Ocean Energy

Key trends and statistics 2018

Ocean Energy Europe

DISCLAIMER

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- 3.7 MW of tidal stream capacity was put in the water in 2018, making this a solid year for tidal activity.
- Overall, 26.8 MW of tidal stream has been deployed in Europe since 2010. Of this, 11.9 MW is currently operating, and 14.9 MW has been decommissioned.

WAVE ENERGY: STEADY GROWTH IN CUMULATIVE CAPACITY SINCE 2010

- 500 kW of wave energy was installed in Europe in 2018.
- Overall, 11.3 MW of wave energy has been installed in Europe since 2010. Of this, 2.9 MW is currently in the water and 8.4 MW has been decommissioned.

RECORD-BREAKING ELECTRICITY PRODUCTION IN 2018

- Power generated since 2015 has significantly increased, providing reliable electricity to European homes.

FRANCE, THE UK AND ITALY LEAD INSTALLATIONS

- France and the UK remain at the epicentre of tidal stream installations. National support is urgently needed for larger-scale projects to happen.
- In wave energy, Scandinavia and Italy are currently leading the way.

The rest of the world is catching up

- Europe remains the world leader in wave energy installations, however, the rest of the world is catching up in tidal stream.
- Outside Europe, Canada and China lead the number of real sea installations in 2018.

More projects to hit the water in 2019

- Up to 8 MW of tidal stream and 3.4 MW of wave energy could be installed in Europe in 2019 - a sharp increase on 2018.

2018: A solid year for ocean energy activity in Europe

Wave energy developers are steadily progressing as several are now scaling up and testing a new generation of full-scale devices. Tidal stream[1] developers are feeding sharply increasing quantities of electricity into the grid and preparing for commercialisation. Valuable learnings continue to be gained from the numerous ongoing tests and pilot projects.

Tidal stream: Installation rates accelerating since 2015

TIDAL STREAM - INSTALLED CAPACITY

Annual installations - 3.7 MW of tidal stream capacity was put in the water in 2018. This represents more than twice the capacity installed in 2017, making this a solid year for tidal activity.

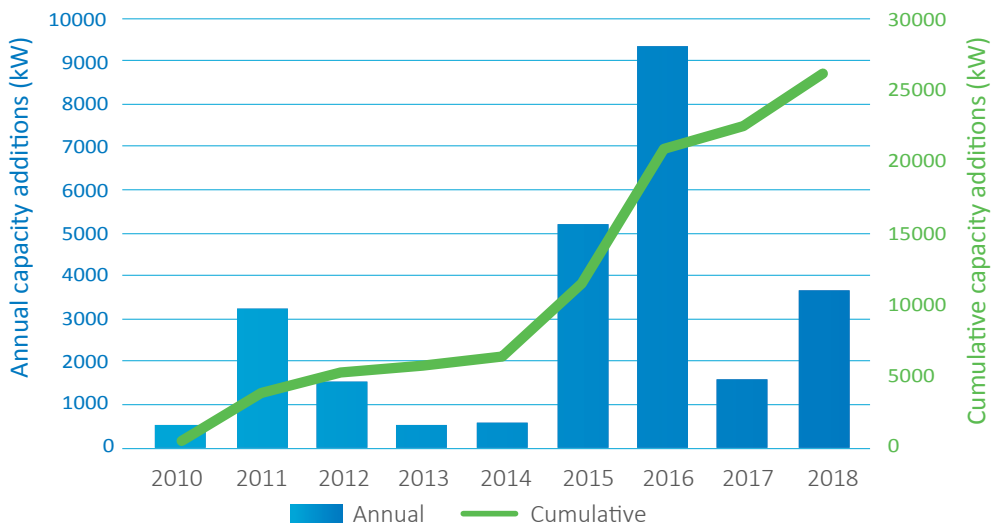

Figure 1: Annual & cumulative tidal stream capacity in Europe

Source: Ocean Energy Europe

3.7 MW CAPACITY WAS ADDED IN 2018 - DOUBLE THE 2017 FIGURE

[1] Tidal Stream turbines (typically 2- or 3- bladed) harness the water flow generated by the tides or marine currents to generate electricity. This new technology is very different from older Tidal Range turbines, which use conventional hydropower technology.

Cumulative installations - 26.8 MW of tidal stream technology has been deployed in Europe since 2010. Of this, 11.9 MW is currently operating, and 14.9 MW has been decommissioned as projects successfully complete their testing programmes.

Over the past decade, the sector's growth has been primarily driven by testing opportunities and RD&I funding programmes. From 2015 onwards, the first pilot farms, as well as high-capacity single devices, make up the bulk of installations.

Further acceleration is anticipated in the coming years, as there is a significant pipeline of tidal stream projects in Europe. Dedicated revenue support at national level is now needed to unlock these large-scale projects.

26.8 MW OF TIDAL STREAM HAS BEEN DEPLOYED IN EUROPE SINCE 2010

TIDAL STREAM - NUMBER AND TYPE OF DEVICES INSTALLED

Six devices were deployed in Europe in 2018 as part of demonstration projects. Half of the turbines installed were rated above 500 kW and half below 150 kW. This reflects the two main development strategies followed by tidal stream players: preparing for utility scale projects and adapting to small scale/ island markets.

Further convergence towards a 'wind-like' – horizontal-axis turbine – design can also be observed, although a small number of vertical-axis turbines are also under development.

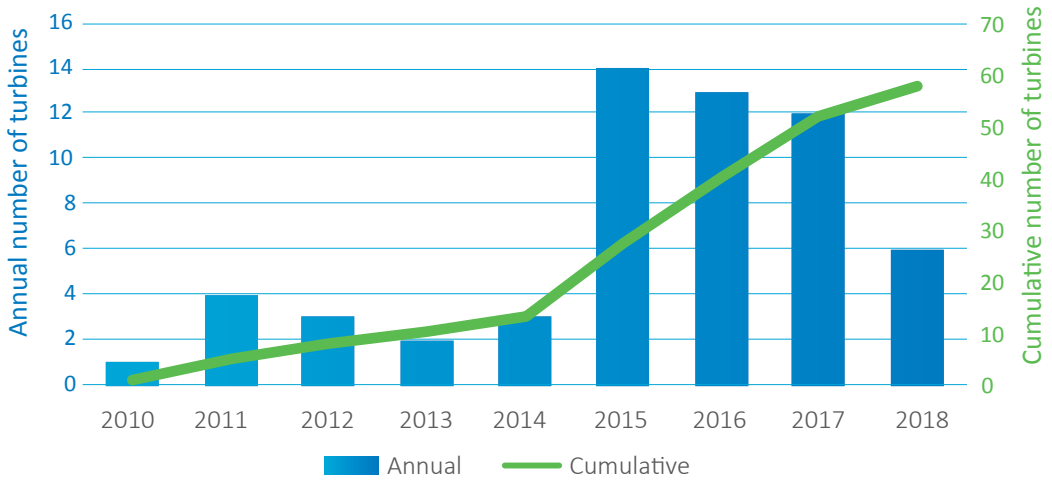

Figure 2: Annual & cumulative tidal stream installations in Europe

Source: Ocean Energy Europe


Photo: Corpower

Wave energy: Steady growth in cumulative capacity since 2010

WAVE ENERGY - INSTALLED CAPACITY

Annual installations - 500 kW of wave energy was installed in Europe in 2018, mostly from devices producing grid-ready electricity. Installations have been mainly driven by testing opportunities and RD&I funding.

Several wave device developers are also targeting niche markets, such as aquaculture and oil & gas, who are becoming off-takers for ocean-produced electricity. These sectors require electricity to support offshore operations, and make use of smaller, tailored wave energy devices.

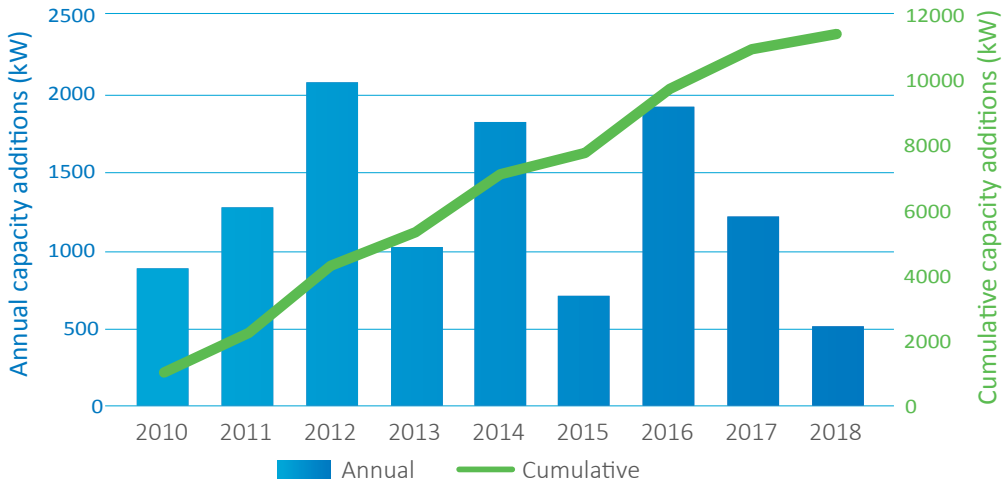

Figure 3: Annual & cumulative wave energy capacity in Europe

Source: Ocean Energy Europe

Cumulative installations - 11.3 MW of wave energy has been installed in Europe since 2010. 2.9 MW is currently in the water and 8.4 MW has been decommissioned following successful completion of testing programmes. The steady increase in cumulative capacity shows the continuous development of the wave energy sector.

11.3 MW OF WAVE ENERGY HAS BEEN INSTALLED IN EUROPE SINCE 2010

WAVE ENERGY - NUMBER AND TYPE OF DEVICES INSTALLED

8 wave energy converters (WECs) were installed in European waters in 2018. Several different concepts, targeting different types of wave resource, have been developed successfully. However, among devices based on a similar concept, we see that design convergence is taking place.

The average WEC capacity was around 60 kW. All but two were sub-scale devices, with full-scale versions to be developed in the coming years.

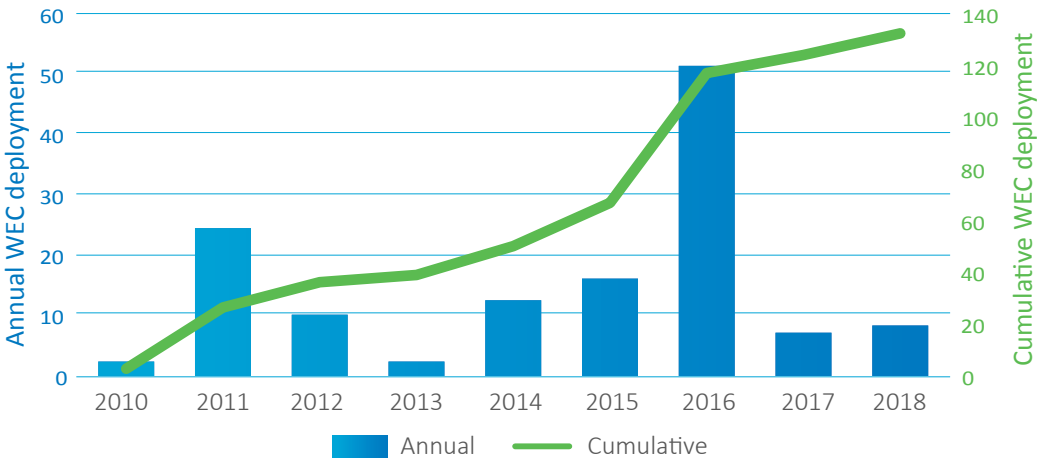

Figure 4: Annual & cumulative wave energy converter deployment in Europe Source: Ocean Energy Europe

Record-breaking electricity production in 2018

Installations of both tidal and wave energy devices have significantly accelerated since 2015. Demonstration and pilot projects made up the bulk of those installations, with devices that will stay in the water for the long term. This is in sharp contrast to previous installations for testing programmes, where electricity production was limited to a short period.

As shown below, for the tidal stream sector this resulted in a sharp increase in GWh produced and fed into the grid. Beyond the electricity generated, these projects provide invaluable learnings on the behaviour of machines in an aggressive offshore environment.

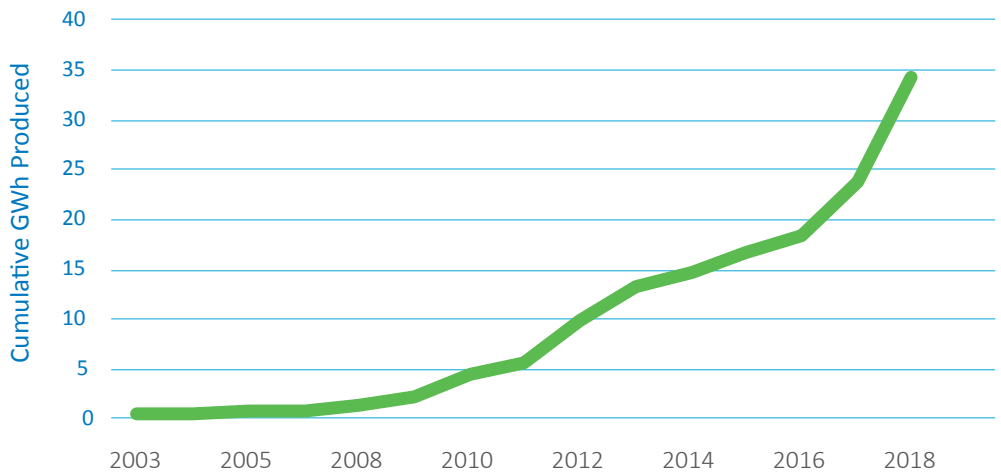

Figure 5: Cumulative GWh produced by tidal stream in Europe

Source: Ocean Energy Europe[2]

[2] Information gathered by OEE from the Ofgem Renewables & CHP Register, public releases from developers and information provided directly to OEE from developers.

Photo: SIMEC Atlantis Energy

SIMEC ATLANTIS ENERGY IN FULL OPERATIONAL PHASE

The Meygen project (phase 1A) is the biggest tidal stream demonstration project in the world. It boasts four 1.5 MW turbines and is the first stage in a consented 86 MW project. The project aims to demonstrate that the development of tidal arrays is both commercially viable and technically feasible. Invaluable lessons from the construction, installation, operation and maintenance of this project phase will help reduce costs for the next stages.

8 GWh of predictable, clean energy was generated in 2018. In March of that year, MeyGen set a new world record for monthly production from a tidal stream array, generating 1,400 MWh.

Photo: Nova Innovation

NOVA INNOVATION: CHAMPIONING SMALL-SCALE TIDAL

Nova Innovation has developed the world's first fully-operational, commercial, grid-connected offshore tidal array. In 2016/2017, three 100 kW tidal turbines were deployed in the Bluemull Sound, off the Shetland Islands in Scotland. Consistent, predictable power from the array is being exported to the Shetland grid.

Nova Innovation has recently secured funding to increase the size of the array to six turbines. This next phase will demonstrate that array reliability and performance can be maximised through best-practice maintenance regimes.

SABELLA: POWERING ISLANDS

Sabella is the most advanced tidal stream energy player in France. The Brittany manufacturer has already tested several turbines and has projects in France, Indonesia and the Philippines.

After several months of upgrades, Sabella successfully re-installed its D10 tidal turbine near Ushant in Brittany, France in autumn 2018. The full-scale turbine has been successfully providing power to the grid since then, generating on average 15% of the island's electricity needs, reaching 50% during peak tides.

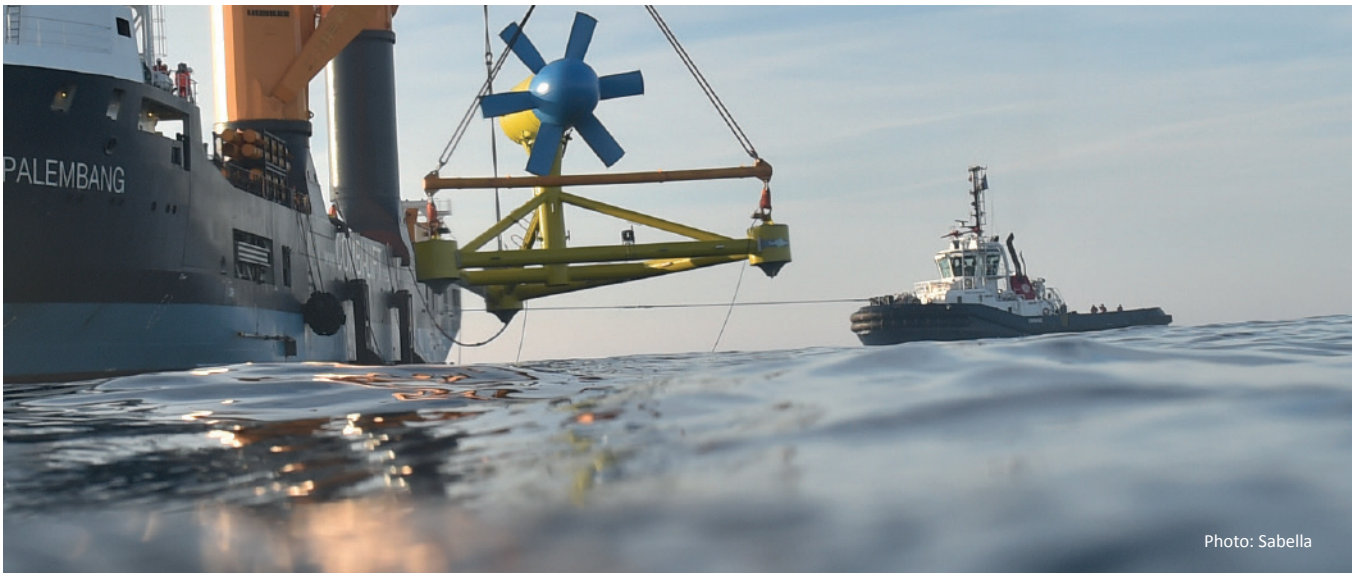

Photo: Sabella

TOCARDO: TRANSFORMING BARRIERS INTO POWERHOUSES

In September 2015, the Dutch developer Tocardo successfully installed a complete tidal energy array in the Eastern Scheldt storm surge barrier in just 2 hours. The five-turbine device is rated at 1.25 MW and produces enough electricity to power 1,000 households. This project represents a big step forward for the Dutch sector and the global tidal energy industry.

Photo: Tocardo

France, the UK and Italy lead installations

In 2018, Western and Northern Europe remained at the epicentre of ocean energy device installations. Deployments were mainly aimed at testing scaled and prototype devices in real sea conditions in both the tidal stream and the wave energy sectors.

France and the UK favourites for tidal deployments

Tidal stream developers predominantly chose France and the United Kingdom in which to test their devices. The world-leading test facilities and potential for scaling up were the main drivers of these decisions. Several developers intend to develop new, larger-scale projects both in Scotland and off the French North coast. However, national support is now urgently needed to propel the industrialisation of the sector, as political uncertainty pushes tidal developers to look beyond the Atlantic.

Country	Map Ref.	Location	Device Developer	Type	Capacity Device (kW)	Number of Turbines
FRANCE	1	Seeneoh	DesignPro Renewables and Mitsubishi Electric	Vertical axis	25	1
	2	Port of Brest	Guinard Energies	Horizontal axis	3.5	1
	3	Brittany - Fromveur	Sabella	Horizontal axis	1000	1
UK (SCOTLAND)	4	EMEC	Magallanes Renovables	Horizontal axis	2000	1
UK (WALES)	5	Anglesey	Minesto	Kite	500	1
BELGIUM	6	Port of Antwerp	Water2Energy	Vertical axis	150	1

Figure 6: European tidal stream deployments by country in 2018

Source: Ocean Energy Europe

Italy and Scandinavia driving wave energy activity

Many EU coastal countries enjoy a wave resource ranging from good to excellent. This fosters dynamic wave device developments all across the EU, with an emphasis on Italy and Scandinavia for 2018.

In Italy, 40South Energy is working on the updated version of its devices with Enel Green Power in the Marina di Pisa. The oil and gas utility ENI is also active in the sector, partnering with the US-based company OPT on a project in the Adriatic Sea.

Scandinavian developers have also been very active. Corpower continued with the testing of its S3 device at EMEC. Crestwing deployed its full-scale wave energy converter in the port of Frederikshavn. Wavepiston started the test of its sub-scale device at the Danish wave energy Centre.

Supported by a grant from the German government, SINN power added 2 new wave energy converters to its project in the Greek port of Heraklion.

Country	Map ref.	Location	Device Developer	Type	Capacity (kW)	Number of devices
ITALY	1	Marina di Pisa	40South energy	Submerged pressure differential	50	1
	2	Adriatic	OPT	Point absorber	3	1
UK (SCOTLAND)	3	Shetland	Aqua Power Technologies	Point absorber	5.2	1
DENMARK	4	Port of Fredrikshaven	Crestwing	Attenuator	300	1
	5	Danish Wave Energy Centre, Hanstholm	Wavepiston	Attenuator	12	1
FRANCE	6	Port of la Rochelle	HACE	Oscillating water column	50	1
GREECE	7	Heraklion	SINN Power	Point absorber	24	2

Figure 7: European wave energy deployments by country in 2018

Source: Ocean Energy Europe

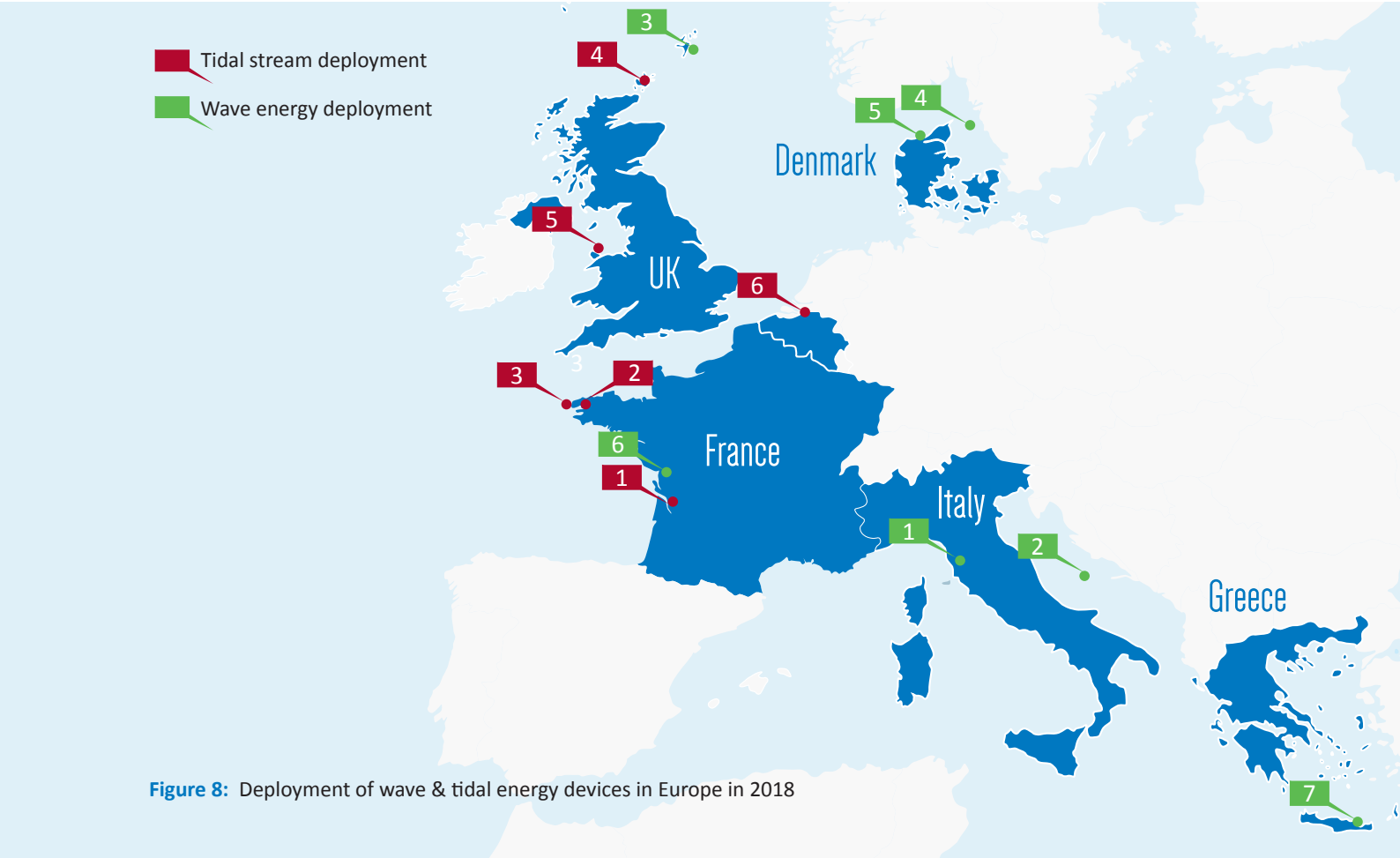

Figure 8: Deployment of wave & tidal energy devices in Europe in 2018

Rest of the world: closing the gap on Europe

Historically, Europe has been the development centre of the ocean energy sector, but the rest of the world is slowly catching up. The lack of long-term perspective and national support in Western Europe is pushing European developers to look for export opportunities.

Europe remains the world leader in wave energy installations

With an average installed capacity of 1250 kW per year since 2010, Europe remains the world leader in wave energy converter deployment. Its strong support mechanisms for RD&I and its world-class research centres have helped wave energy manufacturers to innovate and progress towards commercialisation.

Australia has driven the bulk of international wave energy deployment in the past few years, but its current national energy policy isn't supportive enough to maintain this lead.

The USA has recently become a strong contender: the country has an abundant wave resource and several national device manufacturers. Financial incentives have been ramped up in recent years, reaching US$70M yearly spending in 2017 and 2018. Those will most likely boost the American ocean energy sector in the coming years.

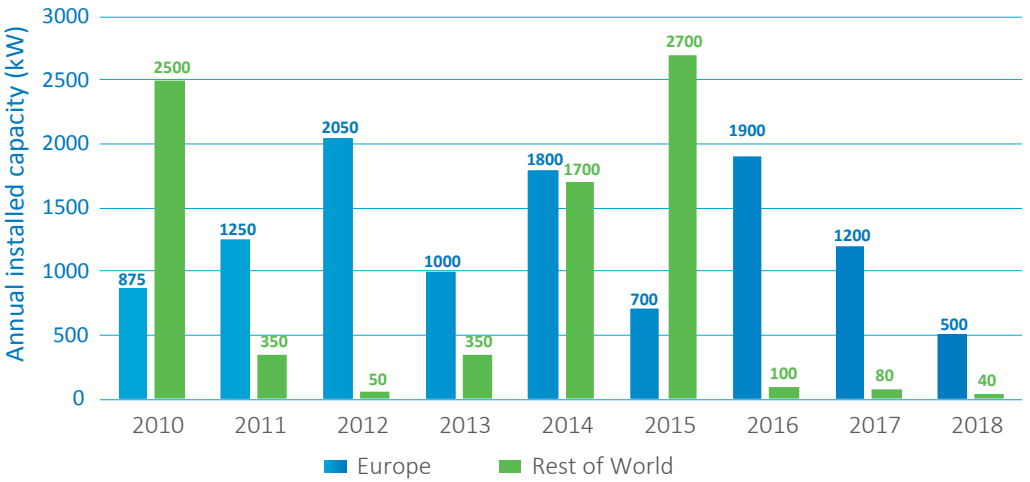

Figure 9: Global installed wave energy capacity

Source: Ocean Energy Europe

EUROPE LEADS THE WORLD IN WAVE ENERGY, AVERAGING INSTALLATIONS OF 1250 KW PER YEAR

However, the rest of the world is catching up in tidal stream

Europe has been and remains a leader in terms of tidal stream capacity installations and state-of-the-art technology. A healthy research ecosystem, combined with adequate RD&I support, has driven the sector to the pilot farm/pre-commercial stage. However, the absence of revenue support at national level is slowing down the sector's take-off.

Other countries such as Canada, China and the USA have now entered the race and are partnering with European companies to create a homegrown tidal stream industry. Several full-scale prototypes are being manufactured and tested.

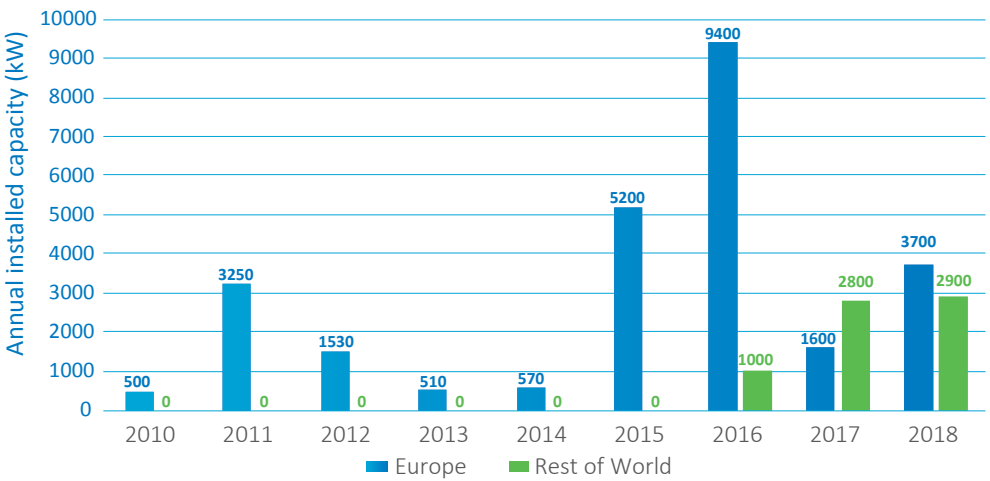

Figure 10: Global installed tidal stream capacity

Source: Ocean Energy Europe

Photo: Sustainable Marine Energy

Canada: A new, blue El Dorado?

In recent years Canadian public authorities, both national and regional, have built a framework which is very attractive to ocean energy developers and investors, in particular for tidal energy technology.

Grid-connected, fully-consented tidal energy sites supported by multi-year revenue support of €330/MWh[3] are available to European developers.

2.4 MW of ocean energy was deployed in Canada in 2018:

- The 280 kW Schottel/Sustainable Marine Energy Plat-I floating tidal platform was deployed in the bay of Fundy;
- The Canadian developer Big Moon Power deployed a sub-scale 100 kW device in Nova Scotia;
- Naval Energy deployed its full-scale Open Centre 2 MW turbine at its berth in Fundy;
- Neptune Wave installed a 2.5 kW wave energy converter in British Columbia.

China: A discreet but dynamic player

Interest in ocean energy technologies has increased recently in China, with two partnerships being signed with European companies in 2018 (Wello, SIMEC Atlantis) and several homegrown devices being tested – some very similar to European technologies.

The Chinese company LHD plans to deploy 3.4 MW of tidal stream in Zhoushan. Two 500 kW turbines were installed in 2016 and another 500 kW turbine was deployed in 2018, raising the plant capacity to 1.5 MW.

More is planned for 2019, as Blue Shark Tidal and China Shipbuilding Industry Corporation aim at launching their first turbines in Chinese waters next year.

[3] 'DP Energy Expands Canadian Investment' DP Energy press release, Jan 2018. All Canadian dollars converted into euros, 1 CAD = 0.62 EUR

2019 outlook: More projects to hit the water

Up to 8 MW of tidal stream and 3.4 MW of wave energy could be installed in Europe in 2019 - a significant increase on 2018 deployments.

Tidal energy: One of the best years ever

2019 could be tidal stream's best year ever in Europe, with up to 8 MW of projects in the pipeline. Installations should be driven by SIMEC Atlantis Energy's Meygen extension and deployments at TTC-Grevelingendam in the Netherlands.

Outside of Europe, tidal stream deployments could reach 3.1 MW. Canada, China and the USA will lead the way in terms of new installations.

Wave energy: Going full scale

2019 is set to continue the impressive progress made by European wave developers, with AW Energy, Wello Oy and Laminaria all expected to deploy full-scale devices. In total, 3.4 MW could be installed in Europe – six times more than in 2018. 1.2 MW could be installed in the rest of the world, mostly in the USA.

Photo: FORCE

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 the many benefits of membership:

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Ocean Energy Europe

About Ocean Energy Europe

Ocean Energy Europe (OEE) is the largest network of ocean energy professionals in the world. Our mission is to create a strong environment for the development of ocean energy, improve access to funding, and enhance business opportunities for our members.

Over 120 organisations, including Europe's leading utilities, industrialists and research institutes, trust OEE to represent the interests of Europe's ocean energy sector. If you're active in the ocean energy sector, we can help your business grow.

As a not-for-profit organisation, every euro invested in OEE is used to promote the European ocean energy industry.

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