A SERCEL COMPANY

TREND REPORT

3 Key Trends in Renewable Energy and Subsea Cables

A Deep Dive for Engineers

Exploring the intersection of sustainability, technological advancements, and the offshore energy sector

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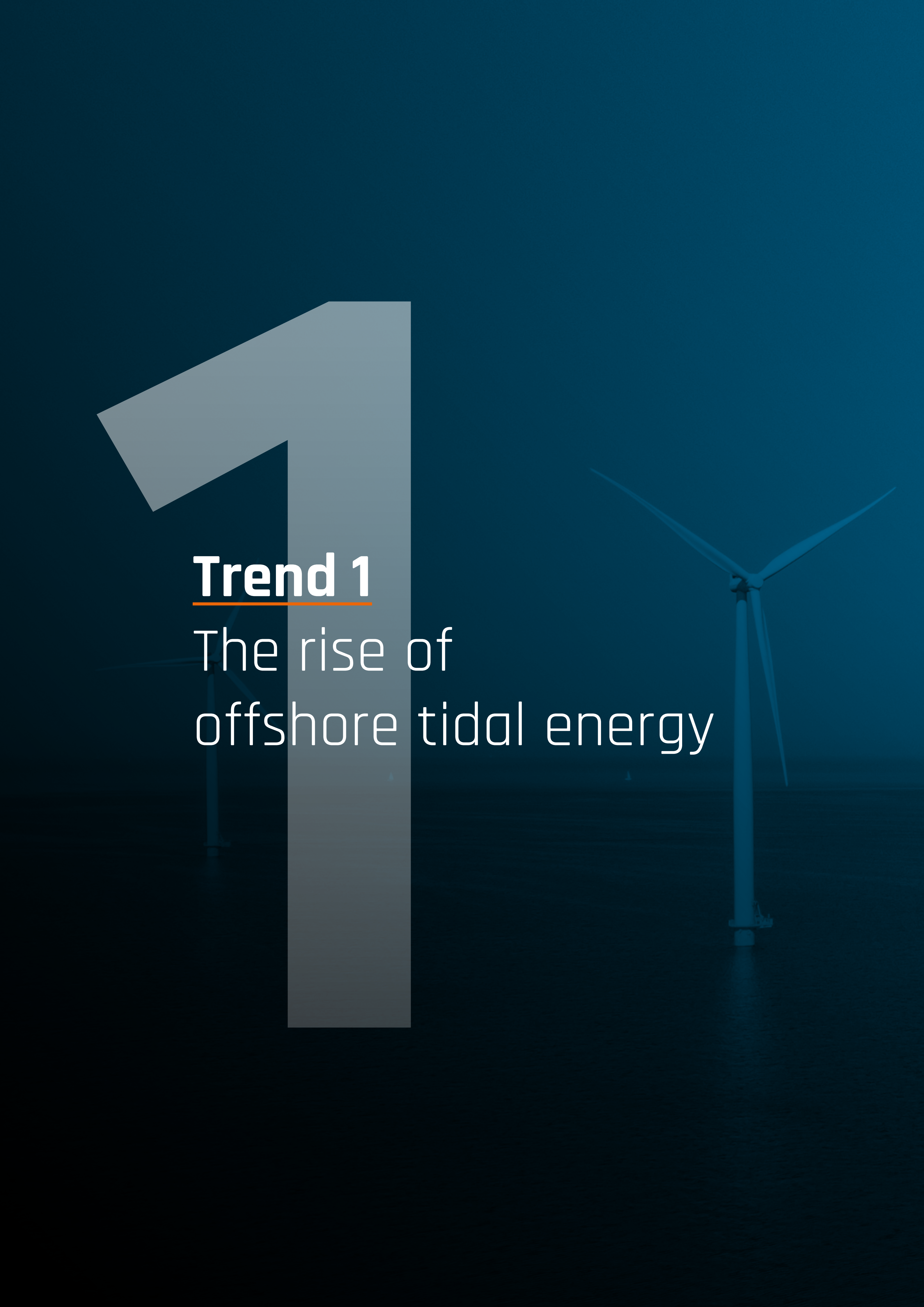
Introduction

How the growth and diversification of the ocean energy industry results in new and more efficient subsea connections

At the COP28 U.N. climate summit in Dubai, nearly 200 countries agreed to "transitioning away from fossil fuels in energy systems, in a just, orderly and equitable manner...so as to achieve net zero by 2050." They also set a global goal to triple renewables by 2030.

Over the past decade, solar power and offshore wind have proven that they can make a difference toward decarbonizing the energy supply. However, wind and solar both have certain limitations. In the quest for net zero carbon emissions, power companies also are looking towards alternative renewable technologies, specifically tidal stream and wave energy capture.

In this report, we outline three major trends in the offshore energy sector that are revolutionizing the renewables market by providing alternative sources that can help fill in gaps left by wind and solar, and also reduce the cost of energy to consumers.



Trend 1

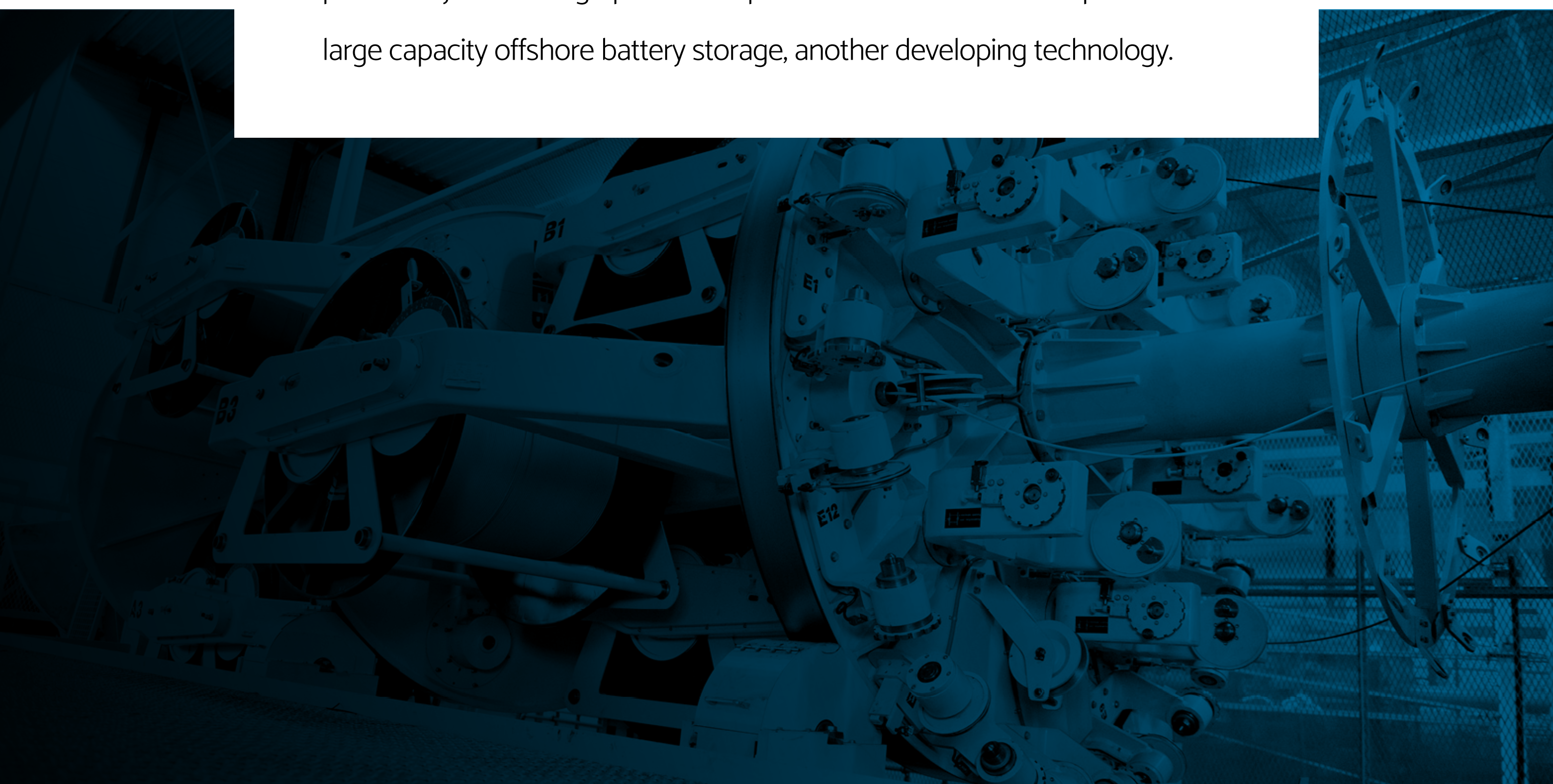
The rise of offshore tidal energy

Beyond today's wind and solar power on-shore

Offshore wind and on-shore solar are fast becoming major sources of energy in Europe and around the world. However, due to their intermittent nature–they are available only when the sun shines or the wind blows–these sources cannot be relied on for 24/7/365 electrical power.

To add to the problem, the price of electricity is constantly changing, so at certain times of day, such as early morning, the price per KWH is very high. Then, as solar and wind energy come online during the day, the price dips. But when the sun goes down, solar and wind generation drop and prices rise.

Seasonal patterns also mean that in winter months wind produces much more energy, while in summer, solar produces more energy. When it's too windy, more power is generated than what is needed on the grid. This causes the price of energy to drop so far that wind turbines lose profitability. But saving up the extra power to use later would require large capacity offshore battery storage, another developing technology.



The need for more alternatives

Coal, natural gas and nuclear energy continue to contribute power to the grid. But for countries that have pledged to work towards 100% renewables, there's a big need for alternative energy sources, such as tidal and wave energy. Building up a mix of several different types of renewable can significantly decrease the amount of fossil fuels needed. Because of the nature of tides, the energy generated by tidal turbines is nearly constant. And the peak generation of wave energy lines up closely with yearly consumption requirements, especially when combined with solar. Adding these complementary alternatives to the mix will help countries reduce reliance on fossil fuels faster and more reliably and create stability and a net positive for the energy grid.

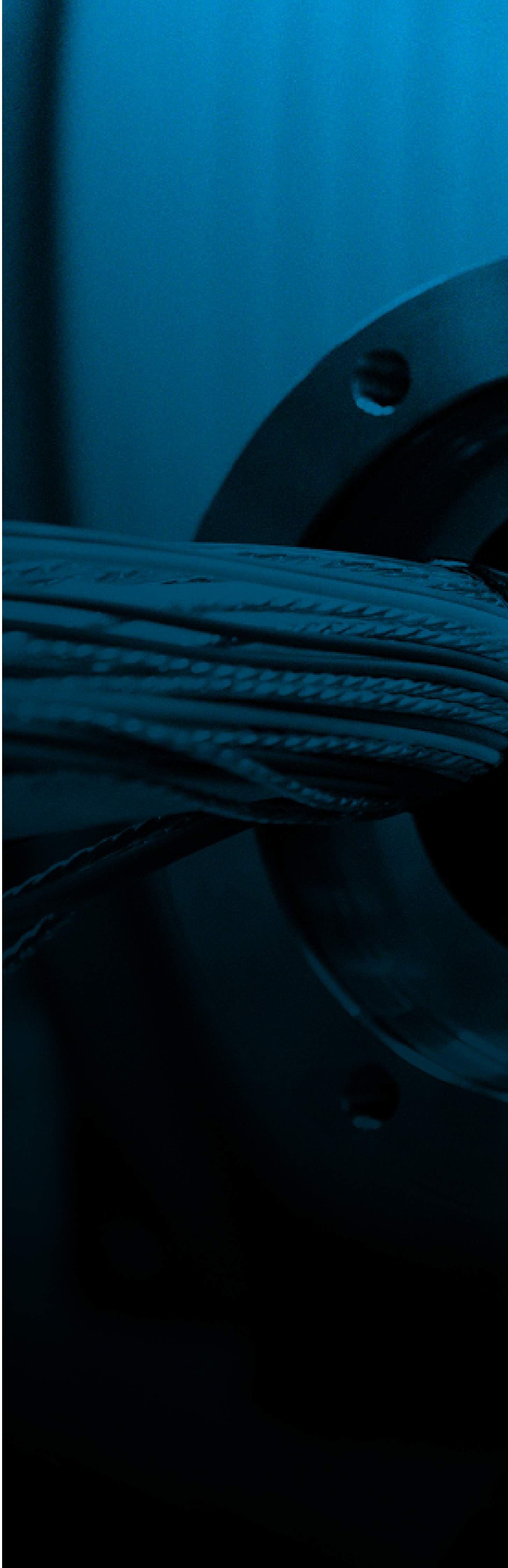
Technical challenges and solutions

For several years, a variety of projects around the world have been testing a wide range of solutions to discover the best, most efficient technologies for capturing energy from waves and tidal streams. Developers are quickly iterating designs, so that as each device goes in the water, a new one is designed which far surpasses the last one. The most important challenge for developers now is to move from building and testing a single device to scaling up to a production line which can make several devices a year. These will be deployed in larger numbers in order to reach commercial level power generation.

Subsea cable strategies

The overarching goal of wave and tidal energy projects is to transmit as much power as possible from sea to shore through secure, leak-proof cables and connectors. Two types of connectors will be needed–wet-mateable and dry-mateable.

Both types consist of electrical and optical connections as well as a mechanical design that can securely connect the cable to the hub underwater without leakage. New designs will be required to accommodate increased voltage and power transmission.



Political and economic factors

The political will to divest from fossil fuels received a huge boost once the Paris Climate Accord was signed in 2014. Since then, rising concerns about air pollution in 2nd and 3rd world countries like China have also nudged those countries toward change.

The nuclear disaster in Fukushima may have added to the push for renewables in Japan. And in the U.S. climate change mitigation has become a major focus for the current Administration.

The 2019-2020 pandemic and the Ukraine war have intensified the push for diversifying ocean energy sources. As a result of the geopolitical situation in Europe, RepowerEU was launched in May 2022 with the decision to stop using gas and coal entirely. Since then Europe has rapidly increased capacity in solar and wind. Diversifying with other technologies, including tidal and wave power, would make the transition go even faster.

While offshore wind remains a major source of renewable energy and will continue to grow, supply chain woes have tempered this growth due to difficulties in finding enough supplies (steel) to support rapid growth. At the same time, inflation and high interest rates have put a damper on investment, slowing the pace of growth for offshore wind.

Enter the CfDs

The UK has been hardest hit by the crisis, with energy prices for consumers nearly double those in Europe. The British Energy Security Strategy seeks a goal of 95% of electricity coming from low-carbon sources by 2030.

Working towards that goal, the UK's Contracts for Difference (CfD) scheme has encouraged industrial development of renewables, including alternatives such as tidal and wave energy. The scheme guarantees a stable price for electricity to project developers investing in renewable energy facilities.

The fourth round CfD in 2022 awarded 41 MW of capacity to tidal stream technologies for the first time. In 2023 the fifth round CfD awarded 11 different tidal energy projects with a budget of 11,6 million euros to produce over 50 MW of power. A sixth round is planned for 2024.

European focus on renewables

While wind and solar remain the largest sources of renewable energy, European governments looking to reduce and eliminate dependency on Russian natural gas are offering support and subsidies for developers of alternative renewable power generation.

For example, a third EU Renewable Energy Directive in 2023 included a goal of 5% of new installed capacity for renewables from innovative ocean energy sources, such as wave and tidal energy. This will help balance the grid by providing energy at different seasons and times of day than solar and wind.

After a successful 2-year test, a 17.5MW pilot tidal energy farm called FloWatt was approved under the France 2030 program. The seven 2.5MW turbines will be installed in the English Channel off Normandy and be operational by 2026, providing electricity for 20,000 people for 20 years. This large-capacity project is designed to demonstrate industrial level power generation using tidal stream technology developed by HydroQuest.

The Dutch Marine Energy Center (DMEC) provides technical and financial expertise to companies planning to invest in offshore renewables, including wave and tidal energy. Its models help governments and corporations determine optimal solutions for marine energy developments both in the Netherlands and around the world.

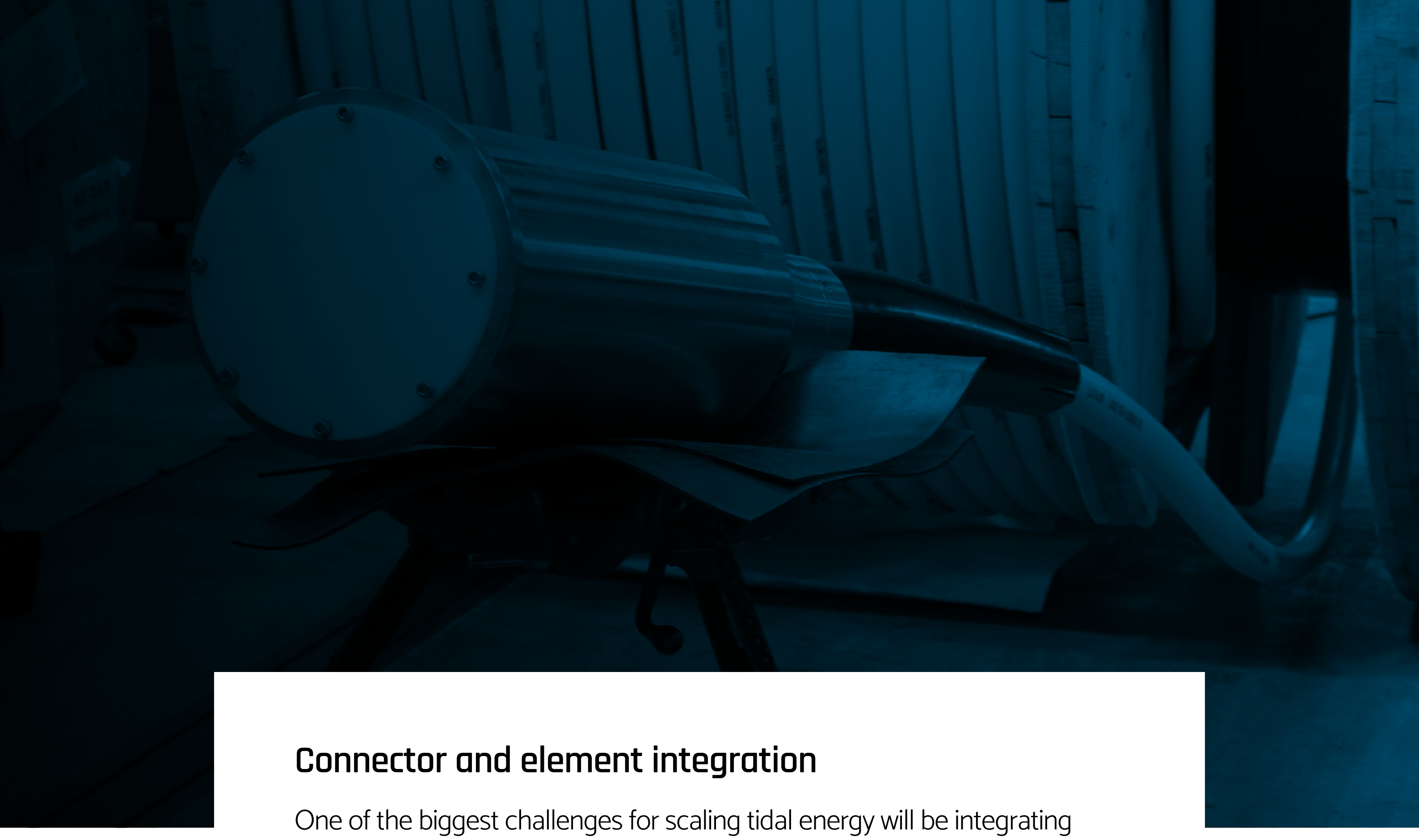
Trend 2

Scaling tidal energy for commercial power transmission

The hub and spoke model

Unlike offshore wind, industrial level tidal stream and wave energy devices will be designed in a hub and spoke model, in which a central hub fixed to the seabed will be connected to 5-8 individual devices in an array.. Rolling out multiple devices on a site means that designers need to go from connecting a single prototype to a power export line already in place on a test site, to multiple devices connected to an undersea hub.

For instance, at the Menter Môn tidal stream project at Morlais in Wales power companies will provide multiple tidal turbines connected to a hub on the seafloor with a single power export cable leading to the grid onshore.



Connector and element integration

One of the biggest challenges for scaling tidal energy will be integrating the electrical and optical lines from the individual devices through the hub and into the single power cable to shore. Typically this cable would connect to the hub with a very heavy, high-capacity connector that can handle 10 KV and between 10MW and 15MW.

The hub and spoke design will require a secure attachment of the hub to the seabed as well as a completely new electrical infrastructure inside the hub.Most important is developing a cable strategy in which wet-mate connectors can securely mate to the hub underwater and can combine power at a safe voltage.

The connectors must be able to carry a certain amount of power at a certain voltage generated by the tidal devices. Each one must then integrate seamlessly into the hub, where the power is converted and transmitted through the main connector cable to shore.

Deployment strategies

The hub will weigh a couple of tons, so once it is installed it's not going to be moved. This means that it will require a solid dry-mate cable connection installed before deployment. But the device must be designed to accept multiple connectors from the individual devices. Wet-mate connections would be the most logical choice, because the devices will be put into place after the hub is fixed to the sea floor, but the design will have to ensure a secure and leak-proof connection.

In some cases, the individual devices could be movable, and if so would require dynamic cables, sometimes called jumper cables. Designing and building these different types of cables and connectors is one of the challenges that tidal energy providers will need to achieve for commercialization.

Design for scalability

Scaling tidal power technology will require expanding from a single prototype to small batch production. To accomplish this, developers are experimenting with ways to ramp up the production timeline.

Building one floating tidal power device may take one or two years. But to get this type of device into serious production, a more efficient use of space and possibly a change in the design – for example constructing it in two pieces and then welding it together – could allow more units to be built faster.

Meanwhile the installation of devices could be made more efficient. Attention to these kinds of issues will increase capacity quickly, and get more ocean power online to meet ambitious decarbonization goals.

One example of scalable design is a project by Orbital Marine Power along with the European Marine Energy Centre (EMEC). At their Fall of Warness site near Orkney Islands, they have been producing tidal power using a versatile floating generator with twin turbines which can be deployed for projects in different locations with different needs. This cigar shaped platform and blades are designed for low fabrication costs and use modular assemblies which can be scaled for volume manufacture and deployed in arrays.

Trend 3

Decarbonization of offshore oil & gas assets

Energy storage significance

While net zero is the ultimate goal, the offshore oil & gas industry will likely continue to pump fossil fuels for many years to come. But adapting ocean renewables for electrical power on oil & gas platforms in the meantime can help reduce carbon emissions.

To make the most of offshore renewable energy requires more–and more advanced–energy storage solutions to harness the maximum amount of energy from intermittent sources. Offshore wind power, for example, varies widely with the winds, and so must be captured, stored, and then fed to the onshore grid as needed.

Technological advancements

Several schemes for storing the electricity generated by renewables include lithium ion batteries and hydrogen, although this latter technology has experienced problems getting off the ground.

Lithium-ion battery storage technology will be a big market for wave energy converters, but developers will need to prove the reliability of their system. With the help of DeRegt's 70 years of experience interconnecting cables with offshore oil & gas platforms, we can help ensure a reliable connection.

Wave energy conversion projects

One option for maximizing the use of offshore renewables involves converting wave energy to power that can be used directly to "decarbonize" oil & gas assets. For example, a collaborative project with Archer in the UK North Sea tested a Blue X wave energy converter supplied by Mocean Energy connected to an underwater Halo lithium-ion battery energy storage system built by Verlume. The battery was used to charge electronics modules for control and communications that would be used for subsea well heads.

In another example, C-power is testing the Halo battery with their SeaRAY autonomous offshore power system (AOPS) at the U.S. Navy's Wave Energy Test Site in Hawaii.

The project uses wave energy to generate power that is stored in the battery fixed to the seabed. The AOPS provides connectors and cable interfaces for power, data and communications for payloads such as a Saab Sabertooth hybrid autonomous underwater vehicle (AUV) which can roam the area collecting sonar imagery of underwater infrastructures, to detect any issues in order to prevent breakdowns.

Connecting wave energy converters with energy storage can provide a total package of constant power using renewable energy. Providing this continuously generated electricity to an offshore oil & gas platform means they don't have to spend millions of dollars to lay power cables from shore, for sensing and other tasks, while also reducing their dependence on fossil fuels.

Nature-positive design

In the quest for decarbonizing the energy grid, the concept of using "nature-positive design" is becoming more important, especially as a qualification for new tenders.

For subsea cables, nature-positive design means they will not be manufactured with any aggressive anti-fouling products that could harm marine life. The thick plastic sheath protecting the cable will likewise not shed any microplastics. While connectors may experience some marine growth, the fact that they are made of stainless steel means that they won't be negatively affected, nor will they negatively affect the environment.

Toward a fully commercial clean-power grid

Tidal and wave energy technologies are fast filling in the gaps around the major renewable energy sources of solar and wind. While these two have received most of the funding and financial incentives for decarbonizing the electrical grid, adding other types of ocean renewables to the overall mix makes the goal of reducing or eliminating fossil fuels much faster and easier.

Many national governments and nonprofits are beginning to offer technical assistance and favorable terms, including guaranteed pricing, for novel marine power designs, especially wave and tidal energy systems. These organizations are looking for developers who can scale up prototype projects to commercial production that will make a significant contribution to the electrical grid.

Successful scaling will require technical advancements in subsea cable, connector and hub designs, as well as practical manufacturing methods that make for faster production and rollout of multiple devices.

About DeRegt Marine Cables B.V.

Since 1912 DeRegt has provided leadership in the development and manufacturing of high-quality cable solutions for oil & gas, seismic, ROV, and renewable applications.

As the leading provider of custom-designed and manufactured submarine cables, DeRegt offers umbilical systems and specialized cables for the offshore renewable energy market.

Our durable cable solutions range from low-voltage to medium-voltage cables for generating energy with floating tidal and wave-buoy installations.

For input on your tidal stream or wave energy plans, contact George Brandenburg to learn about the possibilities for your next deployment.

Contact