

THE Ethical CORPORATION MAGAZINE

THE SUSTAINABLE OCEANS ISSUE

September 2020

- Big data takes to the high seas
- Can aquaculture feed the world?
- Countries pin climate hopes on offshore wind
- Fashion industry 'slow to act on microfibre pollution'



Drifting towards disaster

The race against time to protect our oceans

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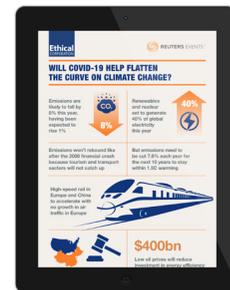
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September 2020 issue:

Sustainable oceans

It's easy to overlook oceans in the battle against climate change. But, as we report in our briefing on sustainable oceans this month, they could contribute as much as 21% of the emissions reduction needed to put us on a 1.5C pathway by 2050, according to the High Level Panel for Sustainable Ocean Economy.

Alarming, warming waters and ocean acidification caused by greenhouse gas emissions, fertiliser run-off, over-fishing, and destructive activities like bottom-trawling are all contributing to the increasing loss of biodiversity and the ocean's ability to mitigate climate change by storing carbon. An [international study](#) of 1,300 species of fish and

invertebrates found that 82% were being removed faster than they could repopulate.

A goal of protecting at least 30% of oceans by 2030 is at the heart of the UN Convention on Biological Diversity, which was supposed to be negotiated this autumn, but has now been put off to 2021 because of the pandemic.

As Angeli Mehta reports, 30% seems a highly ambitious target, given that an agreement reached 10 years ago to protect 10% of the oceans by 2020 looks unlikely to be met, with just 7% nominally protected by 2019, and even those areas poorly enforced.

She also reports on the new surveillance and supply chain traceability technologies being deployed in the battle to save the oceans, with a focus on ending illegal, unreported and unregulated fishing, which is estimated to account for >

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WILLYAM BRADBERRY/SHUTTERSTOCK

20-25% of all fishing today. Among these is the use of blockchain to trace the provenance of fish from where they are caught through each stage of the journey they undertook to arrive on consumers' plates.

With wild-fish stocks in decline, a huge increase in farmed fish will be needed to help meet the protein needs of the planet. James Richens reports on how the search for sustainable aquaculture sources is focusing on the deep oceans, on land and even the laboratory.

Of the 17 UN Sustainable Development Goals, SDG14 on the conservation and sustainable use of the ocean and its resources attracts the joint lowest share of investment, at 3.5%. As Mike Scott reports, there is growing investor interest in the sector and a small but growing market for blue bonds focused on ocean projects.

While there is a high level of awareness of issues like plastic bottles and discarding fishing nets, this visible junk may represent only a tiny fraction of the problem. The rest is made up of microfibres, tiny threads that are shed by clothes during manufacturing and when they are washed, and have been found to lace the food chain. Mark Hillsdon reports on how a handful of fashion brands are starting to address their contribution to the toxic soup of ocean plastic.

This month's briefing ends by looking at what the High Level Panel for Sustainable Ocean Economy identifies as the ocean's biggest CO₂ mitigation potential in future: renewable energy installations like offshore wind, wave and tidal energy and floating solar arrays.

Offshore wind today may only account for 0.3% of power generation globally, but, as I report, the industry is scaling up rapidly amid dramatic falls in cost, increases in turbine sizes, and recognition in Europe of its critical role in fostering a green hydrogen economy.

I hope you enjoy this month's deep dive into oceans. Next month we will look at the future of work post Covid-19. ●



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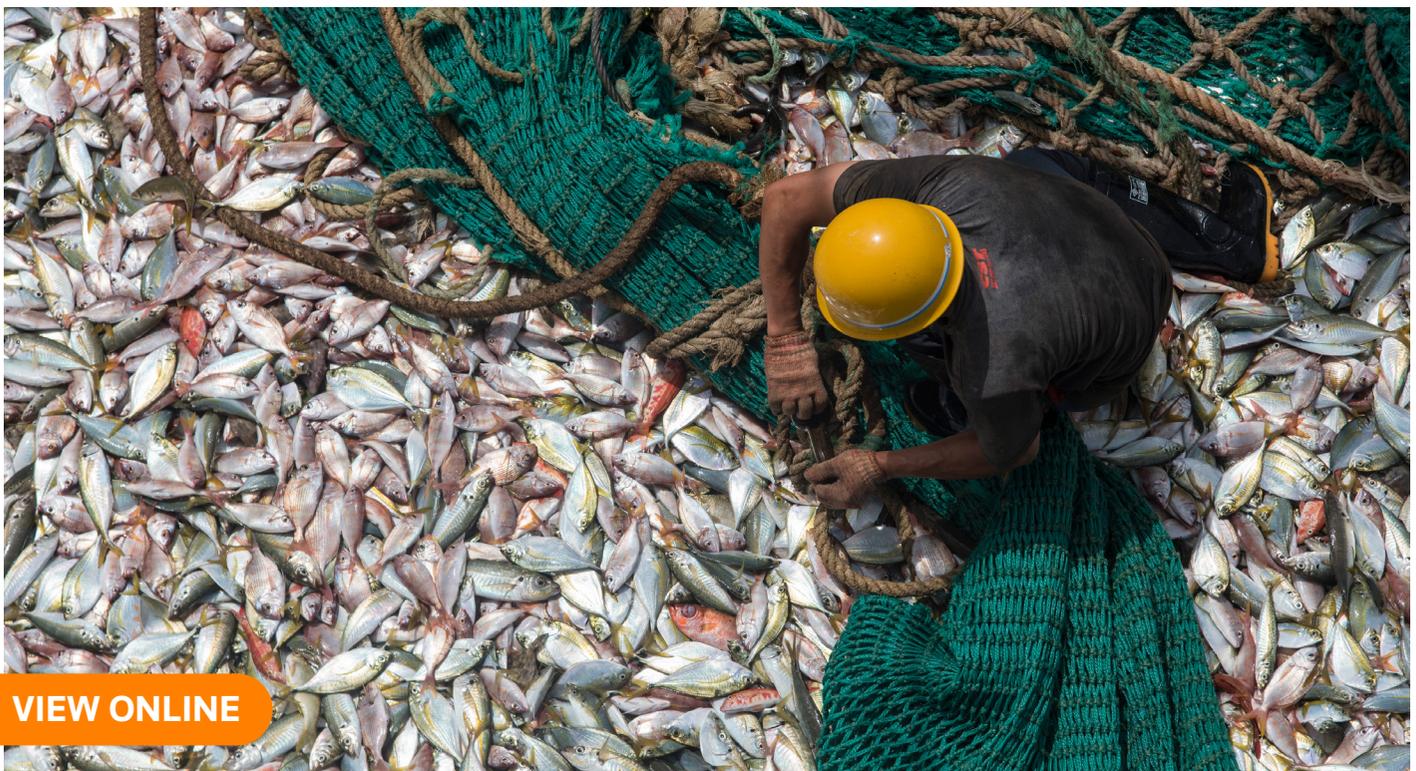
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Time 'rapidly running out to save oceans'

Protecting at least 30% of oceans by 2030 is critical to prevent the collapse of Earth's life-support system, but with destructive activities like bottom-trawling happening even in the 7% of areas that are meant to be protected, the challenge is huge. **Angeli Mehta** reports



PIERRE GLEIZES/GREENPEACE

VIEW ONLINE

It's not an overstatement to say that our oceans are in crisis. Warming waters and ocean acidification caused by greenhouse gas emissions; fertiliser run-off creating dead zones where there's no oxygen for life to survive, and over-fishing are all contributing to the destruction of biodiversity and loss of the ocean's ability to mitigate climate change by storing carbon.

Research done for the High Level Panel for Sustainable Ocean Economy highlights the crucial role played by oceans, which account for 70% of the planet's surface. It sets out ocean-based climate action that will cumulatively contribute as

much as 21% of the emissions reduction needed to put us on a 1.5 degree pathway. These include sustainable seafood production; ocean-based renewable energies; the greening of shipping, and the conservation of mangroves and seagrass that store carbon.

To meet the goals of the Paris climate change agreement, a big proportion of the ocean has to be returned to a natural state, according to the [Global Deal for Nature](#), a paper that sets a science-based target of protecting at least 30% of land and oceans by 2030.

The 30% protection goal is at the heart of the UN Convention on Biological Diversity, which was supposed to be negotiated this autumn, but has now been put off to 2021 because of the pandemic.

Enric Sala, marine ecologist with National >

Geographic and co-author of the Global Deal, describes 30% as a stepping stone. "If we are to prevent a massive extinction and the collapse of our life-support system we need half of the planet in a natural state."

It seems an impossibly ambitious target, given that an agreement reached 10 years ago to protect 10% of the oceans by 2020 looks unlikely to be met, with just 7% protected by 2019. In the meantime, stocks have been declining rapidly. [An international study](#) of 1,300 species of fish and invertebrates found that 82% were being removed faster than they could repopulate.



When the Law of the Sea was passed in 1982 nobody would have thought that there would be this massive pressure in the high seas and on the edge of exclusive economic zones everywhere

This summer, conservationists have watched in horror as hundreds of Chinese-flagged vessels have fished just outside the protected zone of the Galapagos. Ecuador's navy can do nothing but observe, a task made harder when many of the vessels began switching off electronic systems that allow their movements to be detected. China's distant water fleet accounted for about 15% of global fishing catch in 2018, and China is the worst offender for illegal, unreported and unregulated (IUU) fishing, according to a [global index](#) published in 2019.

GOVERNING THE SEAS

The governance of the high seas – those waters that lie beyond nations' 200-mile exclusion zones, where most fishing is done – is patchy. For some years the United Nations has been brokering discussions on a legally binding treaty that would conserve biodiversity in areas beyond national jurisdictions, "but we don't have it yet," observes Sala. The EU says it will push for such an agreement, as well as the creation of three vast Marine Protected Areas in the Southern Ocean.

"When the Law of the Sea was passed in 1982, nobody would have thought that there would be this massive pressure in the high seas and on the edge of exclusive economic zones everywhere, like there is now. And conservation was barely mentioned, >



The global market for seafood is causing fish to be removed faster than they can repopulate.



A Chinese boat is circled by a vessel from Ecuador's navy while fishing in seas off the Galapagos islands.

DAMIR SAGOLJ/REUTERS

SANTIAGO ARCOS/REUTERS

it was all about exploration and exploitation,” explains Sala. Again the pandemic has put paid to a treaty, for now. Not only have countries to agree which fragile ecosystems to protect, but how to share in the benefits of marine genetic resources.

“There is a myth that protected areas in the ocean will harm fishing, and the fishing industry is saying ‘if we manage them [fisheries] well, we don’t need protected areas’. Well, we have 70 years of experience with contemporary fisheries management. And, sorry, [but] it’s not working except for a few examples,” asserts Sala.

Today, just 2.5% of the oceans are fully protected, but there is evidence that fully protected areas help **replenish** the oceans. Most recently, an analysis of 23 fully protected areas showed a spill-over of higher biomass and abundance of stocks up to 200 miles outside them.

So, where should the 30% of protected ocean be?

“In an ideal world, we would be looking at global priorities across the entire ocean, but in practical terms, it’s going to be every country that decides how much and what to protect,” says Sala.

“There are countries that have resources that are globally more important, so they would have to protect more than 30%; other countries will be fine protecting less than 30%.” Most of the effort will be within economic exclusion zones of coastal countries.

To pay for the replenishment of nature, subsidies need to be redirected. The world had agreed to eliminate or reform subsidies that harm



C.A. COOLJMAN/SHUTTERSTOCK

biodiversity by this year – but that has been another missed target.

“Five hundred billion dollars per year are spent subsidising industries that destroy nature or pollute our environment. [Whereas] the annual investment for managing 30% of the planet’s protection will be \$140bn. We’re spending three times more to subsidise activities that destroy our life-support system than what it would cost to protect a third of our planet. Notwithstanding, of course, that the benefits are going to outweigh the cost,” states Sala.

Indeed, he adds, one of the most destructive types of fishing – bottom-trawling – would not be commercially viable were it not subsidised.

Sala and colleagues have just **published** the first maps of the carbon stocks in marine sediment. >

Since fishing stopped in Lamlash Bay off Scotland in 2008, biodiversity has increased.

SUSTAINABLE SEAS IN NUMBERS

- An international study of **1,300** species of fish and invertebrates found that **82%** were being removed faster than they could repopulate.
- Ocean-based climate action could contribute **21%** of the emissions reduction needed to get to **1.5C**.
- A science-based target of protecting at least **30%** of land and oceans by **2030** is at the heart of the UN Convention on Biological Diversity, yet today only **2.5%** of the oceans are fully protected.
- China’s distant water fleet accounted for some **15%** of global fishing catch in **2018**, and China is the worst offender for illegal, unreported and unregulated (IUU) fishing.
- While **12.4%** of the EU marine area is designated as Marine Protected Areas, many are poorly managed and don’t actually prevent bottom-trawling.
- Protecting **30%** of seas and land would cost **\$140bn** a year, while **\$500bn** is spent a year subsidising harmful activities like bottom-trawling.

“We found that the top metre of the sediment on the sea floor has more than twice the amount of carbon of the soils of the land.”

Some of that carbon will be disturbed by bottom trawling, and in the future by deep sea mining, although carbon emissions of such activities are not included in any country’s carbon accounts, he points out.

A recently completed [review](#) recommending the creation of Highly Protected Marine Areas (HPMAs) in UK waters concluded that one of the criteria for their selection should be to protect habitats that help capture carbon, such as seagrass. HPMAs would conserve all species and habitats within their boundaries, including passing migratory species. Pilots would test how to introduce, manage and evaluate them.

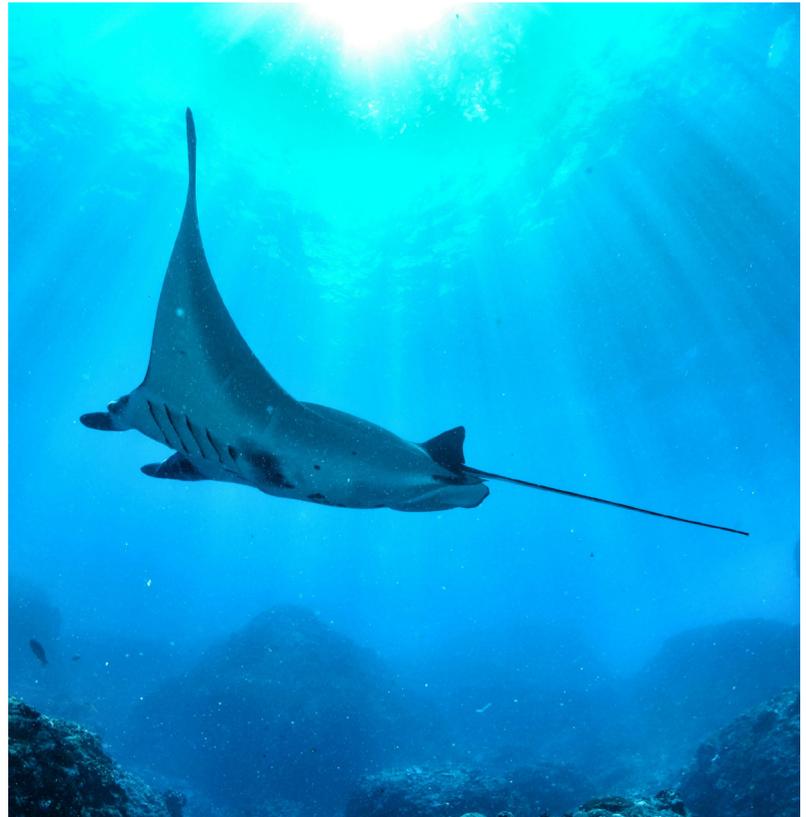


This year the Pacific islands of Palau implemented a National Marine Sanctuary that will fully protect 80% of its waters, the Seychelles committed to protect 30% of its waters, and Chile expanded protection to 42% of its waters

There is much to learn from a small no-take zone instituted by a coastal community in Lamlash Bay in the Firth of Clyde on the west coast of Scotland. [A recent study](#) suggests there’s been a big boost in biodiversity since fishing stopped in 2008, with numbers and density of creatures like lobsters and scallops some four-fold higher than 10 years ago.

While 12.4% of the EU marine area is designated as Marine Protected Areas, many are poorly managed and don’t actually prevent bottom-trawling. The EU’s own assessment suggests about 79% of Europe’s coastal seabed and 43% of the shelf area is physically disturbed, mainly as a result of bottom-trawling. [A 2019 report](#) from found that trawling intensity was actually higher within Marine Protected Areas than outside them.

Perhaps it’s not surprising, then, that the EU hasn’t met its goal of halting biodiversity loss in the decade to 2020. However, a new strategy, launched during the pandemic, and billed as a central element of the bloc’s recovery plan, takes a much



KIM GYI RI/SHUTTERSTOCK

more holistic view of the environment and considers all the pressures on the oceans.

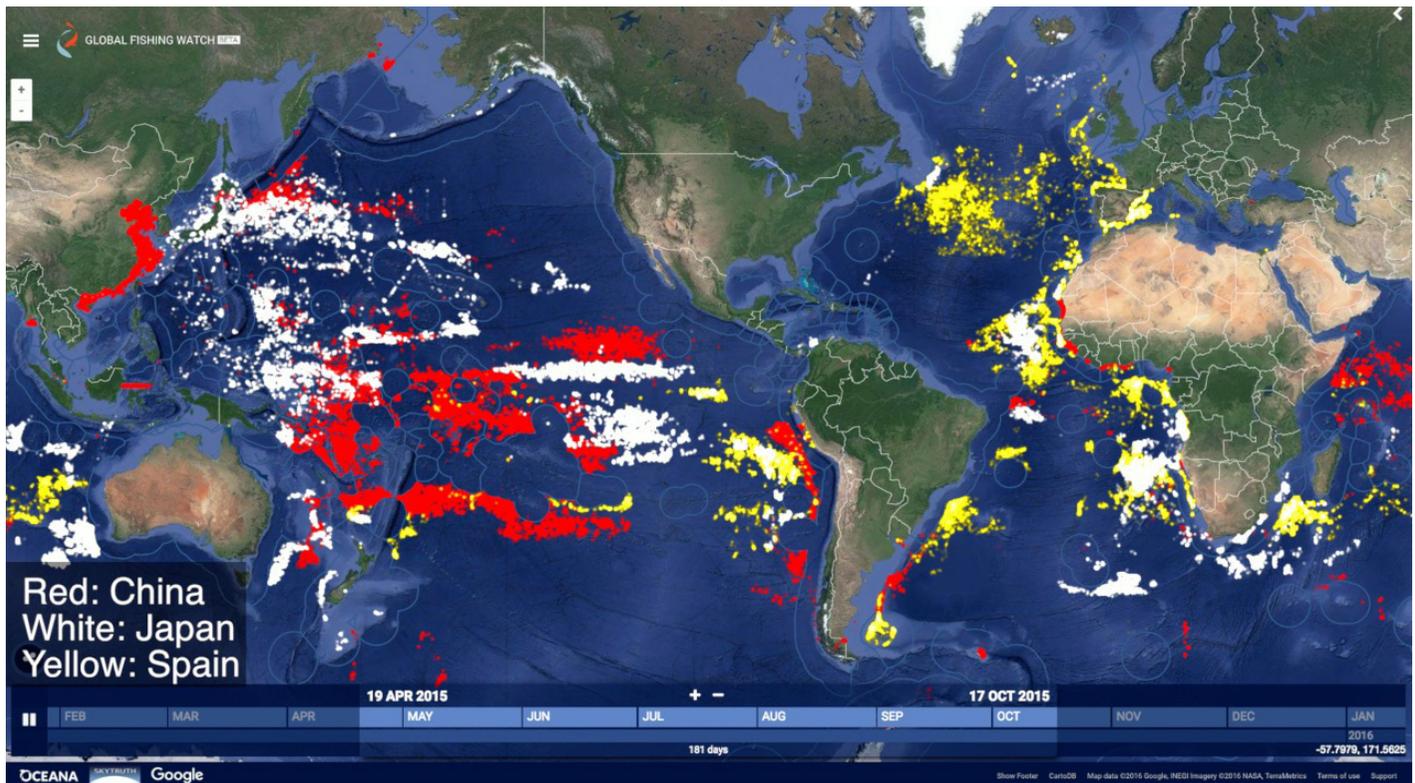
“We need to allow biodiversity to flourish, not only through Marine Protected Areas, but by managing sustainable activities, either fisheries or energy production, and all activities on land that produce pollution, like agriculture, chemicals, and pharmaceuticals that pollute the ocean,” says Vivian Loonela, the Commission’s spokesperson for the European Green Deal. Quantitative targets are to be developed over the next year.

The question is whether all these efforts can be harnessed in time to preserve Earth’s life-support systems. There are some encouraging signs. This year the Pacific islands of Palau implemented a National Marine Sanctuary that will fully protect 80% of its waters, the Seychelles committed to protect 30% of its waters, and Chile – a big fishing nation – expanded protection to 42% of its waters. But many more nations need to step up. ●

A manta ray off the Pacific islands of Palau.



Angeli Mehta is a former BBC current affairs producer, with a research PhD. She now writes about science, and has a particular interest in the environment and sustainability. [@AngeliMehta](#).



Can big data save the BIG BLUE SEA?

Angeli Mehta looks at the new surveillance technologies being deployed in the battle to protect the oceans

[VIEW ONLINE](#)

To protect the planet’s oceans, we have to know what’s going on in them and what we are taking out. Ending illegal, unreported and unregulated (IUU) fishing is critical, but many countries don’t have resources for patrols at sea and remote surveillance, leaving much of their 200-mile exclusive economic zones (EEZs) unprotected. Many also lack sufficient regulations, oversight, or inspections at ports.

But experts at Pew Charitable Trusts say the establishment of an effective global governance system to protect the oceans could make ending IUU fishing an achievable goal, given a concerted effort between nations and seafood businesses and the use of the best available technology.

One organisation shining a light on the murky waters is Global Fishing Watch, a partnership between international conservation organisation Oceana, satellite technology company SkyTruth and Google.

It uses satellite technology and machine learning to track vessels and monitor their behaviour in near real-time, making its data available in a freely accessible [map](#). Indonesia, Peru, Panama, Chile and Costa Rica are openly sharing their vessel-monitoring data, and chief executive Tony Long hopes to soon add Ecuador and several African nations to that list. >



PIERRE GLEIZES/GREENPEACE

Global Fishing Watch also uses signals from a vessel’s automated identification system (AIS), which are designed to avoid collisions and picked up by satellites across the globe.

Combined with other information like changes in speed and direction, its system can assess which vessels are likely to be fishing.

The organisation has also been working with Pew Charitable Trusts to better understand what happens on trans-shipment vessels, large refrigerated transport vessels that take on catch from commercial fishing boats and provide them supplies, typically on the high seas and out of sight of the authorities. Trans-shipment vessels have been criticised for enabling illegal, unreported and unregulated fishing, which accounts for 20-25% of fishing globally, as well as human trafficking and the smuggling of weapons.

“You can use machine learning to recognise patterns of fishing, or even where it’s likely that they’re conducting a trans-shipment. So this is why it becomes quite a powerful piece of technology to inform policy, and show you the gaps in governance,” explains chief executive Tony Long.

“Those two things put together, openness and transparency, can make a significant shift in



You can use machine learning to recognise patterns of fishing or even where it's likely that they are conducting a trans-shipment

A Greenpeace ship monitors a trans-shipment vessel.

understanding what’s happening out at sea, but more importantly make people realise that they can be held accountable,” Long suggests.

One big challenge is that the data isn’t comprehensive. There are numerous different vessel-monitoring systems; not all countries operate one, and of those that do, the systems don’t always talk to each other, a situation exploited by illegal fishing vessels.

The Agreement on Port State Measures, ratified by 65 nations and the EU, is designed to prevent those that fish illegally from being able to unload.

But Long argues that ports should focus on rewarding the vessels that obey the rules. That >

would avoid resource-strapped nations having to invest heavily in deterrence measures.

“When they come to port, it’s much easier to check a set of things that are present and correct than it is to go seeking things that aren’t,” he says. Companies will be incentivised to become compliant if they get rapid access to port so they can land their fish and quickly get back out to sea.

Since 2018, 10 of the world’s largest seafood businesses, which together account for 20% of global seafood production, have come together under the auspices of the Stockholm Resilience Centre to collaborate on getting the industry on a more sustainable footing.

Members of the Seafood Business for Ocean Stewardship, SeaBOS, include the two largest companies by revenues (Maruha Nichiro Corp and Nippon Suisan Kaisha Ltd), tuna giants Thai Union Group and Dongwon Industries, salmon leaders Mowi and Cermaq, the two largest aquafeeds companies (Skretting and Cargill Aqua Nutrition), as well as the Japanese tuna purse seine company



The theory is that if they can be working towards sustainable seafood production, that will get picked up by the remainder of the seafood businesses around the globe

Kyokuyo and the agro-industrial conglomerate Charoen Pokphand Foods.

“The theory is that if they can be working towards sustainable seafood production, that will get picked up by the remainder of the seafood businesses around the globe,” explains SeaBOS’s managing director, Martin Exel.

Exel points out that a fully traceable supply chain will improve inventory and quality controls, as well as generate customer demand because companies will be able to communicate with them about sustainable provenance, rather than compete on price.

ELECTRONIC MONITORING

One of its first projects is a proof of concept study with US IT group Unisys, to develop an electronic monitoring and machine-learning platform for traceability. It provides options to track the labour or the crew on individual vessels (to address concerns of forced labour); to track the vessels



A bottom-trawler unloads in port, where monitoring is easier.

KATE DAVISON/GREENPEACE

themselves in terms of where they’re operating; and with electronic monitoring of the catch to develop estimates, which are constantly being updated and refined using machine learning, of how much fish is in each haul, and the species caught.

All that information is uploaded via blockchain.

SeaBOS has also been collaborating with the Global Dialogue on Seafood Traceability, which has just released the first standard for data and platform interoperability.

“I might be a buyer from 74 different producers and I want to make sure I know what’s going on, and it’s not much use if I’ve got to sit at 74 different platforms. So the aim is to try and create at least some standards that can then be applied globally, for the key data elements: things like the name of >

the boat, the day the fish was caught, how much was caught, where was it offloaded,” said Exel.

Satellite technology is also being used to monitor what is happening to fish stocks as a result of climate change.

The impact of warming waters is being keenly felt in the Gulf of Alaska, where five years of heatwaves mean cod stocks are so depleted that fisheries have been closed. The stocks that do

remain are essential to support endangered species such as Steller sea lions.

“This massive heatwave came through and affected the entire ecosystem where we have lower productivity of plankton and zooplankton, which affected everything up the chain – whales, seals, birds. It was very scary,” explains Steve Barbeaux, research fisheries biologist at the National Oceanic and Atmospheric Administration’s Alaska Fisheries Science Center.

Further west, cod in the Bering sea seem to be swimming north into cooler waters. The scientists are using satellite tags that are programmed to detach from the fish at specified intervals – once on the surface of the water they transmit data to satellites or are picked up by fishermen. “You get a really good picture” of how far they travel and the depth to which they swim, says Barbeaux. One was found 1,500km away.

NOAA would typically be sending out research vessels to do acoustic surveys of pollock stocks, but its research vessels have not been able to sail due to the pandemic. Instead it’s teamed up with California-based Sairdrones, whose unmanned >

Electronic monitoring will be able to estimate how much fish is in each haul.



The aim is to create at least some standards that can then be applied globally for key elements like the name of the boat, the day the fish was caught, how much was caught, where it was offloaded



ATHIT PERAWONGMETHA/GREENPEACE

CHELSEA CAMERON/SHUTTERSTOCK



Steller sea lions in the Gulf of Alaska are reliant on what is left of its depleted cod stocks.



SAILDRONE

surface drones do the job remotely. AI helps the SAILdrones harness the winds to reach their destination, and solar energy powers echo-sounding.

“We don't get the age structures [ranges] of the fish, or any of the biology, but it gives us a quick picture of what we think is happening with the pollock population.” Information that's essential to inform fisheries management for the coming winter.



Most innovation has allowed us to catch more fish, to find new resources deep under water... but it does hold potential for us to do a much better job as ocean stewards

Another technology being explored is machine vision, which is used to interpret images captured on cameras on board fishing vessels, to identify and measure the fish being caught. Nevertheless, observer data is still required to assess the age distribution and weight of the fish, again crucial in making stock assessments.

Speaking at a UN session at the World Economic Forum in January, Jim Leape, co-director of the

Stanford Centre for Ocean Solutions, pointed out that all these new data sources equip scientists to be better stewards of ocean resources. “They allow us to know in real time when a heatwave is coming that could threaten coral reefs and fish stocks; when a storm is coming that could cause a nutrient pulse that creates a dead zone in coastal waters or an algal bloom that kills all the fish that live there.”

Crucially, it means mitigating action could be potentially taken.

But he cautioned that innovation is a double-edged sword. “Most innovation has allowed us to catch more fish, to find new resources deep under water. So we have to be mindful of that. We have to manage these innovations but they do hold potential for us to do a much better job as ocean stewards.”

The technology, the data and the detective work all provide the opportunity for humans to become stewards of the oceans, rather than just exploiters of their bounty. So in this coming UN Decade of the Ocean, perhaps there's a chance to ensure the oceans are in a better place in 2030. ●

Saildrone's unmanned surface drones are being used to remotely monitor pollock populations.



VIEW ONLINE

Using blockchain to bring transparency from sea to plate

By empowering consumers to make more sustainable choices in the fish they buy, the impact for biodiversity in the oceans could be profound, reports

Angeli Mehta

How do you know that the fish on your plate is sustainably caught when you can't even be sure it is the species advertised on the label?

In 2013, genetic testing by oceans conservation group [Oceana](#) found 44% of 1,200 seafood samples collected from grocery stores, restaurants and sushi venues in 21 US states had been miss-labelled.

Oceana pointed out that given the fact that a fish caught in one part of the globe might change hands dozens of times and undergo multiple forms of >

RIDO/SHUTTERSTOCK



If you give the Costcos and Tescos of the world the ability to select products that come from verified and trustworthy sources that can steer behaviour a lot faster than regulation



WWF/NETFLIX

processing and packaging, it's impossible to know where in the supply chain the seafood fraud had actually taken place.

According to the conservation group WWF, blockchain technology is the solution to such opacity, a tamper-proof digital ledger that can guarantee provenance by verifying the accuracy of every step from boat to supermarket shelf.

Since January 2019, Perth-based **Austral Fisheries**, one of Australia's largest fishing companies, has been using blockchain technology developed by WWF through its OpenSC joint venture with Boston Consulting Group Digital Ventures to guarantee the provenance of high-value Patagonian toothfish, caught in sub-Antarctic waters, which it supplies to 13 countries around the world.

Bubba Cook, western and central Pacific tuna programme manager with WWF, explained that WWF and its technology partners **initially trialled** blockchain with SeaQuest, an ethical long-line tuna fishery based in Fiji.

A re-usable radio frequency identification (RFID) tag was attached to each fish after it was caught, and information like type of fish and weight was uploaded via an app.

The tag **follows the fish** from catch to processing facility onshore, with all the relevant data on the fishing vessel and catch location following it. When the fish is packaged the tag is swapped for a QR code that can then be used to track the fish all the way to consumer, who then has the story of the journey of their piece of fish.

By empowering consumers to make more sustainable choices in the fish they buy, the impact for biodiversity in the oceans could be profound, Cook said.

He pointed to yellowfin tuna, which is heavily overfished in the Indian Ocean; but fares better in the Pacific.

"If you can get just to that level of granularity where you can say, 'we're not going to buy from the Indian Ocean', you've already created the incentive to source from those fisheries that are managed sustainably and punish those fisheries that aren't, so that they take more urgent actions to address the sustainability issues in those regions," Cook said.

But while other seafood industry players are piloting the technology on products from scallops to farmed salmon, there needs to be a big increase in demand from major seafood players to take its use to scale.

"[It's] going to require a concerted push from all of the markets to collectively come together and say: we want this level of transparency, we need this level of transparency and we're ready to invest in it," suggests Cook.

"If you give the Costcos and the Tescos and others around the world the ability to ... select products that come from verified and trustworthy sources that don't engage in environmental harm and human rights violations, then that can really steer behaviour on the water a lot faster than regulatory requirements."

He adds: "It has the potential to change the world." ●

Top right: Genetic testing of seafood samples from supermarkets and sushi venues found produce had been mis-labelled.

Above: Consumers can use a QR code to track where their fish came from.

Can sustainable **AQUACULTURE** feed the world?

With wild-fish stocks in decline, a huge increase in farmed fish will be needed to help meet the protein needs of the planet. **James Richens** reports on how the search for sustainable sources is focusing on the deep oceans, on land and even the laboratory

VIEW ONLINE



SALMAR





Aquaculture, the farming of aquatic animals and plants in the sea or inland waters, has a crucial role in meeting the challenge of how to feed a growing population while reducing the environmental impacts of food production, experts say. It can also create jobs and improve security of food supplies at a time of great economic uncertainty due to the coronavirus pandemic.

From 1990 to 2018 there was a 527% rise in global aquaculture production, according to data from the [Food and Agriculture Organization \(FAO\)](#) published in June. In contrast, production from wild-capture fisheries increased by only 14% over the same period.

In 2016, aquaculture overtook fisheries as the main source of fish for human consumption, and accounted for 52% of global production in 2018. The FAO forecasts that aquaculture’s share of production will increase to 59% (109 million tonnes) by 2030.

There are many sustainability benefits driving the growth in aquaculture. Fish is less resource-intensive to farm and has a lower carbon footprint than meat, but with only 65.8% of wild-fish stocks at biologically sustainable levels, according to the FAO, down from 90% in 1974, aquaculture will be needed to make up the shortfall.

Over 20 million people are employed in aquaculture, according to the FAO, with the majority in small-scale activities in developing countries.

Marine aquaculture – also known as mariculture – offers most potential for growth, according to a recent report for the [High Level Panel for a Sustainable Ocean Economy](#), a group of 14 heads of government from countries such as Canada, Norway and Japan. It says that the ocean is an under-used resource, as almost 63% of existing aquaculture is in freshwater areas such as lakes and rivers, where space and the variety of farmed species is limited.

The ocean could supply over six times more food than it does today, the report says, reaching 364 million tonnes of animal protein and more than two-thirds of the edible meat that will be needed to feed the future global population, which the UN expects to reach 9.8 billion by 2050.

SalMar’s Ocean Farm 1, which is 22km off the Norwegian coast, has had a lower fish mortality rate.



Whether the full potential of aquaculture is realised depends on factors such as demand shifts, and clear policies that support mariculture

“There is a growing body of evidence that marine aquaculture has substantial potential to produce food, and do so sustainably,” says one of the report’s authors, Dr Halley Froehlich, assistant professor at the University of Santa Barbara, California. “However, whether that full potential is realised still depends on factors such >

as demand shifts, and clear policies that not only regulate but support mariculture, using best practices," she adds.

LIMITS TO GROWTH

Mariculture could supply both unfed seafood such as mussels and seaweed, which take their nutrition from the water, and fed mariculture such as salmon and prawns, which need feed inputs. On the face of it, unfed mariculture offers the greatest potential for growth since its input requirements are much lower. But consumer preference has favoured fed mariculture, the report says, and a major limiting factor is where the feed comes from.



Around 18% of wild-caught fish are processed into feed for farmed fish such as salmon and prawns, a practice that has been strongly criticised by campaign groups

In the wild, fish species such as salmon eat a variety of food, including smaller fish. When farmed they are fed fishmeal and fish oil, which contain essential nutrients derived from other fish, in particular omega-3 fatty acids. Around 18% of wild-caught fish – mainly forage fish such as anchovy,

sardine and herring – are processed into fish feed.

This practice has been strongly criticised by campaign groups, who argue that these fish are an important source of food for people living in poor coastal communities. A report by [Changing Markets Foundation](#) in 2019 accused fish-feed producers, the aquaculture industry and supermarket retailers of “stripping the oceans bare” to meet demand for popular farmed fish products such as salmon and prawns.

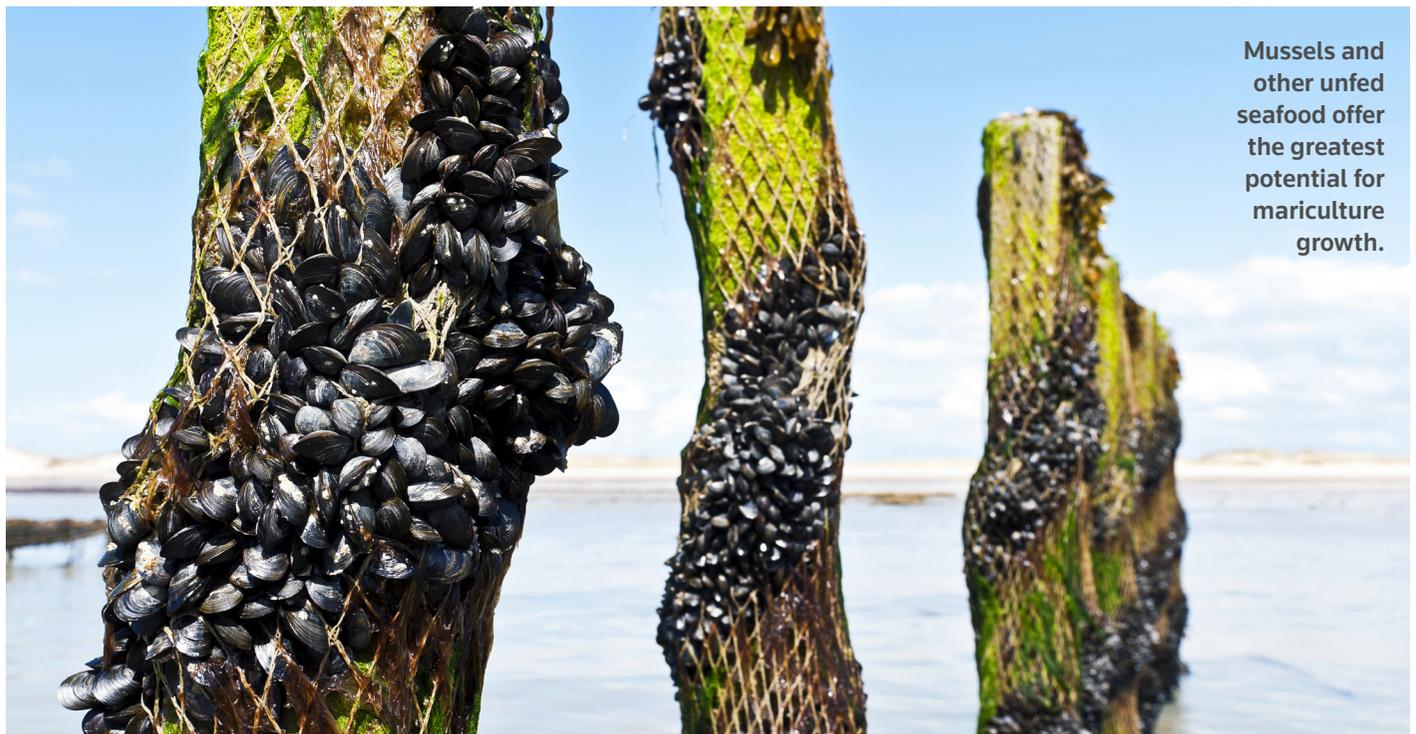
“We’re talking about millions of tonnes of fish being taken out of the ocean every year,” says Natasha Hurley, campaign manager at Changing Markets Foundation. “People in west Africa don’t have that fish to spare.”

The aquaculture industry has greatly reduced the proportion of feed derived from wild-caught fish by switching to fish by-products as well as plant-based alternatives. For example, fishmeal and fish oil inclusion rates in the diets of salmon farmed in Norway have dropped from 29% and 24% respectively in 2000 to 15% and 8% respectively in 2018, according to data from the Marine Ingredients Organisation (IFFO).

However, switching to alternative feeds may not be sustainable if they come from sources such as soy, which can contribute to other environmental problems such as deforestation. It is also important that they provide the nutrients that farmed fish need. Some companies are looking at innovative options such as industrial fermentation.

Veramaris is a joint venture formed in 2018 by Dutch-based biotechnology company DSM and >

GERARD KOUDENBURG/SHUTTERSTOCK



Mussels and other unfed seafood offer the greatest potential for mariculture growth.

German chemicals firm Evonik. In July 2019, the partnership opened a \$200m manufacturing site in the US state of Nebraska, which will supply 15% of the global omega-3 fatty acid demand for salmon aquaculture, the equivalent of over one million tonnes of wild-caught fish.

The process works by fermenting marine microalgae with sugar from beet, wheat or corn to make an oil that contains omega-3 fatty acids at a 50% concentration.

Consumer-facing businesses with reputations at risk have an important role in driving the switch to sustainably farmed fish. UK supermarket chain Tesco has been working with its key salmon suppliers to scale up the use of more sustainable feed ingredients. One of its suppliers in Norway has started to supply salmon that was partially fed with omega-3 algal oil.



We're talking about millions of tonnes of fish being taken out of the oceans every year. People in west Africa don't have that fish to spare

Mariculture faces other sustainability challenges that it must overcome to realise its potential to help feed the world. Most is done close to the coast for ease of access, but this means that fish farms can cause water pollution and degrade local ecosystems. Disease and parasite transmission between farmed and wild fish is also a major problem, as well as a commercial cost through fish mortality.

One solution being explored by Norwegian aquaculture company SalMar, one of the world's largest producers of salmon, is to open sites much further offshore. In 2017 it launched a pilot aquaculture facility 22km off the coast of Norway in an area of sea called Frohavet. The facility, called Ocean Farm 1, has a production cycle capacity of 7,000 tonnes of salmon and cost 1bn Norwegian Kroner (\$110m) to design and build.

Trine Sæther Romuld, chief financial and operating officer of SalMar says: "We would like to go offshore because that is the natural habitat of the salmon." The deeper waters allow for optimal temperatures, currents and water quality for the fish to thrive and grow, she explains. However, operating in rough weather conditions also raises technical challenges. Ocean Farm 1, constructed by



Many smaller fish are processed into fishmeal for farmed species such as salmon.

AMNAT30/SHUTTERSTOCK

AQUACULTURE IN NUMBERS

- From 1990 to 2018 there was a **527%** rise in global aquaculture production, according to the FAO, while production from wild-capture fisheries increased by **14%**.
- In 2016, aquaculture overtook fisheries as the main source of fish for human consumption, and accounted for **52%** of global production in 2018.
- Aquaculture's share of production is forecast to rise to **59%** (109 million tonnes) by 2030.
- Fish is less resource-intensive to farm and has a lower carbon footprint than meat, but with only **65.8%** of wild-fish stocks at biologically sustainable levels, down from **90%** in 1974, aquaculture will be needed to make up the shortfall.
- Over **20 million** people are employed in aquaculture, with the majority in small-scale activities in developing countries.

Source: FAO

the China Shipbuilding Industry Corporation, can withstand waves 10 metres high.

A faster exchange of water in the pen compared with coastal locations is driven by natural ocean currents, keeping the water clean and reducing the risk of disease and parasites. Ocean Farm 1 has demonstrated a lower fish mortality rate than the average of just under 5% across SalMar's operations in 2019.

SalMar is planning a new facility called the Smart Fish Farm, which is double the capacity of >



ANDREY ARMYAGOV/SHUTTERSTOCK



Most salmon farming is carried out close to the coast, where it can cause water pollution and degrade local ecosystems

Ocean Farm 1, and is due to commence operation in 2023/24. It will be located some 35km offshore and will be designed to withstand wave heights of over 30 metres.

MOVING ON TO DRY LAND

Another innovative solution is to move the entire aquaculture operation out of the ocean and on to land. This is the approach of Nordic Aquafarms, which has been operating three land-based aquaculture farms with a total production capacity of 2,500–3,000 tonnes: a salmon farm in Norway, since 2019, and two yellowtail kingfish sites in Denmark, since 2017.

It is planning to build a site in the US state of Maine, which is due to start operations in 2024, and a further site in California. Each will produce some 33,000 tonnes of fish per harvest.

Erik Heim, president of Nordic Aquafarms, explains that the logic of locating land-based sites in the US is to get closer to its customers. At present, fresh salmon and kingfish is imported >



Veramaris's \$200m omega-3 facility in Nebraska.

VERAMARIS

REUTERS



via airfreight; producing fish in the US will halve its carbon footprint. The US also has restrictive regulations on coastal developments that make conventional aquaculture difficult.



At present one kilogramme of lab-grown shrimp meat costs \$5,000, but this could be cut to \$50 by reducing the cost of growing media

Land-based aquafarms use large tanks in which circulating water is constantly filtered and treated to provide optimum, bio-secure conditions for the fish. Effluent is treated before being discharged, minimising pollution. Energy use is the main impact, but Heim says the grid electricity mix at the US sites has a good proportion of renewables. Because the fish swim constantly in the tanks, their meat has a lean and firm texture that attracts a premium price.

But despite these advantages, "it's not just plug and play technology," warns Heim. "You need to have an in-depth understanding of the design decisions that impact fish welfare and biosecurity, and experienced staff who really know their stuff." In such a highly controlled environment, human error or technical failure can result in a catastrophic loss of stock.

Seafood could even be grown in the laboratory without the need for water or even fish. Shiok Meats, founded in 2018 and based in Singapore, is developing technology to cultivate meat using stem-cells from crustaceans such as shrimp, crab and lobster. The cells are cultivated in a stainless steel tank that provides the right temperature, humidity and nutrients, becoming meat in four to six weeks.

However, commercialisation of cell-based seafood seems some way off. At present, one kilogramme of lab-grown shrimp meat costs \$5,000, although this could be cut to \$50 by reducing the cost of the growing media. The company is raising \$5m to build a pilot plant to scale up production. Shiok also needs to obtain approval for its products from food regulators.

Which of these solutions is leading the race towards sustainable aquaculture?

When you look at demand internationally, it's clear that we're going to need multiple methods, including wild-catch, to meet demand," says Heim, of Nordic Aquafarms. "You have to pursue sustainable and responsible production whatever method you use." ●

A dumpling made of shrimp cultivated from stem-cells by Singapore-based Shiok Meats.



James Richens is an experienced business journalist specialising in corporate sustainability, green finance and environmental policy. He was editor of The Economist Group's World Ocean Initiative, sustainability editor of The ENDS Report and research editor at Trucost, part S&P Global.

Insights and analysis in 2020 to inform a decade of action

JANUARY

Calls to action

Thought-leaders and the investment community, including John Elkington, Paul Druckman, Mindy Lubber, Eise King, Sally Uren and Sunny Verghese, give their marching orders for business in the coming decade of action on climate change and the SDGs

FEBRUARY / MARCH

Deforestation Risk

In a two-part assessment of deforestation risk in supply chains we will do deep dives into palm oil and forest and timber products in February and at soy and beef in March

APRIL

Smart and resilient cities and energy efficiency

How cities are adapting to climate change through the use of nature-based solutions and cooling technologies. Our second briefing will focus on the global drive to double energy efficiency

MAY

How Covid-19 has changed sustainability

Commentary and reportage on how companies are rising to the Covid-19 challenge, and the impact of the pandemic on ESG investment, biodiversity, the energy transition and workforces

JUNE

Accelerating the circular economy

Full-issue focus on how Covid-19 will affect the circular economy, looking at the impact of the pandemic on circularity in plastics, fashion, food and agriculture, e-waste and the automotive industry

JULY / AUGUST

Powering the energy transition

For our summer issue we look at the role of investors in speeding the energy transition, new energy storage technologies, and the rise of geothermal energy.

SEPTEMBER

Sustainable seafood and healthy oceans

Ocean-based solutions, from offshore wind and tidal power to sustainable seafood and cleaner shipping, could provide 21% of the solutions to climate change. This briefing will explore the new front in the climate battle

OCTOBER

The future of work

How has Covid-19 changed working practices, including managing employee well-being, supply chains, video conferencing and business travel

NOVEMBER

Water risk and biodiversity

We look at growing water risk as a result of climate change. Our second briefing will be on the business-led initiatives to protect biodiversity through more sustainable land use

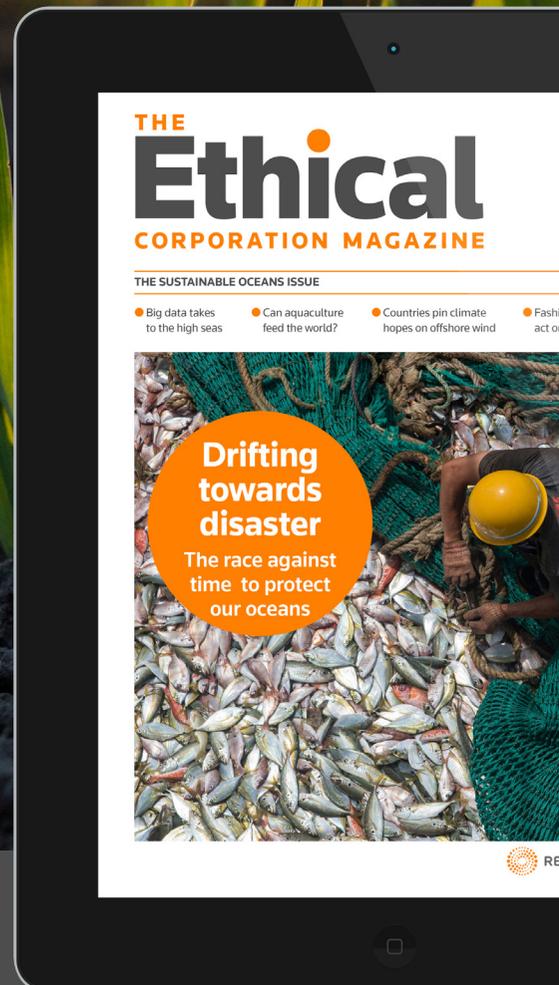
DECEMBER

Sustainable comms and marketing.

How has Covid-19 changed messaging for consumers. Plus: Are science-based targets up to scratch, or do they need to be revised in a post-pandemic world?

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The Seychelles has
launched the world's first
sovereign blue bond.

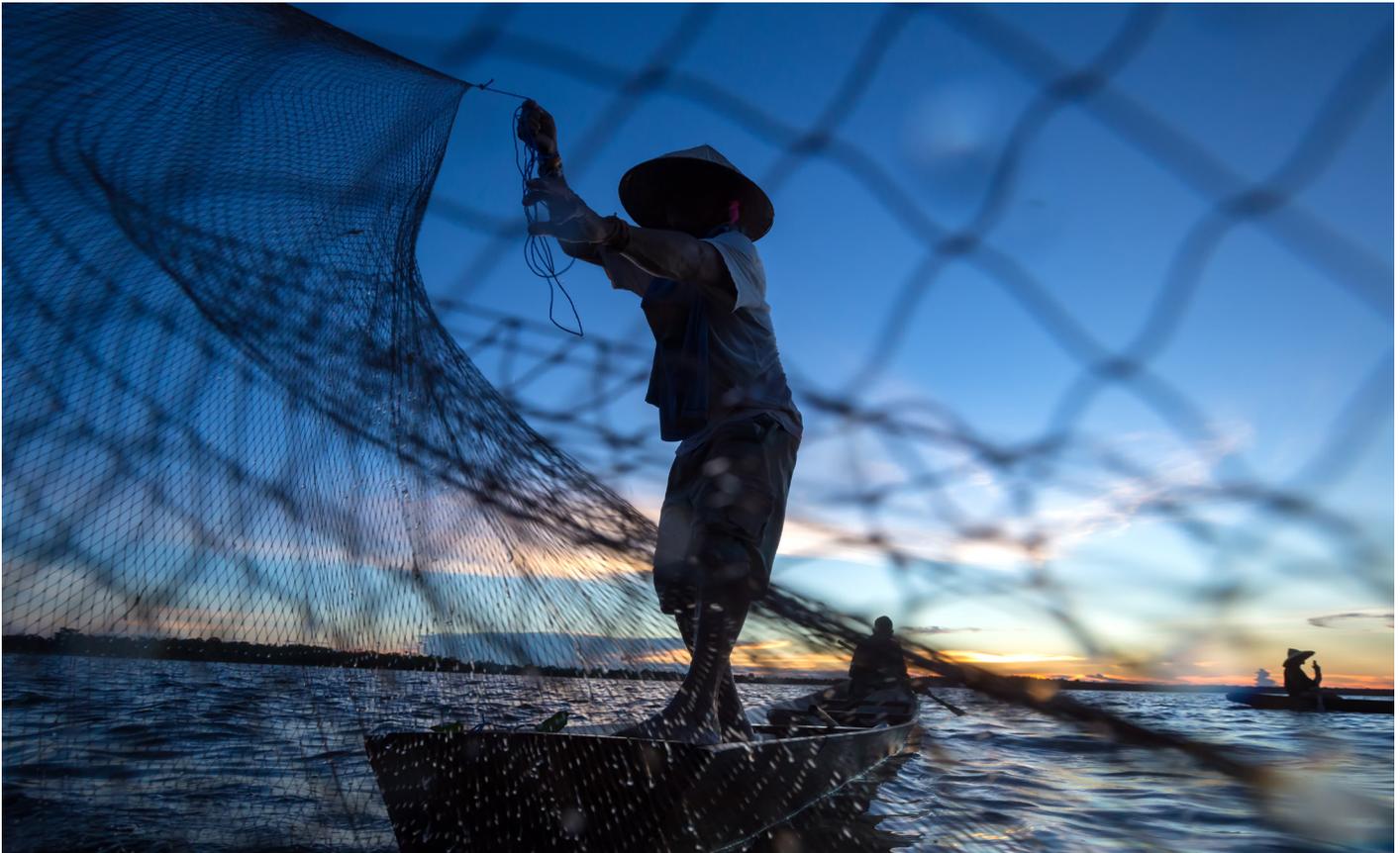
JAG_CZ/SHUTTERSTOCK

Blue finance seeks NEW HORIZONS

Attracting investment into the conservation and sustainable use of oceans is crucial, but there are a plethora of challenges, writes **Mike Scott**

[VIEW ONLINE](#)





SUTIPOND SOMNAM/ SHUTTERSTOCK

The ocean economy is estimated to be worth \$2.5tn a year,, meaning that if it were a country it would be the world’s seventh-largest by GDP. At the same time, the oceans cover 70% of the earth’s surface, play host to a huge amount of biodiversity, provide us with food, energy, recreation and transport, as well as playing a vital role in regulating the water and carbon cycles.

Yet for such a dominant feature of the natural world and the global economy, it is curiously underfunded and much of the existing investment comes from philanthropic or impact investors.

Of the 17 UN Sustainable Development Goals, SDG14 on the conservation and sustainable use of the ocean and its resources attracts the joint lowest share of investment (3.5%), shared with SDG15 (Life on Land).

“It is a hugely under-invested economic opportunity that is crucial to the way we have to address living on one planet,” says Simon Dent, director of blue investments at Mirova Natural Capital.

However, there is a growing understanding of the importance of the oceans to our future health and prosperity, and investor interest in the sector,

which has been dubbed “blue finance”, is growing.

“The global ‘blue economy’ is expected to expand at twice the rate of the mainstream economy by 2030 and already contributes \$2.5tn a year in economic output,” says Marisa Drew, CEO of impact advisory and finance at Credit Suisse.

Fisheries and aquaculture alone provide direct or indirect employment to 10–12% of the world’s population, with more than 90% of those employed located in developing countries, she adds.

Over 3 billion people (40% of the world’s population) depend on the biodiversity and services offered by marine and coastal ecosystems, according to [a report](#) in June by the Italy-based One Ocean Foundation. These include food and fresh water supply, renewable energy, benefits for health and wellbeing, cultural value, tourism, trade and transport.

Yet Drew points out that over two-thirds of the ocean’s direct economic value relies on its good health. “Decades of harmful approaches, from industrial fishing depleting fish populations and destroying habitats, to the ocean being used as dumping grounds for chemical, plastic and human waste, coupled with the damaging effects of climate change, have put the long-term survival of the ocean, and therefore its investment potential, at risk.”

One problem for investors is the vastness of the oceans, and of the issues involved, which range >

Fisheries and aquaculture employ 10%-12% of the world's population.

STOCKPHOTO-GRAF/SHUTTERSTOCK



Over-fishing, climate change and pollutants such as human waste have put oceans at risk

from rising sea levels to the livelihoods of coastal communities to the health of coral reefs. The key ocean economy sectors – tourism, fisheries, energy and shipping – are also very diffuse. In addition, some of the most pressing issues, such as tackling pollution and plastic waste, actually originate onshore and must be tackled at least partly on land.

“Blue finance means different things to different people. There are a lot of stakeholders in the ocean,” says Ted Janulis, founder of Investable Oceans, which connects investors to blue economy market opportunities. “One reason it is difficult to talk about the ocean economy is because it is so fragmented. There’s not a lot of companies with ‘Ocean’ in their name, for example.”

Many stakeholders with a key interest in, and impact on, the ocean are far from obvious, he points out. IKEA, for example, has a big impact on the oceans through the amount of packaging it uses, the transportation of its products and even its restaurants: through its in-store cafes it is one of the world’s largest restaurant chains and is very active in aquaculture.

SUSTAINABLE FISHERIES

Fisheries and aquaculture attract a lot of investment, but are the areas where practices are most unsustainable. The \$12tn FAIRR Initiative, an investor network that raises awareness of the environmental, social and governance (ESG) risks and opportunities caused by intensive livestock production, warns that growth in the \$232bn global fish-farming sector could be undermined by a

failure to manage risks such as climate change, a dependence on wild fish stocks for feed, excessive use of antibiotics and poor governance.

“There are a lot of companies out there, but very few are listed,” says Teni Ekundare, FAIRR’s investor outreach manager for the UK and northern Europe. “Lots of investors want to invest in this area, but there are very few stocks to buy.” ([See Planet Tracker’s mission to shine light on investment risk from fishing](#))

Dr Darian McBain, global director for corporate affairs and sustainability at Thai Union, known for its John West and Chicken of the Sea brands, Darian says ocean finance is hugely complex - everything is connected, and there are a lot of different governance and regulatory regimes. “How investing in the ocean works and how returns occur is different to how it works on land,” she says. “It’s still a sector in the early stages of development so there is no clear path for investment and return. It is challenging to find projects to invest in.”

Nonetheless, as interest grows, the first dedicated ocean investment products have started to appear, along with the market infrastructure needed to help investors understand the issues.

The World Benchmarking alliance has released a [Seafood Stewardship index](#) to help investors put their money into companies working responsibly in that sector. It ranks Thai Union Group, known for its John West and Chicken of the Sea brands, and aquaculture feed suppliers Mowi and Charoen Pokphand Foods as top three performers among the 30 largest seafood companies. >



FOTOGRAFF/SHUTTERSTOCK

Funds such as the Blue Ocean Impact Fund and Mirova Natural Capital’s Althelia Sustainable Ocean Fund are investing in areas such as coastal fisheries, sustainable aquaculture projects, the seafood supply chain and other coastal projects with the aim of improving food and climate security, livelihoods and ecological biodiversity, says Dent, the fund’s investment director.

“We have three investment pillars,” Dent says. “We focus on seafood, looking at sustainable fisheries and aquaculture; circular economy in areas such as waste infrastructure to tackle ocean-bound plastic, and ways to reduce pollution from ships; and ocean conservation, which encompasses areas such as eco-tourism, coastal protection and mangrove restoration. Mangroves are incredibly important in terms of ‘blue carbon’ – they store a huge amount of carbon – and as a breeding ground for fish and other biodiversity, as well as coastal protection.” (See [Can aquaculture feed the world?](#))

BLUE BONDS

Following on from the success of green bonds, there is a nascent "blue bond" market focused

on ocean projects. BNY Mellon worked with the government of the Seychelles to launch the world’s first sovereign blue bond, a \$15m issue that will be used to develop sustainable fishing practices in a designated area of the country’s waters.

The island nation issued an unusual follow up this year that saw it use some of its national debt to make 30% of its exclusive economic zone into marine protected areas, working with The Nature >

IKEA affects oceans through its packaging and procurement as one of the world’s largest restaurant chains.

HOW THE WORLD'S BIGGEST SEAFOOD COMPANIES SCORE ON SUSTAINABILITY

1	Thai Union Group (Thailand)	2.7/5
2	Mowi (Norway)	2.42/5
3	Charoen Pokphand Foods (Thailand)	2.32/5
4	BioMar Group (Denmark)	2.22/5
5	Nueva Pescanova (Spain)	2.04/5

Source: World Benchmarking Alliance



NACHO DOCE/REUTERS

“
Mangroves are incredibly important in terms of ‘blue carbon’, as a breeding ground for fish and other biodiversity, and coastal protection

Conservancy on a mechanism known as a debt-for-nature swap.

US investment bank Morgan Stanley has chosen to focus on plastic waste as its contribution to ocean sustainability and has pledged to “prevent, reduce and remove 50m metric tons of plastic waste from entering rivers, oceans, landscapes and landfills by 2030”.

Since launching the commitment, the bank helped PepsiCo to launch its inaugural \$1bn green bond, which includes a commitment to reduce 35% of virgin plastic content across its beverage portfolio by 2025, and underwrote the World Bank’s first blue bond, which directed proceeds toward marine projects that promote biodiversity and support economies reliant on healthy and sustainable fisheries, says Audrey Choi, chief sustainability officer at Morgan Stanley.

One area that could hold great potential for improving ocean sustainability is technology. While emerging areas such as renewable energy are technologically advanced, there is a lot of potential in areas such as fisheries/aquaculture, shipping and tourism.

“There is a lot of spillover from tech and we can borrow things from other sectors like internet of things, to create better monitoring of fishing boats and cruise ships,” says Janulis of Investable Oceans. [\(See Can big data save the big blue sea?\)](#)

In fisheries, a lot of work is going into making wild fishing and aquaculture more sustainable, as

well as into creating artificial alternatives. Atlantic Sapphire is one of the few listed companies working on recirculating aquaculture systems (RAS), which offers a way to do land-based fish farming. This has many potential advantages, says FAIRR’s Ekundare, including being able to rear fish closer to centres of demand, reducing the incidence of sea lice and contaminating wild populations. Because the environment is more controlled, it should also be possible to reduce the use of antibiotics.

There are still many risks: Atlantic Sapphire lost more than 200,000 fish in a “mortality event” recently, pushing its harvest revenue back by four months. More fundamentally, there remains a problem with the taste. “You can solve all the sustainability problems you want, but if it doesn’t taste right, no one will buy it,” Ekundare adds.

“Ocean sustainability probably should always have been a huge concern for investors,” says Choi. “But we’re definitely seeing a steady increase – blue finance as a theme is very much rising up the agenda now, and I expect that to continue.” ●



Mike Scott is a former Financial Times journalist who is now a freelance writer specialising in business and sustainability. He has written for The Guardian, the Daily Telegraph, The Times, Forbes, Fortune and Bloomberg.

Planet Tracker's mission to shine light on investment risk from unsustainable fishing

One reason that investors have not paid enough attention to oceans is that ownership of fisheries supply chain operations can be hugely opaque.

"They're very complex ownership structures, sort of integrated webs of companies that control these operations. When you do start peeling back the onion on these sectors it's pretty remarkable who's actually underneath," says Matt McLuckie, director of investor relations at Planet Tracker, a sister organisation to Carbon Tracker, which was set up to shine a light on how unsustainable practices in commodities like seafood undermine the stability of global investment portfolios.

The [opacity of ownership structures](#) was also highlighted by the World Benchmarking Alliance in its Seafood Stewardship index, which ranks 30 of the world's biggest seafood companies on five indicators. (See [Blue finance seeks new horizons](#)) It said the "complexity and diversity of company business structures and activities across operations, subsidiaries and supply chains ... increases environmental and social risks."

McLuckie said one of the biggest "pinchpoints" for traceability is when fish are transferred onto trans-shipment vessels. "Fish are just deposited there, and you lose all sense of traceability, like diamonds going through Antwerp."

Using data from Global Fishing Watch, "we're trying to look at who actually owns those facilities and who's insuring them, and how we can then actually use the shareholders and insurers to try and create much more transparency and traceability around the operations of these reefers [trans-shipment vessels]," explains McLuckie.

With Japan accounting for 23 of the top 100 stock exchange listed seafood companies by revenues, Planet Tracker investigated the ownership structure of the Japanese seafood industry and has made the



Rows of tuna fish at a seafood auction in Tokyo, Japan.

information publicly available on a [data dashboard](#).

Its [Perfect Storm](#) report points out that rising share prices don't reflect the fact that wild-catch seafood production in Japan has been in serious decline since 1985, and investors are setting themselves up for a fall. "Over-fishing poses serious financial and reputational risks, not just to Japanese wild-catch companies, but to the investors and credit lenders who finance them," the report says. "Currently they have limited ability to tell whether the companies they finance are sourcing wild-catch fish sustainably or not."

On the other hand, "if Japanese fisheries were managed sustainably to achieve their maximum sustainable yield, the global industry could earn an estimated \$51bn-\$83bn billion extra every year." ●

Angeli Mehta

MICHAEL VON AICHBERGER/SHUTTERSTOCK



WILLIAM BRADBERRY/SHUTTERSTOCK

Fashion ‘ignoring its links to plastic pollution’

With textiles the biggest source of the toxic soup of microfibres that have entered the human food chain, **Mark Hillsdon** looks at nascent efforts by the garment industry to clean up its act

[VIEW ONLINE](#)

While images of plastic bottles littering beaches, and marine wildlife caught up in abandoned fishing nets, have dramatically raised the profile of ocean pollution, this visible plastic junk represents just 1% of the problem. The rest is made up of microfibres, tiny threads that are shed by clothes during manufacturing and when they are washed. Research has shown that one machine load of washing can shed more than 700,000 of these fibres.

Although around 50% of our clothing is made from plastic, new research from Italy’s Institute of Marine Sciences suggests that the majority of these tiny threads aren’t made of synthetic fabrics such as polyester and nylon, as had been presumed, but cotton, linen and other man-made fibres such as rayon, which have been so impregnated with chemicals that they aren’t able to naturally biodegrade.

Whatever their make-up, microfibres are flooding the oceans. While some are caught by filters in washing machines, and others are extracted at >



MEGASTOCKER/SHUTTERSTOCK

One machine load of washing can shed more than 700,000 microfibres.

waste treatment plants, it's estimated that some 1.4 quadrillion are floating in our seas, absorbing pollutants and other poisonous substances, and becoming highly toxic.

They are also starting to enter the food chain, with research showing that 63% of shrimp in the North Sea now contain microfibres, as marine life mistakes the threads for food. Another report in July revealed microfibres have been found in the guts of sharks living off the UK coast for the first time, while a [recent study of the Atlantic Ocean](#) in Nature Communications found that both "inputs and stocks of ocean plastics are much higher than determined previously".

Dr Laura Foster, the Marine Conservation Society's head of clean seas, says: "Tiny microfibres are less visible than a plastic bottle but we need to make more of a connection between the sea and what we do in our everyday lives, including the clothes we wear and put in the wash. It all becomes part of a soup of ocean plastic."

While the textile industry is thought to be responsible for nearly 35% of all microfibre pollution, critics say fashion brands have been slow to address the risk.

MICROFIBRES IN NUMBERS

- Visible plastic pollution in oceans only accounts for **1%** of the problem.
- Two-thirds of textile fibres are made of plastic and one machine load of washing can shed more than **700,000** microfibres.
- There are **1.4 quadrillion** microfibres floating in oceans, absorbing pollutants and other poisonous substances, and becoming highly toxic
- Only **8.2%** of microfibres collected in seawater samples in one study were synthetic, while 79.5% were cellulosic (including cotton, linen and man-made fibres like rayon/viscose) and **12.3%** of animal origin.

Carry Somers is founder of Fashion Revolution, a community interest corporation that publishes an annual [Fashion Transparency Index](#), based on a survey of over 250 leading fashion brands. The current survey revealed that only 20% of companies had a strategy in place to prevent microfibre >

shedding from their clothing. "Textiles are the biggest contributors to ocean plastic pollution, so why are so few brands doing anything about it?" asks Somers. "Why aren't they looking at microfibre shedding, because you can pretty much guarantee they are all using synthetics."

H&M is one of the companies on the index that is tackling microfibres, and in a statement told The Ethical Corporation that as well as designing yarns and fabrics that minimise microfibre shedding, it is also looking at alternative, bio-based materials.



Although fashion is an industry at the forefront of sustainability, you need more people to move the needle. It needs the power of the collective

"We think that microfibre pollution needs to be tackled with a holistic view on several perspectives: design, production, fabric construction, usage on washing machines and end-of-life," read the statement.

The company is also part of MinShed, a project run by the Swedish research institute SWEREA, which is helping the textile industry design clothes made of fabrics that don't emit microfibres.

H&M is also part of another industry body, the Fashion Pact. Launched at last year's G7 in Biarritz, the pact is made up of fashion industry chief executives representing over 60 leading businesses, from Adidas and Nike through to luxury names such as Burberry and Prada.

One of the pact's three commitments is to protect the oceans and includes supporting innovation to eliminate microfibre pollution from the washing of synthetic materials, as well as efforts to educate consumers on product care.

But while the pact's executive director, Eva von Alvensleben, confirms that CEOs are now meeting to find solutions to the problems posed by microfibres, she is tight-lipped about exactly what the pact is doing, saying the results of their action will be communicated at the end of the year.

She does, however, concede though that while "it's an industry that is at the forefront of sustainability," fashion does need to up its game. "You need more people to move the needle," she says. "It needs the power of the collective."

This collaborative approach is epitomised by the Microfibre Consortium (TMC), a UK-based industry group that has developed the first standardised methodology for measuring microfibre shedding and what triggers it.

Developed with support from the University of Leeds, the methodology goes live at the end of the year, explains TMC founder Sophie Mather. This will allow different materials to be tested at scale, >

Inset: Microfibres are entering the food chain, with 63% of North Sea shrimp found to contain them.

JACE CAMERON/
SHUTTERSTOCK



It is estimated there are 1.4 quadrillion microfibres floating in our seas.



CATHAL MCNAUGHTON/REUTERS

improving R&D and creating a database. The goal is to create a traffic-light system for shedding rates similar to that used by other consumer goods such as fridges. "That's what the brands and retailers are really wanting to move towards," she says.



We need to move away from just pointing the finger at synthetics; this is an issue that affects all fibres

Such a system will also help to drive change further down the supply chain, says Mather, and help brands make better-informed decisions about what materials are used and how garments are put together. For instance, using laser cutting rather than scissors creates less frayed edges and reduces shedding.

The consortium is also supporting the development of alternative textiles by looking at composition and fabric structure, but progress is slow. "I'm not seeing the level of innovation and technology at the yarn or the fabric level that I would anticipate at this stage," says Mather.

Somers agrees. "There seems to be very little

brand appetite for those alternative textiles," she says. "It's not like there's easy options out there for the industry... we need to see a lot more brands investing in innovation."

Some progress is being made, however, particularly in the US, where Mango Materials has developed a process that turns methane into bioplastic, a naturally biodegradable material that can be used by the clothing industry. Elsewhere, biotech company Genomatica is manufacturing nylon made from plants instead of crude oil.

But Mather also stresses that biodegradable materials don't necessarily hold all the answers. "We need to move away from just pointing the finger at synthetics; this is an issue that affects all fibres," she says.

This is a point born out by Giuseppe Suaria's research at the Institute of Marine Sciences. Published in [ScienceAdvances](#) in June, it showed that although microfibres are traditionally reported as microplastics in plastic pollution studies, in fact only 8.2% of microfibres it collected in 916 seawater samples from six oceans were synthetic, with 79.5% being cellulosic (including cotton, linen and man-made fibres like rayon/viscose) and 12.3% of animal origin.

It was a surprise finding, considering that synthetic polymers currently account for two-thirds of global fibre production, the researchers said. >

Natural products like wool and cotton that have been chemically treated do not biodegrade.

NOKURO/SHUTTERSTOCK



“Our results highlight a considerable mismatch between the global production of synthetic fibres and the current composition of marine fibres,” said Suaria.

The study pointed out that despite being considered biodegradable, little is known about the degradation of wool and cellulosic fibres in marine environments. “Rayon and cotton yarns are often processed, finished, dyed, and coated with a wide range of chemicals including resins, softeners, and flame retardants, which may considerably slow their remineralisation.”

According to Fashion Revolution, more than 15,000 chemicals are regularly used in textile manufacturing, from dyes to anti-shrinking agents and water repellents: “It’s an endless list,” says Somers. Yet 60% of brands don’t publish an inventory of the chemicals they use. “A lot of these chemicals are sitting in or on the microfibres,” she adds, yet “there is so little information, considering what a huge issue it is.”

It’s a question that another US business, Evolved by Nature, is seeking to tackle with a textile finishing chemistry called Activated Silk. Made from pure silk protein dissolved in water, it’s a technology that has already spiked the interest of several major brands, says company manager Meg Roberts.

“Our goal is to reduce or completely replace the

use of petroleum-derived finishing chemistry in the textile industry, which is also contributing to the microplastic problem,” she explains.

“Many people don’t realise that clothing is coated in different chemicals that impart desirable performance properties such as waterproofing, moisture-wicking, or anti-wrinkle. Similar to washing a synthetic garment where microfibres are shed, these chemicals are also being washed into waterways, where they accumulate and, in some cases, become more toxic.”

While the end of the year should see more announcements from the Fashion Pact, and the release of TMC’s methodology on shedding, Somers also sees the need for legislation. “This problem isn’t going to go away and we really need regulation because there are always going to be those laggard brands who aren’t going to move unless they’re compelled to do so,” she says. ●

H&M is designing yarns and fabrics that minimise microfibre shedding.



Mark Hillsdon is a Manchester-based freelance writer who writes on business and sustainability for The Ethical Corporation, The Guardian, and a range of nature-based titles including CountryFile and BBC Wildlife.

Soaring growth in offshore renewables puts wind in the sails of the energy transition

Terry Slavin reports on how technology breakthroughs allowing wind power to penetrate new markets, falling costs and growing demand for green hydrogen are driving a rapid expansion in the industry



VIEW ONLINE

Oceans are critical in the battle against climate change, absorbing 25%-30% of annual CO₂ emissions, but it is a role that is being undermined as oceans warm and become more acidic. In the future, scientists say, the greatest CO₂ mitigation potential will have to be found not in the depths of the oceans, but in what lies on top: renewable energy installations like offshore wind, wave and tidal energy and floating solar arrays.

The High Level Panel for a Sustainable Ocean Economy envisages ocean-based renewable energy will account for 5.4 GtCO₂e (gigatons of CO₂ equivalent) of the 11.8 GtCO₂e mitigation potential of the oceans by 2050, delivering one fifth of the cuts necessary to help keeping global temperature rises below 1.5C.

That is almost as much as all other ocean-based climate solutions the panel cites combined. And much of the heavy lifting will come down to one technology: offshore wind.

Offshore wind today only accounts for 0.3% of power generation globally, with a total installed capacity of 29GW. But that is literally a drop in the ocean of its potential, according to the IEA, which says there is enough offshore wind resource globally to meet total global electricity demand 18 times over.

And the industry is scaling up rapidly, amid dramatic falls in cost, increases in turbine sizes, and recognition in Europe of its critical role in fostering a green hydrogen economy ([see Netherland's wind-powered green hydrogen hub begins to take shape](#)).

BloombergNEF reported last month that offshore wind had defied the Covid-19 downturn, seeing \$35bn investment in the first half of this year, up 319% on the previous year, with green lights given >

Estimates suggest there is enough offshore wind resource to meet total global electricity demand 18 times over.



to 28 sea-based windfarms, including the 1.5GW [Vattenfall Hollandse Zuid project](#) off the coast of the Netherlands, the 1.1GW [SSE Seagreen project](#) in the UK, and 17 projects in China, where investors rushed to take advantage of a feed-in tariff due to expire at the end of 2021.

While current forecasts are for capacity to reach 190GW by 2030, and 350 GW by 2040, in June, the Ocean Renewable Energy Action Coalition (Oreac), a group led by offshore wind energy majors Ørsted and Equinor, announced an ambition to install 1,400 GW of offshore wind globally by 2050.

John Olav Tande, offshore wind specialist at Norway’s SINTEF, an independent research organisation, said in an interview that the 1,400GW target for wind was “ambitious but absolutely doable and would be a very important step to reach climate targets.”

He added that because the space covered by oceans is much larger than land “it is possible to find places where there are opportunities to do really large projects with little or negligible environmental impact” if proper planning and surveys are conducted to assess impacts of birds and sea mammals.

The UK, which has a target of 30GW of offshore wind capacity by 2030 to help meet its climate goals, is sitting world leader, having already

commissioned 6GW to date, including the 3.6GW [Dogger Bank wind farm](#), 130 kms off the Yorkshire coast in the North Sea.

The project, a partnership between Norwegian oil major Equinor and SSE Renewables, will cover an estimated 5% of the UK’s electricity generation when it is up and running in 2023, and produce electricity for about £40 per megawatt hour.

“This success demonstrates that offshore wind is the key technology to enable the UK to become carbon neutral by 2050 in the most cost-effective >

An albatross at sea – surveys need to assess the impact of ocean wind on birds and sea mammals.

ONDREJ PROSICKY/ SHUTTERSTOCK

way, whilst also delivering significant economic benefits across the country," said Jim Smith, managing director of SSE Renewables, when the £9bn project was announced last September.

FLOATING TURBINES

The UK is also the location of the world's only commercial floating wind installation, Equinor's 30MW Hywind Scotland, a pilot project that has been operating off the Aberdeenshire coast in 105m of water since October 2017, much deeper than the 20m to 50m at which conventional offshore wind turbines are installed.

The five turbines have been reaching 65% of their maximum capacity even in hurricane conditions, a vast improvement on the average 40-50% capacity of land-based turbines.

Tande sees floating wind turbines as critical to fulfilling the technology's potential because they can be installed in areas with deep water, where 80% of the world's wind resource is located.

In some geographies, like large parts of the coast in North America, Japan or Norway, floating wind will be most suitable because of the water depth, Tande said.



Floating wind is seen as critical because turbines can be installed in deep water areas, where 80% of the global wind resource is located

"I think floating wind will be a big part of 1400GW. But we need R&D to scale up in the right way, and with the right technical solutions."

Arne Eik, leading developer of floating offshore wind at Equinor, told The Ethical Corporation that although floating wind currently costs twice as much as bottom-fixed, the latter has seen its levelised costs of producing electricity, a measure of the average cost per megawatt hour over the full lifetime of a plant, cut in half in the past few years.

He expects floating wind to follow the same trajectory, and fall to €40 per megawatt hour (MWh) by 2030, with bottom-fixed as low as €30 per MWh.

"We are seeing more projects coming, and we are also seeing big developers from bottom-fixed and oil and gas majors moving into floating wind," a development that will allow the industry to get to scale and drive down costs.

Levelised costs have already come down 40% at Equinor's second floating wind project, the 88MW



Equinor's 30MW Hywind floating turbines, which at 253m dwarf Big Ben, have been operating off the Aberdeenshire coast since 2017.



Hywind Tampen, which is due to start operations in 2022, Eik said. Located 140 km off the Norwegian coast, Tampen will supply power to the Snorre and Gullfaks offshore oil and gas fields. The project, which has NOK 2.3bn in state support, is expected to reduce CO₂ emissions by the installations by more than 200,000 tonnes per year.

Eik said Equinor, which this year announced targets to reduce greenhouse gas emissions from its offshore oil and gas fields and onshore plants by 40% by 2030, has ambitions to retain the early world leadership it has established in floating wind. >

Once commercial, Equinor sees the technology as crucial for opening up offshore wind opportunities in South Korea, Japan, China, Taiwan and the US state of California.

According to a [2016 NREL report](#), California has technical wind energy resource potential of at least 100GW off its coast, which it has been unable to exploit because its deep waters are unsuited to bottom-fixed offshore wind technology. Under the Donald Trump presidency, the US has also been opposed to renewables development in federal waters, something that could change if Joe Biden wins in November.

The California Public Utilities Commission estimates that about 7 GW of offshore wind could be part of California’s ideal zero-carbon electricity mix by 2045, the target date for the state’s electricity to be zero-carbon.



Offshore wind speeds tend to increase in the evenings, when solar power supplies fall but air conditioner use soars

Critically, offshore wind speeds tend to increase in the evenings, when solar power supplies fall but air conditioner use soars, one reason the recent heatwaves have pushed the state’s solar-power-heavy grid to the limits and forced the imposition of blackouts to balance supply and demand.

But there are hurdles that floating wind will have to overcome for the technology to become commercial, and it is not just down to cost. One looming challenge will be opposition from the global fishing industry.

“We’d like co-existence [with the fisheries industry] and we’d like to see marine spatial planning be developed to decide where to have fisheries and where to have offshore wind,” Eik said. “Having an early dialogue process with other stakeholder interests at sea is key for offshore wind to succeed. I’m very hopeful that we are getting there.”

Søren Lassen, senior offshore wind analyst for Wood Mackenzie, is also upbeat about the prospects for offshore wind, particularly beyond 2030. He said Orec’s target to have 1,400 GW of offshore wind installed globally by 2050 “is a little bit crazy, but that doesn’t mean it can’t happen”.

Both floating and fixed-bottom wind will benefit from hundreds of millions of euros in EU funding



DJ MATTAAR/SHUTTERSTOCK

earmarked for green hydrogen in its coronavirus recovery package and Green New Deal.

And Lassen pointed to recent announcements by countries including South Korea, which aims to have 12GW of offshore wind installed by 2030, up from 100MW today, and French plans to boost its existing 2MW capacity to 12.4 GW by 2028, including 1.5GW of floating offshore wind.

“We already see policy targets [for offshore wind] from various governments of more than 200GW by 2035 and that isn’t the end. We expect more governments to set targets and for existing targets to be upgraded.”

And while the sheer size, complexity and lead time for floating wind concepts will limit investment in the near term, he believes it will be an increasingly important technology post 2025. “We are seeing more experienced players get on board and position themselves in this space” through alliances and memorandums of understanding, and some 75 different concepts for how it will develop being explored. “How it will look like I’m not sure, but I do believe it’s going to happen.” ●

Despite the Covid-19 pandemic, investment in sea-based wind farms rose 319% this year.



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Netherlands' wind-powered green hydrogen hub begins to take shape

The EU, which has a goal of cutting greenhouse gas emissions in half by 2030, sees a massive increase in offshore wind – from 20GW today to 450GW by 2050 – as necessary to fuel a [green hydrogen economy](#), with electrolyzers located either on land or built into wind towers at sea using renewable energy to convert seawater into zero-carbon hydrogen.

Not only could it provide zero-carbon fuel in industrial quantities for hard to decarbonise sectors like steel and long-distance trucking, green hydrogen could be converted to ammonia and used as a clean fuel for shipping.

The Netherlands is leading the way, announcing earlier this year plans to turn off the tap on natural gas production in the north of the country by 2025 and create a green hydrogen hub in its place, fuelled by offshore wind farms and using the same gas network infrastructure.

This began to take shape in July, when a consortium of Shell and Eneco secured the right to build the 759MW Hollandse Kust North project, 18.5

kilometres off the Dutch coast, which will generate 3.3 terrawatt hours (TWh) of wind per year.

Shell said the wind farm, which will come online in 2023, will also feature a floating solar park, and produce green hydrogen. While the hydrogen will initially be used to decarbonise production in Shell's Pernis refinery, in future it would connect to the NorthH2 green hydrogen hub in the Port of Rotterdam, projected to open in 2027.

While new partners will be required, the ambition is for new wind farms in the North Sea to feed 3-4MW of power a year into a mega-hydrogen facility in Eemshaven by 2030. By 2040 volumes could be 10MW, producing 800,000 tonnes of green hydrogen for industrial users in the Netherlands and northwest Europe, enough to avoid 7 megatons of CO₂ emissions annually.

Another innovative idea is to locate floating wind installations on shipping routes, where ships would dock to fill up with clean ammonia fuel, produced in situ from hydrogen derived from seawater and nitrogen extracted from the air. This is a solution being promoted by the [Zero Emission Energy Distribution at Sea \(ZEEDs\)](#) initiative, led by Finnish energy company Wärtsilä, and including Aker Solutions, DFDS, Grieg Star, Kvaerner and Equinor. ●

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THE DISRUPTORS



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