Renewable energy

Scottish Government
Riaghaltas na h-Alba
gov.scot

Key message

Between 2014 and 2018 offshore wind capacity increased by 216%. There has been a 214% increase of marine energy (wind, wave and tidal) capacity and a 142% increase in generation. The world's first floating offshore windfarm, Hywind (located in the Long Forties Offshore Marine Region near Peterhead), became operational in 2017.

Beatrice offshore wind farm during construction, August 2018.

What, why and where?

Marine renewable energy is provided by wind, wave and tidal devices. It has an important role in helping to tackle climate change by contributing to the Scottish Government's ambitious emissions reduction and energy strategy. Total marine generation equates to 5% of total renewable energy generation in Scotland and 6% of installed capacity.

In 2018 offshore wind generated 1,371 GWh, while wave and tidal installations generated 9.3 GWh. Installed offshore wind capacity increased by 377 MW since 2017 to 623 MW in 2018 (mainly from the Beatrice wind farm) (Table 1). Hywind, the world's first floating offshore wind farm became operational in 2017 and demonstrates the commercial potential of floating offshore wind technology. This opens up deep water sites and makes locating wind farms further offshore viable, increasing the potential of offshore wind power generation.

Figure 1:
Hywind Turbine. Photo by Giulia Agnisola.

Scotland is a pioneer of wave and tidal technology, with more test and demonstration devices deployed than in any other country. Orkney is home to the world's first grid-connected wave and tidal energy centre and the world's largest tidal turbine. The Pentland Firth is home to the world's largest planned tidal stream array.

For further information on this topic go to: https://marine.gov.scot/sma/assessment/renewable-energy

Table 1: Wave/tidal and offshore wind installed capacity and generation (2014 to 2018).

	Installed capacity (MW)		Generation (MWh)	
	Wave/ tidal capacity	Offshore wind capacity	Wave/tidal generation	Offshore wind generation
2014	7.388	197.35	2,146	569,226
2015	7.638	187.35	1,994	538,573
2016	13.007	187.35	9	502,426
2017	17.918	246.35	4,194	614,145
2018	19.918	623.15	9,298	1,370,571

Source: BEIS Energy Trends, September 2019 Table 6.1.

Installed capacity: the maximum output of electricity that can be produced under ideal conditions at time of installation.

Generation: The actual output of electricity produced in the given time period.

There are 4.47 GW of marine renewable projects currently in the pipeline (projects with consent) (Scottish Energy Statistics Hub). Almost 1 GW of this is currently under construction, mainly in the Moray Firth (Figure 2).

Contribution to the economy

While the capacity and generation of offshore renewable energy are well documented, the financial information needed to estimate Gross Value Added (GVA) specifically for the offshore elements of renewable energy is not yet available. A research study is currently exploring the availability of specific marine economic data

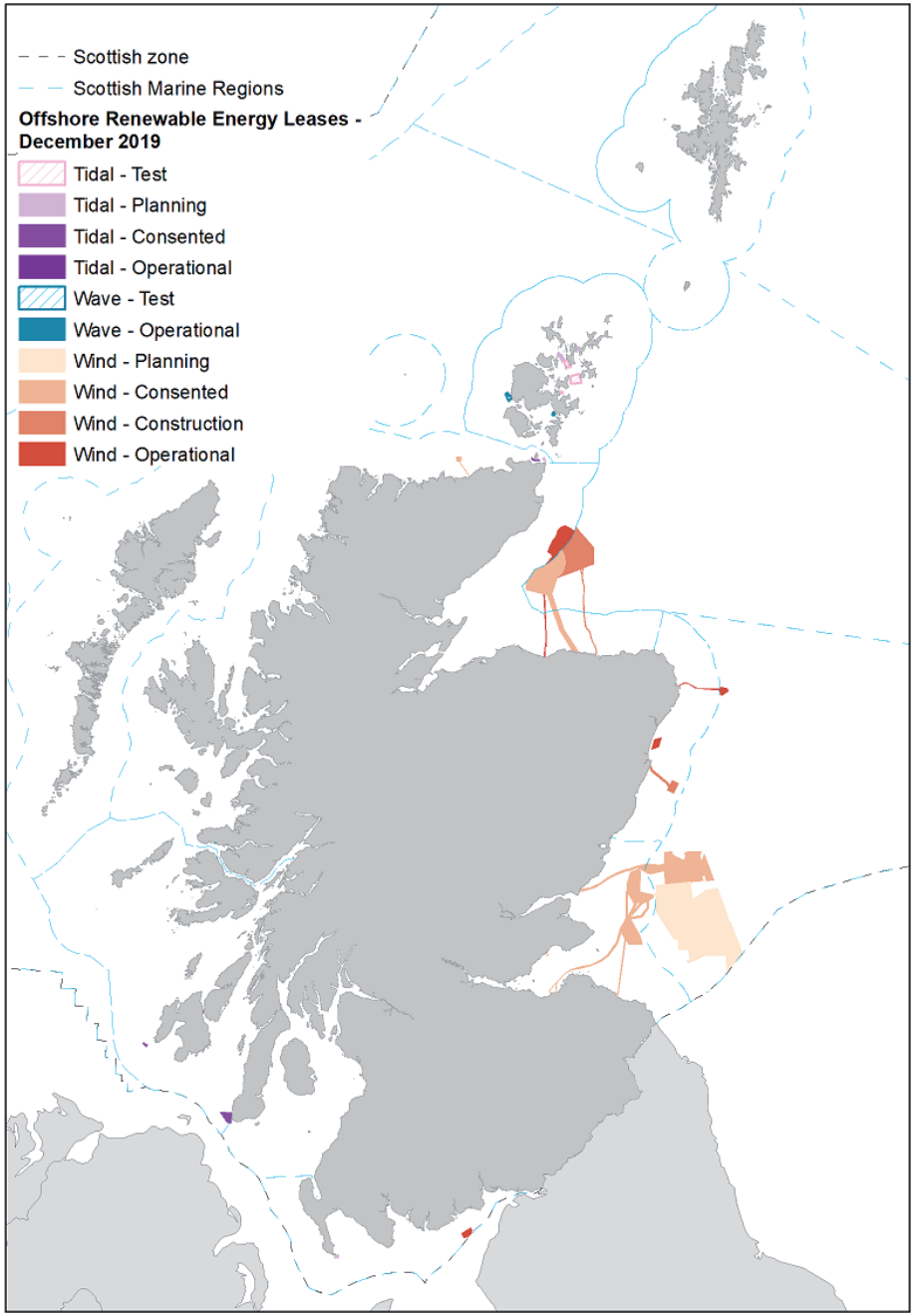


Figure 2:
Location of wind, wave and tidal sites, in relation to Scottish Marine Regions / Offshore Marine Regions. Based on Crown Estate Scotland leases December 2019.
Source: Crown Estate Scotland lease data © Scottish Government project data 2019.

including, marine renewable energy related economic data in Scotland. This will be reviewed with a view to incorporating the information into Scotland's Marine Economic Statistics.

Implementing and sustaining local involvement (i.e. jobs or construction/operations contracts) is critical for Scotland to realise the benefits of offshore wind. Scotland has existing engineering, project management and marine engineering expertise which is well placed to provide services for this sector. Several large-scale offshore wind developments and cable/interconnector projects have been concluded since 2011 (see Subsea cables assessment), with further projects anticipated to commence construction in the next 2 years (see Forward Look).

The offshore wind sector expects to invest up to £210 billion between 2016 and 2025, primarily in Europe. (Source: Scottish Enterprise, Oil and Gas 'Seize the Opportunity' Guides – Offshore Wind) which presents tremendous opportunities for Scottish supply chain and manufacture.

In 2018, the low carbon and renewable energy (LCRE) sector directly supported 23,100 full-time equivalent jobs in Scotland. This represents around 10% of employment in the UK LCRE sector. In 2018, the Scottish low carbon and renewable energy economy directly generated £6.4 billion. The renewable energy part of the LCRE sector is particularly important in Scotland where it accounts for more than half of Scotland's low-carbon turnover. In contrast, renewable energy accounts for around 35% of LCRE turnover in the UK as a whole. Offshore wind itself produced an estimated **£0.26 billion** turnover during 2018, employing just under 2,000 people according to the ONS Low carbon and renewable energy economy survey published in January 2020.

The Offshore Renewable Energy Catapult, 'Tidal Stream and Wave Energy Cost Reduction and Industrial Benefit' report in April 2018 by the Offshore Renewable Energy Catapult found that the tidal stream industry could generate a net cumulative benefit to the UK of £1.4 bn and support 4,000 jobs by 2030. Also that wave energy could provide a net positive contribution to the UK economy of £4 bn and support 8,100 jobs by 2040.

Examples of socio-economic effects

- Increased employment (both full and part time) via manufacturing, construction, operation and maintenance, research, monitoring, decommissioning.
- Diversity of electricity supply and meeting energy objectives and climate change targets.
- Stable and reliable supply of power.
- Potential tourism associated with visits to offshore sites.
- Potential competition for marine space with other users.

Pressures on the environment

An OSPAR agreed list of marine pressures is used to help assessments of human activities in the marine environment. The marine pressure list has been adapted for use in Scotland via work on the Feature Activity Sensitivity Tool (FeAST). Renewable energy activities can be associated with 23 marine pressures – please read the pressure descriptions and benchmarks for further detail.

Forward look

Renewable energy development is anticipated to expand over the coming decades. Technological advancements will likely support the deployment of floating offshore wind within deeper waters, which is important given the increasing constraints posed to traditional, fixed-bottom offshore wind developments that require shallow water. The forthcoming Sectoral Marine Plan for Offshore Wind Energy, due in 2020, will identify Plan Options suitable for the deployment of several GW of offshore wind (Figure 3).

The volume of wave and tidal development predicted in 2011 has not come to fruition, due to issues surrounding the commercialisation of such technologies. Also due to the lack of a route to market resulting from the removal of the ring-fenced Contract for Difference (CfD) for wave and tidal energy in 2016. This means wave and tidal projects compete against the much cheaper offshore wind for a guaranteed energy price.

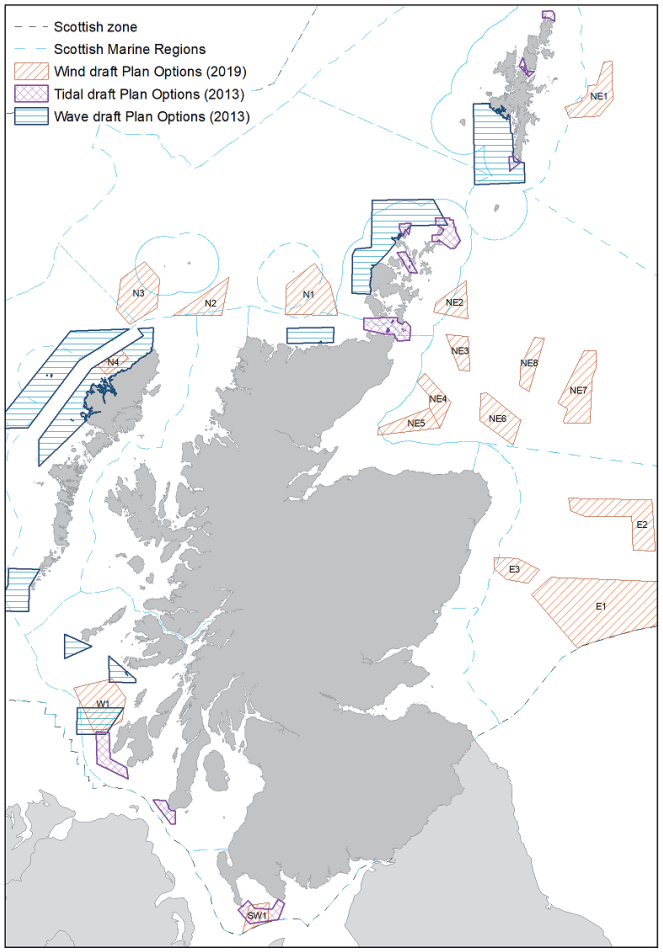


Figure 3:
Sectoral Marine Plan for offshore wind energy draft Plan Options (2019) and draft plan options for wave and tidal (2013).

The potential of these technologies as part of the future energy mix continues to be explored through numerous forums and programmes including the Scottish Marine Energy Industry Working Group, Wave Energy Scotland, and the significant level of marine energy expertise in Scotland's universities, notably the University of Edinburgh. There are existing wave and tidal draft Plan Options from 2013 (Figure 3).

Economic trend assessment

Economic trends are based on the change, between 2014 and 2018, in generation for offshore renewables, with wind, wave and tidal generation combined, and are reported by local authority. While trends are provided here, the full picture, showing generation by year, local authority and renewable energy type is given in Tables a and b . As not all offshore generation can be allocated to a local authority, the Scotland trend is based on total Scotland generation rather than the sum of the local authority figures. Where a change is less than 5% this is shown as stable. Where a percentage change cannot be calculated due to having generation figures in 2018 but none in 2014, this has been shown as an increase.

Confidence

Scotland, 3 stars as from published statistics. Local Authority level, 2 stars as not all offshore generation can be allocated to a local authority.

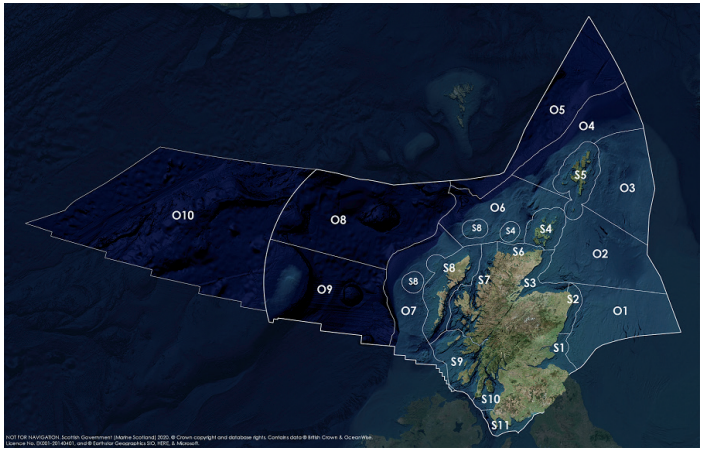
Local authority	Offshore renewables
Aberdeenshire	
Argyll & Bute	
Dumfries & Galloway	
Fife	
Highland	
Moray	
Orkney Islands	
Shetland Islands	
Scotland	

Status and trend assessment legend

Status assessment (for Clean and safe, Healthy and biologically diverse assessments)		**Trend assessment (for Clean and safe, Healthy and biologically diverse and Productive assessments)**	
	Many concerns		No / little change
	Some concerns		Increasing
	Few or no concerns		Decreasing
	Few or no concerns, but some local concerns		No trend discernible
	Few or no concerns, but many local concerns		All trends
	Some concerns, but many local concerns	**Confidence assessment**	
	Lack of evidence / robust assessment criteria	**Symbol**	**Confidence rating**
	Lack of regional evidence / robust assessment criteria, but no or few concerns for some local areas		Low
	Lack of regional evidence / robust assessment criteria, but some concerns for some local areas		Medium
	Lack of regional evidence / robust assessment criteria, but many concerns for some local areas		High

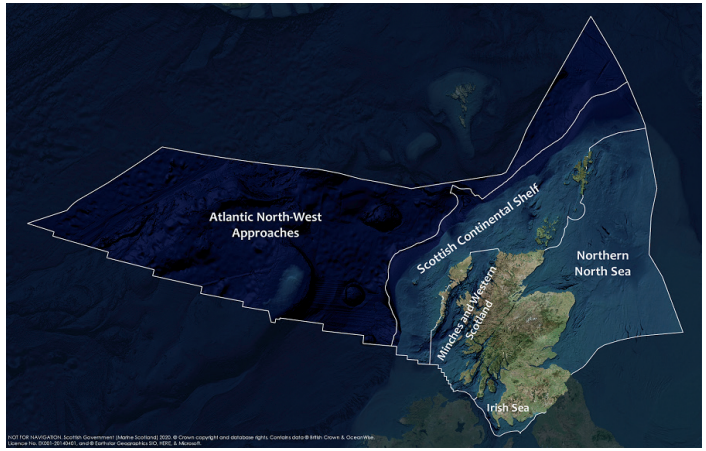
Overal confidence

Assessment regions

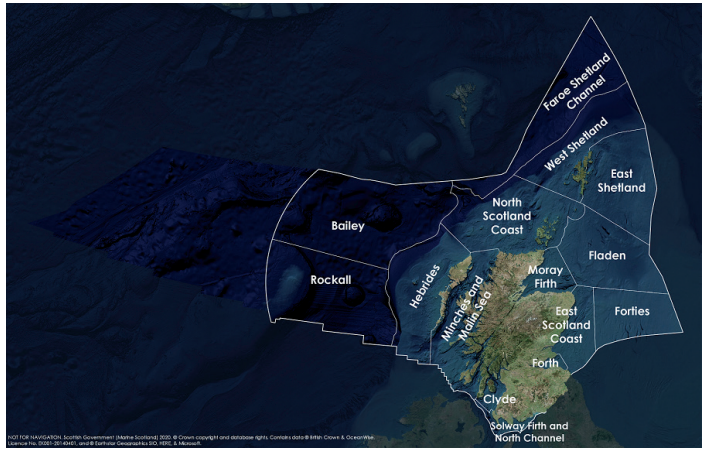


The Scottish Marine Regions (SMRs; S1 – S11) and the Scottish Offshore Marine Regions (OMRs, O1 – O10)

Key: S1, Forth and Tay; S2, North East; S3, Moray Firth; S4 Orkney Islands, S5, Shetland Isles; S6, North Coast; S7, West Highlands; S8, Outer Hebrides; S9, Argyll; S10, Clyde; S11, Solway; O1, Long Forties, O2, Fladen and Moray Firth Offshore; O3, East Shetland Shelf; O4, North and West Shetland Shelf; O5, Faroe-Shetland Channel; O6, North Scotland Shelf; O7, Hebrides Shelf; O8, Bailey; O9, Rockall; O10, Hatton.



Biogeographic, Charting Progress 2 (CP2) Regions. These have been used as the assessment areas for hazardous substances.



Scottish Sea Areas as used in Scotland's Marine Atlas 2011. These are sub divisions of the biogeographic, or Charting Progress 2 (CP2), Regions.

This material was published on the Scottish Marine Assessment 2020 portal, December 2020