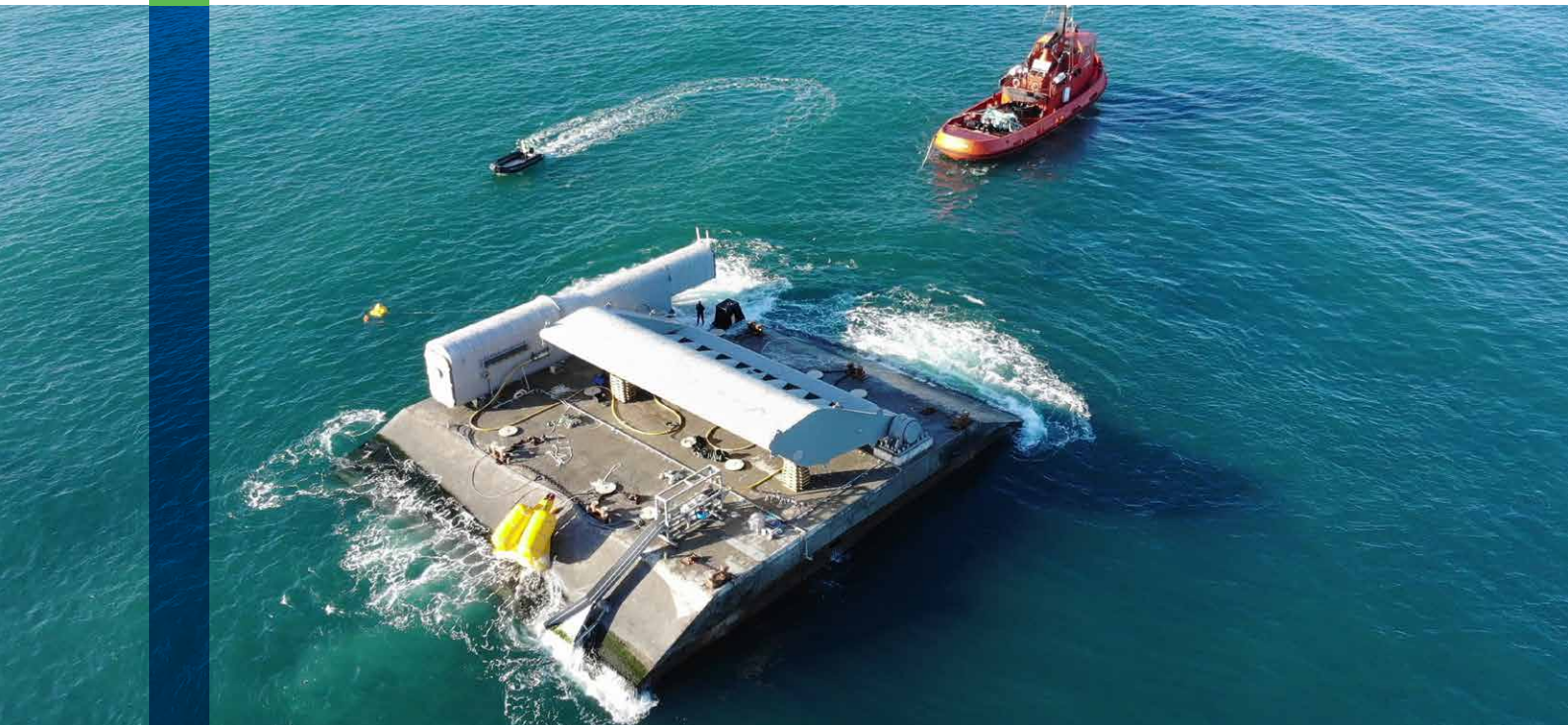




Ocean Energy

Key trends and statistics 2019

March 2020



Ocean Energy
Europe

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Table of contents

Key findings	4
Europe: Continued progress in 2019	6
Tidal Stream: Power generation goes up a gear	6
Cumulative capacity continues to climb despite slower 2019.....	6
Innovative designs take the spotlight in 2019	7
France and the UK still top choice for installations	8
Electricity production up by 50% in 2019	9
Wave energy: Deployments growing steadily	10
2019 capacity increases propel wave energy growth	10
Wave energy heading to full-scale	12
All eyes on the Atlantic for 2019 installations	13
Project spotlight	14
Global perspective	16
Deployments picking up speed in North America and China	16
Strong support for tidal stream beyond Europe	16
Increasing competition in the wave energy sector.....	18
2020 set to be a bumper year for ocean energy	20
Tidal energy: New devices to hit the Atlantic	20
Wave energy: Thinking big in 2020	21



Key findings



Europe: Continued progress in 2019



TIDAL STREAM

Record-breaking production

2019 INSTALLATIONS

1.52 MW
capacity added.

This dip comes as many developers are preparing larger multi-device projects scheduled for the early 2020s.

CUMULATIVE INSTALLATIONS

27.7 MW
installed in Europe
since 2010.

10.4 MW is currently
in the water.



FRANCE



UK

&

remained the most popular places
to develop tidal stream projects in 2019.

Tidal energy projects
exported close to **15 GWh**

enough to power
4,000 households per year.



WAVE ENERGY

Deployments growing steadily

2019 INSTALLATIONS

0.6 MW
capacity added.

+25% compared
to 2018.

CUMULATIVE INSTALLATIONS

11.8 MW
installed in Europe
since 2010.

1.5 MW is currently
in the water.

Wave device installations were
spread along the Atlantic coast
from Portugal to Scotland.



BELGIUM



FRANCE



ITALY



PORTUGAL



UK



Global: Deployments picking up speed in North America & China



TIDAL STREAM

Strong support beyond Europe



CANADA



USA



CHINA

are snapping at Europe's heels

largely thanks to revenue support systems targeted at tidal stream projects and generous RD&I programmes.



WAVE ENERGY

Increasing global competition



CHINA

has significantly increased its budget for ocean energy.

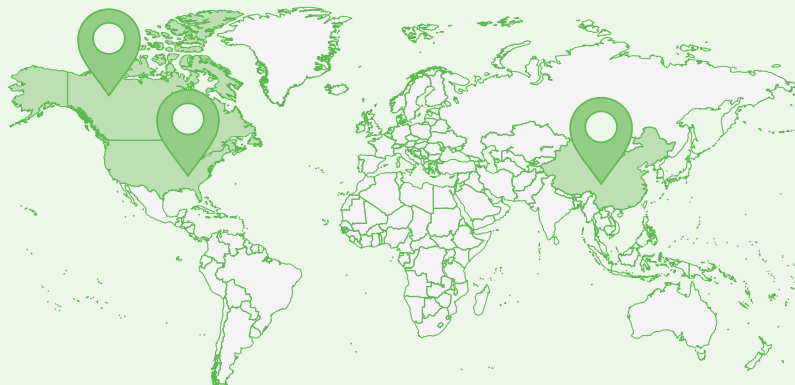
Several domestic companies are now testing devices in Chinese waters.



USA

support for wave developers has increased and the sector is progressing steadily.

The first full-scale American wave energy converters will be tested in Hawaii in 2020.



Outlook for 2020

2020 set to be a bumper year for ocean energy, as a new generation of devices hits the water.



TIDAL STREAM



3.4 MW

EUROPE



1.8 MW

REST OF THE WORLD



WAVE ENERGY



3 MW

EUROPE



1.2 MW

REST OF THE WORLD



Europe: Continued progress in 2019

2019 was another busy year for wave energy developers, with several new devices hitting the water, while tidal stream installations slowed as developers gear up for pilot farm deployments in 2020.

Power generation from Europe's pilot tidal stream farms went up a gear, with exports to the grid up 50% on 2018 figures.



TIDAL STREAM: Power generation goes up a gear

Cumulative capacity continues to climb despite slower 2019

Annual installations – 1.52 MW of tidal stream capacity was deployed in Europe in 2019, down from 3.7MW in 2018. This dip comes as many developers are busy preparing larger multi-device projects scheduled for the early 2020s.

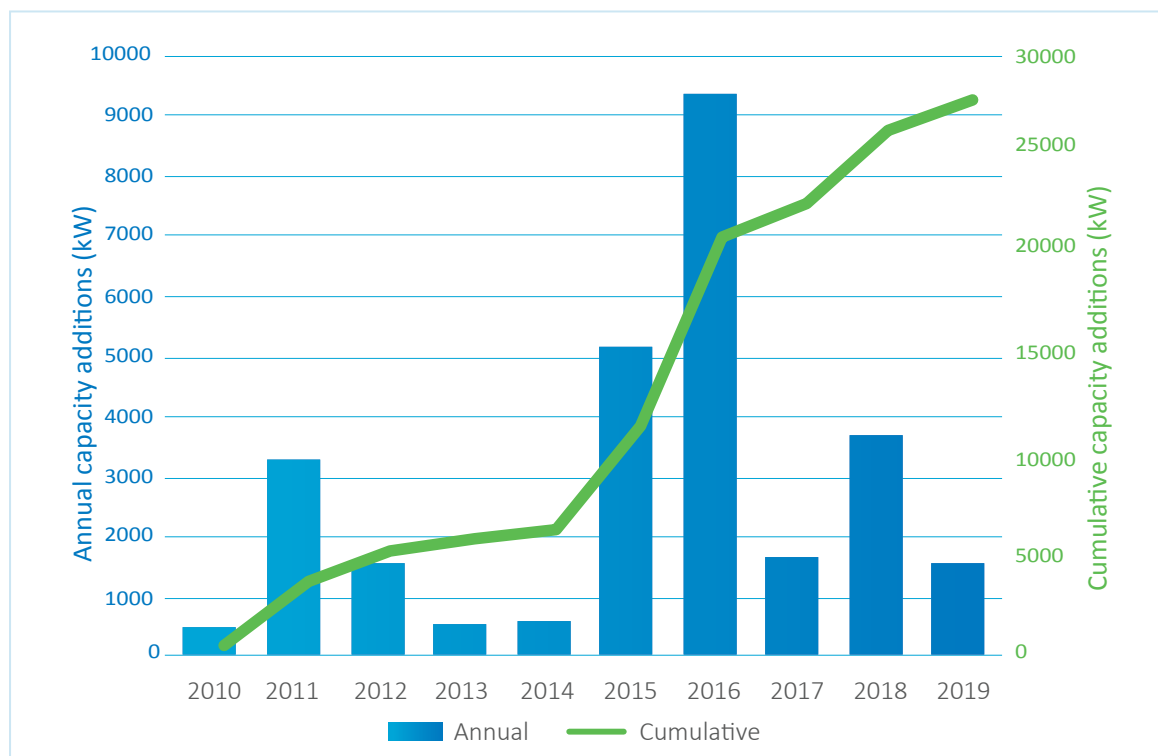


Figure 1: Annual and cumulative tidal stream capacity in Europe

Source: Ocean Energy Europe

Cumulative installations – 27.7 MW of tidal stream technology has been deployed in Europe since 2010. Of this, 10.4 MW is currently operating, and 17.3 MW has been decommissioned as projects successfully complete their testing programmes.

Hundreds of megawatts have already been pre-consented and could be deployed off Europe's Atlantic coast in the coming few years. National governments now need to provide revenue support to secure the future of these larger demonstration farms.

Innovative designs take the spotlight in 2019

Three full-scale devices were deployed in Europe in 2019 as part of demonstration projects. The tidal turbines deployed by the Swedish developer Minesto and French outfit CMN HydroQuest are both high-capacity (> 500 kW) devices oriented towards utility-scale markets. Also hailing from France, Guinard's smaller tidal turbine is aimed at the community energy market.

These newcomers have opted for unconventional designs, such as tidal 'kites' and funnel-shaped casings to accelerate tidal flows, which can efficiently harvest tidal energy in areas with medium or low resources.

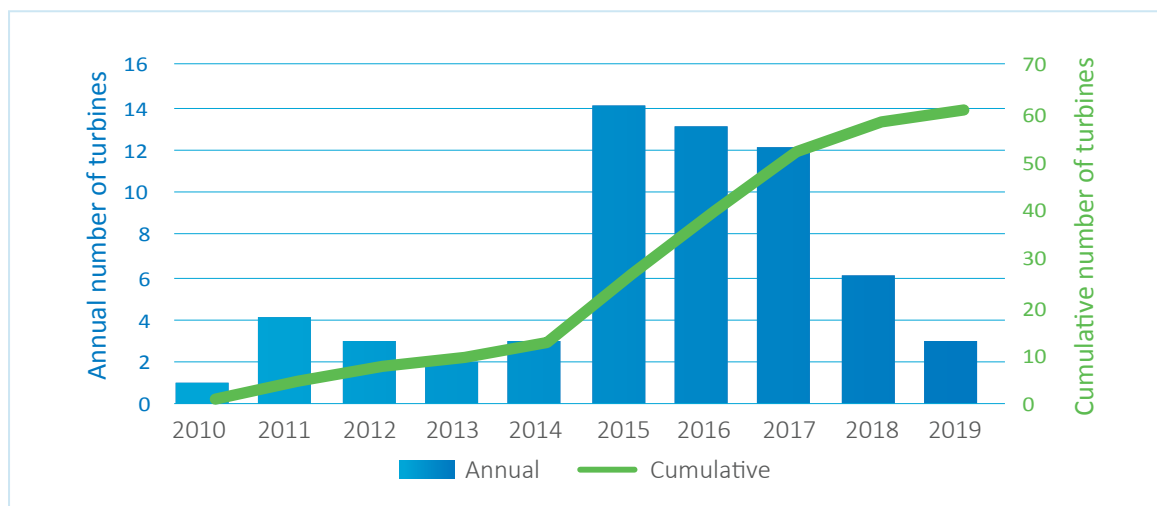


Figure 2: Annual and cumulative tidal turbine installations in Europe

Source: Ocean Energy Europe

France and the UK still top choice for installations

France and the UK remained the most popular places to develop single device tidal stream projects in 2019. Competitive test facilities offering grid connection and the potential for scaling up were the key factors for developers selecting these locations.

The Channel region should remain a dynamic area for the sector over the next three years, thanks to its large resource and forthcoming European/regional funding. However, revenue support is still needed on both sides to kick-start the commercialisation of tidal stream.

Country	Map Ref.	Location	Device Developer	Device Name	Type	Capacity Device (kW)	Number of Turbines
FRANCE	1	Paimpol-Bréhat	Hydroquest	Hydroquest Ocean	Vertical Axis	1000	1
UK (WALES)	2	Holyhead Deep	Minesto	DG500	Kite	500	1
FRANCE	3	Ria d’Etel	Guinard	P400	Horizontal Axis	20	1

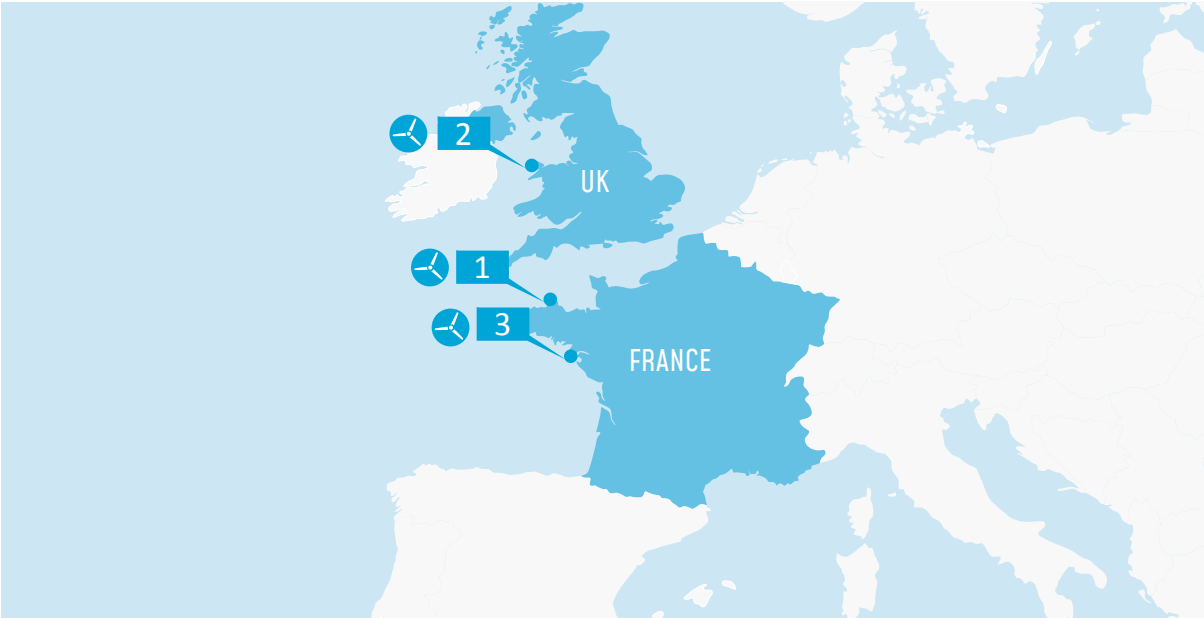


Figure 3: European tidal stream deployments in 2019

Source: Ocean Energy Europe

Electricity production up by 50% in 2019

Electricity production from tidal farms and demonstration projects moved up a gear in 2019. Led by Meygen and the EnFAIT project, the European tidal stream sector exported close to 15 GWh last year – enough to power 4,000 households. This 50% increase on 2018 is the result of increased operating hours in existing farms rather than from newly installed capacity.

Beyond electricity generation, European developers have gained hours of invaluable experience in an aggressive maritime environment. Tidal projects are no longer counting operational time in weeks and months, but in years. As the technology matures, it is both reducing its costs¹ and proving its reliability.

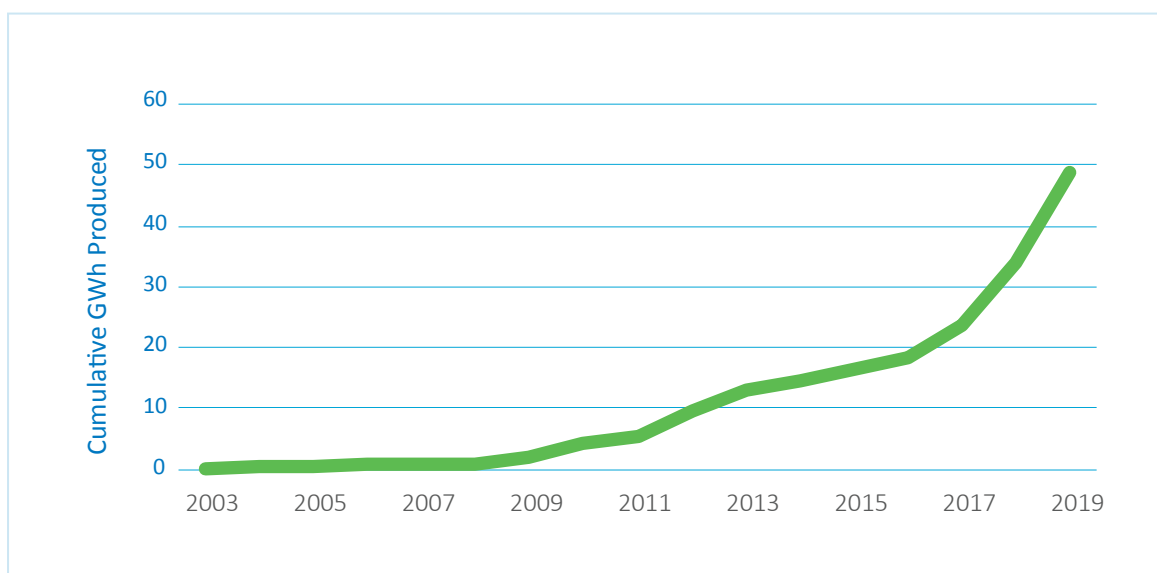


Figure 4: Cumulative GWh produced by tidal stream in Europe

Source: Ocean Energy Europe²

¹Tidal stream reduced its costs by 40% between 2015 and 2019, according to the EU Joint Research Council (SETIS Magazine, May 2019, p12)

²Public releases from developers, information supplied to Ocean Energy Europe by developers



WAVE ENERGY: Deployments growing steadily

2019 capacity increases propel wave energy growth

Annual installations – 603 kW of wave energy was installed in Europe in 2019, an increase of over 25% on the previous year's capacity additions. The majority of these devices are grid-connected. Testing opportunities and RD&I funding remain dominant factors in the frequency and location of installations.

Two types of development strategy now coexist. Devices above 100 kW are usually developed with utility-scale markets in mind. Smaller devices - usually below 50 kW - are manufactured primarily for specialist applications such as oil & gas, aquaculture, maritime monitoring and defence.

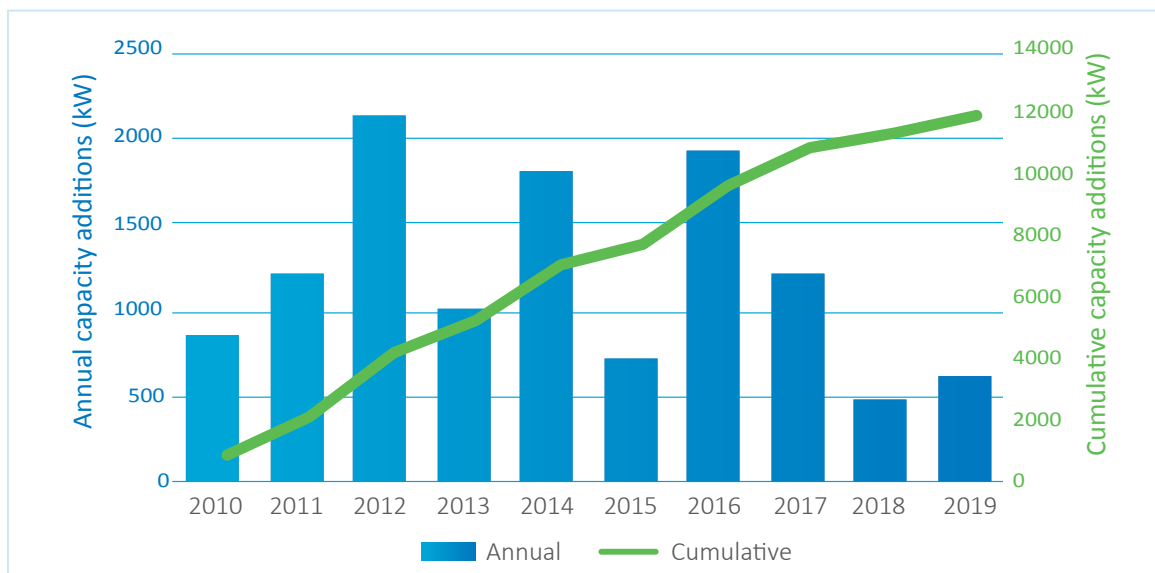


Figure 5: Annual and cumulative wave energy capacity in Europe

Source: Ocean Energy Europe

Cumulative installations – 11.8 MW of wave energy has been installed in Europe since 2010. 1.5 MW is currently in the water and 10.3 MW has been decommissioned following the successful completion of testing programmes.

Wave energy's cumulative installed capacity has been steadily increasing over the last five years. This reflects the fact that technological advances and sustained RD&I funding are leading to the deployment of bigger and better devices.



Wave energy heading to full-scale

Six wave energy converters (WECs) were installed in European waters in 2019, all of them single units.

Scale

GEPS Techno and AW Energy installed their first full-scale devices. This represents a major achievement and the is first step towards wave energy pilot farms. Both developers have announced their intentions to design even more powerful devices in the coming years. OPT'S device is also full-scale, - its lower capacity is appropriate for directly powering monitoring equipment and similar applications, rather than utility-scale power generation.

Sub-scale devices represented half of the installations in 2019, with NEMOS, AMOG and Waves4Energy all installing devices of half-scale or under.

Design

The 2019 installations clearly illustrate the variation in designs of wave energy converter technology. The different concepts reflect both the various applications that the devices are aimed at and the type of resource harnessed.

Several device manufacturers have developed hybrid concepts combining wave energy with other renewable energy sources or integrated storage.

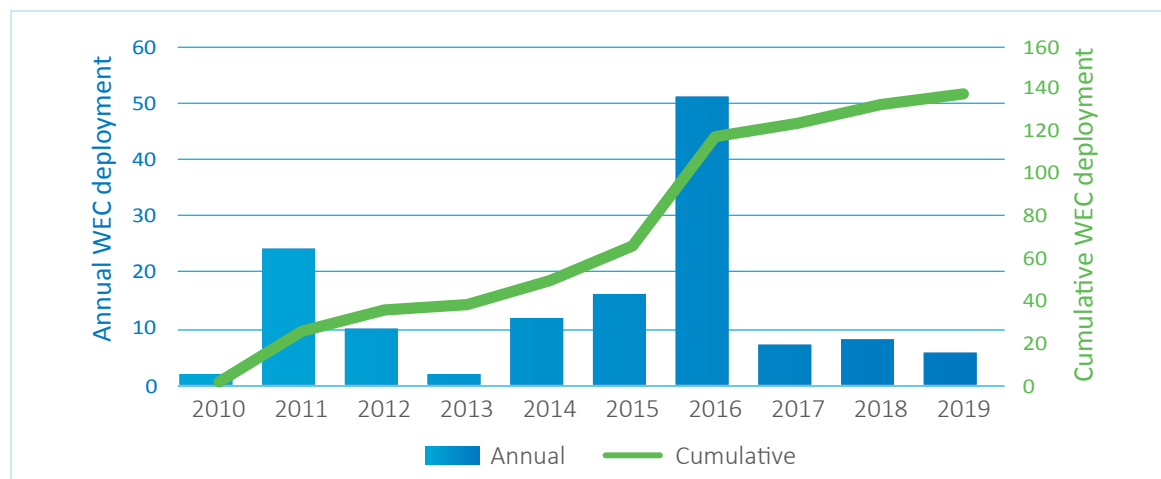


Figure 6: Annual and cumulative wave energy converter deployments in Europe

Source: Ocean Energy Europe

All eyes on the Atlantic for 2019 installations

In 2019, wave device installations were spread along the Atlantic coast from Portugal to Scotland. For the majority of developers, test facilities and funding opportunities were the main drivers in choosing a deployment site.

OPT signed one of the first commercial deals in the wave energy sector. The deployment of its wave energy converter in the North Sea is based on a nine-month lease that includes a purchase option.

Country	Map Ref.	Location	Device Developer	Device Name	Type	Capacity Device (kW)	Number of Turbines	Scale
PORTUGAL	1	Peniche	AW Energy	Waveroller	Flap	350	1	1
FRANCE	2	SEM REV (Nantes)	GEPS Techno	Wavegem	Wave rotor	120	1	1
BELGIUM	3	Ostend	NEMOS	NEMOS WEC	Point absorber	70	1	1:5
ITALY	4	Ravenna	Wave for energy	ISWEC	Rotating mass	50	1	1:2
UK (ENGLAND)	5	FabTest (Cornwall)	AMOG	AMOC WEC	Pendulum	40	1	1:3
UK (SCOTLAND)	6	Huntington Field	OPT	PB3	Point absorber	3	1	1

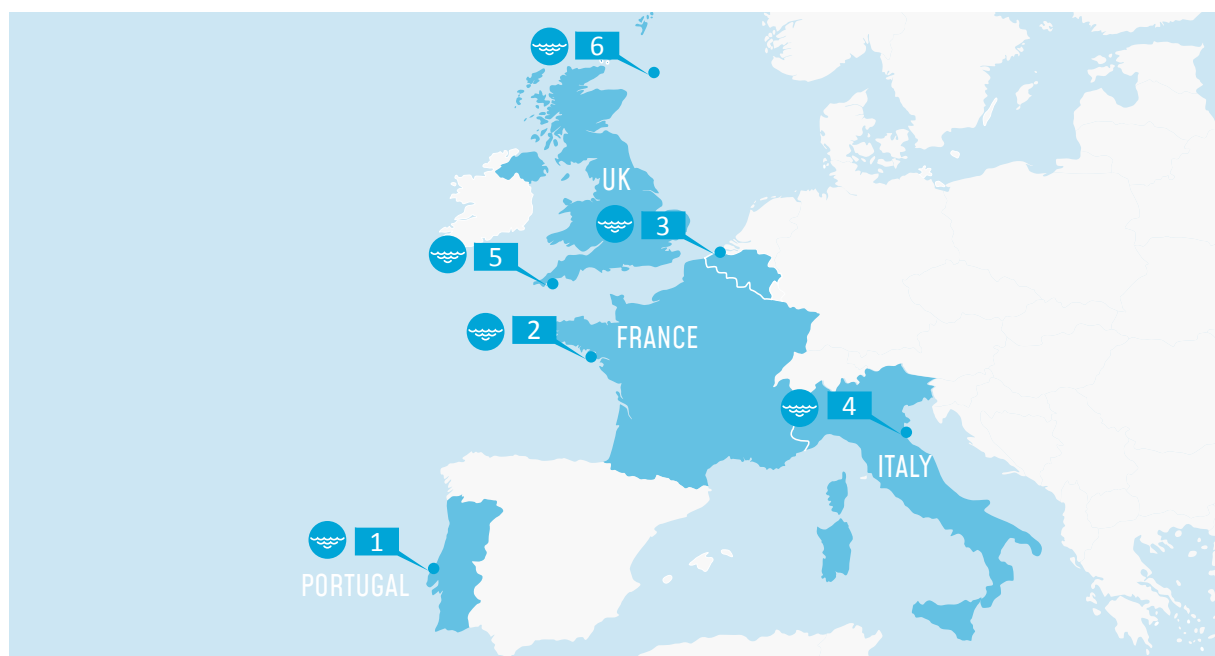


Figure 7: European wave energy deployments in 2019

Source: Ocean Energy Europe



Project spotlight

AW ENERGY

Using wave energy to power the Portuguese grid

The Finnish company AW Energy successfully deployed its full-scale WaveRoller in Portuguese waters last year. The 350 kW wave energy converter was connected directly to the grid and started producing electricity a few days later.

Engineers are tracking the device's performance using the company's monitoring software which can be used to remotely access the device from anywhere in the world at any time.



HYDROQUEST

A new competitor in French waters

Building on its longstanding experience generating power from rivers, HydroQuest partnered with Constructions Mécaniques de Normandie to produce its first tidal turbine. The 1 MW HydroQuest Ocean device was successfully installed on the EDF-run site of Paimpol Bréhat in Brittany during the summer.

The project is breathing new life into the test site. It will generate valuable hours of operational experience and data, enabling the developers to prove the capability and reliability of their technology.



OCEAN ENERGY IRELAND

Irish engineering powering Hawaii

Ocean Energy chose the American construction company VIGO to build its first full-scale device: the 1.25 MW OE35. Built in Portland, the device has been towed to Oahu, Hawaii where it will be moored at a US Navy test site and hooked up to the electrical grid to provide clean, renewable power for the local community.



MINESTO

Preparing for utility scale projects

Minesto's marine energy technology, Deep Green, consists of a subsea kite carrying a turbine. The kite flies across the underwater current, significantly enhancing the water flow speed through the turbine. The Swedish company successfully tested its 500 kW full scale tidal turbine: the Deep Green 500.

Building on the learnings from this deployment, Minesto will start deploying its technology on a larger scale in the Faroe Islands next year under a Power Purchase Agreement (PPA) with the utility SEV.





Global perspective

Overall, Europe remains the global leader in ocean energy, but a lack of national revenue support and increasing activity elsewhere is putting this position under pressure. The impact of feed-in tariffs in Canada and China clearly reinforces the importance of such support when it comes to deployments.



Deployments picking up speed in North America and China

Strong support for tidal stream beyond Europe

With three pilot farms and numerous full-scale devices in the water, Europe is leading the global tidal stream sector. The most advanced European companies now have thousands of operating hours under their belts and have delivered high volumes of electricity to the grid.

However, Canada and China are snapping at Europe's heels, largely thanks to revenue support systems targeted at tidal stream projects.

The Canadian province of Nova Scotia boasts a Feed-In Tariff of around €350/MWh for several tidal demonstration farms, which has attracted four leading European developers.

China has also surged forward in recent years. By investing heavily in RD&I, the country has produced several domestic turbine manufacturers. In 2019, this investment was complemented by the introduction of a Feed-In Tariff of around €330/MWh, launched to encourage the growth of the sector. The success of this approach is illustrated by significant installations made in 2018. Although no devices were installed in China in 2019, a number of new deployments are foreseen for 2020.



Photo: Sustainable Marine Energy

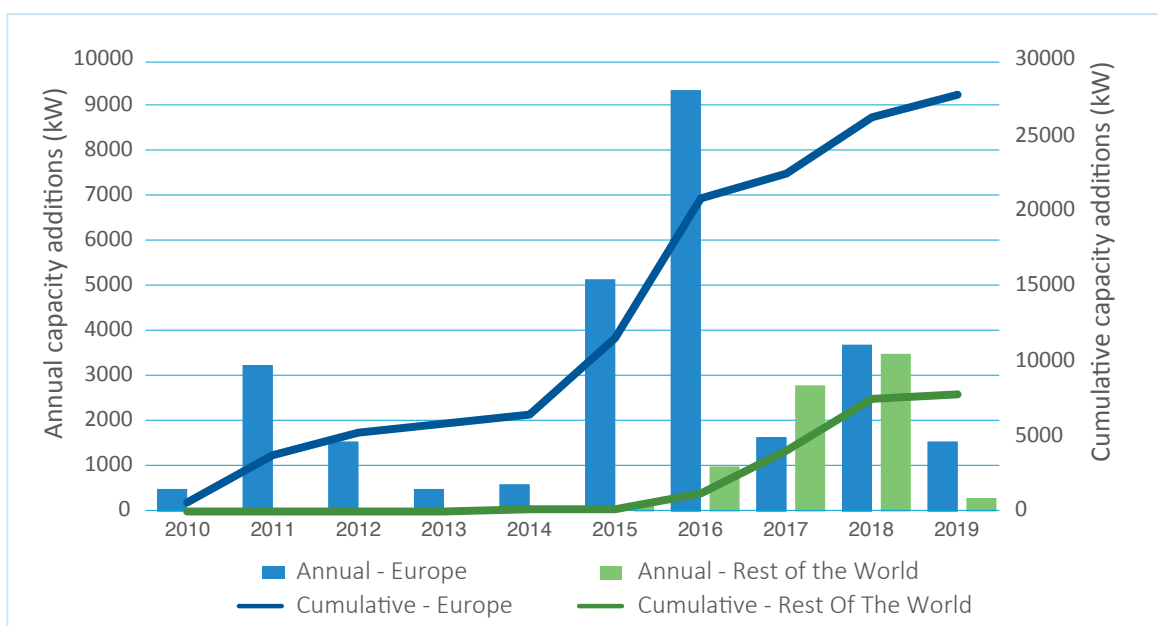


Figure 8: Installed and cumulative global tidal stream energy capacity

Source: Ocean Energy Europe

Country	Device Developer	Device Name	Type	Capacity Device (kW)	Number of Turbines
CANADA	Sustainable Marine Energy	Plat-I	Horizontal axis	280	1
SINGAPORE	Mako Turbines	Mako 7	Horizontal axis	Unknown	1

Figure 9: Tidal stream installations outside Europe in 2019

Source: Ocean Energy Europe

Increasing competition in the wave energy sector

Europe is still the leader in wave energy technology development worldwide. Robust RD&I support combined with access to competitive testing facilities have enabled European developers to deploy a new generation of full-scale wave devices in real sea conditions. Medium-term market visibility is now needed to maintain Europe's leadership and get the first wave energy pilot farms in the water.

For the second year in a row, other global regions have overtaken Europe in terms of annual installed capacity. This trend is mainly led by China and the USA. China has dedicated significantly more budget to the development of ocean energy in the past few years. As a result, several domestic wave energy developers are now testing their devices in Chinese waters.

In the USA, the Department of Energy has also been increasing its support to wave developers and the sector is progressing at a steady pace. The first full-scale American wave energy converters will be tested in Hawaii in 2020.

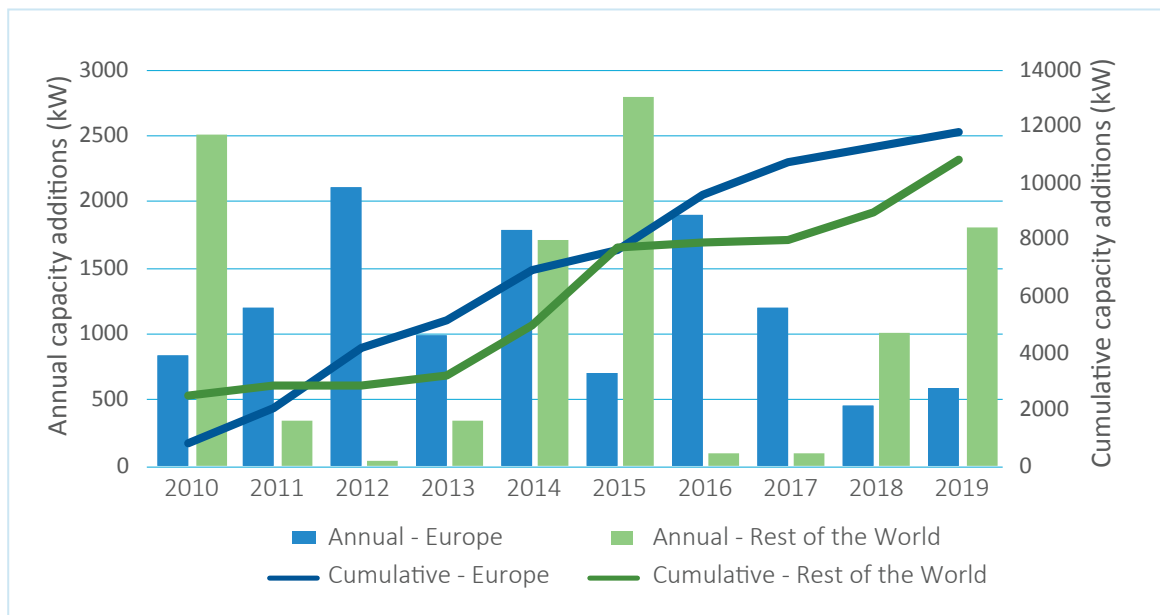


Figure 10: Installed and cumulative global wave energy capacity

Source: Ocean Energy Europe

Country	Device Developer	Device Name	Type	Capacity (kW)	Number of devices
USA	Ocean Energy IE	OE35	OWC	1250	1
CHINA	GIEC	Sharp Eagle	Attenuator	200	1
		Penghu	Unknown	120	1
	Chaohu Silver Ring Navigation Buoy Co.	Ocean Star	OWC	150	1
		Ocean Star	OWC	90	1

Figure 11: Wave energy installations outside Europe in 2019

Source: Ocean Energy Europe





2020 set to be a bumper year for ocean energy

Deployments will be on the rise for both tidal and wave in 2020 as several flagship projects are expected to go ahead in the UK, Spain, Canada, China and the USA. Although tests of single devices will still account for the bulk of new installed capacity, some pilot projects have reached financial close and could start in the near future.



TIDAL STREAM: New devices to hit the Atlantic

Europe

2020 will be a busy year for tidal stream in Europe, with up to 3.4 MW of deployments planned. Several new devices will be tested at the European Marine Energy Centre (EMEC) in Scotland, supported by the EU-funded Ocean DEMO project. Minesto recently signed a PPA with Faroese utility SEV to install two of its 'tidal kite' devices in the Faroe Islands.

Global

Outside Europe, installations in 2020 could add 1.8 MW of tidal energy capacity to the global total. China will lead the pack, with three device deployments foreseen; the USA and Canada are set to install at least one device apiece.



Photo: Magallanes Renovables



WAVE ENERGY: Thinking big in 2020

Europe

3 MW of wave energy is lined up for deployment in 2020, the bulk of which will come from full-scale, high-capacity devices. The majority of these deployments will occur in the UK and Spain, with funding from the EU's BlueGift and Ocean DEMO projects. Three new full-scale devices should hit European waters – made by Bombora, Wello and Waveston.

Global

Outside Europe, installations could add 1.2 MW of wave energy capacity to the global total. Several devices are expected to be deployed in China (GIEC), the USA (Columbia Power Technologies) and Australia (Wave Swell Energy).



Photo: Corpower Ocean



Want to go into more detail?

Did you know that Ocean Energy Europe members can request information from our 'Kit-in-the-Water' database about projects deployed around the world?

Contact us now to find out more about this and the many other benefits of OEE membership!

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