

Introduction to the ocean energy roadmap to 2050

Ireland, like every other country, has commenced a transition to a low carbon future. It has already begun, but it is a long term project.



And this presents a challenge: we must envisage our ambition for many years in the future, and we must now take the preparatory steps to achieve this ambition.

The challenge is clear in ocean energy, where I have no doubt Ireland has a tremendous opportunity to develop not only a huge source of clean energy, but also deliver a sizeable enterprise sector in the process. But it will take time. Ocean energy is a nascent industry in Ireland, yet, we anticipate that investment in ocean energy, today, will enable an industry to develop along a pathway that can eventually produce a vibrant maritime energy sector.

Why ocean energy? It is Ireland's greatest energy resource. Our ocean territory extends to an area ten times our land area, and includes seas with some of the strongest wave energy

content in the world. It is inevitable that this resource will be exploited – it is a clean, carbon free renewable indigenous energy resource that could not only meet Ireland's energy needs but could also be exported across Europe. But realizing this future vision depends on many technological developments that are today far from ready.

This Roadmap is our first attempt to map out how the ocean energy sector in Ireland could look in 2050. Since so much is uncertain at this early stage, we have mapped two scenarios that show a range of outcomes that are possible. But they also clearly show that huge success is indeed possible. The Roadmap is based on a number of economic and technical assumptions that can of course be debated. The main purpose of the Roadmap is to stimulate such debate.

We will refine this Roadmap as our knowledge of the sector improves. We were able to draw on a number of recent studies undertaken by SEAI and others as our examination of the potential for ocean energy in Ireland continues. We were also able to learn from the deliberations of the many stakeholders actively engaged in Ireland's ocean energy strategy. We remain committed to further engagement with all actors involved in this sector as we try to build a sector that meets expectations and ambitions. We welcome all comments and insights from interested parties, and I would ask you to submit your views to us at roadmaps@seai.ie.

I would like to thank all those that have already contributed to this process.

Ireland has already been acting to develop an ocean energy sector. A number of Irish companies are trialling devices and a number of international companies are looking to work in Ireland – where the resource is. But other countries are pursuing the same ambition. If we are to establish ourselves we need to continue to act and invest, even when the returns are as yet some years off. This is the core societal challenge for ocean energy. I believe we should take up the challenge.

A handwritten signature in black ink, reading "J Owen Lewis".

Prof. J Owen Lewis
Chief Executive Officer, SEAI

Ocean Energy Introduction

This roadmap outlines the growth potential of the ocean energy industry in Ireland to 2050

Potential employment opportunities of up to 70,000



Potential cumulative economic benefit of up to €120 billion euro by 2050



This Roadmap has been formulated by the Sustainable Energy Authority of Ireland. It is designed to initiate a debate about the pathway to 2050 for ocean energy in Ireland. Its analysis is based on programme experience, analysis and modelling, and a number of commissioned studies. Looking at two bounding scenarios, the Roadmap gives an indication of the resource potential and quantifies the opportunities for CO₂ abatement. The pathways are also analysed in terms of economic competitiveness, employment opportunities and energy security.

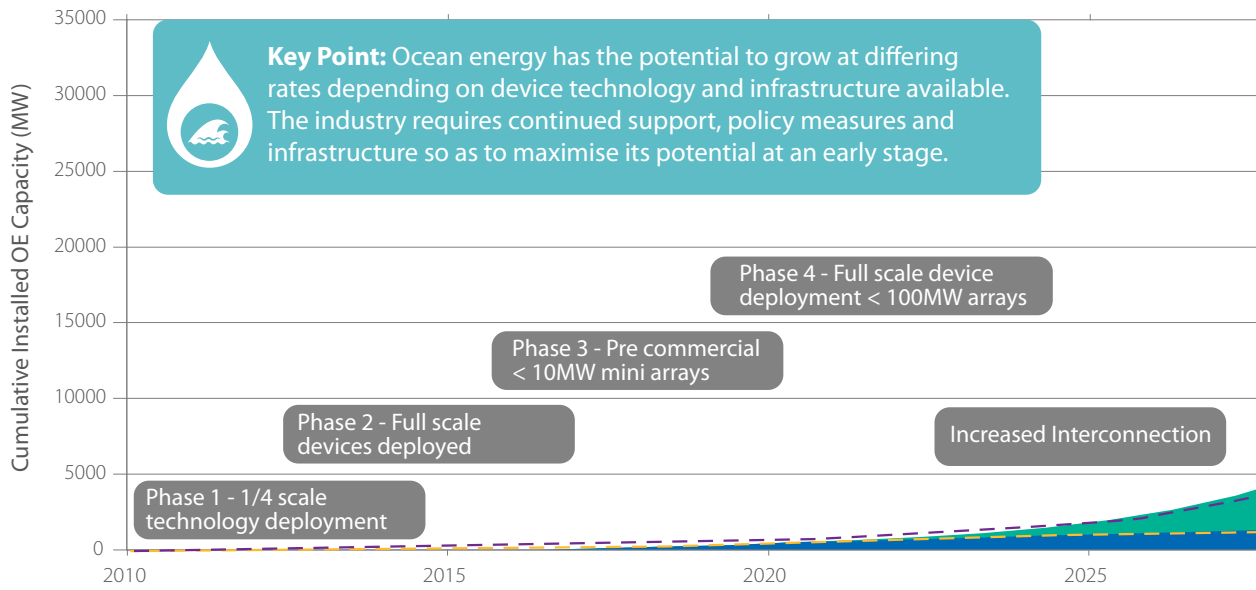
Key Findings

- Strategic environmental assessment underway reports that potentially 29GW of ocean energy capacity can be installed without likely significant environmental effects
- Employment opportunities of up to 70,000. Achieving high levels of employment within the industry is accomplished by Irish companies exporting key technology and services, and providing expertise to the global market
- Cumulative economic benefit up to €12 billion by 2030 and up to €120 billion by 2050 from factors such as electricity generated, emissions reductions, security of supply, regional development & knowledge created
- Ocean energy can be a significant addition to decarbonising our economy
- Ireland has world leading ocean energy companies, marine engineering and research capabilities
- Estimated CO₂ abatement potential of up to 94 MtCO₂ to 2050 from power generation
- Cumulative maximum primary energy diverted from electricity generation measures up to 356 Mtoe to 2050
- National energy security is significantly enhanced
- Continued research & development in device technology is critical in reducing costs
- Developing infrastructure is critical to ensure maximum returns for the sector and Irish economy.

Ocean Energy - wave and tidal installation capacity and

2010

2020



POLICY FRAMEWORK AND SUPPORTS

- Set up of SEAI Ocean Energy Development Unit in 2009 with the function of providing support, infrastructure and policy input to the Ocean Energy Industry in Ireland
- SEAI study for 80% renewables
- NREAP scenario ambition of 500MW installed by 2020 delivering electricity into the national grid, which will contribute to Ireland's binding 16% renewable energy target through directive 2009/28/EC
- OREDP scenario of 1500MW of installed Ocean Energy by 2030
- Establishment and operation of an effective foreshore leasing and consenting process

PUBLIC ENGAGEMENT AND ENVIRONMENT

- SEA completed for Irish waters
- Public consultations ongoing with local communities & utility companies
- SEA for GRID 25 underway

DEVICE TECHNOLOGY

- Advanced power systems and composite materials reduce costs and increase device efficiencies
- Industry funding
- Demonstration phase

TECHNOLOGY SUPPORT MECHANISMS

- Prototype development funding of €10 million made available to developers
- SEAI continues investment in developers & industry research contracts
- Research funding to 2014 of €3.5 million
- HMRC supports developers with modeling & wave tank testing. Facility will be integrated within MERC3 development

INDUSTRY

- Continually assess and support investment in ports and marine infrastructure to ensure that ocean energy industry growth requirements are being fully considered
- SEAI continuing supply chain analysis and resource requirements proliferation
- REFIT of 220 €/MWh guaranteed to developers for 15 years for projects developed by 2015

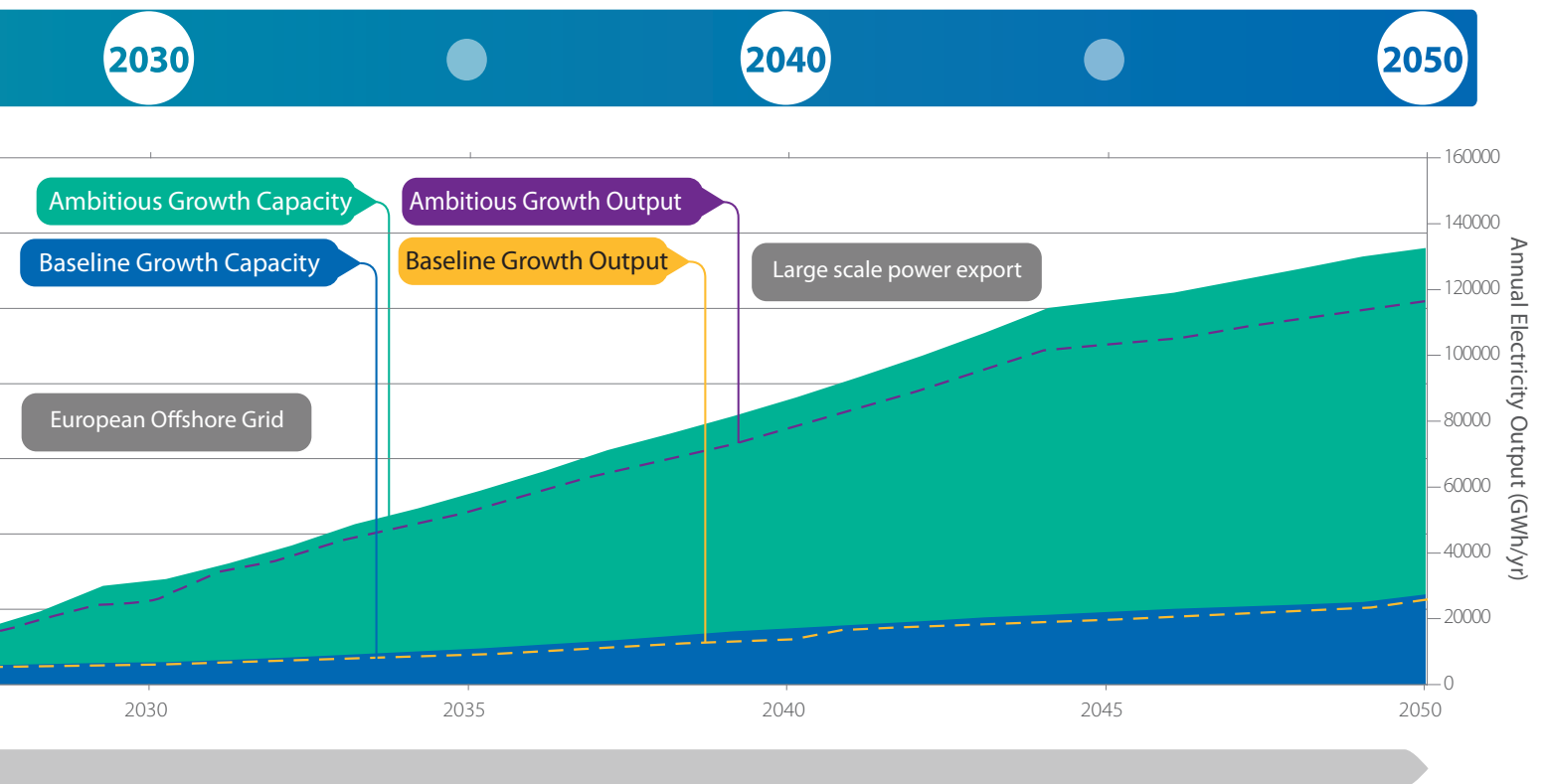
INFRASTRUCTURE

GRID

- GRID25 to deliver additional overall power capacity of 60% by 2025 requiring a €4 billion investment
- Evolved planning for the development of offshore grid infrastructure
- ISLES project
- North Sea grid initiative
- Evolution of regulatory, consenting and trading environment
- Planned interconnect to the UK (EWIC) by 2012
- Increased interconnection to maximize renewable energy export
- Irish - European grid integration and development of offshore grids to allow industry expansion
- Galway Bay 1/4 scale test site in operation Smart Bay & Smart Ocean development programmes underway
- Full scale test site with 10MW grid connection
- Marine energy research centre and commercial cluster (MERC3) in place to assist in marine industry development

Marine Institute, SEAI-OEDU

electrical generation potential to 2050



“Ocean energy has the potential for up to 29 GW of installed capacity”

“Ireland can become a world leader in deployment of marine energy projects and can export this expertise”

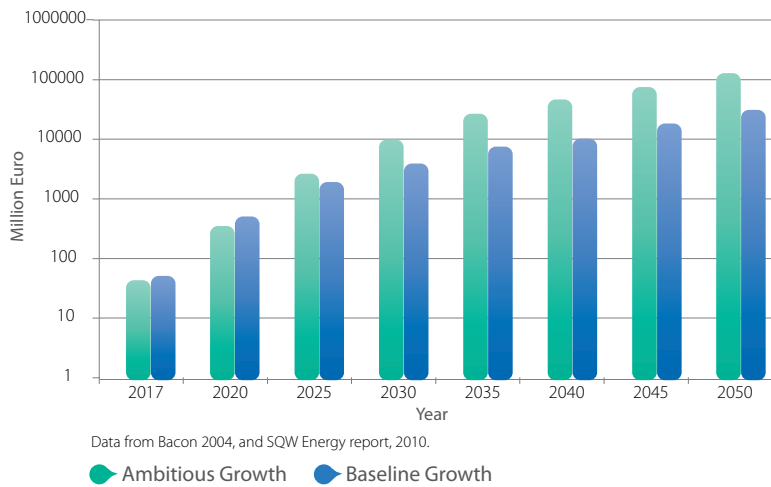
Glossary

- OEDU Ocean Energy Development Unit
- SEAI Sustainable Energy Authority of Ireland
- EWIC East West Interconnector
- OREDP Offshore renewable energy development plan
- SEA Strategic environmental assessment
- NREAP National renewable energy action plan
- ISLES Irish Scottish Link on Energy Systems
- HMRC Hydraulic and Marine Research Centre
- MW MegaWatt
- GW GigaWatt
- O&M Operations and Maintenance
- boe barrel of oil equivalent

KEY

- Government & governing bodies
- Industry
- Power systems & regulators

Analysis of the potential cumulative economic benefit from the ocean energy industry to 2050



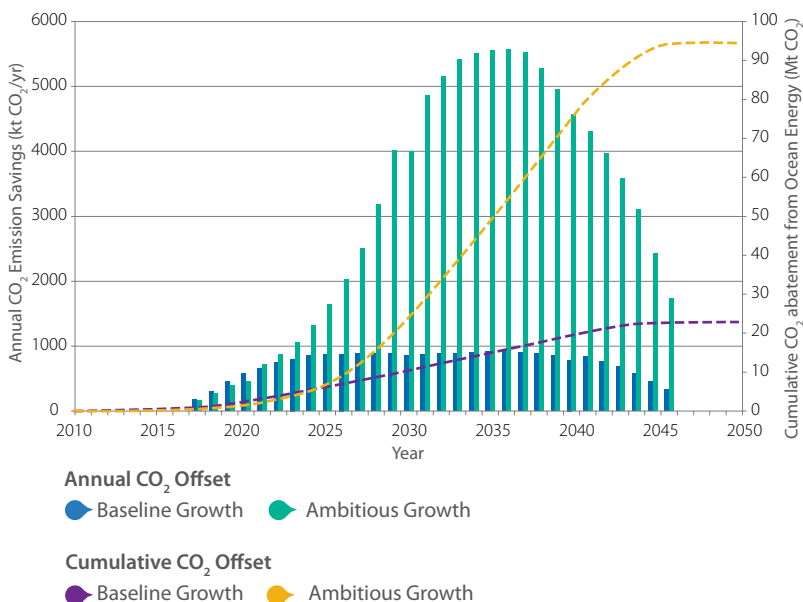
Key Point:

Significant economic benefits may be realised from ocean energy industry, both domestically and from the global market

Next 10 years

- Continue to support industry infrastructure and national test sites
- Continue grid modelling, upgrading & interconnection that support device deployment
- Continue to support research and development, technology innovation, smart ocean and smart bay concepts
- Evolve industry supportive policies
- Develop expertise in manufacture, deployment, O&M and specialist support services
- Public consultations to continue

Estimated annual & cumulative CO₂ emissions offset from power generation to 2050



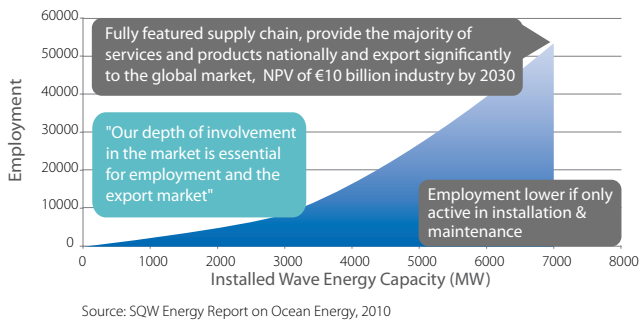
Key Point:

Ocean energy can significantly contribute to decarbonising our electricity production by 2050

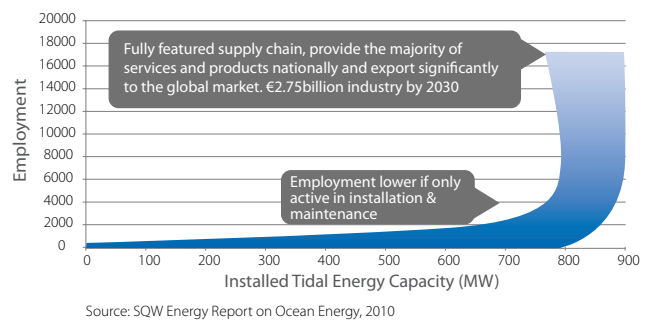
Summary of Results from the Cumulative Assessment

Assessment Area	Wave (MW) 10 to 100m Water Depth	Wave (MW) 100m to 200m Water Depth	Tidal (MW)
Total Development Potential (MW) without likely significant adverse effects	12500 to 13600	15000 to 17500	1500 to 3000

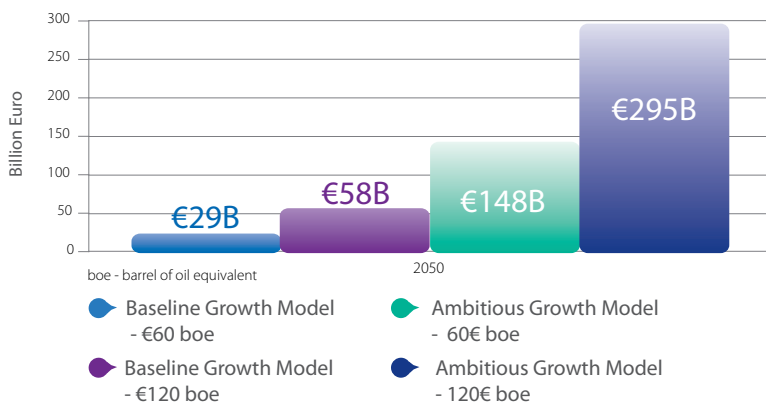
Analysis of irish wave energy market employment under different scenarios



Analysis of irish tidal energy market employment under different scenarios

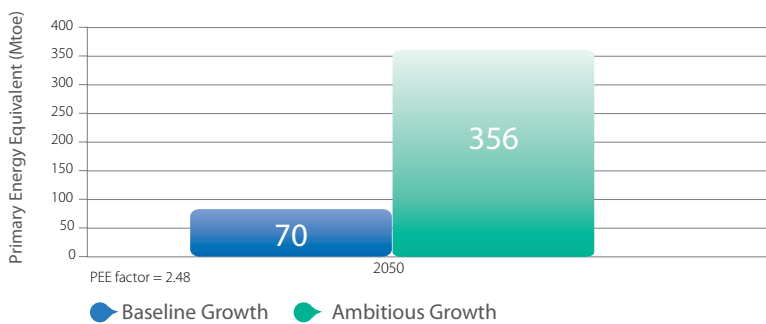


Cumulative ocean energy resource value expressed in cost per barrel of oil equivalent to 2050



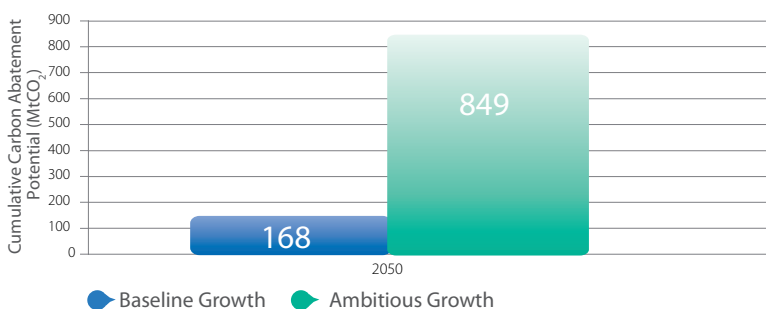
Key Point: These valuations reflect the potential economic value of our ocean energy resource in cost of oil terms.

Cumulative primary energy equivalent resource potential from ocean energy to 2050



Key Point: A cumulative resource potential of up to 356 Mtoe by 2050

Cumulative CO₂ abated from ocean energy generation potential to 2050 when compared to natural gas electricity generation



Key Point: A potential of up to 849 MtCO₂ abated from ocean energy power generation



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