OBSERVATORY NOTES
#16 MARCH 2022

TIDAL STREAM ENERGY
ON THE THRESHOLD OF PILOT FARMS

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The technological challenges raised by tidal stream energy technologies are being overcome, as demonstrated by the many projects in advanced development or already successfully completed.

Costs are falling, but visibility and volume are needed. There are many advantages, such as the limited environmental impact of the machines, particularly given the small footprint, the predictability of production, and the absence of landscape impact for most technologies. In addition, the French value chain, which is already being structured and creating jobs, offers good opportunities for coastal communities.

It should be remembered that the economically exploitable potential in the next 20 or 30 years is of the order of 50 to 100 GW worldwide, including 4.5 GW in France, making our country one of the biggest potentials for this energy source.

France benefits from substantial investments, available port infrastructures and networks as well as numerous feedbacks in this domain. It must seize the opportunity to become one of the world leaders. In a very competitive international context, our country must now plan the allocation of the necessary volumes with appropriate support mechanisms

WHAT ARE WE TALKING ABOUT?

A tidal turbine is a device, usually a turbine, that uses the kinetic energy of marine and/or river currents to generate electricity.

It consists of several elements:

➡ A turbine composed of blades that collect the kinetic energy of the current and transform it into mechanical energy ;

➡ A supporting structure to hold the turbine underwater, close to the surface or on the bottom ;

➡ A mechanical transmission (gearbox) and a generator to transform mechanical energy into electrical energy.

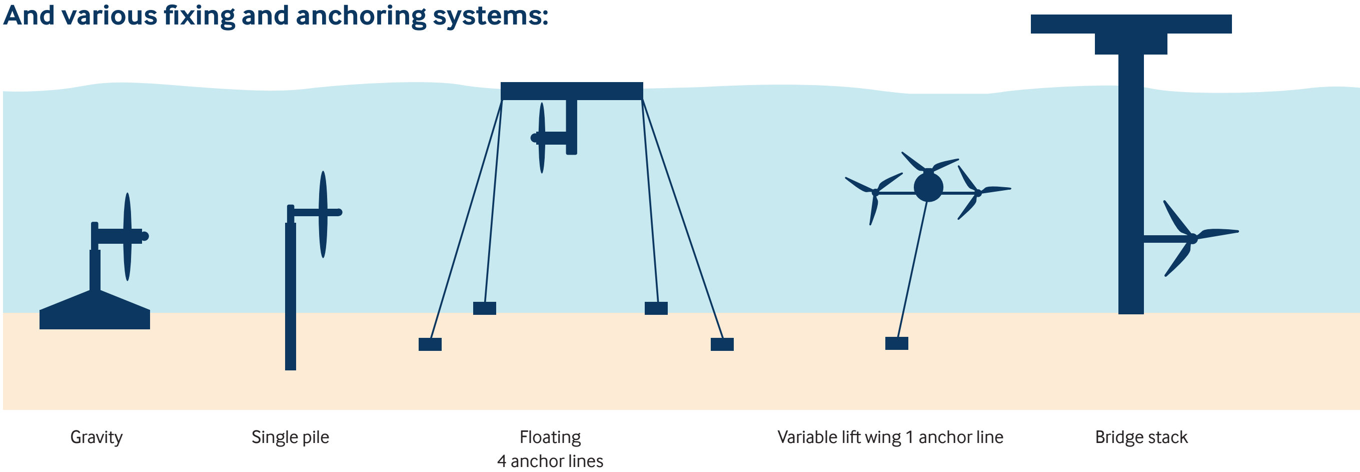
There are several concepts:

➡ Axial flow tidal turbines: the rotation of the blades is caused by a current parallel to the rotation axis.

➡ Transverse flow tidal turbines: the axis of rotation of the rotor is perpendicular to the direction of flow of the current.

➡ Oscillating hydrofoil tidal turbines: the motions of a wing/hydrofoil are taken up by a linear generator or a piston injecting a high-pressure fluid to a turbine to produce electricity.

And various fixing and anchoring systems:



TIDAL STREAM ENERGY, A LOCALISED RESOURCE

Tidal currents are generally accelerated by the topography of the continental shelf, especially around capes, in straits between islands and in areas of shallow water.

The current speeds sought are generally greater than 2m/s at depths of 30 to 50 m or more depending on the technology. The tidal stream resource is therefore very localised but not negligible. It totals around 100 GW in the seas and oceans. To this should be added the potential of the world's major rivers, whose resources are still poorly estimated.

OCEAN ENERGY, A PARTICIPATING RESOURCE TO ACHIEVE CARBON NEUTRALITY IN EUROPE BY 2050

Tidal stream energy is a key technology for achieving European and French objectives

On 19 November 2020[1], the European Commission set out its strategy for harnessing the potential of marine energy for a climate-neutral future by 2050. The aim is to increase the installed capacity of ocean energy (tidal and wave) to 100 MW by 2025, to 1 GW by 2030 and to 40 GW by 2050[2].

Europe is investing massively in R&D and innovation projects for the benefit of marine renewable energies, with €383 million injected into the Horizon 2020 programme and almost €200 million into the INTERREG programmes since 2016. In addition, there are other tools and funds including the European Maritime and Fisheries Fund, OceanERA- NET, NER300, InnovFin, etc.[3]

THE MOST MATURE OCEAN ENERGY SECTOR, TIDAL ENERGY IS THE MAIN CONTRIBUTOR TO THE EUROPEAN ENERGY MIX.
FRANCE CAN PLAY ITS FULL PART WITH A PORTFOLIO OF 30 MW OF PROJECTS IN ADVANCED DEVELOPMENT OFF THE FRENCH COAST.

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TIGER, A UNIQUE EUROPEAN PROJECT IN SUPPORT OF THE TIDAL TURBINE INDUSTRY

Sabella, Normandie Hydroliennes, Hydroquest and SEENEOH are partners in the INTERREG France (Channel) England project TIGER - Tidal Stream Industry Energiser - which brings together the main players in the tidal stream industry on both sides of the Channel. Supported by leading academics, the aim of the project is to create cross-border partnerships to develop new technologies, test them and deploy them on several sites in order to demonstrate the economic profitability of tidal energy and strengthen its contribution to the energy mix of France and the UK.

1. COM(2020)741
2. These figures should be seen in the context of the current installed capacity of 13.5 MW.
3. SET-Plan Ocean Energy – Implementation Plan – revision October 2021

THE DECREASE IN THE COSTS OF TIDAL STREAM ENERGY, A TRAJECTORY THAT HAS BEGUN

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How much does a tidal turbine cost?

In 2020, the cost of a tidal turbine demonstrator is on average €12M per MW installed. A floating offshore wind turbine costs €10M per MW installed and a fixed offshore wind turbine costs €7.3M[4] per MW installed (excluding connection).

These differences can be explained by the fact that offshore wind is three decades ahead of tidal power. Indeed, the current installed base of tidal power (30 MW in Europe) corresponds to the volume of offshore wind installed in the late 1990s[5].

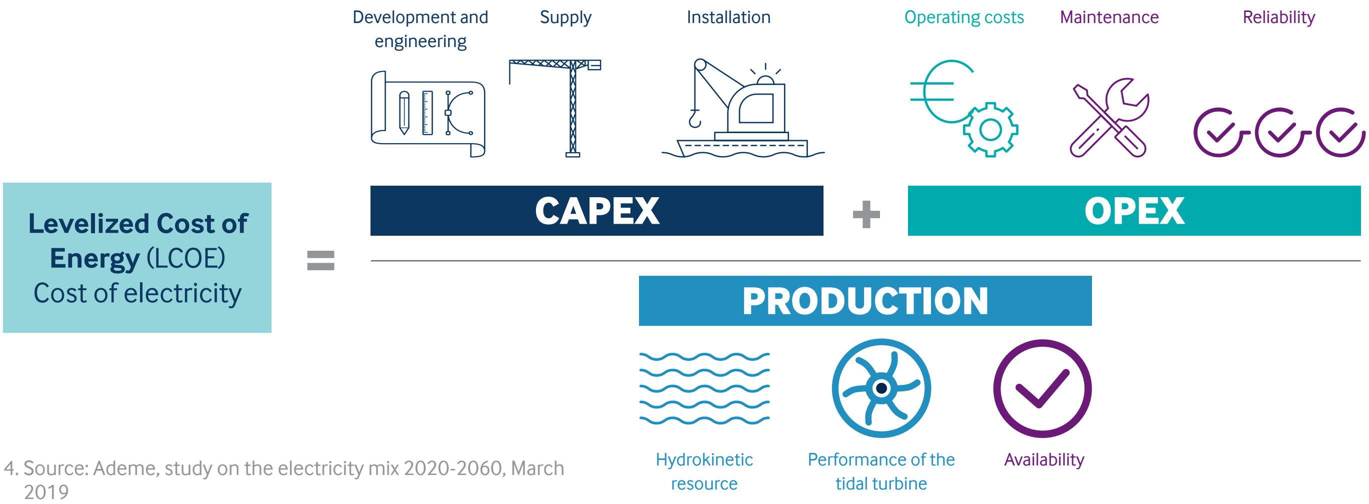
As with all renewable energies, tidal energy technologies are experiencing a significant decrease in costs as they progress:

➡ 50% of machine costs between the demonstrator and the pilot farm

➡ 30% of machine costs between the pilot farm and the first commercial farm

The cost of electricity or *Levelized Cost of Energy* (LCOE) is composed of many parameters. Firstly, the resource, i.e. the speed and quality of the power, has a major influence on the deliverability. The engineering, manufacturing and installation of the machines will determine the investment cost for the deployment of the project. Finally, the operation and preventive or curative maintenance operations will determine the annual operating cost of the installation. The reduction in costs will be reflected in all of these levers.

THE COMPARISON WITH THE DECREASE IN COSTS OBSERVED IN THE OFFSHORE WIND INDUSTRY HIGHLIGHTS A COMPARABLE TRAJECTORY FOR TIDAL POWER, WHICH WILL RELY ON THE SAME COST REDUCTION LEVERS.



4. Source: Ademe, study on the electricity mix 2020-2060, March 2019
5. Étude stratégique de la filière hydrolien, CVA for ADEME, 2018.

The cost of the electricity produced

Today, in the demonstration phase, the cost of tidal energy is around €300/MWh, i.e. a cost level comparable to that of solar photovoltaic energy in 20106 for only 30.2 MW of installed tidal energy capacity. As we move into the commercial phase, this cost will be reduced to around 100€/MWh7. Projections for the Raz-Blanchard site, an exceptional site, make it possible to drastically reduce this cost even more quickly, according to the information gathered from several industrial players:

The Raz-Blanchard an exceptional resource accessible at low cost

By 2030, the LCOE will reach about 80 €/MWh according to the following development trajectory:

2022, the realisation of the pilot farms :

- ➡ LCOE of 200 to 300 €/MWh
- ➡ 10 to 20 MW facilities
- ➡ Unit capacities from 0.5 to 3 MW
- ➡ Projects under development: 30 MW

2025, the launch of the first tenders for pre-commercial farms:

- ➡ LCOE of 120 to 150 €/MWh
- ➡ 100 MW facilities
- ➡ Unit capacities from 0.5 to 5 MW
- ➡ Projects awarded: 250 to 500 MW

2030, the launch of commercial tenders:

- ➡ LCOE < 80 /MWh
- ➡ 500 MW facilities
- ➡ Unit capacities up to 5 MW
- ➡ Projects awarded: >1 GW

Cost reduction factors

Economies of scale and volume effects

Economies of scale refer to site size and turbine size. Volume effects are related to the increase in project size.

- ➡ **Multi-megawatt turbines** are in advanced development and will be able to reach up to 5 MW of power.
- ➡ **The increase in the size of sites and projects** makes it possible to industrialise and standardise common components, to pool machine costs.

These phenomena, which are intuitive and observable in all industries, will occur under the same conditions in the case of tidal energy.

Learning curve

The experience gained has a considerable impact on the LCOE. These learning effects can be observed in all phases of development: engineering, manufacturing, installation, operation. They are numerous and among them can be mentioned:

- ➡ Knowledge of the environmental conditions of the sites, e.g. good understanding of the parameter of turbulence or extreme sea states, allows the design and sizing of machines to be improved.
- ➡ Experience of offshore operations, laying, recovery operations, allows improvements from the design stage.
- ➡ Capitalising on investments made for offshore wind in terms of infrastructure, particularly ports and logistic facilities.
- ➡ Real-conditions demonstration provides a great deal of learning

Technological innovations

Some examples:

- ➡ **Subsea connection hub:** from a certain number of connected machines, mutualisation drastically reduces infrastructure costs.
- ➡ **Foundations:** the development of specific drilled foundations will allow a consequent decrease in their costs.
- ➡ For some technologies, t**he buoyancy of the components** to avoid large vessels and to widen the windows of intervention at sea.

6. International Renewable Energy Agency (IRENA), Renewable Power Generation Costs in 2019, 2019
7. ORE Catapult, Tidal Stream and Wave Cost Reduction report, 2018

The cost of capital

As the perception of risk by investors weighs heavily on the cost of financing projects, the pilot farm stage for tidal energy is decisive for accumulating production hours and thus reducing the levels of uncertainty about the deliverability and proper operation of the machines. With 1.4 million hours of operation on the industry's clock, the decrease in the empirical failure rate and the probability of failure has been reduced in proportions comparable to the wind industry at the same stage of development[8].

THESE COST REDUCTIONS ARE THEREFORE POSSIBLE AND REQUIRE THAT FRENCH GOVERNMENT PROVIDES VISIBILITY AND VOLUME TO THE SECTOR THROUGH THE NEXT MULTIANNUAL ENERGY PROGRAMME.

© Hydroquest

Pre-commercial tidal turbine tender already launched in the UK

On 24 November 2021, the British BEIS[9] announced the launch of Auction Round 4, or renewable energy tender including a volume of capacity ring-fenced for tidal stream energy for an amount of £20M per year, considering that 34 MW of projects could thus be financed up to a maximum administrative price (strike price) of £211/MWh, i.e. 250€/MWh.

Nova Scotia, an attractive destination for wind energy projects

In Canada, the government of Nova Scotia introduced a feed-in tariff programme in 2015 for tidal turbine demonstrators and pilot farms of between CAD 385 and CAD 530 MWh (i.e. between €272 and €374/MWh) depending on the unit capacity and expected production.

8. Coles D et al. 2021. A review of the UK and British Channel Islands practical tidal stream energy resource.
9. Department for Business, Energy & Industrial Strategy

A LOW-IMPACT INDUSTRY WITH POSITIVE EXTERNALITIES

Predictable energy to support the power grid

Renewable energies are variable in nature, which means that they produce electricity at a variable power depending on the resource available during the day. Consequently, the grid operator who has to permanently ensure the supply-demand balance or balancing has to both support and manage in real time.

The advantage of tidal energy is that it is predictable and stable. This means that electricity production is predicted and known years in advance, which represents considerable savings.

Recent work[10] has shown that tidal stream energy can smooth out the production curve of other renewable generation sources, particularly in non-interconnected areas, and thus save volumes of installed capacity (renewable or not) mobilised in periods of peak consumption. In addition, its proximity to the coastline means that tidal energy benefits from relatively low connection costs.

Other studies in the United Kingdom[11] have shown that the presence of tidal energy in the energy mix can significantly reduce CO2 emissions by reducing the use of fossil fuels, which still make up a large part of the base-load capacity.

Invisible energy with low environmental impact

The reference literature in the sector[12] , demonstrates **the absence or very low environmental impact** of tidal turbines as far as the tests carried out so far are concerned:

- ➡ No marine mammal or bird collisions were observed ;
- ➡ The noise generated by the tidal turbines is not likely to significantly alter the behaviour or cause harm to marine mammals or fish;
- ➡ Available data suggest that the impacts of electromagnetic fields emitted by export cables are limited, and that marine animals living near the parks are not likely to be affected by these fields ;
- ➡ Tidal turbines and their foundations can provide a benthic habitat that will attract fish and wildlife, creating artificial reefs and refuge areas;
- ➡ Tidal turbines have not been shown to affect oceanographic systems, by altering water circulation, wave height, current speed, sediment transport and water quality.

Environmental monitoring of commercial deployments will help to confirm these initial results and direct research efforts towards any proven risks.


© Hydroquest

10. Trondheim, 2020, Renewable Energy in Isolated Electricity Systems. operation with SEV, Aalborg University and the University of the Faroe Islands (thesis in progress)
11. Coles, D.; Angeloudis, A,Goss, Z., Miles, J. Tidal Stream vs. Wind Energy: The Value of Cyclic Power When Combined with Short-Term Storage in Hybrid Systems. Energies 2021,
12. Copping, A.E. and Hemery, L.G., editors. 2020. OES-Environmental 2020 State of the Science Report: Environmental Effects of Marine Renewable Energy Development Around the World. Report for Ocean Energy Systems (OES)

KEY FIGURES FOR TIDAL INDUSTRY IN FRANCE

(2020 figures)

77 companies are positioned in the sector

148 FTE

3,8 M€ of turnover

5,1 M€

(€21m invested over the period 2017-2020)

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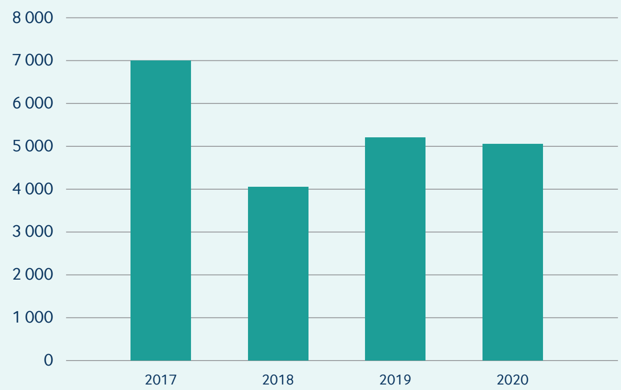
Surveys conducted by the French Observatory of Marine Energies have shown that employment in the sector represents about 150 FTEs since 2019. Nearly 1/4 of these jobs concern research activities (against 5% for offshore renewable energies in general). Developers/operators represent 2% of jobs (compared to 12% for offshore renewables as a whole). 73% of jobs in the sector are FTEs from service providers and suppliers in the value chain. Turnover fell between 2017 and 2020, from €10m to almost €4m. Investments have stabilised at around €5m since 2019. This distribution is characteristic of a sector that is waiting for large-scale deployment before moving to the industrial stage.

Most of the companies developing tidal energy today are from the maritime economy (64% declare this sector as their origin, 24% from shipbuilding and 18% from offshore renewable energy). The majority of the remaining companies are involved in diversifying their initial activity in the field of the environment and land-based renewable energy (26%).

As a pre-commercial technology, the companies' areas of activity focus on project and technology development assignments.

The sector is made up of 66% of VSEs and SMEs, but intermediate and large companies are not left out, representing respectively 24% and 10% of the companies in the sector.

Evolution of the investments made in the tidal energy sector (in k€)



THE FIRST INDUSTRIAL FACTORIES ARE THERE

The French value chain for tidal turbines is illustrated first and foremost by two manufacturers developing tidal turbines (HydroQuest and Sabella), whose concepts have been tested, allowing us to foresee their imminent commercialisation. The industrial subcontracting chain for the construction of tidal turbines is being set up and has a very strong national content. HydroQuest relies on the factory of its industrial and financial partner CMN in Cherbourg to produce its machines and to have recourse mainly to French subcontractors (80% of the cost of its prototype was located in France). Similarly, Sabella will have a relay workshop in 2022 on the MRE polder in the port of Brest to produce its first tidal turbines before building its own manufacturing plant. Also, Simec Atlantis (turbine maker for Normandie Hydroliennes) has already carried out a referencing of its potential subcontracting chain in order to maximise national spin-offs and has concluded that a large majority of the skills required for its activity exist in France and that the company could set up infrastructures there if sufficient volumes were to be produced.
Industrial companies and major French suppliers such as CDK Technologies, Efinor, ENAG, FMGC, Chantier Bretagne Sud, Schneider Electric and others are already active in the sector.

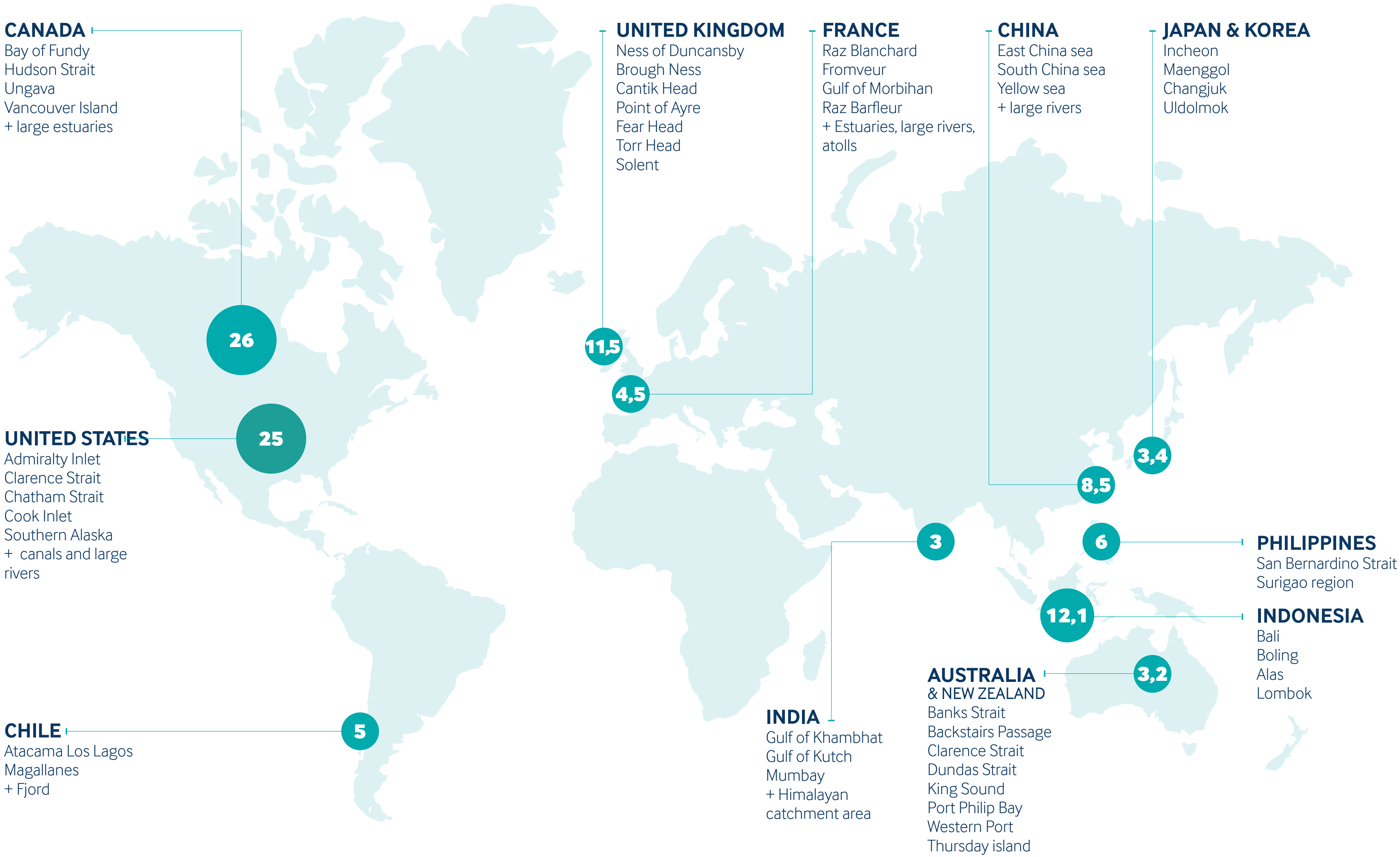
THE PRODUCTION OF 1 GW OF TIDAL POWER WILL GENERATE
1,500 DIRECT JOBS
ACCORDING TO HYDROQUEST.

TIDAL STREAM ENERGY
FRANCE MUST STEP UP A GEAR

The next Multiannual Energy Plan is the opportunity to register between 0.5 and 1 GW by 2030, with an overall target of 4 GW by 2050.
Already, in its production mix scenarios for 2050, RTE forecasts up to 3 GW installed in ocean energies, including tidal turbines.
These projects will enable the sector to become industrially structured, competitive and create jobs in the regions. In this way, tidal stream energy will contribute to the French energy mix, to the achievement of our climate objectives and to our energy sovereignty.

13. 2020. Black&Veatch. Lessons Learnt from MeyGen Phase 1A. Final Summary Report.

THE GLOBAL POTENTIAL OF OCEANIC TIDAL ENERGY IS ESTIMATED AT OVER 100 GW



THE CURRENT INSTALLED CAPACITY IS 30.2 MW AND MANY PROJECTS ARE UNDER STUDY OR BEING DEPLOYED

FRANCE

Sabella
✔⚡ Ushant Islands, 2019 – 2022. 1x1MW D10-1000
🗓📍 Golfe du Morbihan – Morbihan Hydro Energies, 2022, 2x250kW

HydroQuest / CMN
✔⚡ Paimpol Bréhat test site, 2019 to 2021, 1x1MW OceanQuest
🗓✔ Raz Blanchard, 2023.7x2.5MW (FLoWatt pilot farm 17.5 MW)

ECRC Atlantis Energy Normandie Marine turbines
🗓✔ Raz Blanchard, 2023. 4x3MW (12MW pilot farm)

Hydrokinetic Generation Power (HPG)
✔⚡ SEENEOH test site Bordeaux, 2022

GUINARD New Energies
✔ Moulin de Pen Castel-Arzon, Morbihan, 2018 ; 1x3.5kW (P66).
✔ French Guiana, Nouragues Station, Saut Pararé, 2018; 1x3.5kW (P66).

ITALIA

ADAG et SeaPower Scrl
✔⚡ Strait of Messina, 2000. 1x30kW
✔⚡ Venice, 2011. 1x100kW Ocean's Kite GEM
🗓✔ Strait of Messina. 300 kW

DENMARK

Minesto
✔⚡ Faroe Islands, 2020. 1x100 kW DG100.

HOLLAND

SeaQurrent
✔ Wadden sea 2018 & 2019. 1x15kW (1:10) attached to a barge
🗓⚡ Borndiep Pass near Frisian Island (Ameland) 2022. 1x500kW Tidalkite (1:1)

GERMANY

AquaLibre – Strom-Boje
✔ River Donau 2011, 1x50kW
✔ Rhine at Sankt Goar, 2020.1x70kW Strom-Boje 3.2

SCOTLAND

ECRC Atlantis Energy
✔⚡ MeyGen pilot site, Pentland Firth, 2020. 4x1.5 MW (Atlantis Resources AR1500 and Andritz Hydro Hammerfest AH1000 MK1)
🗓 Stroma Island, MeyGen Limited, 398 MW concession.

Orbital Marine Power
✔⚡ Orkney Islands EMEC test site 2019. 2x1MW (SR2000)
✔⚡ Orkney Islands EMEC 2021 test site 2021. 2x1MW (O2)
🗓 Orkney Islands EMEC test site 2023. 2x2MW

Nova Innovation
✔⚡ Bluemull Sound- Shetland Islands, 2020 4x100kW
🗓 2MW Extension
🗓 « Òran na Mara » (Sound of Islay). 3 MW

Sustainable Marine Energy et Schottel Hydro
✔⚡ Connel, Scotland, 2018, Sustainable Marine Energy and Schottel Hydro PLAT-I 4.63 (280kW) 4x70 kW

Magallanes Renovables
✔⚡ Orkney Islands EMEC Test Site 2019. 1x1.5MW ATIR

Jupiter Hydro
✔⚡ Orkney Islands, EMEC test site, 2011 & 2014. 1x1MW

WALES

Nova Innovation
✔⚡ Enli Island (Bardsey Sound), 2021 100kW + electrochemical storage (Tesla)

Minesto
🗓✔ Holyhead Deep, 2022. West Anglesey / Morlais Demonstration Area

✔ **Orbital Marine Power,** Morlais Menter Môn project
✔ **Sabella & Nova Innovation,** Morlais Menter Môn project
✔ **Inyanga Maritime Ltd,** Morlais Menter Môn project
✔ **Instream,** Menter Môn project
✔ **Verdant Isles Ltd,** Menter Môn project
✔ **Sustainable Marine Energy Ltd,** Menter Môn project
✔ **Aquantis,** Menter Môn project
✔ **Magallanes,** Menter Môn project
✔ **Big Moon Power,** Menter Môn project

CANADA

Nova Innovation
🗓 2022, Petit Passage, Nova Scotia Nova Innovation 0.1 MW

Sustainable Marine Energy et Schottel Hydro
✔ Grand Passage to Canada, 2018, PLAT-I 4.63 (280kW) 4x70kW
✔ Digby Neck, Nova Scotia, 2019, PLAT-I6.40 (420kW) 6x70kW. 2022
🗓 2022 (9 MW).
🗓✔ Pempa'q In-stream, FORCE test site, 2022 3 x PLAT-I 6.40 (1.26 MW)

Jupiter Hydro
🗓✔ Bay of Fundy, FORCE test site, 2022 1x1MW
🗓✔ Bay of Fundy, FORCE test site, 2024 1x2MW

NewEast Energy
🗓✔⚡ Passage Minas test site FORCE (Submarine Hub), 2023. 2x50kW (Phase1), puis 3x250kW (Phase2)

BIG MOON
🗓✔⚡ Passage Minas test site FORCE (Submarine Hub), 2023. 2x50kW (Phase1), then 3x250kW (Phase2)

Yourbrook Energy Systems
🗓✔⚡ Kamdis, 2022, 1x500kW + marine STEP (with BC HYDRO).

NewEast Energy
✔ Manitoba River, 2015. 1x25 kW

UNITED STATES

Verdant Power
✔⚡ 2020, New York (Roosvelt Island), Verdant Power 3x35 kW Gen5 (TriFrame™).

Ocean Renewable Power Company *(ORPC)*
🗓✔⚡ Western Passage (Eastport, Maine), 2023, 15x500kW TidGen®.

Ocean Renewable Power Company *(ORPC)*
✔⚡ Kvichak River at Lgiugig, Alaska, 2019. 1x25kW RivGen®

JAPAN

ECRC Atlantis Energy
✔⚡ Naru Strait, 2020 : 1x500kW AR500

CHINA

LHD New Energy Corporation
✔⚡ LHD test site, Xiushan Island, 2016. 400 kW, 600 kW, 400kW + 300kW Blue Shark Power (300 kW).
🗓▶ LHD test site, Xiushan Island, 2022. 4,1 MW

SOUTH KOREA

✔⚡ KIOST test site in Uldolmok (Myeongnyang Strait) 2009. 3 démonstrateurs + 1x500 kW Hyundai Heavy Industries (2011) + 150 kW)
🗓✔ Uldolmok, KIOST, K-TEC and EMEC test site, 1 location 0.5 MW
🗓✔ Jang-Juk Strait, KIOST, K-TEC and EMEC test site, 4 locations 1MW

PHILIPPINES

Sabella
📍 San Bernardino Strait, 2018.

INDONESIA

📍 Flores Timur Regency, 2021.

Tidal Bridge
🗓 Tidal Power Plant Larantuka

AUSTRALIA

Tenax Energy
📍 Clarence Tidal Energy Project in Australia, 2015.

GIBRALTAR

Blue Shark Power
📍 Strait of Gibraltar, 2017.

MADAGASCAR

GUINARD Energies Nouvelles
✔⚡ Ambatolaona, 2018 ; 1x3.5kW.

TOGO

GUINARD Energies Nouvelles
✔⚡ Ambatolaona, 2018 ; 1x3.5kW (P66).

REPUBLIC OF CONGO

Hydro-Gen
✔⚡ Congo River at Loubassa, 2021. 1x10kW

🗓 Planned
📍 Site survey
✔ Authorised
⚡ Connected

FOCUS ON NORMANDIE HYDROLIENNES

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Normandie Hydrolienne is the unprecedented alliance of a leading regional player, the Normandy economic agency – AD Normandie – with the most advanced British turbine manufacturer on the market, SIMEC Atlantis Energy, and EFINOR, a company specialising in metallurgy and design based in Cherbourg.
This union is the strength of the NEPTHYD project, a 12 MW tidal turbine pilot farm in Raz-Blanchard composed of 4 new generation turbines (AR3000) of 3 MW each, i.e. 24 m long blades.
With a pilot project installed in the north of Scotland at Pentland Firth since 2018, the MeyGen tidal farm, SIMEC Atlantis Energy has already made significant progress on several fronts: cost reduction, with a LCOE already below the average of €300/MWh. SAE is already on a cost reduction curve based on that of floating offshore wind. MeyGen's experience feedback, shared in a report made public13, has enabled to move from the AR1500 to the AR3000 version by integrating technical innovations.

The project has also provided an opportunity to learn more about wind turbine blade pitching, as well as a great deal about operations at sea.

"We place the reduction of offshore risk at the heart design of the tidal turbine: everything that can be done on land must be done. Failing that, what must be done at sea must be done quickly and as reliably as possible"
Drew Braxland, Technical Director of Simec Atlantis Energy.

The consortium's industrialisation strategy is based on locating the supply chain as close as possible to the deployment zone. To date, Normandie Hydrolienne is halfway through its pre-qualification process for this first 12 MW project, and plans to mobilise 75% of French companies and an assembly plant based in Cherbourg.

FOCUS ON HYDROQUEST

The year 2021 was marked by the end of the OceanQuest test campaign, a 1 MW tidal turbine, after two years of immersion in real conditions without damage on the Paimpol-Bréhat test site consented to EDF. This is an important step for these companies, which began their collaboration in 2015 and which has been strengthened in 2021 with the arrival of the utility company Qair, for the development of the FLOWATT pilot farm at Raz-Blanchard (17.5 MW). This installation, which is due to be commissioned in 2025, will produce an average of 41 GWh/year for 20 years.

The construction of OceanQuest has mobilised 50 FTEs in CMN's Cherbourg factory. Launched in April 2019 in Paimpol, the tidal turbine was retrieved and brought back in Cherbourg in October 2021. The conclusions of the technical expertise and environmental studies show that corrosion and biofouling have been limited and that a reef effect has been created at the foundations. The acoustic studies do not show any significant impact on marine mammals and fauna.

"The turbine is fully functional after 2 years of immersion, including its generator and its converter. The next generation of the tidal will be more efficient with a greater swept area and a 2.5 MW power unit. It will also be lighter and therefore cheaper to build and install."
Thomas Jaquier, President of Hydroquest.

The company is counting on the first markets off the Cotentin coast to position itself internationally, with a cumulative potential of 100 GW. *"Cherbourg is an ideal manufacturing location for the European market and the UK. The port infrastructures are already dimensioned and an adaptation of CMN's workshops will be sufficient to automate production and gain in competitiveness."*
This activity will generate significant spin-offs for the region since the manufacturer can rely on a chain of subcontractors that is essentially French and mostly regional.

FOCUS ON SABELLA

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Sabella has solid industrial experience, a real portfolio of projects and strong ambitions. The company is running two tidal turbine pilot projects in France: one off the island of Ouessant, and the other off Ile Longue in the Gulf of Morbihan. These emblematic projects, based in Brittany, are two catalysts of the dual strategy implemented by Sabella to maximise the performance equation and reduce operating costs.

Improve performance and reduce operating costs

Upstream, it is a question for Sabella of stabilising the integration of the latest innovative technological bricks which will enable a significant reduction in operating and maintenance costs. In January 2021, GE Renewable Energy's entry into the company's capital will result in a major contribution in terms of innovations from Océade technology (Alstom). Sabella thus has the right cards in hand to merge the best of the two technologies, while integrating its particularly rich experience feedback in terms of offshore deployments.

"The Gulf of Morbihan project will see the deployment of two tidal turbines, each incorporating several innovation to effectively compare the results of different devices and validate the final concept."
Fanch Le Bris, Managing Director of Sabella.

Preparing the future of green hydrogen and broadening horizons

Downstream, on the side of the uses of the energy produced, although the priority remains the validation of the economic model for injection into the power grid, Sabella is in line with the global trajectory of hydrogen development, with a view to widening the market outlets: approximately 30% of the suitable sites targeted by Sabella could be developed under technico-economic conditions more favourable to hydrogen production than to connection to the network.

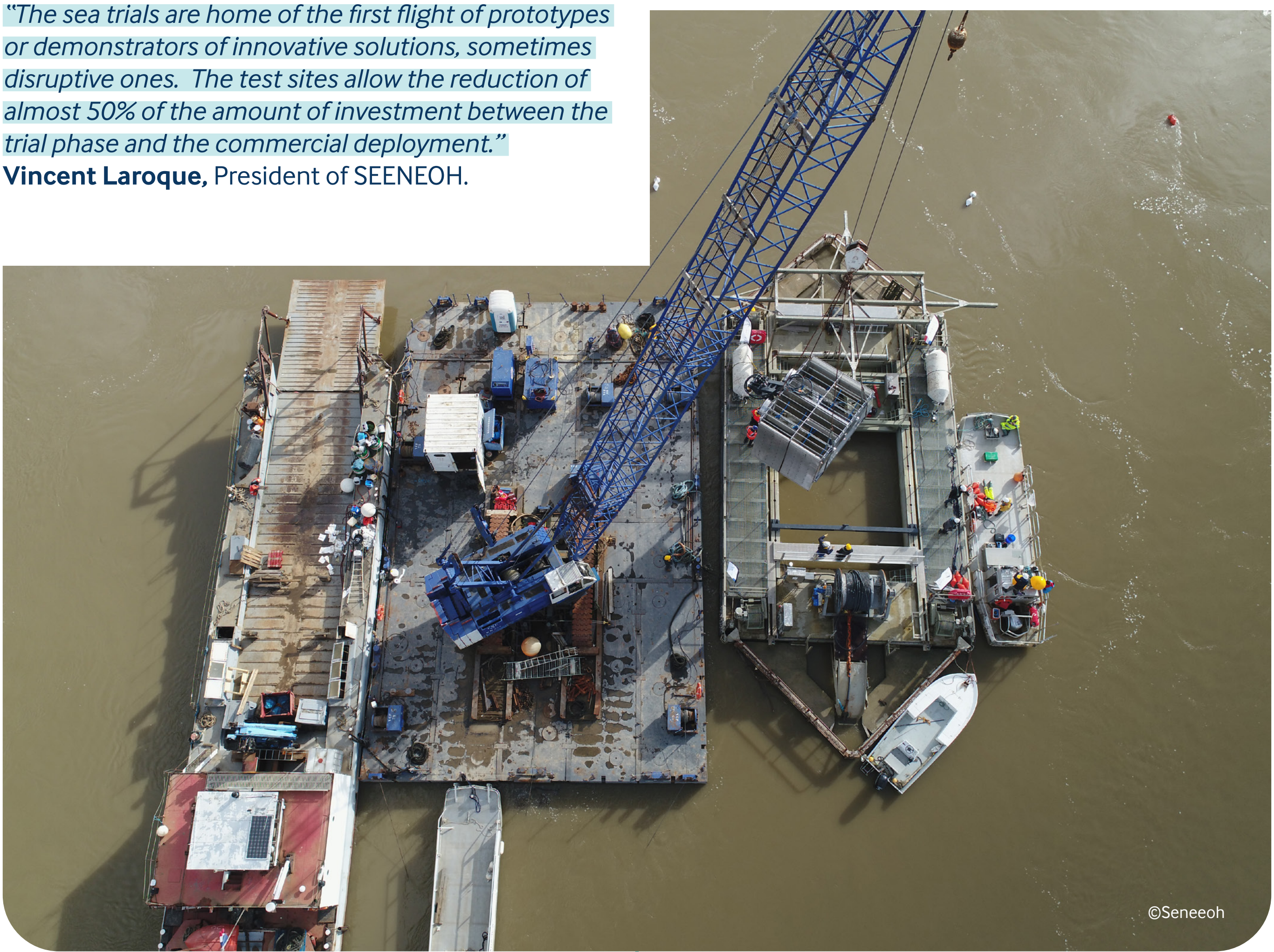
"In Ushant, a first application will be set up with the installation of an electrolyser on land to convert electricity into hydrogen, before setting up underwater or floating hydrogen production units."

FOCUS ON SEENEOH, REAL-SEA DEMONSTRATION

Test sites, such as SEENEOH in Bordeaux, are essential for technological development and the removal of non-technological barriers, as they offer access to infrastructure, simplified authorisation processes and pre-established logistics, all of which are no longer the sole responsibility of developers focused on testing their machines.
Real-sea testing is a fundamental step in the development of marine renewable energy, allowing significant conclusions to be drawn about the behaviour of devices in the natural environment.

France now has two tidal test sites. SEENEOH in Bordeaux, an intermediate-scale test site in the Garonne River, in the heart of the city, and the Paimpol-Bréhat site, in the Côtes d'Armor, granted to EDF, alongside which SEENEOH and the regional partners are organising to perpetuate the investments made by EDF for the testing of tidal turbines. Hydroquest (FR), Design Pro Renewables/GKinetic (IRL) technologies have been tested on the sites. HPG (NL) is expected in 2022.

"The sea trials are home of the first flight of prototypes or demonstrators of innovative solutions, sometimes disruptive ones. The test sites allow the reduction of almost 50% of the amount of investment between the trial phase and the commercial deployment."
Vincent Laroque, President of SEENEOH.



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