) | | | | | .9 | 1.0 | 1.2 | .8 | 1.0 | 1.1 | 1.1 | 1.4 | 1.7 | 2.0 | 2.0 |
| Cumulative operating capacity (at end of year) (GW) | 0.025 | 0.025 | 0.025 | 0.025 | .9 | 1.9 | 3.2 | 4.0 | 4.9 | 6.0 | 7.1 | 8.5 | 17.0 | 27.0 | 37.0 |
| **Energy Strategy** | | | | | | | | | | | | | | | |
| 1 Build ORE deployment strategy | | | | | | | | | | | | | | | |
| 2 Ongoing monitoring of technology landscape | | | | | | | | | | | | | | | |


1 Solidify frameworks
2 Develop long term infrastructure
3 Deliver first projects
4 Stable build-out
2024 2025 2026 2027 2028 2029 2030 2031 2032 2033 2034 2035 2036 -2040 2041 -2045 2046 -2050
3 Deliver and update decarbonised electricity system pathway
4 Firm vision for interconnection and alternative offtake
Policy
5 Establish forum for stakeholder dialogue
6 Clarity on future framework
Frameworks to Enable ORE Delivery
8 Accelerating delivery through enhancing the Irish market attractiveness
9 Framework and policy alignment to balance cost and investment
10 Frameworks allow sufficient time between stages to minimise risk
Framework for Marine Spatial Planning
11 Ensure state run data collection meets developer needs
12 Make DMAP data available to industry


1 Solidify frameworks
2 Develop long term infrastructure
3 Deliver first projects
4 Stable build-out
2024 2025 2026 2027 2028 2029 2030 2031 2032 2033 2034 2035 2036 -2040 2041 -2045 2046 -2050
13 Long term national plan for marine spatial planning
Framework for Seabed Leasing and Offtake
14 Establish regular pattern of ORESS auctions
15 Fully describe ORESS framework and interactions with MAC process
16 Grant exclusive development rights under MACs
17 Issue guidelines on MACs for alternative offtake arrangements
18 Implement suitable longstop date on future ORESS auctions
Framework for Permitting
20 MARA and An Bord Pleanála appropriately resourced
21 Fully define single point of contact permitting process in line with REDIII
Framework for Export System and Grid Connection
22 Clarify grid charging costs, grid connection dates and locations


1 Solidify frameworks
2 Develop long term infrastructure
3 Deliver first projects
4 Stable build-out
2024 2025 2026 2027 2028 2029 2030 2031 2032 2033 2034 2035 2036 -2040 2041 -2045 2046 -2050
23 Consider adoption of integrated offshore hub model
24 Clarify EirGrid's long-term role and ensure it is appropriately resourced
25 Develop strategic roadmap for grid development to 2050
26 Update planning regime for grid transmission infrastructure
Framework Supporting Wider Energy System
27 Investigate an updated regulatory regime for hydrogen
28 Explore opportunities to benefit from hydrogen supply chains
29 Evaluate innovative technologies to support grid access for ORE
Framework for Health and Safety
30 Update offshore health and safety legislation for ORE
31 Update health and safety guidance
32 Develop offshore specific content for Safepass


1 Solidify frameworks
2 Develop long term infrastructure
3 Deliver first projects
4 Stable build-out
2024 2025 2026 2027 2028 2029 2030 2031 2032 2033 2034 2035 2036 -2040 2041 -2045 2046 -2050
Framework for Technology Development and Certification
33 Align certification regime with international standards
34 Focus on certifications for Irish ORE site conditions to manage risks
35 Undertake feasibility study of regulatory sandboxes for ORE
ORE Supply Chain and Skills Development
36 Identify skills funding and R&D initiatives targeting Irish strengths
37 Update local content methodology to capture actual local value
38 Establish a clear and targeted offshore wind industrial strategy
39 Setup investment incentives for large scale infrastructure & manufacturing
40 Assist investment for port infrastructure upgrades
41 Develop enabling policies for industrial clusters


1 Solidify frameworks
2 Develop long term infrastructure
3 Deliver first projects
4 Stable build-out
2024 2025 2026 2027 2028 2029 2030 2031 2032 2033 2034 2035 2036 -2040 2041 -2045 2046 -2050
42 Provide support for industrial clusters through skills and R&D funding
43 Consider an industrial strategy for wave energy
44 Evaluate the competetiveness of future possible energy exports
Research and Development
45 Develop ORE focused research and innovation strategy for Ireland
46 Focus offshore wind research and funding activities on priority areas
47 Focus wave research on low cost, lower TRL activity
48 Maximise R&D value through coaching and collaboration
49 Government collaboration to provide joined-up R&D leadership

SUSTAINABLE ENERGY AUTHORITY OF IRELAND

Rialtas na hÉireann
Government of Ireland

**Sustainable Energy Authority of Ireland**
Three Park Place
Hatch Street
Upper Dublin 2
Ireland
D02 FX65

**w:** www.seai.ie
**e:** info@seai.ie
**t:** 01 8082100

BVGAssociates

BEAUCHAMPS