

LONDON 6-8 JUNE

Germany rules out offshore target rise

BERND RADOWITZ

opes that Germany will increase its offshore wind targets in light of the sector's recent plunging prices have been dashed after a senior figure in the country's energy ministry revealed yesterday that nothing will change until grid bottlenecks have been resolved.

State secretary Rainer Baake told a press briefing at OWE 2017 yesterday that the country's aim of installing 15GW of offshore wind by 2030 will not be changed, despite calls from industry groups to raise the target to 20GW.

"I have heard lately requests from the offshore industry to increase that [15GW] target. And my answer is when it comes to costs of production, the offshore wind industry has a lot of arguments on its side," Baake said. "But we as politicians have to make sure that the produced electricity is

lan Howarth

Photograph |



also reaching the consumers. And as long as we have not expanded the grids, we should not decide on increasing the targets for 2030." Germany is currently upgrading thousands of kilometres of AC power lines, and is also building three highvoltage direct current (HVDC) transmission *autobahns* to transport *CONTINUED on Page 3*

Oil giant calls for 10GW offshore megaprojects

ANAMARIA DEDULEASA

egaprojects in the 10GW range built around "anchor tenant" led development consortia will be needed to make offshore wind a global mainstream energy source, according to Shell New Energies executive vicepresident, Mark Gainsborough.

The oil supermajor believes this model — adopted from the retail sector where a prestige brand store is given lower rent to attract other tenants — will be a better means of accelerating and upscaling the build-out of offshore wind farms CONTINUED on Page 3

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BERND RADOWITZ

he governments of Germany, Belgium and Denmark, together with industry leaders, signed a joint statement at OWE 2017 yesterday to further the deployment of offshore wind in Europe, but fell short of including industry demands for a 6-7GW annual pipeline across the continent.

While reaffirming a commitment made by ten EU governments a year ago in the North Seas Declaration for regional cooperation to add a "significant amount of new offshore wind power in Europe between 2020 and 2030," the signatories of the statement remained vague about actual volumes.

"We recognise that cost reduction can be accelerated in the light of significant yearly deployment volumes and if the respective grid can be developed," the joint statement says.

It was signed by Belgian energy minister Marie-Christine Marghem; German secretary of state in the economics and energy ministry, Rainer Baake; deputy permanent secretary in the Danish ministry of energy, Kristoffer Böttzauw; as well as top executives from Dong Energy, Siemens Gamesa and MHI Vestas.

While the industry says it is ready to deliver 60GW of new capacity by 2030 if at least 4GW a year will be added, many in the sector expect a much faster cost reduction if that annual pipeline were hiked.

"If the market can go to the level of 6-7GW per year that will make a big difference for the supply chain in Europe," Jens Tommerup, chief executive at turbine maker MHI Vestas said yesterday.



Joint statement fails to set build-out target

Dong Energy's executive vice-president for wind, Samuel Leupold, said a better coordination

If the market can go to the level of 6-7GW per year, that will make a big difference

of tendering schedules among European countries would be a massive step forward. That has the effect that the supply chain has to live with times of over- and under capacity at factories, while developers may have to risk taking

> part in an auction without knowing the outcome of previous auctions in which they participated.

"You risk to make commitments on your balance sheet which potentially would be too high, and then you would potentially stay away from the next auction, because you say I haven't seen the outcome of the previous one," Leupold explained.

Shell wants sector to adopt 10GW 'anchor tenant' offshore model

FROM Front Page

than the current tender model being employed in certain European countries, which are driven by 2030 national targets.

"Shell believes that instead of organising the next tranche of leases and tenders simply on the basis of meeting national targets in 2030, we would propose that the next phase be thought of as a stepping stone, a de-risking exercise, towards a much bigger offshore wind industry that operates at the scale of the potential resource," Gainsborough told OWE 2017 yesterday.

"We believe that a few large, integrated projects up to 10GW, with an anchor tenant who takes the biggest risk for about half the project, need to be developed to ensure we all learn how best to do this.

"Think of the cost savings that could be achieved by constructing several hundred wind turbines continuously, like an offshore assembly line."

According to Gainsborough, upscaling development would lower cost, create value across the supply chain, and stimulate economic growth.

Shell, which has plans to earmark around \$1bn a year for investment in renewable energy sources from 2020, is in the early stages of diversifying its portfolio. In the US, the group is a 50-50 joint venture partner in six operating onshore wind projects, and in Europe, in the Netherlands, together with Mitsubishi, Eneco and Van Oord, it won the 700MW Borssele 3&4 offshore tender in last year.

"A cleaner energy future is both desirable and possible... but this will require action in all sectors of the energy system, and will require scaling up opportunities. Long-term integrated policies on climate, energy and economy will be necessary, along with a power market that sends the right investment signals," he says.

Germany rules out offshore target rise until at least 2025

FROM Front Page

cheap wind power from the North Sea and windy coastal regions to industrial in the south.

While the three HVDC lines are expected to be operational by 2025, Baake described the grid expansion as a "constant race" to keep up with Germany's renewables additions.

If 2017 will be a year of normal

weather conditions, the share of renewables in Germany's electricity consumption will rise to at least 35% (from close to 33% in 2016), and to 40-45% in the "next years", Baake said.

"When it comes to possibly more offshore, we are all in favour of that. But we need the grids. That is the bottleneck in Germany."

Later, Baake told Recharge that if

the Green party — of which he is a member — were to become part of the next German government after elections in September, it will push for a faster build-up of renewables in the country.

But additional volume would come from onshore wind in the south and PV across the country in order to not worsen the grid bottleneck situation.

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RECHARGE OFFICIAL EVENT DAILY

WIND ENERGY 2017

Ideol to offer turnkey floating solutions after €8m investment

DARIUS SNIECKUS

Floating wind pioneer Ideol has added over €8m (\$9m) to its war chests as it gears up to commercialise its innovative 'damping pool' foundation concept.

The French technology company has received fresh capital investment from German offshore contractor Siem and Japanese engineering giant Hitachi Zosen, as well as from European private equity fund Amundi, as part of plans to offer a "one-stop shop" for floating wind projects around the world.

Ideol chief executive Paul de la Guérivière says the partnership agreements signed would give his company a "unique capability" in all major international markets to provide developers with a turnkey solution from the engineering and construction of its floating foundations to their offshore installation.

The 2MW flagship of Ideol's concrete platform-based concept is currently being built under the aegis of the EU's €25m FloatGen project at French port of Saint-Nazaire, with expectations it will be towed out this autumn for first trials in the French Atlantic.

Ideol is amassing a multigigawatt order pipeline with projects off France, Japan, Taiwan and the UK, with recent tie-ups annosunced with Irish utility Gaelectric and UK-based ocean-energy developer Atlantis Resources.





Senvion's 10MW-plus machine 'will be on the market by 2022'

BERND RADOWITZ

envion's upcoming 10MWplus offshore turbine will hit the market in time to supply projects won at German and Dutch tenders this year namely, before 2022, the OEM's offshore vice-president Cornelius Drücker, tells *Recharge*.

The German turbine maker revealed its plans for the next-generation machine at the AWEA Windpower show in California two weeks ago, then declaring that it would reveal more details about the model at OWE 2017.

But Drücker told *Recharge* yesterday that the company would not be providing any more information.

"We don't want to spread information about turbines to come in a few years' time very widely. We have to hold discussions with the major stakeholders first," Drücker said, adding that these include Senvion's customers and supply chain. "We are now facing an environment where our customers are competing against each other in all the auction systems."

Other companies also kept information close to their chest on turbine developments that go beyond upgrading current platforms.

Siemens Gamesa chief executive

The size needs to be bigger, but it also needs a hit a spot where you can actively install it

for offshore wind, Michael Hannibal, reiterated his company is also working on a 10MW-plus machine.

"The size needs to be bigger, but it also needs to hit a spot where you can actively install it, and you can actively have your suppliers and supplying components for such a machine," Hannibal said at an OWE 2017 press conference. "That's basically, where the industry is working hard to find the sweet spot."

Dong Energy and EnBW won 1.49GW in capacity in Germany's first offshore tender in April mostly with zero-subsidy bids that will require the next generation of 10MW-plus turbines to drive costs

down sufficiently — but the winning projects do not have to be commissioned until 2024-25.

The Netherlands are slated to hold their next offshore wind auction in the third quarter, for the 700MW Hollandse Kust South 1&2 zone. Winners

of that tender will have five years — or until 2022 — to complete their projects.

"We can definitely supply in that time scale for the projects that won the German auction," Drücker told *Recharge*. "There are auctions upcoming in the Netherlands, where we would be ready with the turbine." 🖬

Seawind to install 6.2MW two-blader in 2018

DARIUS SNIECKUS

wo-bladed wind turbine pioneer Seawind is on track to install a first full-scale 6.2MW prototype off western Norway next year after securing financial backing from engineering consultancy Enzen.

The funding — which will add to a $\in 15m$ (\$16.9m) loan from Norwegian technology body Enova and "in kind" support from a number of suppliers — will clear the way for a turbine mounted on a concrete gravity-base

foundation from Olav Olsen to be installed off Karmøy at the Marine Energy Test Centre (MetCentre).

Image | Seawind Ocean Technologies

"This is a key milestone for our company as we move from proof of concept to commercialisation of our revolutionary two-bladed offshore wind energy systems." says Seawind chief executive Martin Jakubowski.

"The money from Enzen is the

AGENRODO



equity portion [of the €25m project capital cost] of the demonstrator," he continues. "The remainder will come from Enova and certain other suppliers are contributing because they believe very much in our system. "We have a floating model but we will start with bottom-fixed because we want to show now we can install an integrated [turbine, tower and foundation] concept that does not have the added complexity of a floater."

Installation of the flagship is targeted for September, "otherwise we will have to wait until spring [2019]", says Jakubowski. "As we know, everything is a question of time," he adds. "So we have to run."

The Seawind 6 turbine design will feature a 126-metre-diameter rotor fitted to a hybrid mechanical-elastomeric hinge that is engineered to filter out wind-driven gyroscopic loads and so cushion the impact on the machine's two-stage geared drivetrain, while allowing for power control to be finessed by yawing rather than by adjusting blade pitch.

The turbine will be installed in 38 metres of water at MetCentre, a grid-connected 40MW offshore wind laboratory not far from the Hywind 1 floating wind demonstrator.

OPINION: Page 14



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JDR lined up to supply WindFloat 66kV cables

Subsea power cable specialist JDR has been chosen by the WindPlus consortium as the preferred cable supplier for the 25MW WindFloat Atlantic (WFA) floating wind farm being developed off Portugal.

The array, being built around three MHI Vestas V164 turbines mounted on Principle Power steel semi-submersible foundations, will see the industry's first application of high-voltage 66kV dynamic cables for a floating project.



Iberdrola and Catapult collaborate on jackets

Iberdrola-owned ScottishPower Renewables and the UK's Offshore Renewable Energy Catapult have agreed to collaborate to prioritise "innovation needs" for the developer's portfolio of offshore wind projects, starting with a jacket-fabrication feasibility study.

The aim of the lead-off project will be to review efficiency opportunities in foundation fabrication, with an eye on helping UK companies gain a competitive edge and maximise longer term economic benefit.

Totaro software picks up artificial intelligence

Innovation strategy consultancy Totaro & Associates has inked a deal to use machine-learning company Super H's algorithms for content aggregation and analysis on its software.

The company's IP Prism for intellectual risk evaluation and technology trend analysis tool, as well its IntelStor market intelligence data archive, will be first to incorporate the Super H "back-end" functionality.

GustoMSC unveils new-breed jack-up for 10MW-plus turbines

DARIUS SNIECKUS

arine contractor GustoMSC has launched its next-generation offshore installation vessel, a selfpropelled jack-up with telescopic leg crane, for the coming 10MWplus wind turbine models.

The NG-20000X design which uses the company's proven variable-speed-drive jacking system and has a variable load capacity of 16,500 tonnes — can make a round trip to a project site with six complete sets of turbine components or jacket foundations.

"The wind turbines currently under design and testing will require a new generation of installation jack-ups to deal with the increasing weight and installation height of wind turbine components and the ever-heavier foundations," says GustoMSC commercial director Jan-Mark Meeuwisse. "However, a different strategic approach is required for the future turbines with capacities beyond 10MW.

"Key to the new approach is to stop the spiraling trend of growing crane weights due to the increasing requirements related to the heavy foundations and high installation heights, and to stay close to the proven design technology at the same time.

"By scaling up the jack-up design and jacking system and solving the challenging crane requirements in an innovative manner, the NG-20000X represents the next generation wind turbine installation jack-up in all its facets."

The telescopic leg crane was developed to make possible a unit with both high hoisting height for ultra-large turbines and heavy load capability for foundation installation.

By introducing a telescopic boom that features an ultra-high hook-height when extended (1,250 tonnes at 160 metres) and a greater hoisting capacity when retracted (2,500 tonnes at 120 metres), it promises to "break the cycle of extremely long protruding booms and increasing crane weights, resulting in a more economic crane design and increased variable load available for operations", says Meeuwisse.



UK offshore rebounds to 2010 high

CHRISTOPHER HOPSON

he level of development activity in the UK offshore wind sector — with projects containing 830 turbines under construction — is the highest seen since 2010, according to a new report from UK seabed landlord The Crown Estate.

Contributory factors to this increased activity were quickening offshore construction rates and further growth in turbine capacity, demonstrating increasing efficiencies in the installation, technology and performance of assets, the Crown Estate writes in its fifth annual *Offshore Wind Operational* report, published yesterday.

Investment opportunities and risk profiles are attracting a broader pool of investors to the UK sector with pension funds and corporates entering the market for the first time, including



participation at the construction phase, the report says.

"Together with the conclusions of the latest Contracts for Difference round in the months ahead, this report offers growing evidence of offshore wind's competitiveness as a low-carbon energy resource, says Huub den Rooijen, director of energy, minerals & infrastructure at the Crown Estate. "Growth has been driven by three main factors: world-class offshore wind resources, strong policy support, and an industry that has risen to the challenge of becoming a mature power player." **G**

Grid costs 'must be cut to become truly subsidy-free'

BERND RADOWITZ

The offshore industry needs to concentrate on reducing grid connection costs in order to truly achieve subsidy-free energy, the deputy permanent secretary at Denmark's energy ministry told OWE 2017 yesterday.

"The cost for grid connection is still a rather substantial shadow cost, or an indirect subsidy, for offshore wind," said Kristoffer Böttzauw.

"Before we can talk about real subsidy-free offshore wind farms, we will have to lower cost for grid connection."

Whether that could be done via more interconnectors between European countries or a North Sea power hub in the middle of the sea as suggested by grid operators, is the "next big question," he added. **E**

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CONFERENCE

GLOBAL MARKET DEVELOPMENTS 9:30 - 10:45, Room 11

Start day 2 with keynote addresses from representatives from key global offshore wind markets will give policy and project updates as well as an analysis of consenting and funding models.

> Session Chair:

Ben Backwell, Managing Director, FTI Consulting, UK

> Speakers:

Ulrik Stridbæk, Senior Director, Head of Group Regulatory Affairs, DONG Energy, Denmark

Jose Zayas, Director, Wind Energy Technologies Office, US Department of Energy, Office of Energy Efficiency and Renewable Energy, USA

Jason Folsom, Commercial Head of Offshore Wind for America, Siemens Gamesa Renewable Energy, USA

Lucas Lin, President, Swancor REnewable Energy Co., Ltd, Taiwan

SHARE FAIR: WINNING CONTRACTS IN OFFSHORE WIND 11:30 - 12:45, Rooms 11

'Share Fairs' are amongst the most popular sessions at recent RenewableUK events as they focus on companies entering the offshore wind market and winning their first contracts, as well as existing players expanding their operations into new markets, in and beyond the UK. Be among the first to hear about business development opportunities from major developers and key partners.

> Session Chair:

Karl John, Offshore Wind Specialist, Department for International Trade, UK

> Speakers:

Chris Leach, Project Execution Director for East Anglia ONE offshore wind farm, ScottishPower Renewables, UK

Paul Savvides, Procurement Manager, Siemens Gamesa Renewable Energy, UK

Amund Dårflot, Head of Procurement International Projects & New Energy Projects, Statoil, Norway

IMPROVING PLANNING OF OFFSHORE WIND FARMS AND COEXISTENCE IN INCREASINGLY BUSY SEAS

14:15 - 15:30, Room 7

The sea is becoming an increasingly busy place as the number of offshore wind installations grow and more are planned. This session investigates the factors that may influence the choice of future sites and how coexistence issues are or could be addressed.

Session Chair:

Paula Low, Senior Development Manager, EDP Renewables

> Speakers: Marta Silva, Project Manager, Wavec Offshore Renewables

Laura Schröder, ForWind, Centre for Wind Energy Research

Tara Hooper, Environmental Economist, Plymouth Marine Laboratory

Dominique Ramard, Vice-President, Regional energy policies, Conseil Régional de Bretagne

Fabrice Cassin, Lawyer, LPA CGR Avocats

THE ROLE OF SITE TENDERING VS. LEASING IN DELIVERING COST REDUCTION ACROSS EUROPE

16:15 - 17:30, Room 11

With the recent cost reductions being witnessed across Europe, this session aims to compare how the tendering of offshore wind sites versus leasing of sites contributes to cost reduction.

> Session Chair:

Will Apps, Head of Energy Development, Energy, Minerals and Infrastructure, The Crown Estate, UK

> Speakers:

Keegan Kruger, Offshore Wind Analyst, Bloomberg New Energy Finance, UK

Ray Thompson, Head of Business Development, Siemens Gamesa Renewable Energy, UK

Ruud De Bruijne, Project Manager, Offshore Wind Energy, Netherlands Enterprise Agency

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EXHIBITION

DEMO ZONE (South Hall, S-D50)

It will showcase products from selected exhibitors throughout the event. Stop by during the below times.

11:05 - 11:30	Floating Power Plant (FPP)
13:30 - 13:55	ProPlanEn presents WakeBlaster
16:00 - 16:25	Survitec

OUTDOOR VESSELS

Step outside the South Hall to see the mighty Atlantic Enterprise and Siem Moxie offshore service vessels. Free tours of these 80+ metre vessels will take place every day of the event. Visit their stands for more information: Atlantic Marine (S-K21), Siem (N-E10).

2050 – AN ENERGETIC ODYSSEY

Located in the South Hall this large-scale video installation demonstrates what should be done if we are to take the two-degree climate target seriously.

NETWORKING

WINDEUROPE OFFSHORE 2019 LAUNCH PARTY 16.30 – 18.00, Pavilion of Denmark, North Hall

Join DWEA, DWIA and WindEurope for the event launch party and network with your peers over drinks and snacks. The winners of the two Lego sets will also be announced - make sure you're there!

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'The keys to unlocking floating wind are scale and financing'

ANDREW LEE

he challenges of achieving scale and securing finance loomed large as leading players in floating wind met to discuss the sector's future at a Recharge Thought Leaders roundtable in London on Monday.

Citing estimates of 4,000GW floating wind potential in European waters alone, WindEurope chief executive Giles Dickson claimed advances in technology and the lessons learned from the fixed-bottom offshore sector mean that "we're no longer an R&D play", and predicted "commercialisation is just around the corner" if key

and marketing officer at Ideol, which is poised to deploy the first floater off France, said access to affordable finance will be decisive as the sector seeks to move beyond the concept phase.

"There will not be commercial-

scale deployment if there is no support from the financial community ... so how are we going to reassure those guys that the technology out there is reliable? It's all about economic viability."

Bent Christensen, a senior vice-president at Siemens Gamesa, told the event that the plethora of foundation concepts in the market needs to rapidly narrow if floating wind is to make the required

leaps in industrialisation and standardisation. "I believe in a few years the four different families or the 15-20 concepts we see in the market right now will boil down to a few that can really make a difference," he said.

Matthieu Monnier from French wind association FEE, whose government is leading Europe's floating wind charge, said high-level policy backing is vital if the continent is to keep pace with the rest of the world.



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Samuel Leupold is executive vicepresident of Dong Energy

SAMUEL LEUPOLD

hen Dong Energy recently won two German offshore wind projects with zerosubsidy bids, it sent a clear signal to policymakers: offshore wind is not only the obvious choice due to its utility scale and carbon-free output, it's also becoming the obvious choice for economic reasons.

Let me be clear that zero-subsidy is not the new normal. The two German projects had unique circumstances, most notably the fact we have until 2024 to build them, which allows for the introduction of the next generation turbine in the range of 13-15MW. This will, once again, help take costs to a new low. Also, the German projects do not include the transmission assets. But still, the downward cost trend is strong, and costs have come down faster than anybody had imagined only a couple of years ago.

Benefits for the US

Offshore wind projects in the US will benefit from the reduced cost driven by the large volumes in Europe, but for obvious reasons, the supply chain is still immature here. It will inevitably take time to reach the same level of maturity as in Northern Europe, where suppliers of towers, transition pieces, turbines, cables, vessels, etc, have spent a decade maturing their businesses and their collaboration with us and other developers.

But prospects for an accelerated maturation curve in the US are good considering the strong American industrial competencies in combination with experienced European suppliers who could be looking to set up shop in the US as the market emerges.

Visibility key to success

Looking back over the past decade, the industry has built one offshore wind turbine per day in Europe.

At Dong, we call for Europe to keep this momentum post-2020 and to set the targets now, as volume and visibility remain the key drivers for investments and continued costouts. In the US, the market is just getting started, but the fundamentals for offshore wind in the US are strong: great site conditions, increasing electricity consumption, ageing conventional capacity and not least the industry's ability to create thousands of jobs and



Low costs will pave the way for US offshore wind

reindustrialise coastal areas. Policymakers increasingly acknowledge the inherent benefits from offshore wind, and this probably explains why we have seen breakthroughs in regulation in Massachusetts, Maryland, North Carolina and New York.

Prospects for an accelerated maturation curve in the US are good due to the strong American industrial competencies

Visibility and commitment to volume targets is exactly what has made offshore wind successful in Northern Europe. Most notably in the UK, Germany and Denmark, but increasingly also the Netherlands, which has recently tendered 1.4GW offshore wind and seems to have an appetite for much more due to falling prices.

We will keep pushing the limits

At Dong Energy, we intend to keep pushing the limits for what this industry can achieve. We challenged ourselves and the supply chain when we set the \in 100/MWh target back in 2013.

> We did it again in 2016 with the winning bid in the first Dutch offshore wind tender, and we certainly laid down another challenge with the German bids.

We're aware that we will rely on the supply chain to deliver the necessary innovations and cost-outs. But knowing this industry, we are confident that it will

be possible, and we will certainly throw our full engineering capacity into making it happen.

The industry's goal should be to make offshore wind the number-one alternative for any policymaker in the world considering building new capacity, and with low costs, clean fuel and job creation, we're rapidly getting there. 🖬

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Martin Jakubowski is chief executive of Seawind Ocean Technologies, a two-bladed wind turbine system developer that is due to begin construction of its 6.2MW demonstration machine in Norway next year

MARTIN JAKUBOWSKI

t is a mere quirk of history that almost all wind turbines today have three blades rather than two.

Three blades did not become the standard due to technical considerations or a systemic approach to the fundamentals of wind turbines, but because of the trial-and-error approach of the industry's "garage" pioneers in 1970s Denmark. The three-blade configuration simply worked, so was used repeatedly.

But for many, the two-blade turbine would have looked a more likely winner. In 1982, when the first 100kW turbine was erected in Denmark, NASA were operating a 4MW two-blade turbine in Wyoming under the guidance of US helicopter pioneer Glidden Doman.

At 40 times larger, and with the industrial, political and financial might of NASA behind it, the WTS 4 should arguably have kick-started a revolutionary two-bladed wind industry.

Yet the US soon abandoned its wind turbine programme in response to the 1980s oil glut. Denmark, however, introduced legislation to allow citizens to produce energy from wind turbines, and Germany soon followed up with its famous feed-in tariff, which created a market for all those small three-bladed Danish wind turbines. Two-bladed machines largely disappeared.

Yet NASA and helicopter pioneers such as Doman, Anton Flettner and Kurt Hohenemser understood that two-bladed rotors are better suited for wind turbines because of their flexible configuration — namely, their attachment to the shaft by a flexible hinge. This allows the rotor to have a second degree of freedom: to both rotate (first degree) and to teeter around the axis of the hinge like a seesaw (second degree).

This flexible hinge reduces the impact of cyclic loading (fluctuating stresses and strains from the wind), and strongly reduces wear and tear — fatigue — on the components, thus extending the lifetime of the turbine.

The elasticity of this teetering hinge also removes the need for the blade pitch mechanism — the number-one source of failure in wind turbines — which controls the angle of the blades. Power output



Two-bladed offshore turbines could cut the cost of energy by 50%

can instead be closely controlled by simply yawing (turning) the turbine into or away from the wind.

Without the pitch mechanism, the weight of the rotor decreases by 50%. Overall weight reductions — including from having one less blade — substantially reduces the cost of the machine. And perhaps more importantly, without the pitch mechanism, the complexity of the overall system is dramatically reduced. A simpler offshore machine, with less parts, will require lower operations and maintenance costs than its threeblade counterparts.

A lighter and simpler machine also removes the need for costly installation vessels. The complete two-bladed wind turbine system, including its foundation, can be floated over to the site and then sunk to the seabed using gravity-base foundations or installed as a floating turbine. No lifting and assembling at sea is required.

Two-bladed wind turbines do generate about 2% less electricity than three-blade machines of the same size, but this shortfall is more than offset by the much lower capital and operating expenditure — which together result in an overall levelised cost of energy (LCOE) reduction in the order of 50%.

In fact, recent university studies have found that the wake losses at a two-blade wind farm are lower than those at a traditional wind farm — virtually eliminating the 2% lower energy yield from individual machines.

It is also worth noting that the blades and rotors for two-blade machines can be manufactured by the existing supply chain — no additional specialist parts are required, apart from the relatively small teetering hinge.

The only relevant disadvantages of the two-blade design — less-pleasant aesthetics and slightly higher tipspeed noise — are unimportant offshore.

Studies show that a 10MW offshore two-bladed turbine with a rotor diameter of 200 metres could produce an LCoE of well below \$30 per MWh, including the cost of grid connections.

While developers, financiers and insurers might initially be more wary of two-bladed offshore machine, the potential for increased reliability and LCoE reduction will be too hard to ignore. The future will have two blades, not three.

mage | Seawind Ocean Technol



AN INVESTMENT IN KNOWLEDGE ALWAYS PAYS THE BEST INTEREST

Benjamin Franklin

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