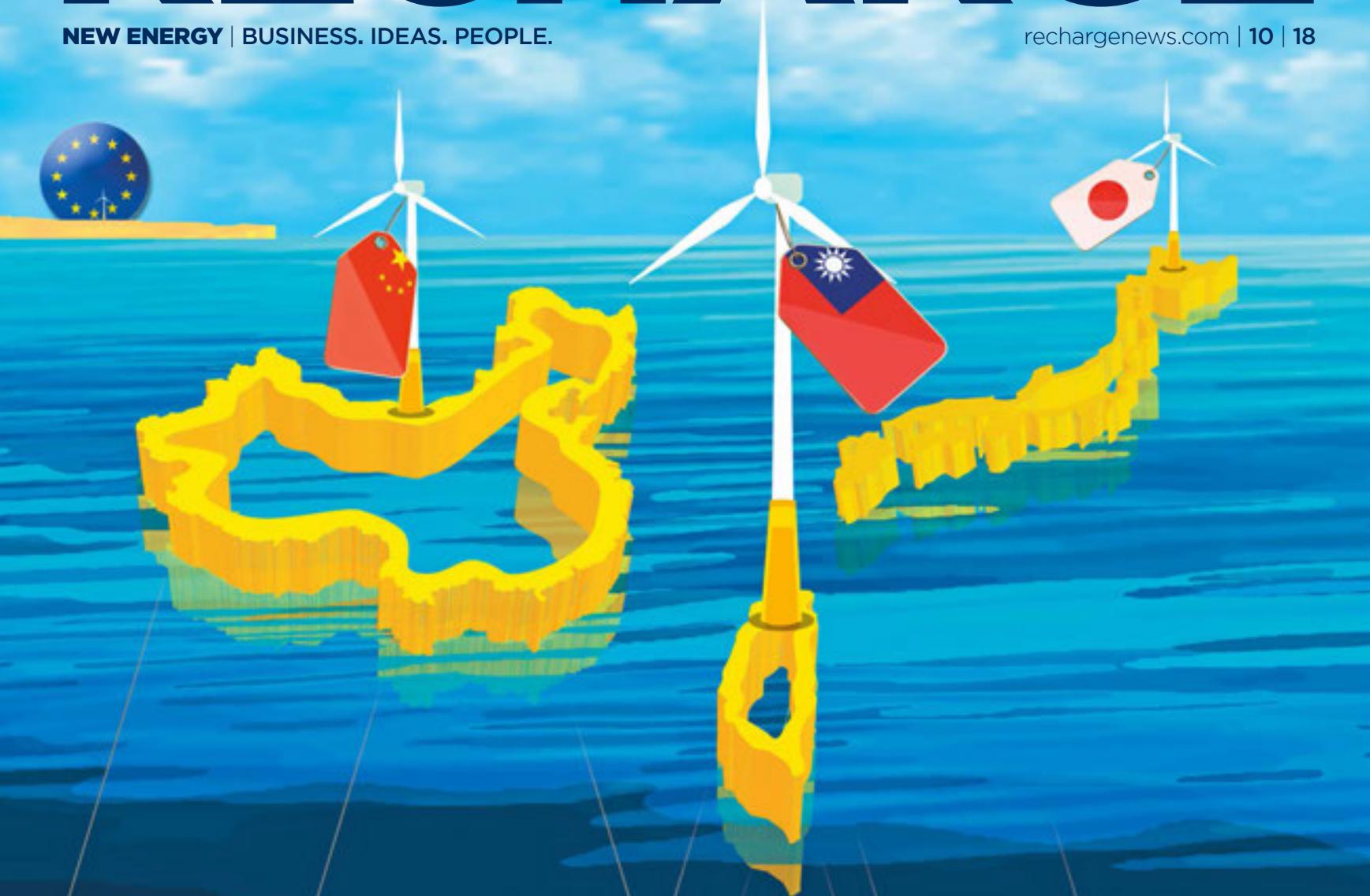


# RECHARGE

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## FLOATING WIND BLOWS INTO ASIA

Fast-emerging sector is heading east, where up to half the world's fleet could be turning in 2030

### Business

Chinese OEMs building 10MW+ models ahead of Asian offshore take-off

### Ideas

As low tender prices bite, how long will turbine makers have to struggle?

### People

Wu Gang on Goldwind's unique first step into the Brazilian wind market



**GOLDWIND**

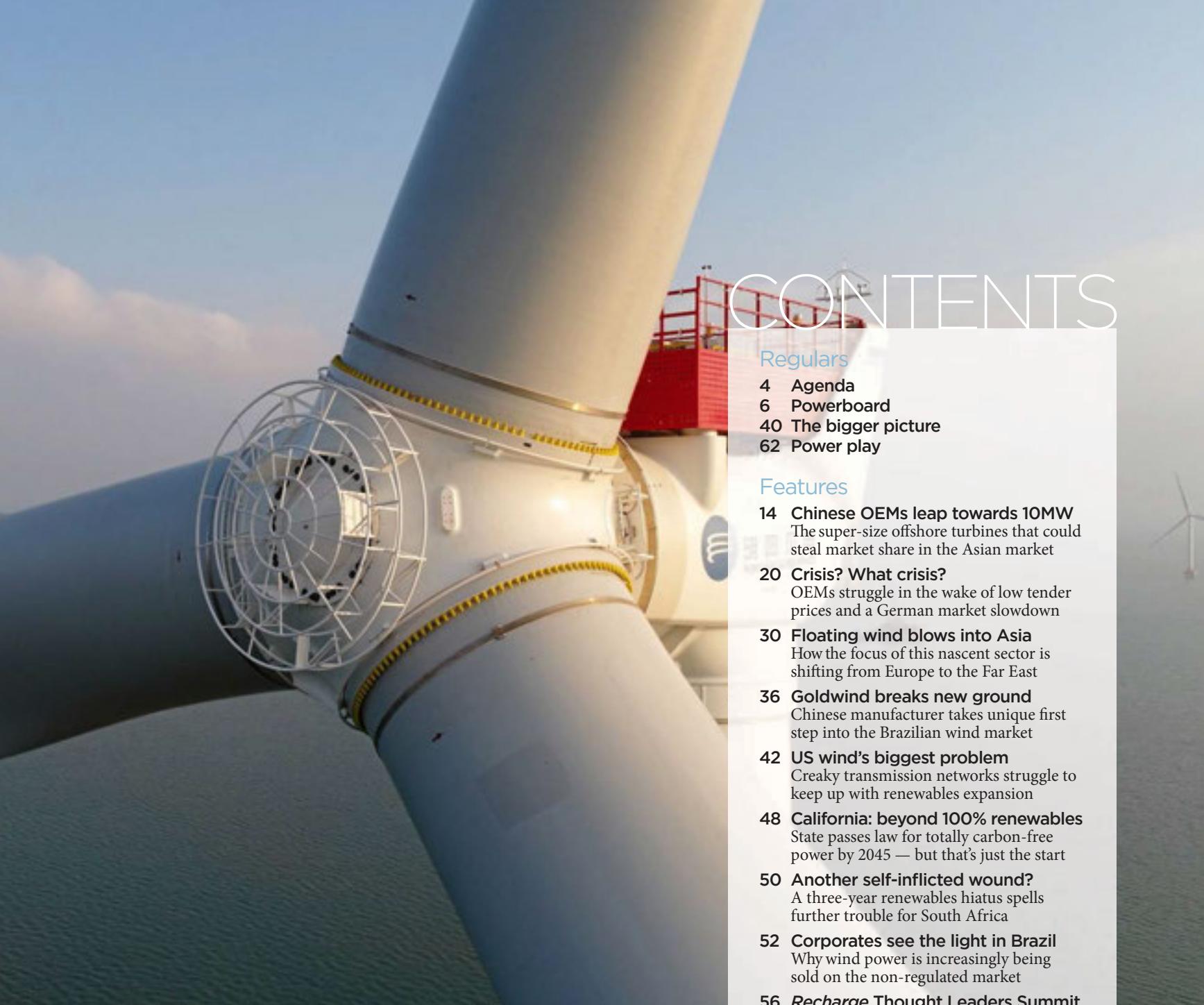
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# CONTENTS



## Regulars

- 4 Agenda
- 6 Powerboard
- 40 The bigger picture
- 62 Power play

## Features

- 14 Chinese OEMs leap towards 10MW  
The super-size offshore turbines that could steal market share in the Asian market
- 20 Crisis? What crisis?  
OEMs struggle in the wake of low tender prices and a German market slowdown
- 30 Floating wind blows into Asia  
How the focus of this nascent sector is shifting from Europe to the Far East
- 36 Goldwind breaks new ground  
Chinese manufacturer takes unique first step into the Brazilian wind market
- 42 US wind's biggest problem  
Creaky transmission networks struggle to keep up with renewables expansion
- 48 California: beyond 100% renewables  
State passes law for totally carbon-free power by 2045 — but that's just the start
- 50 Another self-inflicted wound?  
A three-year renewables hiatus spells further trouble for South Africa
- 52 Corporates see the light in Brazil  
Why wind power is increasingly being sold on the non-regulated market
- 56 Recharge Thought Leaders Summit  
Behind the scenes at our invitation-only, off-the-record conference in Hamburg

## Opinion

- 60 Thought Leader | Giles Dickson  
'We have to fight for every turbine'
- 64 Thought Leader | Gareth Brown  
Turbine design standards have not kept pace
- 66 Thought Leader | Edwin Haesen  
Network planners must embrace uncertainty



30



36

## Contributors



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**Yuki Yu**  
Recharge's Beijing-based Asia correspondent is an expert on the Chinese power and renewables markets, and was previously an industry analyst for China Southern Grid.

**CLEAN ENERGY LEADERS?** Boys look at their smartphone next to a coal fired power plant on the outskirts of Beijing

# China is the key to beating climate change

Inspiring as this year's Energy Transition Outlook (ETO) report from DNV GL was — its projections see electricity's share of total global energy demand more than doubling to 45% by mid-century, with renewables making up 80% of production — it also contained the ultimate inconvenient truth. The planet is nowhere near shifting with sufficient speed from its consumption of fossil fuels to renewables to forestall the most catastrophic impacts of climate change. On current trajectories, the Paris Agreement target will be missed by a wide margin, however bullish the build-out forecasts for "high fractions" of wind and solar power to soon be supplanting that from oil, gas and coal.

Coal is clearly being driven into extinction, but it is not going without a fight. A report published by Greenpeace, Sierra Club and Coalswarm earlier this year confirmed a contradictory picture: the number of coal-fired power plants built worldwide has indeed fallen sharply over the past two years — commissioning of new plants dropped 41% while construction rates worldwide plummeted by 73%. But in Asia — in some part arguably by industrial-evolutionary rights — building of new coal capacity is carrying on unhindered, with 85% of plants under development in the world's top 20 coal-producing countries in the Asia-Pacific (APAC) region.

China, of course, leads the APAC greenhouse-gas emissions table, supercharged by a

construction spree that brought almost 700GW of coal-fired plant on line during a breakneck run in 2016-17. The added CO<sub>2</sub> emissions can in no way be sustainable, not least in the land of the "Airpocalypse"; and



Darius Snieckus  
Editor-in-Chief, Recharge

nor is the economics. Output from the Asian superpower's existing coal fleet already far exceeds domestic power demand — making every additional plant a potential multi-billion-dollar capital expenditure sinkhole.

Bringing the full force of renewables power production to bear on a "faster, further" global energy transition will also be China's lead to take, underpinned by a world-beating wind and solar fleet, 168.5GW and 130.06GW, respectively. The main levers that can be pulled to accelerate away from fossil fuels, as was underlined in a recent Stockholm Environment Institute Asia Centre study, are all instantly relevant to the Chinese situation: scrapping subsidies to oil, gas and coal; swapping feed-in-tariffs for auctions and promoting an open market to overcome "one of the biggest obstacles to economic development, the cost of energy" — which would be particularly revolutionary for many Southeast Asian countries where power costs are disproportionately high due to issues of maintaining baseload whatever the levels of electricity demand.

It is worth remembering that China topped the EY renewables attractiveness index for the third time in a row this year. So, by metrics, there is progress. But more heartening perhaps is to think — on both the renewables-industry and climate-change fronts — of the impact on the global energy industry of the nation's planned policy shift to wind and solar auctions as soon as 2019. This is bound to radically reshape the domestic market structure and fundamentally influence the ongoing internationalisation ambitions of many of China's largest developers and OEMs.

"In China, you can have hundreds of competitors within the first hours of going live. Ideas are not important in China," as Ma Huateng, founder and chief executive of investment holding company Tencent, which has the highest market cap in Asia, notes. "Execution is." The next decades will tell how far this philosophy travels. □

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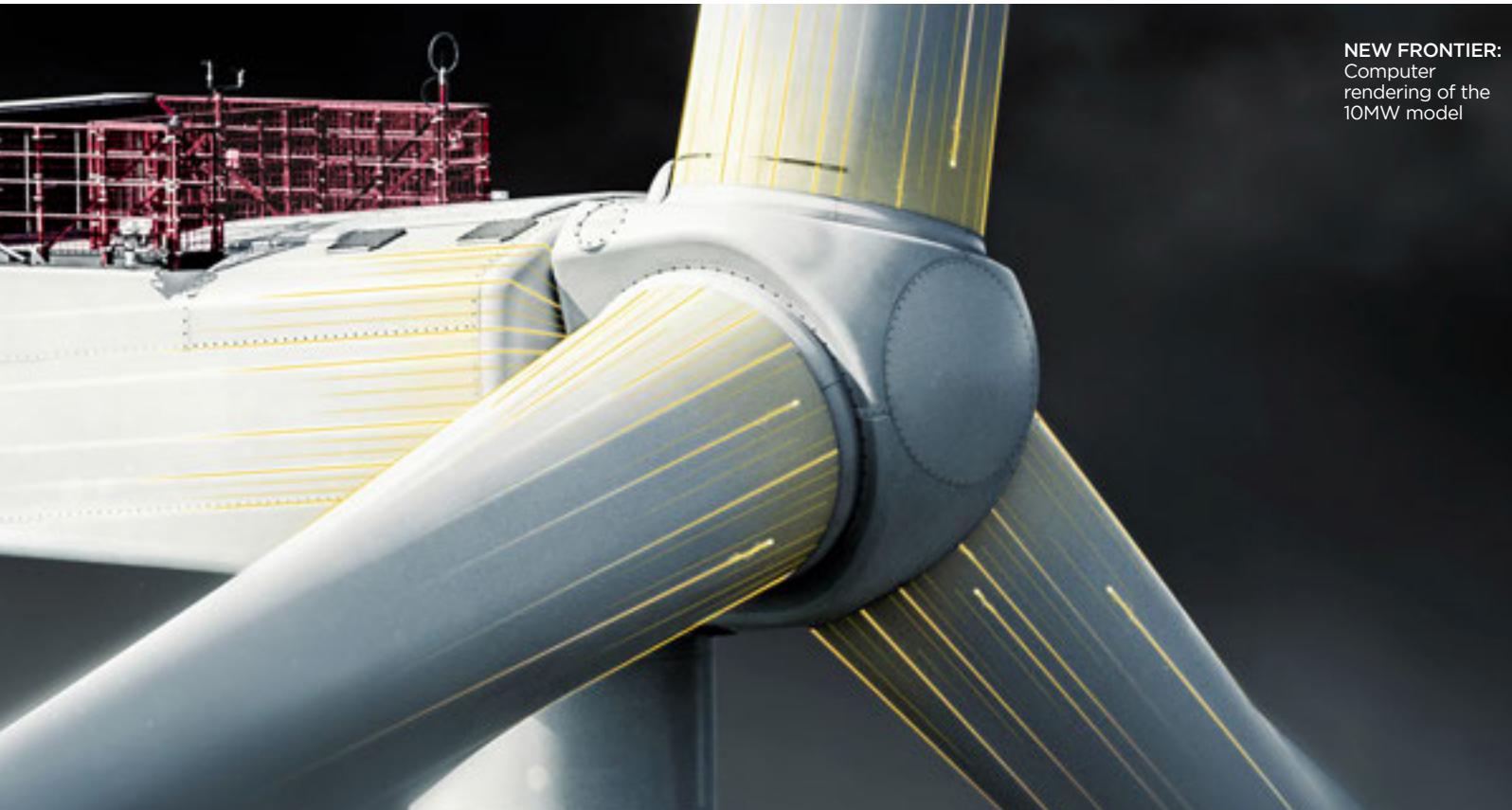
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# POWERBOARD

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NEW FRONTIER:  
Computer  
rendering of the  
10MW model

## MHI Vestas unveils the first 10MW turbine

DARIUS SNIEKUS

**M**H Vestas has launched a 10MW version of its V164 offshore turbine, with a beefier gearbox, mechanical upgrades and a design tune-up that enhances air flow and increases cooling in the converter.

The machine, which began life as a 7MW concept in 2011 and has been consistently stepped up in power rating since, is being made available for sale immediately, with first deliveries expected in 2021.

"Crossing the [10MW] threshold is important both in production terms and psychologically too for the industry. If I had been told when I came into the industry that there would one day be a 10MW machine, I'm not sure I would have believed it," chief executive Philippe Kavafyan said on the sidelines of the *Recharge Thought Leaders Summit* in Hamburg (see pages 56-59). "It is a new frontier.

"But what is really encouraging is that it has been a natural growth [in nameplate capacity]. I don't see this as 'disruptive' — not least in the supply chain. And I don't think anyone is thinking we will stop here. We are moving forward with our practice of incremental innovation through all parts of the value chain."

"What was unreachable before has become the new benchmark."

Each V164-10.0MW, designed to run at full power in wind speeds of 10 metres per second, and to last for 25 years, will be able to power the equivalent of almost 6,000 European homes.

The OEM has delivered more than 100 of its sub-10MW V164s already and has secured 2.2GW of firm and unconditional orders for projects to be built in 2018-20 in Europe, as well as being named preferred supplier for a further 2.7GW, including a breakthrough 900MW in Taiwan.

One of the first machines to be purpose-built for use offshore, the V164 has been designed as "foundation-agnostic". First units were erected on monopiles in 2016 at the 258MW Burbo Bank Extension wind farm, with follow-on installations at two other UK projects: on concrete gravity bases at Blyth and on suction-bucket jackets at Aberdeen Bay.

Kavafyan noted that the 10MW version will also be well-suited to floating wind farms, building on the experience it expects to gain on the 25.2MW WindFloat Atlantic project off Portugal, where it is delivering three V164-8.4MW turbines. "We are certainly going to continue following this path," he said. □



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# WindEurope expects 87GW of growth to 2022



**CHRISTOPHER HOPSON**

European wind power is on course for “solid” annual growth of an average 17GW to 2022 — but urgently needs policy clarity beyond that, according to the latest market outlook from WindEurope.

With 87GW of wind due to be installed between 1 January 2018 and 31 December 2022, including an annual record of 20.5GW next year, Europe is set to reach 258GW of installed capacity by 2022, according to *Wind Energy Outlook in Europe*.

Most of the extra installations will be onshore — 70.4GW compared to 16.5GW offshore.

The report says ever-larger turbines will help drive this growth, with 4MW-plus becoming the new norm onshore and 8MW-plus machines at sea.

Germany will remain the continent’s wind leader, with 73GW of accumulated capacity in 2022, followed by Spain (30GW) and the UK (26GW).

However, Germany’s share of new installations will fall from 40% on average in the past five years to 24%. Spain and Sweden will see strong growth with record years in 2019. So should the Benelux countries, Norway, Turkey and France.

Alongside the new capacity, the coming years will see the first serious decommissioning of Europe’s first-generation wind farms.

By 2022, 22GW of installed capacity will be more than 20 years old. Some projects will be repowered, “but as things stand, between 4.3GW and 6.4GW of existing wind farms will be fully decommissioned in the next five years”, WindEurope says.

Globally, Europe will account for 25% of installations over the period. “Wind energy is on track for solid further expansion in Europe over the next five years. But this growth comes mostly from yesterday’s decisions,” says WindEurope chief executive Giles Dickson.

“The outlook for new investment decisions over the next five years is less clear. Most governments still haven’t clarified their plans for new wind farms up to 2030. And partly because of this, it’s getting harder to secure permits for new wind farms.”

Dickson says the National Energy and Climate Plans for 2030 that EU nations have to draw up “will be crucial. They’ll define the volumes of new renewables countries want and how and when they propose to auction the new capacity”. □

## ANALYSIS: US O&M to exceed spending on construction

**KARL-ERIK STROMSTA**

By 2021, more money will be spent maintaining existing North American wind farms than building new ones.

The North American market for wind farm O&M is worth \$5bn-6bn per year and is on track to reach \$7.5bn by 2021 as the base of existing projects expands, researcher IHS Markit predicts.

The shift towards operating expenditure will be spurred by the expiration of the wind production tax credit, which is expected to dent the US market for new projects in the early 2020s.

The industry “will need to shift its focus away from infrastructure build and toward providing services and minimising costs at existing projects”, says Maxwell Cohen, associate director for North American renewables at IHS Markit.

Wind farm owners are adopting a variety of strategies for cutting O&M costs. Some, such as Pattern Energy, are shifting the work in-house. Others are following TerraForm Power, which recently hired GE to perform O&M for more than 900 operating turbines. “It’s not a clear-cut situation where one strategy’s always going to get you the lowest costs,” Cohen adds.

The shift away from capital expenditure has important implications for owners and turbine suppliers, many of which have put a far greater emphasis on the O&M side of their business in recent years.

The 100GW fleet of more than 50,000 turbines in the US and Canada is still fairly young. At the end of last year, 27% of the US fleet was less than three years old, and just 4% was older than 15 years, according to the American Wind Energy Association.

But as new installations decline next decade, the average age of US projects will rise steadily, reaching 14 years by 2030, IHS Markit says. □

## Vestas sheds 400 jobs as growth shifts from Europe

**ANDREW LEE**

Danish OEM Vestas is shedding 400 jobs, which it says reflects “a shift in growth from more traditional wind markets to high-growth markets primarily outside of Europe”.

Three quarters of the cuts will come in Northern and Central Europe and are expected to affect mostly white-collar staff.

The main impact on Vestas’ production base will be felt at its converter factory in Hammel, Denmark, where about 80 posts will be lost as the facility moves to a more research-based role.

Vestas, which employs 24,300 people globally, expects to save €30m (\$34.9m) annually from 2019 with the cuts, which reflect growing pressure on the European supply chain as the

wind sector’s centre of gravity shifts to Asia and the Americas.

Chief executive Anders Runevad said: “It’s always hard to let good, hardworking colleagues go, but with most of market growth expected to be outside of Europe, our global footprint must reflect the market development we see in order to grasp those growth opportunities.” □

## EU energy ministers vow to boost green hydrogen

Energy ministers will increase research into the use of hydrogen in power and transport as part of the EU's target of cutting emissions by 40% by 2030.

A non-binding initiative will see 25 states boost spending and co-operation to investigate the potential for hydrogen in areas including storage, which Austrian sustainability minister Elisabeth Köstinger said is a key area for integrating renewables into Europe's energy system.

### \$5.9bn for Hornsea

Ørsted has agreed to sell a 50% stake in its 1.2GW Hornsea 1 offshore wind farm for £4.46bn (\$5.86bn). Global Infrastructure Partners will fund half of the payments under an EPC contract for the entire project in the North Sea off eastern England.

## Argentine renewables plans shielded from crisis

Argentina's renewables programme is "well shielded" to ride out the economic storm, the country's most senior renewable-energy official insists.

Argentina is struggling with a contracting economy, a falling currency and strikes, but renewables under-secretary Sebastián Kind says the global wind industry should take comfort from measures introduced to reassure international investors.

"Of course the country is suffering turbulence in terms of the depreciation of the currency and so on..." he told *Recharge* at the Global Wind Summit in Hamburg. "But the renewables programme [is] so well shielded out of Argentinian risk that we are still on track..."

Kind led the design of the RenovAr programme, which has driven procurement of 6GW of wind and solar since 2015. The programme features safeguards such as US-dollar-denominated 20-year power-purchase agreements underwritten by the Argentinian Treasury, and a \$500m World Bank guarantee.



## GE launches 5MW-plus onshore wind platform

GE Renewable Energy has launched a platform called Cypress that will for the first time push its onshore turbine product line-up beyond 5MW, with a design featuring a two-piece blade that will help with the logistics of transport and installation.

The platform includes the 4.8-158 model launched last year, but adds a new 5.3MW machine with a 158-metre rotor diameter that GE says can generate 20GWh per year — 50% more than its 3MW platform.

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'RISING FORCE': Fatih Birol speaking at the Global Wind Summit

## IEA tips offshore wind to approach 200GW by 2040

KARL-ERIK STROMSTA

The International Energy Agency (IEA) sees offshore wind as a "rising global force on the energy landscape", executive director Fatih Birol told the WindEurope conference, part of the Global Wind Summit in Hamburg.

With less than 20GW of wind installed at sea today, compared with more than 500GW onshore, the offshore sector has not figured prominently in previous IEA analysis of the energy market.

But the agency now expects the world's offshore capacity to more than triple by 2025, and

edge close to 200GW by 2040 — with the potential to go substantially further if aggressive government policies were introduced.

Auction results and larger turbines herald a period of ever more competitive offshore wind power, with Birol expecting "strong growth, first in Europe and then around the world".

"The developments in Europe can spark a wave of offshore wind appetite outside of Europe — there's some fertile grounds for that. First of all Asia, with China followed by India," he said. "But also North America and Latin America — there's big room [for growth] there."

The substantially higher capacity factor of offshore wind farms compared with onshore wind or solar makes it a "very important opportunity" as renewables grow and spread, Birol said.

He also tipped his hat to the growing promise of floating wind, which could unlock big electricity markets off the coasts of places such as California.

The IEA is "working very closely" with industry leaders to better understand the "opportunities floating turbines can provide for offshore wind developers across the world", he added. □

FEATURE: Pages 30-35

## Equinor and Petrobras eye Brazil offshore wind

ANAMARIA DEDULEASA

Brazilian oil group Petrobras and Norway's Equinor have signed a memorandum of understanding to jointly develop offshore wind projects in Brazil.

No investment or capacity plans were announced. The partners plan to spend two years identifying and assessing

potential projects before moving towards development, said Anders Opedal, Equinor's Brazil president.

"Engineers who are used to working in oil and gas will now use their skills to develop offshore wind farms," he said.

Equinor, which has pledged to invest 15-20% of its annual capital expenditure in renewables by 2030, is already

advancing plans to replace some gas turbines at the Snorre and Gullfaks platforms in the North Sea with floating wind to reduce carbon emissions.

Petrobras has four onshore wind farms totalling 104MW via a partnership in Rio Grande do Norte state. It also has a 1.1MW solar R&D facility in Rio Grande do Sul evaluating the potential of four technologies. □

## OPINION: We must not let *Energiewende* fall victim to politics

HERMANN ALBERS

Populism is again on the rise in Europe and it could become a serious problem for Germany's *Energiewende*.

Many underdeveloped and rural areas are losing basic infrastructure such as schools, hospitals and police stations. This could lead to a "democracy problem", as disenchantment with politics and support for populist parties grow.

The national coalition government is led by the Christian Democratic Union (CDU) and its Bavarian ally, the Christian Social Union (CSU). But these parties, traditionally rooted in rural areas, where they have a loyal voter base, are reluctant to face this new challenge. In Bavaria and even more in eastern Germany, where elections will be held in Thuringia, Saxony and Brandenburg in autumn 2019, they fear losing votes to the Alternative für Deutschland party, which generally denies the existence of climate change.

But decentralised renewable energies are powerful structural programmes in many places. They provide local authorities and landowners with a financial foundation, integrate village communities and create supply and service companies in areas where investment is scarce.

The results are self-confident communities that no longer depend on the state's financial resources, and mayors who are able to maintain their local kindergarten and primary school.

The CDU/CSU should recognise the contribution of green energy in rural areas, where it increases the value and quality of life and contributes to the preservation of our climate. Instead of torpedoing the development of renewables by fighting the populists on their own terms, they should be showing a commitment to the *Energiewende*. □

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# FUTURE IS RENEWABLE

**R**enewables will account for 80% of the world's energy production by 2050, according to DNV GL's latest *Energy Transition Outlook*, with electricity's share of total global energy demand more than doubling to 45% by then.

Half of all new cars sold are expected to be electric in Europe by 2027 and globally by 2033, it adds.

The report calculates that by the early 2030s, global primary energy supply will peak and cease to be dominated by coal, oil and gas, with the energy mix "split equally" between

fossil and non-fossil fuels by 2050.

Although onshore wind's 600GW installed base will continue to be the bedrock of production in the short term, DNV GL's calculations point to offshore and PV showing breakaway growth in the coming decades.

"Scaling [of offshore wind] will be self-reinforcing: the more you expand, the better you are able to expand further," DNV GL Energy chief executive Ditlev Engel tells *Recharge*. "Offshore wind is starting from a much lower base [than onshore] but we are

expecting an 85-fold growth in the offshore wind sector by 2050.

"After Europe, the US has a huge pipeline for offshore wind, and Asia is difficult to read beyond our broad sense that the growth there will be exponential."

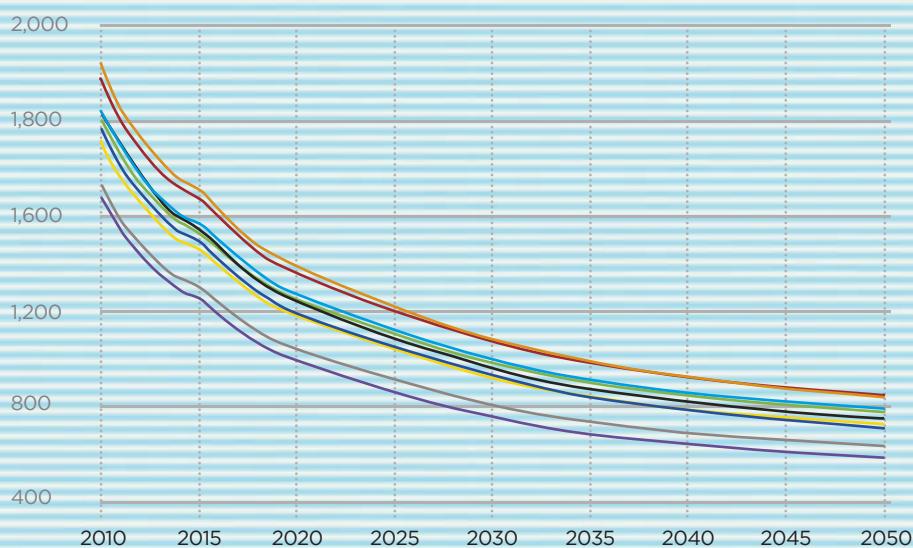
But he cautions that the "black swan" in this process is unlikely to come from the technology side — which has been key in reducing the cost of wind and solar to grid parity — but instead will be found in governments' regulatory systems.

*Darius Snieckus*

## Solar PV average unit investment cost, before support (\$/kW installed)

■ North America ■ Europe  
■ OECD Pacific ■ Sub-Saharan Africa  
■ Latin America ■ Middle East & North Africa

■ Northeast Eurasia  
■ China & Taiwan  
■ Indian subcontinent  
■ Southeast Asia

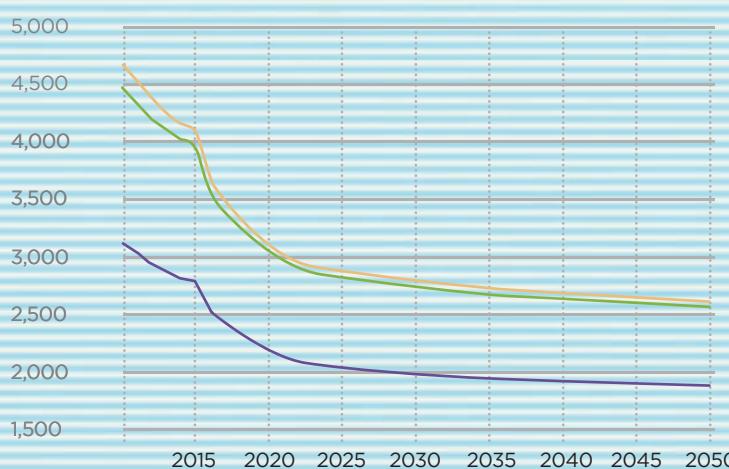


## World installed electricity capacity

	Installed capacity (GW)	
	2016	2050
Coal-fired	19,551	506
Gas-fired	16,474	376
Oil-fired	5,122	845
Nuclear	420	502
Hydropower	12,092	343
Biomass-fired	377	1,061
Solar PV	2,901	8,895
Solar thermal	5	30
Onshore wind	4,526	146
Offshore wind	14	1,034
Geothermal	15	20

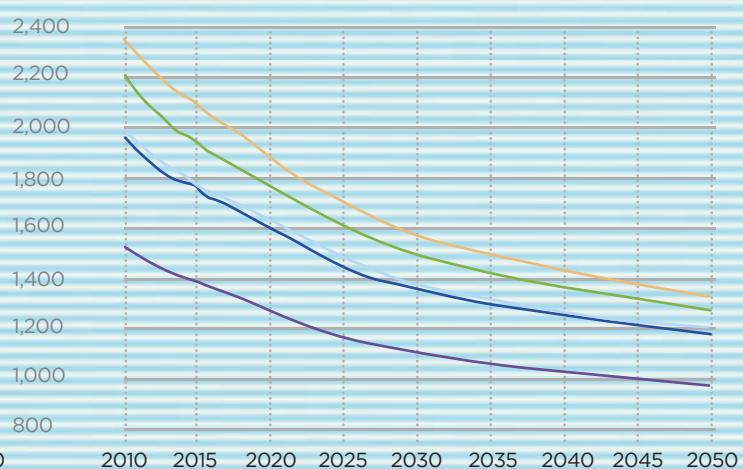
## Offshore wind average unit investment before support

\$/kW installed

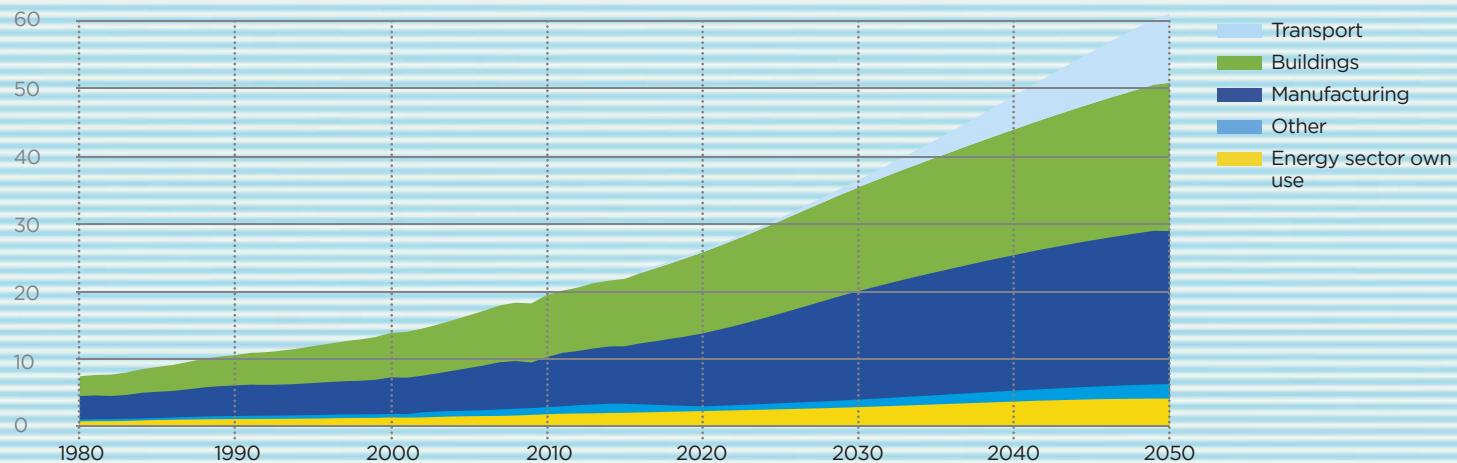


## Onshore wind average unit investment before support

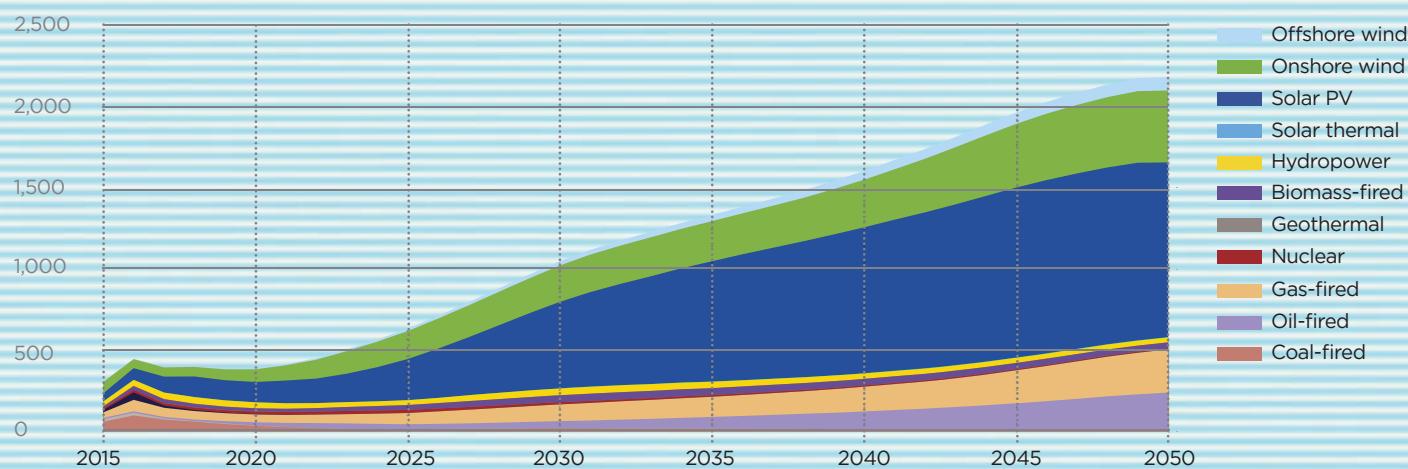
\$/kW installed



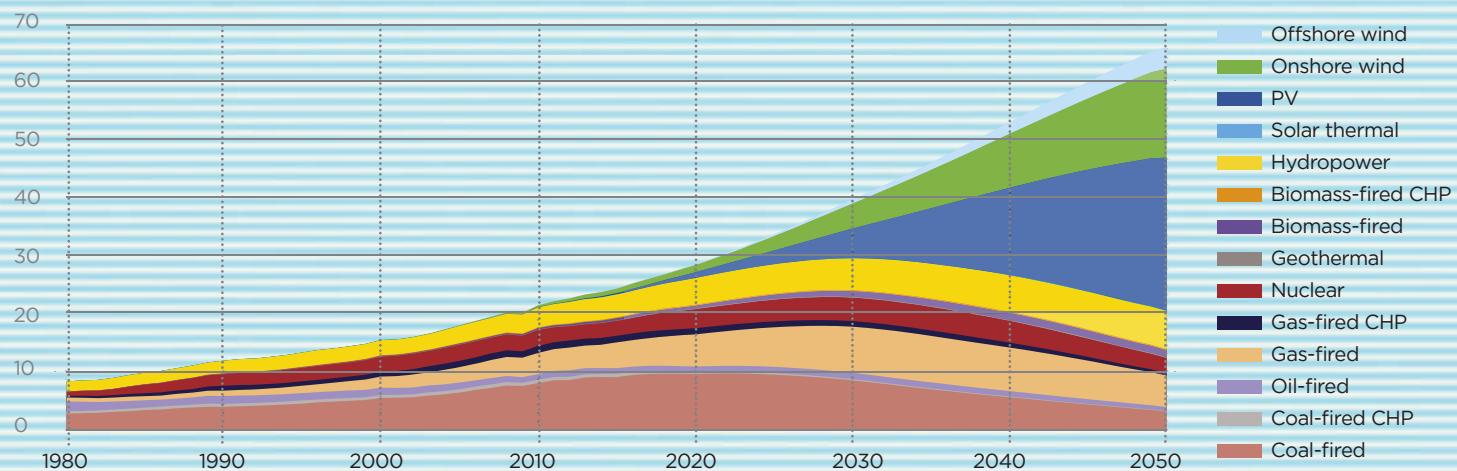
### World electricity demand by sector (PWh/yr)



### World electricity capacity additions (GW/yr)



### World electricity generation by power station type (PWh/yr)



# CHINESE OEMs LEAP TOWARDS DOUBLE DIGITS

As many as eight Chinese manufacturers are developing 10MW-plus offshore wind turbines that could be stiff competition for Western rivals in the Asian market, writes Yuki Yu in Beijing

Only a few weeks ago, MHI Vestas unveiled the first 10MW offshore turbine, while its closest rivals, Siemens Gamesa, GE and Senvion, are working on developing their own double-digit-megawatt machines.

What is less well known is that as many as eight Chinese turbine makers are doing exactly the same thing.

And with the Asian offshore wind market set to take off in the coming years, cheaper Chinese turbines — with lower shipping costs — may soon offer stiff competition to the established international players.

Yet for all their ambitions, the Chinese OEMs are, to a large extent, playing catch-up. Most of the 2.79 GW of turbines installed off China have been 4MW models, with 6MW machines only recently finding their place — compared to the 7-8MW machines now being seen off Europe.

And while the largest turbine installed in European waters has been the 8.8MW version of MHI Vestas' V164, the biggest machines installed off Asia are the two 6.7MW Goldwind

**THINK THAT'S BIG?** Ming Yang's 5MW turbine — the manufacturer is now working on an 8-10MW platform. *Inset:* Ming Yang's Zhang Qiying



Photography | Ming Yang | Goldwind







**JUST THE BEGINNING:** Installation of Goldwind's 6.7MW machine at the Xinghua Bay project. Opposite: the now completed 300MW Huaneng Rudong wind farm. Inset: Goldwind's Cao Zhigang

turbines installed five months ago at China's Xinghua Bay pilot project. Ming Yang has since launched a 7.6MW prototype design and has already won an unspecified order from developer Huadian.

Goldwind — the world's number three turbine maker last year, according to several sources — is planning to launch an 8MW machine by the end of 2018, with developer China Three Gorges already reserving a spot for a prototype at its Xinghua Bay wind farm.

"In two years' time, 8MW will be the offshore wind market norm in China's key regional markets like Fujian and Guangdong," Goldwind executive vice-president Cao Zhigang tells *Recharge*.

Cao explains that the company has already kicked off R&D for 10MW-plus turbines, expecting the first designs to be ready by 2020, with an official product launch by 2022.

Ming Yang has also begun development of an 8-10MW platform, company president and chief technology officer Zhang Qiyang tells *Recharge*.

"We are confident to launch the

prototype by 2020," he says, pointing out that the turbine design will be scaleable, so it will be "easy" to produce 8MW or

10MW machines. The eventual size of the next-generation turbine will depend on what the market wants in 2020, he adds.

Zhang explains that the machine will have a new hybrid drivetrain design, combining a medium-speed gearbox and a permanent-magnet synchronous generator.

"We are fully capable of designing and manufacturing the 10MW turbines, and we have the key components in line," he says. "It is only a matter of time when the [10MW] turbines are introduced to the market with price competitiveness."

He adds that Ming Yang has already initiated conceptual designs for a 12MW turbine.

At a recent offshore wind conference in Fujian, executives from XEMC, CSIC Haizhuang and Dongfang Electric said that their companies have committed to launching 10MW turbines in the next two to five years.

XEMC and Dongfang are perhaps the most bullish, promising to

release an 8-9MW model in 2019 and 10MW machines by 2020, according to corporate filings at the Shanghai stock exchange.

CSIC Haizhuang, a subsidiary of China Shipbuilding Industry Corp (CSIC), says it will deliver a large prototype — an 8MW or 10MW model — by 2020. If development goes smoothly, the OEM will skip the 8MW step altogether, a company source told *Recharge* earlier this year.

Shanghai Electric — the dominant offshore OEM in China thanks to its licensing deal to build and sell proven Siemens Gamesa turbines — is planning to build its own research centre, in conjunction with a Zhejiang-based university, to develop its own 10MW design. In the meantime, it is licensed to sell Siemens Gamesa's 7MW and 8MW models, and has already won an order for ten 7MW machines for China Three Gorges' 200MW Pinghaiwan project, which is scheduled to come on line next year.

Shanghai Electric vice-president Miao Jun says the firm could provide a 10MW option "immediately, if there is market demand; if not, we could wait."

Minor players Sinovel and Shandong Swiss Electric — which are currently not active offshore players — are



also promising 10MW-plus turbines, although there is some doubt as to whether such plans will ever come to fruition.

Several of the Chinese turbine makers are utilising European expertise to help with their super-size developments.

Goldwind, Ming Yang and XEMC have established Europe-based research capabilities, while CSIC Haizhuang is collaborating with Dutch wind design consultancy Mecal.

But not all Chinese offshore contenders are bullish on super-size machines. Envision, China's number-two in offshore wind, says it has a "pessimistic view" on the economics competitiveness and technology feasibility of Chinese players' attempt to develop 10MW turbines.

Envision, which also focuses on smart grids, software and batteries, so far only has a 4.5MW offshore turbine, but that is mainly targeted at low-wind-speed regions.

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## Supply chain

Of course, for Chinese turbine makers to manufacture 10MW machines, local suppliers would also have to expand to offer super-size components.

The scale-up of electrical parts "such as generators, full-scale converters, inverters and other components are relatively easy to achieve", says Cao.

For one, CRRC Yongli, the dominant Chinese wind generator supplier, is confident that it can produce a 10MW model by 2020. "We are committed to the development of 10MW and even 12MW generators," the company's chief technology officer Duang Zhiqiang tells *Recharge*.

Blade manufacturing, however, is a different story.

Larger turbines must fly with longer and, thus, heavier blades that could significantly increase loads, making them more susceptible to fatigue and thus shorten their working lives.

And the unique characteristics of the Chinese market add to the problem. While Fujian province sees average offshore wind speeds of more than

nine metres per second (m/s), China's other coastal areas typically have wind speeds of 7-7.5m/s. Lower wind speed regions would therefore require longer blades in order to harvest the same amount of wind as seen off Fujian, Cao explains.

"For the same 10MW level turbine, 180-metre rotor diameters would be sufficient for Fujian province, but the diameters of those installed in Jiangsu or Shandong would exceed 200 metres."

And as the length of the blade exceeds 80 metres, manufacturers "can no longer transport the blades from the existing inland factories to the coastal projects by truck," explains Wang Peng, marketing director at Chinese blade maker Sinoma. "Instead, we need to build new factories near the sea ports."

A business manager at rival blade maker CSIC Luoyang Sunrui, who declined to be named, pointed out that the investment costs for new quayside factories would be "massive". It may take a while for Chinese suppliers to build a mature supply chain for super-sized blades,

he explains, but adds: "It is entirely possible to deliver the [10MW] blade design and prototype by 2020."

Western blade maker LM Wind Power and TPI Composites also operate factories in China, and is considered slightly ahead in terms of the development of longer blades, but Sinoma and Luoyang Sunrui blades are thought to be cheaper. It could be the case that the first batches of 10MW-plus Chinese turbines use LM or TPI blades, with Sinoma or Luoyang Sunrui for serial production, once their blades are proven.

Given the unclear economic consequences of double-digit-megawatt turbines, Goldwind does not believe that "larger simply equals better".

Cao explains that there will be an "inflection point" at which larger turbines and longer blades will actually increase the levelized cost of energy and reduce profitability.

Sinoma and Luoyang Sunrui agree, but are nevertheless working on larger blades. Sinoma is developing an 81.8-metre model for 8MW turbines, with production to be launched in 2020, while it could start to design a longer blade for 10MW turbine as early as

## Western turbine makers' double-digit-megawatt plans

MHI Vestas' 10MW machine is an upgrade of its V164 turbine, which began life in 2011 as a 7MW model and has been consistently been stepped up in power rating since, building up a European order pipeline of a "firm and unconditional" 2.2GW with its sector-leading 9.5MW version. The 10MW model is now in the showroom for sale, but first deliveries are not expected until 2021.

Siemens Gamesa originally led the way with its '1X' concept – the 'X' denoting that the machine would be a platform for the 12-15MW models to come. But with a highly successfully upscaling of its 6MW model, first to 7MW and then to the 8MW SG 8.0-167 DD, the company now wants to upgrade further to a 9MW rating. And the OEM has gone somewhat off radar on its 10MW-plus machine, with offshore wind chief executive Andreas Nauen saying recently the 1X was a lesser priority to cutting €500m (\$617.8m) in costs over the next three years at the merged OEM "to maintain our profitability".

GE Renewable Energy – whose 6MW Haliade is now seen as too small for the market – is investing more than \$400m into developing its 12MW Haliade-X platform, which was launched earlier this year with Parisian flourish as having a rotor star "five times the size of the Arc de Triomphe". First nacelles are expected to be completed in time for a demonstration project next year, with 107-metre blades supplied by its subsidiary LM Wind Power. Flagship orders are due to be shipped out in 2021.



Senvion – once an early offshore pace-setter with the first 5MW turbines installed offshore – is developing a 12MW platform via a consortium-based €25m (\$29.9m) EU project, called ReaLCoE, which stands for Robust, reliable and large offshore wind energy converters for clean, low cost and competitive electricity. The project's longer-term ambition is to bring a model to market that will spur "a swift evolution towards 14-16MW rated capacities", with a prototype expected to be installed offshore by 2021.

To sell into the Asian offshore market, these companies will have to build so-called T-class turbines that can withstand the 120-250km/h wind speeds of the typhoons that regularly lash east Asian coasts. MHI Vestas and Siemens Gamesa will have typhoon-proof versions of their 9MW and 8MW turbines ready by 2020, while GE recently erected a T-class 4.2MW prototype in the Netherlands.

*Darius Snieckus*

"2019, if the customers demand so".

"We believe that the industry should avoid rushing to new products without thorough simulation and testing," says Cao. "It may be better for the offshore wind sector to move forward at a steady pace."

As part of this process, Goldwind is building a testing facility to put turbines of up to 16MW through their paces — the largest of its kind in the world.

### Is there an export market?

Chinese turbine makers such as Goldwind and Ming Yang have been working hard to sell their turbines outside China, with certain successes in some markets, but as yet, this has not translated to the offshore business. (CSIC Haizhau has come closest, winning an order for two of its 5MW turbines for the Dounreay Tri floating project off Scotland, which has been on hold since the developer went into administration in 2017.)

"We are now brewing a plan to kick off an international offshore demonstration [project] between 2018 and 2020," Goldwind's Cao tells Recharge. "After 2020, we will look to export our offshore turbines."

However, Chinese OEMs have little

chance of selling their machines in the burgeoning Taiwan offshore market, as the Taipei government places strict limitation on the import of Chinese goods —turbines are not included in the import "white list". And although Taiwan does not prohibit Chinese mainland OEMs to invest and build turbine manufacturing factories on the island, there are in fact various limitations on their business scope, making it extremely difficult for most Chinese OEMs to thrive.

But if Chinese OEMs manage to industrialise 10MW-plus turbines, their machines are likely to be far cheaper in the wider Asian market than those produced in the West — due to the shorter shipping distances, as well as cheaper fabrication costs.

And the Chinese OEMs' expertise with typhoon conditions — where they have more experience than their Western rivals — could also push Asian developers in their direction, particularly in Japan and South Korea.

However, the Chinese manufacturers are also expected to face competition from other Asian turbine suppliers. Japan and South Korea — like China — are fond of prioritising domestic technology and manufacturing. Seoul

has tasked Doosan Heavy Industries with building an 8MW offshore turbine for its burgeoning offshore market, while Japan's Hitachi has already won an order for 21 5.2MW offshore turbines for Taiwan Power's Changhua project off Taiwan.

Whatever happens, it is fair to say that European wind suppliers are concerned — not least because of the way that Chinese companies undercut and decimated the European solar manufacturing sector over the past decade.

"The German wind industry [which includes Senvion and Siemens Gamesa] is not really able to compete on price when you compare it to turbines coming out of China," said Bernhard Zangerl, managing director of Bachmann, a leading supplier of automation technology to the global wind industry, at the recent Global Wind Summit in Hamburg.

"[Chinese turbines] are not the same quality but they're definitely significantly below the cost of a German wind turbine. But they're learning fast. My concern is sooner or later they will have turbines that are not just very cheap but also of a certain quality. ■

**BIG ISSUES:**  
Clockwise  
from top left: A  
Shanghai Electric  
turbine being  
installed at the  
400MW SPIC  
Binhai North H2  
project; the last  
blade of an 8MW  
MHI Vestas V164  
is installed at  
the UK's Burbo  
Bank Extension;  
satellite image of  
a typhoon off the  
coasts of China  
and Taiwan. *Inset*  
*above:* another  
8MW MHI Vestas  
turbine being  
erected at the  
Burbo Bank  
Extension

# CRISIS? WHAT CRISIS?

Many Western turbine makers are struggling in the wake of low tender prices and a slowdown in the German wind market, writes **Bernd Radowitz** in Berlin

**I**t is widely assumed that the recent plunge in wind power prices around the world is a good thing for the wind sector — but is this true?

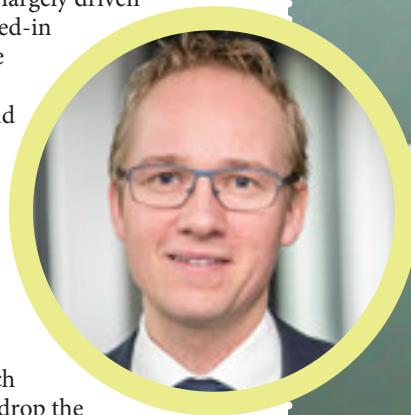
In many parts of the world, wind is now by far the cheapest method of electricity generation on a per-MWh basis. At a power auction last November, for example, Mexico saw an average wind price of \$20.57/MWh — less than half the levelised cost of energy (LCOE) of the cheapest newbuild combined-cycle gas plants.

Such low prices — largely driven by the move from feed-in tariffs to competitive tenders — have encouraged more and more governments to embrace wind power, growing the sector globally.

However, this downward price pressure is leaving its mark on manufacturers, which have been forced to drop the prices of their products if they want to win orders.

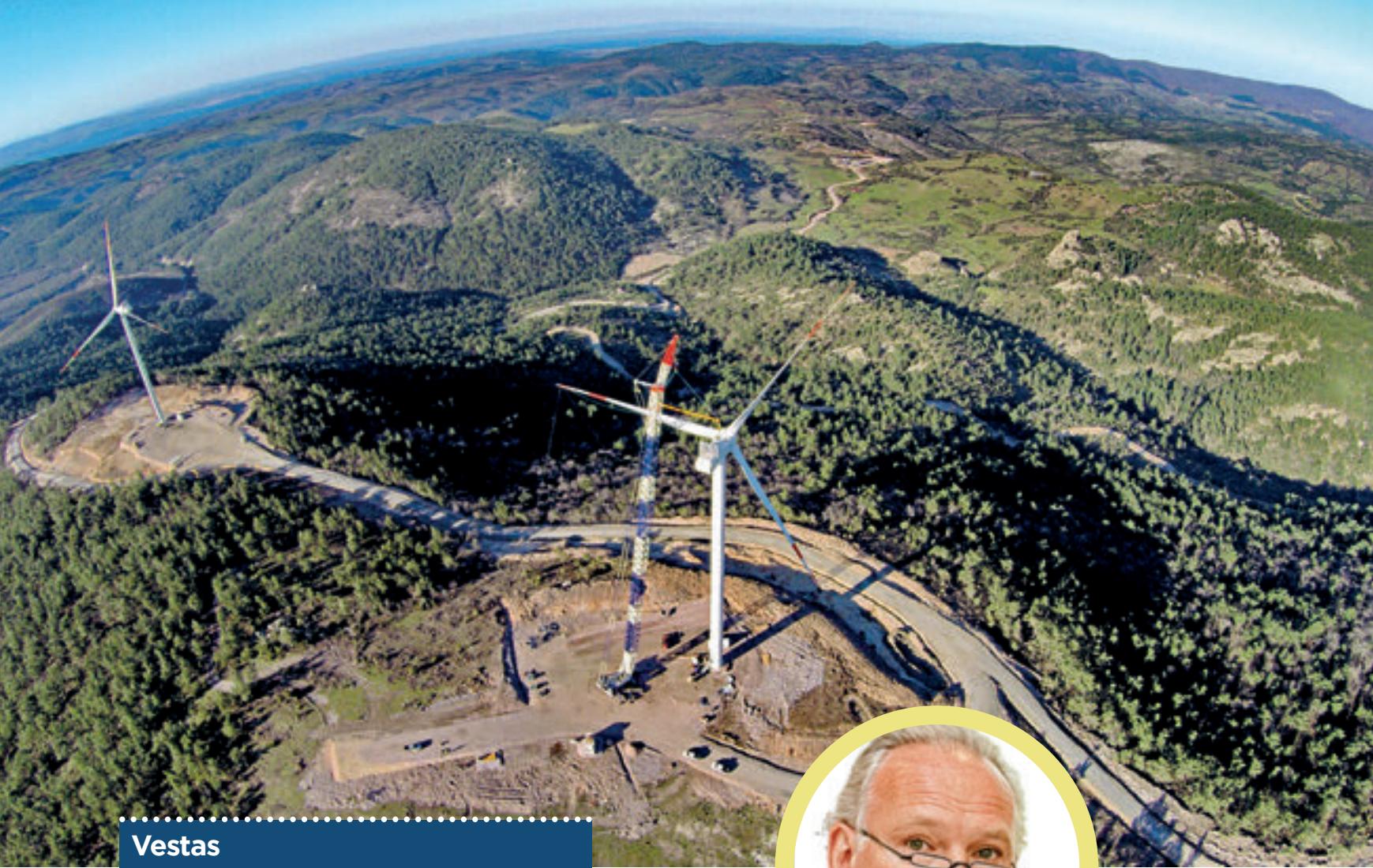
“The selling price of wind turbines has dropped in two-digit figures over the past few years — we’ve seen drops

Photography | AFP/Getty | Sydbank



**TRUE COLOURS:**  
A rainbow over  
a wind farm in  
northern Germany.  
*Inset: Jacob  
Pedersen*





## Vestas

The Danish OEM has been outperforming all of its peers in terms of profitability, increasing its second-quarter revenues to €2.26bn (\$2.6bn) – from €2.21bn in the same period last year – but net profit fell slightly from €186m to €184m in the same time frame due to lower average project margins.

New order intake, however, surged 43% in the second quarter to a record 3.81GW.

"We leverage our market-leading position and financial performance to invest more in developing new solutions, while efficiently managing our costs," explains chief executive Anders Runevad.

Sydbank analyst Jacob Pedersen says Vestas is better prepared to weather the current wave of lower prices as it has a more solid financial foundation than many of its rivals.

"It is easier to withstand pricing pressure when your Ebit [earnings before interest and taxes] margin is 14%, than when it is 4%."

Runevad tells *Recharge* that in the second quarter, Vestas' average selling price has at least stabilised.

"Average selling price developments will hopefully reflect technological improvements and cost-out going forward," Runevad says.

of 15% or so in one year," Sydbank analyst Jacob Pedersen tells *Recharge*.

"That of course puts a huge pressure on the earnings and profitability of wind turbine producers."

On top of this, a major slowdown in Europe's biggest wind market, Germany — where annual installations are falling from 5.3GW in 2017 to an estimated 3.5GW this year and less than 2GW in 2019 — isn't helping matters, particularly as many of the OEMs have headquarters or bases there.

"If you experience a volume reduction of 60% or 70% in a market segment, that is one thing," says Hermann Albers, president of German wind industry body BWE. "Another is if the revenue decline is exacerbated through a steep fall in sales prices."

Some manufacturers are already loss-making, such as Germany-headquartered Senvion and Nordex, which have shed 780 and up to 500 jobs respectively in the past year; Germany's Enercon has announced that about 800 jobs will be lost at its German suppliers; revenues at

German-Spanish OEM Siemens Gamesa (SGRE) and US-based GE are falling; and even

Denmark's Vestas, which seems the least affected, has acknowledged lower profit margins (*see separate OEM panels for more details*).

In this environment, turbine makers are being forced to adjust their strategies to compensate — entering new markets, sourcing cheaper components from outside their home countries and, in some cases, focusing on cheaper brands (*see below*). Other factors, such as the expiration of the US production tax credits and the growing trade war between the US and China and the EU, will further increase pressure on manufacturers.

"Some of the [turbine makers] will have to merge to survive longer-term," says Pedersen. "I think consolidation in the industry is not over."

Gernot Blanke, chief executive of German developer WPD, agrees. "A lot of market players will just disappear," he says. "Consolidation will happen."

"I think it is not only related to the [turbine] manufacturers, but it goes for the whole industry — whether





you are a developer or a supplier of foundations."

#### New markets

With falling revenues in established markets, OEMs are increasingly trying to increase revenues in new markets.

Senvion, for example, has made major inroads in India, Australia, Chile and Argentina, while Nordex Group pulled in 52% of its €1.6bn (\$1.84bn) of turbine orders in the first half of this year from Latin America. But competition is fierce.

In some countries, there are already established local champions, such as Suzlon and Inox in India, while Chinese turbine makers are also seeking new markets due to subsidy cuts at home (see *China panel*, page 29).

On top of this, some ambitious new markets — including Russia, Turkey and Argentina — have established local-content requirements, forcing OEMs to set up manufacturing

**EMERGING MARKETS:** Far left: Vestas turbines at the 50MW MUT wind farm in Turkey; Vestas machines at the Rawson wind complex in Argentina. Inset far left: BWE president Hermann Albers; inset left: Nordex Group boss José Luis Blanco

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## GE

Wind power has never had a bigger spotlight at GE as the struggling US giant sells off many of its other businesses, but the GE Renewable Energy unit has not exactly thrilled investors with its recent performance.

GE-RE's profit fell 30% to \$159m in the first half of 2018, while revenues tumbled 19% to \$3.3bn — among the worst divisional showings at GE, though not out of line with peers in the wind business.

Like many of its rivals, GE is struggling with the intense price pressure seen across the global wind industry. "We are still feeling effects from the European auction environment," GE chief financial officer Jamie Miller told investors in July.

Only a month earlier, GE confirmed that renewables — alongside aviation and power — would be one of the company's three industrial pillars going forward, even as it sells off divisions like oil & gas, healthcare and transportation.

France-based GE, launched as a stand-alone division after GE's 2015 acquisition of Alstom's power business, has a few reasons to be optimistic. First, its push for geographic diversification beyond the US is finding traction, with promising deals secured this year from Chile to Turkey to Pakistan.

GE's growing prominence in offshore wind was underscored in September when it installed the final 6MW Haliade turbine at the 396MW Merkur project off Germany — not to mention the high-profile launch this year of its 12MW Haliade X model.

Finally, the US market — still by far the most important for GE — is in the midst of what is likely to be its biggest three-year boom in history, as developers race to finish projects in time to receive the production tax credit before it is finally phased out.

Even in the US, though, GE has had its share of recent headaches. In August, utility American Electric Power pulled the plug on its 2GW Wind Catcher project in Oklahoma — for which GE was set to supply 800 turbines, its largest order since acquiring Enron's wind business early in the millennium.

facilities there. Vestas has already opened its first nacelle assembly plant in Russia, while Siemens Gamesa says it also wants to set up shop there, and is also building factories in Turkey.

Enercon says it is working on the medium-term assumption that it will be generating the majority of its sales in international markets.

"To do so we will have to overcome the entry barriers for the specific countries, particularly where the procurement of components in that country is concerned," says Enercon boss Hans-Dieter Kettwig.

"For these reasons, a reduction in supplier contracts in the home market is unavoidable."

## Cut-price components

This push into new markets,



## Siemens Gamesa

In its financial quarter ending on 30 June, Siemens Gamesa Renewable Energy (SGRE) saw revenues decline by 21% year on year to €2.14bn (\$2.51bn), impacted by a lower sales volume in offshore and lower prices and volumes in onshore.

Earnings before interest and taxes (Ebit) fell 26% in the same period to €156m, but net profit rose from €12m to €44m.

Chief executive Markus Tacke said the OEM's €2bn cost-reduction programme is beginning to show results and that he expects a strong result for the quarter that ended on September 30.

SGRE has been successful in selling its Gamesa turbines in emerging markets, such as South Africa, which have made its order intake swell to €12bn in the 12 months to the end of June, a 19% rise from the previous quarter. And this is despite India, where Gamesa held a market-leading position, seeing a policy-induced freeze that paralysed the sector last year.

SGRE also recently won a 1.25GW turbine order for the UK's Hornsea 2 offshore wind farm and the 120MW extension to Taiwan's first commercial offshore array, Formosa 1.

combined with the price pressures, mean that turbine makers are increasingly looking to source cheaper components, usually from China.

"Without doubt, it is essential for companies to constantly question their production and procurement strategies," says Matthias Zelinger, managing director of VDMA Power Systems, a German group representing wind manufacturers. "A globally active industry will also purchase globally, which means that suppliers are in global competition for innovation and costs."

Senvion is quite advanced among manufacturers in shifting component procurement to Asia. Last year, it closed a deal to buy blades from US manufacturer TPI Composites' Chinese factory, and has also lined up China's CRRC Zhuzhou Electric to provide the generators for its 3.XM turbine series.

Senvion admits, though, that shifting

**NEW TERRITORY:**  
*Clockwise from bottom left:*  
Staff gather to celebrate the first blade at Siemens Gamesa's blade plant in Tangier, Morocco; a wind farm near Santiago, Chile; Gamesa turbines in India; Gamesa machines at the Serra de Meira wind farm in northwest Spain.

*Inset:* Enercon managing director Hans-Dieter Kettwig

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## Enercon

Unlike its publicly traded peers, the leading OEM in the German market is owned by a private foundation and therefore doesn't release earnings or other financial figures.

But signs are clear that business is going far from smoothly at the company, which is based in Aurich, northwest Germany.

A first indication came in May, when the city of Aurich imposed a budget freeze, citing a drastic plunge in business taxes from Enercon.

An even bigger blow came in August when Enercon announced a shift in focus to international markets in response to the slump in its home market, resulting in the loss of some 800 jobs at its German suppliers.

A first success in entering new markets came when Enercon announced an order for a 77MW wind farm in Vietnam in September.

As well as pushing down the cost of its high-quality turbines by ditching its iconic egg-shaped nacelle, it is pushing lower-price turbines made by its recent acquisition, Lagerwey, in new markets.



to cheaper suppliers isn't easy.

"It is a long process, getting suppliers on board, getting prototypes, testing them rigorously, making sure that they adhere to the standards of Senvion quality," Dhaval Vakil, vice-president of capital markets and M&A at Senvion, tells *Recharge*. "All of that takes a long time, typically a one- to two-year process."

TPI Composites has also been selling to Vestas and Nordex Group's Acciona Windpower (AWP) brand from its China facility, and to GE, Nordex and Enercon from its plant in Turkey.

Vestas chief financial officer Marika Fredriksson tells *Recharge* that it is important to have a global footprint in the supplier base, especially to be able to react to challenges such as the imposition of trade tariffs, which her chief executive, Anders Runevad, believes could increase production costs by up to 1.5% next year.

"We are constantly revisiting our supplier base, and where and how we produce," says Fredriksson, adding that suppliers can also be changed on the grounds of quality and ability to deliver.

Obviously, this trend is not good news for the established supply chains in the West.

BWE says that at least 10,000 manufacturing jobs have been lost in Germany since the downturn begun, although it is still working to compile an exact figure.

## Cheaper turbine models

The mergers of Siemens Wind Power and Gamesa, and Nordex and AWP, have done more than just increase the size of the merged companies' operations and geographic spread. They have also created new strategies for the wind industry.

In markets such as India that are very price-sensitive, SGRE and



**ON THE JOB:**  
Assembling a nacelle at Senvion's plant in Bremerhaven, Germany; *far left*: computer rendering showing a new slimmed-down Enercon turbine superimposed against the familiar egg-shaped design, which requires a lot more metal. *Inset far left*: VDMA Power Systems' Matthias Zelinger; *inset left*: Vestas boss Anders Runevad

Nordex Group can offer a less pricey range of turbines — namely the former Gamesa and AWP models.

Practically all Nordex's orders in emerging markets are from the AWP brand, with 3MW turbines selling particularly well.

Late last year, Enercon — known for its high-price, high-quality turbines — bought smaller OEM Lagerwey, which had its own 4MW model. As the German parent is increasingly focusing on new markets, it seems likely that its strategy will be to push Lagerwey's machines, rather than its own models.

"Together with Lagerwey, we are developing new LP4 [4MW Lagerwey turbine] types, which will further expand our joint product portfolio and improve our capacity to perform in highly competitive onshore markets," Kettwig says.



But it is still too soon to tell whether having a twin-track product strategy will really give SGRE, Nordex and Enercon a competitive advantage.

"It is very costly to have different models. If Siemens Gamesa is to continue with all the Gamesa models and all Siemens models, it is extremely expensive," Pedersen says. "[If] you have two of everything in your production lines, it is not necessarily good."

Of course, another way to reduce the cost of turbines is to make them cheaper to build. Enercon, for example, is scrapping its famous egg-shaped nacelle shape, which was designed by renowned British architect Sir Norman Foster, due to its expense. The new design (see picture, top left), which resembles the Lagerwey machines, almost halves the

## Senvion

Senvion posted falling revenues and a net loss of €50m (\$57.5m) for the first half of 2018. The company based in Germany, but majority-owned by US private equity firm Centerbridge Partners, expects a loss for the whole of this year.

Installations during the first half dropped by 54% to 288MW, as its offshore erections ceased, while the slump in the German onshore market also harmed results.

But the company has a clear cost-cutting and internationalisation programme in place — which included the shutting of three German factories — that already achieved €52m in savings last year, about 20% more than initially forecast, says acting chief executive Manav Sharma.

"We have also used the past months to expand our footprint into selected new markets such as Argentina, Chile, Australia and India with expected material market share gains, and now are working intensively to increase our supply-chain footprint outside of Europe to reduce product costs further," he tells *Recharge*.

Senvion's order intake grew a strong 26% in the first half of 2018 to €797m, which is expected to drive up future earnings.

Cost-cutting, the increased focus on new markets and sourcing from Asian suppliers "will show material recovery from the second half of next year onwards," adds Dhaval Vakil, Senvion's vice-president of capital markets and M&A.

In August, Centerbridge backed a €62.5m capital increase to fund the expansion into new markets such as India.



## Nordex Group

Sales at Nordex Group plunged 36.2% year on year to €957.1m (\$1.1bn) for the first half of 2018, while the OEM posted a consolidated loss of €40.3m in the same period.

Despite the weak first-half figures, the German-Spanish company maintained its outlook for full-year 2018 sales of €2.4bn-2.6bn, underpinned by soaring orders.

"The situation where we are now is mainly driven by the drop in German orders. We took action proactively one year ago, when we implemented the '45 by 18 programme,'" says Nordex boss José Luis Blanco, referring to a plan announced last year to save €45m in costs by the end of 2018, which he says is currently on track.

The manufacturer's combined projects and service order intake during the first half of 2018 jumped to €1.83bn from €1bn a year earlier (new turbine orders were worth €1.6bn in the first half), with Brazil, France and South Africa being the largest individual markets, and Latin America accounting for a whopping 52% of turbine orders. Nordex announced more large orders in Argentina (99MW) and South Africa (252MW) during the third quarter.

weight of the nacelle, vastly reducing metal costs.

Another obvious way to cut costs is to produce larger turbines that have a lower LCOE. Despite their financial challenges, OEMs need to find money to invest in new products, says SGRE board member Michael Sen.

SGRE still has "quite a lot in our innovation and technology quiver to bring the costs even further down", he says, while cautioning that the velocity of the innovation and price-reduction cycle needs to be balanced.

"It is about the speed of implementation," he adds. "That's a topic where I say, 'Please use a sense of proportion.'"

## Crisis? What crisis?

If there is indeed a crisis in the wind industry, it is only temporary, says Pedersen. Recovery is on the horizon.

Runevad agrees. "The wind industry continues to strengthen its position as the cheapest form of energy generation in many markets, which is driving a strong global demand for wind energy," the Vestas boss tells *Recharge*.

"The steep drop in cost of energy has impacted industry profitability short-term, but longer-term it is enabling higher penetration of wind energy in the world's energy mix, which of course is very encouraging."

The coming electrification of the transport and heating sectors will expand the share of electricity in total energy consumption, Runevad adds,



**ON- AND OFFSHORE:** GE turbine components are loaded onto the Seafox 5 vessel for transportation to the Merkur offshore wind farm. Top left: a blade attached to a Nordex turbine in northern Germany; bottom left: Gamesa turbines at the Campo dos Ventos wind farm in Rio Grande do Norte, Brazil

which will increase the demand for wind power.

Figures from WindEurope and the Global Wind Energy Council (GWEC) seem to underpin Runevad's optimism.

Wind-power additions in Europe this year are expected to decline to below 15GW (following a record 16.8MW in 2017), but they are set to rise again next year and average 17.4GW from 2018-22, WindEurope estimates in its latest outlook.

And while GWEC sees worldwide installations stagnating this year at 52.9GW, they will soon pick up, reaching 62.6GW in 2021.

It is worth noting too that prices at auction, at least in some markets, are beginning to stabilise.

In India, the lowest winning prices at a 500MW tender in March in the state of Maharashtra were 2,850 rupees (\$44) per MWh — higher than both the 2,430 rupees/MWh reached at a similar-sized tender in Gujarat state in December 2017 and the 2,440

rupees/MWh achieved in a 2GW national tender in February.

The average winning bid at German auctions is also rising — reaching €61.60 per MWh at the 670MW onshore wind tendering round in August, up from €57.30/MWh at an auction in May, €47.30/MWh in February and €38.20/MWh in November 2017.

However, it isn't entirely clear when higher prices in some markets might translate into an increase in profitability.

Pedersen reckons that OEMs will be able to regain some of their lost profitability next year, while Nordex boss José Luis Blanco expects his company to be back in the black in 2020.

"Germany was the main reason we [will have] dropped in profitability in 2018, and Germany will be the main reason why we will increase some profitability, and return to profit in 2020." □

## Chinese OEMs going West

Western turbine makers are not the only ones seeking to expand into new markets to compensate for losses in their core markets and generally tighter profit margins.

China is scrapping its long-standing feed-in tariffs (FITs), with new auctions only accepting bids at lower rates than the FITs, pushing turbine makers to look to foreign markets to maintain or increase profits. And with Chinese companies often able to access cheap loans and export subsidies, some in the European wind sector are worried.

Germany's wind power federation, BWE, points to a similar reduction in China's PV market earlier this decade that launched Chinese solar panels onto the European market, eventually displacing most of the European suppliers.

However, Chinese efforts to go global in the wind industry have so far been modest.

From 2007-17, 17 Chinese manufacturers only managed to sell 3.2GW turbines abroad across 33 countries — a drop in the ocean compared to the 188GW of wind power erected in China by the end of 2017.

Chinese OEMs have sold 552MW in the US, and have also made inroads into Pakistan, Australia and South Africa. But sales have been negligible in Europe, where high-quality standards and grid specifications make market entry more complicated.

Goldwind executive vice-president Cao Zhigang recently told *Recharge* that he thinks the coming Chinese auction system will force local OEMs to compete on price, with the inevitable cost cuts making them more competitive abroad.



# FLOATING WIND BLOWS INTO ASIA

The focus of the nascent sector is moving from Europe to Asia, where half the global fleet could be turning by 2030, writes Darius Snieckus

Floating wind has been an almost exclusively European project since the Hywind prototype started turning in the Norwegian North Sea in 2009, with the world's first array brought on line off Scotland a year ago and maiden multi-unit developments now heading for construction off the UK, Portugal and France by 2021. Japan's vanguard Fukushima Forward demonstrator, switched on in 2014, and the now-decommissioned Kabashima pilot, almost seem like footnotes to the wider industrial trend.

But that could soon start to change dramatically. Many analysts now see the epicentre of floating wind — much as with the wider offshore wind industry — potentially shifting to Asia by the end of the next decade. Of the 115-120GW in conventional offshore wind capacity expected to be installed globally by 2030, over 12GW could be floating — and almost half of that would be in the waters off China, Taiwan, South Korea, Japan and the region's other — often island — nations. And according to a recent note from Danish analyst Qvartz, some 22GW could be scoped for future development by then. Bloomberg New Energy Finance takes a balanced view of the global market, with senior analyst Tom Harries noting that "most developers



Photography | Ideol | BNEF

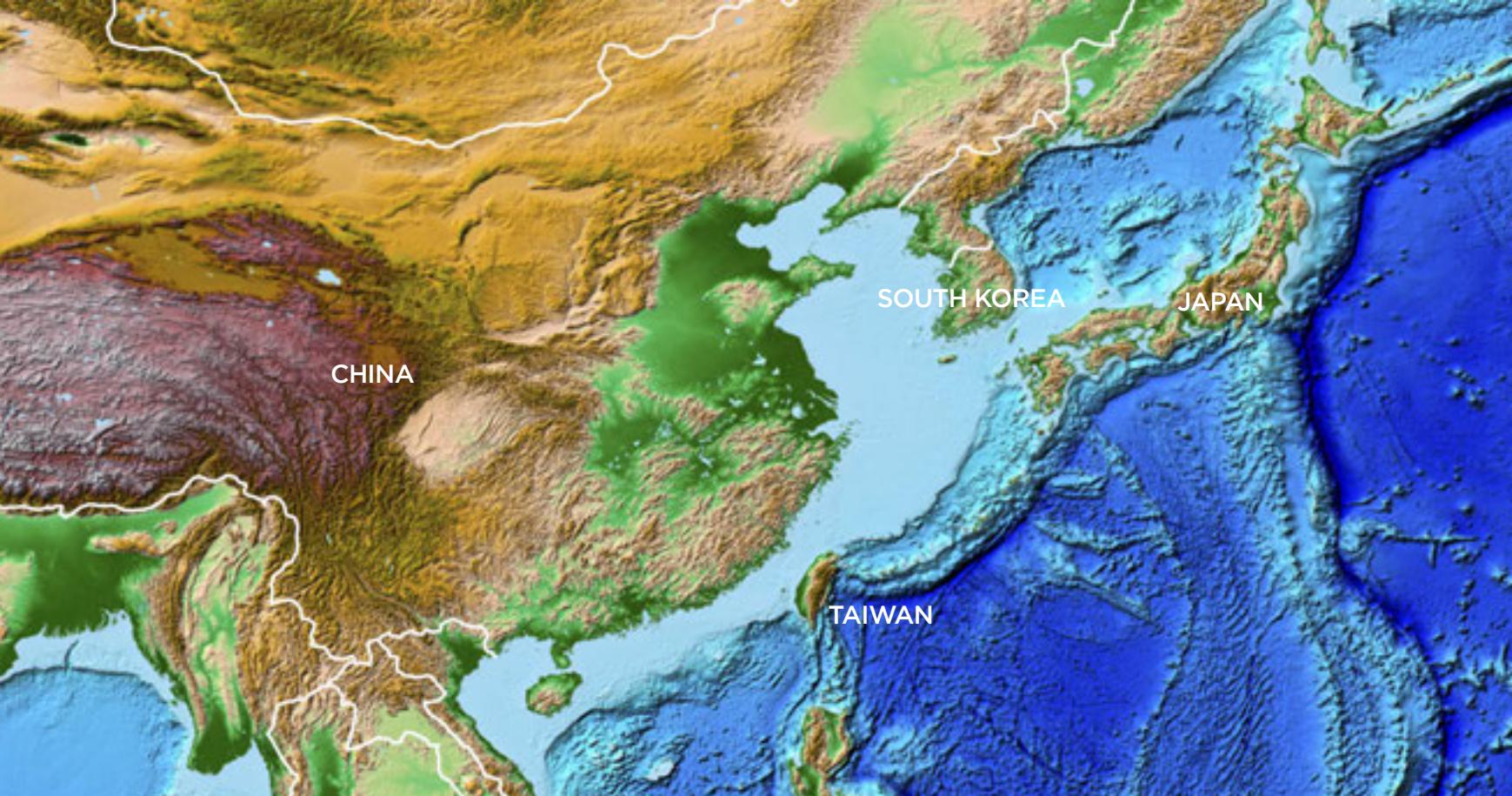
**FIRST OF MANY:**  
Ideol's Floatgen demonstrator, complete with 2MW Vestas V80 turbine, installed in the French Atlantic. *Inset:* BNEF's Tom Harries



would agree a few more projects should have been switched on by now", while also flagging up that "five years ago floating wind was something to think about another time — and now we are building arrays on the way to commercial projects".

"Asia, as a new, opening market, suddenly has the potential to see floating wind differently — actually this is a really interesting technology, there's real promise and the potential for rapid growth," he says. "Nonetheless, there remains the question of cost and how it can be reduced."

Floating wind generally remains seen — like bottom-fixed was a short few years ago — as expensive. The technology is proven — the pilot projects brought on line so far by Equinor (Hywind Scotland), Principle Power (WindFloat1), and Marubeni (Fukushima Forward) have made this abundantly clear. But a levelised cost of energy (LCOE) of over €200 (\$231) per MWh threatens to slow progress in a sector that needs now — as Equinor's recently promoted senior vice-president of new energies, Irene Rummelhof, said last year — to "deploy, deploy, deploy". And though a number of key arrays are under development for installation off Europe and the US, it might be an as-yet-unnamed 500MW-plus project off Japan that becomes the flagship for the sector as it moves into the energy



mainstream. The array — being developed by French sector pioneer Ideol and investors including Acacia Renewables, the Asian arm of global energy investment giant Macquarie — would become the world's largest commercial-scale floating wind farm if brought on line as planned in 2024. Not far behind it, Ideol is working on a separate up-to-1GW project off Japan with an undisclosed partner, which would be built in stages.

"Floating wind needs real-life industrial experience to move on to the next level," says Paul de la Guérivière, Ideol's chief executive. "A market truly exists now in Europe and is quickly getting bigger, and we see Japan as the right market for us to establish ourselves in for Asia. We believe we can help generate momentum in [the region] by creating a bridge between floating wind investors in Europe and Asia."

"We have been working with Acacia closely for some time and feel we could have a very effective collaboration over several projects. Japan could be a tremendous market for us — and the wider floating wind industry."

The deal with Acacia came in the wake of a confidence-boosting €15m capital funding round, led by Hong Kong-headquartered private equity firm Kerogen Capital, closed earlier this year, which Ideol said "secured [its] long-term funding requirements" for the European and Asian markets.

Phillip Jackson, executive board

member at Kerogen, which has over \$2bn in assets in its portfolio, including many in offshore oil & gas, says the investment house had "seen the potential for floating wind for some years" but was "waiting for the confluence of maturing, scaleable technology ready for deployment, a supportive regulatory environment and emerging clarity about time frames for projects to be rolled out".

"We think that the [floating wind sector] is reaching that inflection point," he states.

Jackson agrees with the consensus that Europe will be the sector's key growth driver over the next five years, with France leading the charge, yet highlights that "it is clear that as countries like Japan, Korea and Taiwan seek to de-emphasise nuclear power there is a lot of opportunity in Asia. Important 'keys to those kingdoms' will be in the hands of those who supply the floating platforms".

Harries reckons in the short term, Japan will be central to those developers aiming to put themselves in "pole position" in Asia.

"Certainly, Japan is a hugely prospective market for floating wind," says Harries. "[The government is offering] a generous feed-in tariff for floating wind [of about €270/MWh], it has national ambitions to be an exporter of floating wind technologies and so on. But," he warns, "[500MW-1GW] is going up from a current 30MW [off Japan].

That's a jump. A lot of the success here hinges on the success of Ideol in its pre-commercial projects, which are now both just getting under way.

"Conventional offshore wind took some time to get up to these sorts of project capacities — and that is with an experienced developer like [Danish industry pace-setter] Ørsted. Still, 1GW of floating wind is not unfathomable.

"This project being a success would be unquestionably fantastic for floating wind. The industry as a whole needs the volumes and so if someone can start building multi-hundred-megawatt projects — even 1GW split into five 200MW tranches — that is still market-changing."

If Ideol can build its Japanese pilot project on time and to budget and drive down the cost profile of the technology in the process by building volume, adds Harries, "it will open up not only the Japanese and Asian markets for floating wind but also an abundance of other markets — the US West Coast, island nations... and the regional supply chains too."

"All the key advantages of floating wind [compared to fixed-bottom] — not needing heavy lift installation vessels, doing more of the construction onshore, simpler O&M — all come good if we see the cost falls."

Ideol's two pilots — FloatGen off France and Hibiki off Japan — as Harries notes, will be all-important. The first, based on a concrete version

**HIDDEN DEPTHS:**  
Anti-clockwise from above: a bathymetry map showing the water depths in east Asia (pale blue equals less than 100 metres, the darkest blue, such as that east of Japan, equals more than 8,000 metres); Equinor's Hywind turbine, which has been installed off Norway and Scotland; Ideol's FloatGen off France, Hexicon's two-turbine floater; the WindFloat 1 installed off Portugal by Principle Power, which — like Equinor — is in ongoing discussions for first projects off Japan

*Inset: Ideol boss Paul de la Guérivière*



of its “damping pool” platform fitted with a 2MW Vestas turbine, reached start-up in September in the French Atlantic off Brittany, with power now flowing to 5,000 homes in the area, as it eases into a two-year testing period. The second, manufactured in steel and topped with a 3.2MW Aerodyn two-bladed turbine, is moored off Kitakyushu city in the Hibiki-nada Sea and slated to soon be generating power, under the aegis of a project being run by Nedo, the government’s industrial R&D department.

“These are two important ‘first steps’ in two different regions,” says de la Guérivière. “There are already lessons learned on all levels from these units — on design, construction, installation, everywhere. And even proof of its stable dynamic behaviour in extreme weather [referring to a storm with five-metre waves and 15 metre per second winds that blew through the project site in the Bay of Biscay just after installation in May].

“We are applying our experience offshore already to our thinking on the next generation of our platform’s design, to be a little less conservative — but equally stable.”

Ideol’s foundation — a barge-like hull with a rectangular open centre — could also be an icon of floating wind’s spirit of progress, being the first design not directly adapted from the offshore oil sector.

Advances in technology that carried conventional offshore wind down the cost curve from €150/MWh to €50/MWh in three years could be mirrored by floating wind, as UK consultancy BVG Associates points out in a recent report produced with European technology incubator InnoEnergy. “Floating-specific” innovations across all elements of a wind farm, says BVG associate Kate Freeman, one of the authors of study, could cut LCOE by 20% on projects taking final investment decisions between 2020 and 2030.

“The main innovations that bring these benefits are in the [floating foundation] — both the design and the manufacturing,” states Freeman. “Standardisation and series production play a role, as does whole-system design where the tower, support structure and moorings are all considered as one unit.”

“Reduction in cost and risk on this scale can make floating wind a much



**FRENCH FLARE:** A sunset rendering of an Eolfi floating turbine. *Top left:* Ideol's Japanese demonstrator, equipped with two-bladed Aerodyn turbine; a close-up of the floating unit ahead of turbine mating. *Inset:* Kerogen's Phillip Jackson

more attractive energy-generation technology."

Such is the speed of scale-up in the offshore industry, floating wind developers in fact face a dilemma — though a happy one, as Freeman notes. Namely, that as several 10-12MW turbines are launched — MHI Vestas unveiled its 10MW V164 last month, and Siemens Gamesa, Senvion, GE and Goldwind all have a 10MW-plus design on the drawing board — the decision will have to be taken, she says, as to whether to "choose from the 6-8MW turbines with an established track record, or jump early to 10MW-plus turbines with a significantly shorter track record but offering the possibility of significantly increased project returns".

Though the longer-term horizon is shining brightly for floating wind off Asia, Harries strikes a cautionary note in reiterating that the journey "getting to this point" will be far from plain sailing, in a market where cost is king and conventional offshore wind is fast heading for a subsidy-free existence.

"I am all for floating wind in what it brings to a power system — higher capacity factors, vaster resources [than conventional offshore wind as some 80% of the world's maritime acreage

is in water too deep for bottom-fixed turbines]. But Europe is seeing the advent of auctions now and this is transferring to Asia, post-2020. Water depth will be key, of course. But more widely, it will come down to price. And floating still has its work cut out for it."

BVG director Giles Hundleby shares this circumspection, seeing floating wind taking a 10-12% slice of regional market action by 2030. "Offshore wind capacity in Asia looks set to approach 50GW by 2030, with floating expected to play a small but significant part by then. It will be especially important for Japan, but also attractive for deeper, high-wind sites in other countries. We expect floating offshore wind will be in its rapid growth phase by then, so forecasting its share of the market is challenging."

However, as Harries adds, "when you consider how far Equinor has brought down the price of floating wind over only two projects — a phenomenal drop [of 50% in capital expenditure between first- and second-generation Hywinds] — and so the trajectory is definitely there and that will only be helped by volumes. And so far, [the sector's developers] are meeting their promises." □

## Runners and riders off Asia



With Japan being an early mover in floating wind, with its Marubeni-led 14MW Fukushima Forward demonstration array, *pictured*, Tokyo has been a key outpost for the industry, with Norway's Equinor, US outfit Principle Power and France's Ideol all with offices in the city and each in discussions for commercial-scale deployments, though only Ideol has broken cover on a first multi-unit project. Consultancy Qvartz calculates a lead-off pipeline of floating wind in Japan totalling 3.3GW, 1GW of which is in permitting and sites have been identified for 2.3GW. But it remains to be seen where the centre of gravity of the Asian floating wind industry will eventually anchor itself.

Taiwan, where this year's 5.8GW offshore tender bonanza catapulted the country onto the international stage, could well be a front-runner. French developer Eolfi has formed a partnership with Cobra Concessiones, a subsidiary of Spanish construction conglomerate ACS, to develop a portfolio of five 500MW floating projects, starting with the WIN project off Taoyuan, which is slated for commissioning in 2022. And the Taiwanese government has earmarked 2.1GW for development, though it is unclear how much of this will be auctioned off in the planned 2019 tender.

Though currently something of an outlier, South Korea is exciting interest from various floating wind players, including technology developer Hexicon. Having had to shelve its 10MW Dounreay Tri demonstrator off Scotland due to project-scuppering construction delays, the Swedish outfit has transplanted its ambition to deploy the world's first twin-turbine floating unit in Korean waters and is understood to be progressing "faster than expected" on a lead-off project with Busan-based integrated service provider Coens Co.

China, with its vast stretches of undeveloped tidal plains and shallow waters, remains largely an unknown in Asian floating wind, though it was recently revealed there are plans to launch a five-turbine, domestically developed pilot project by 2020 in the Donghai Sea off Shanghai as a first step to potential utility-scale deployment. The Shanghai Deep & Far Sea Offshore Wind Major Demonstration project began life as a joint research project backed by the Shanghai government, but is now being taken forward by Shanghai Green Environmental Energy, a subsidiary of China's largest power utility, State Grid.

# Goldwind breaks new ground in Brazil

The Chinese turbine manufacturer takes a unique first step into the South American country, with an assembly plant sure to follow, Goldwind chairman Wu Gang tells Alexandre Spatuzza in São Paulo

**JUST VISITING:**  
Goldwind  
chairman Wu  
Gang; top right:  
a Goldwind  
worker fine-tunes  
equipment at  
its factory in  
Dafeng, China;  
**bottom right:** an  
Impsa turbine  
in Brazil, which  
could be repaired  
or replaced by  
Goldwind

After spending years studying different ways of entering the 1GW-a-year Brazilian wind market, Chinese turbine maker Goldwind is finally taking the plunge — but not to sell turbines. At least, not yet.

Goldwind has won a 363MW deal to optimise, repair or replace 242 1.5MW Impsa turbines that have not been serviced since 2015, when the Argentine turbine maker and its developer, Energimp, went bankrupt.

With 181 of those machines currently not working, and Goldwind saying they would upgrade broken turbines with imported 2.5MW or 3MW models, the Chinese OEM could see up to 543MW of their machines installed in Brazil by the end of the two-year contract.

Goldwind was able to secure this \$270m deal with Energimp — now owned by creditor FI-FGTS, a Brazilian government workers' savings fund — because it owns

German turbine designer Vensys, which designed the Impsa turbines. The Chinese company is building two service centres and a spare-parts warehouse to facilitate this work.

"Step by step we will build a supply chain for servicing and eventually we will have an assembly plant in the future," the company's board chairman, Wu Gang, tells *Recharge* during his visit to São Paulo to inaugurate the company's service centres and its first commercial

contract in Brazil.

Goldwind is also considering looking beyond the 1GW of Vensys-designed turbines in Brazil and offering O&M services to machines made by other manufacturers — something that Vestas and Siemens Gamesa are already doing.

"There are a lot of wind turbines that are not running very well and that are resulting in a loss for the investors," says Wu. "It's a pity, renewable energy could do something for them. So we get a feeling it is our responsibility [to help them]."

To actually sell turbines in Brazil, Goldwind would need to set up a nacelle assembly plant in the country to meet local-content requirements. Only turbines that comply with these rules can be bought by local developers with cheap financing from the national development bank, BNDES (*see panel overleaf*).

Goldwind previously tried to enter the market in 2015 — and meet local-content requirements — by buying Impsa's 200MW-a-year nacelle assembly plant in the Northeast state of Pernambuco, but after carrying out due diligence, the Chinese company decided not to go ahead.

Then it studied the possibility of opening a greenfield factory, and that too was discarded. Finally, Goldwind officials worked on the possibility of buying a local project pipeline to compete in tenders, but this didn't work out either.

Nevertheless, these aborted initiatives allowed the company to start to build its presence in the country, gain deep knowledge of the Brazilian market and hire a local team, including the current Brazil manager, José Eduardo Teixeira de Carvalho Filho, who was formerly at Impsa.

Wu believes 5GW of Goldwind's permanent-magnet direct-drive (PMDD) turbines will be installed in Latin America by 2023, while declining to say if these will be imported or built locally.

Turbines built in Brazil could also be shipped to other markets in Latin America, where Goldwind currently has 354MW installed — in Chile, Peru, Ecuador, Panama and Cuba.

By 2023, the region's current installed capacity of 20GW is expected to almost double, led by Brazil, which will surge from 14GW to more than 20GW; followed by Argentina, which will have completed its current 3GW build-out; the



**OVERSEAS SUCCESS:**  
Some of the 73 Goldwind turbines at the 165.5MW Gullen Range wind farm in New South Wales, Australia. *Opposite page:* scenes from Goldwind's Dafeng factory



## How to get big in Brazil

To sell turbines in Brazil, Goldwind would have to meet the same detailed and stringest local-content policy as the six OEMs currently operating in the country.

Developers can only access financing from the national development bank, BNDES — the only cheap and long-term source of loans in the country — if they install turbines that meet local-content rules. The alternatives are financing from abroad, which is risky since power-purchase agreements are denominated in local currency and from private banks, which offer shorter tenures and charge interest rates some five percentage points higher a year.

So a nacelle assembly plant would be the only way to carve out space among the half a dozen European OEMs that have successfully entered the region. They have been selling turbines and developing projects in Latin America for more than 10 years.

This means Goldwind would have to take on companies such as giant Vestas and others of Spanish origin such as Gamesa (now SGRE) and Acciona (now Nortex Group), which are culturally much closer to Latin America, one of the reasons for their success. And the Latin American market won't be a bone these OEMs will give up easily: the region today delivers more than 10% of their global revenues amid a complex and competitive global market.

But in Brazil, Goldwind missed the train of incentives including regular tendering, high power prices and even cheap financing from the BNDES for the supply chain between 2009 and 2016. During this period, Brazil's installed capacity surged from almost nothing to 13GW.

By January 2016, all six OEMs operational in the country today had complied with the 70% local-content rules and are now investing to produce bigger machines. An estimated R\$1bn (\$255.6m) was invested and today Brazil's wind industry has a capacity to churn out 2-3MW every year in turbines.

projects in Argentina but for the long term we will have to build up the domestic service and a domestic components solution," says Wu, referring to the coming local-content requirements there.

This focus on services and project development brings the company back to its roots.

"Goldwind is a flexible company... we have been in the industry for 20 years," says Wu. "[But] for the first ten years, we were a project developer and operator, so we are familiar with the whole process... it was only later that we shifted to manufacturing and, by offering services, we want to get a full feeling of the domestic market and its demands."

consolidation of Chile's growing wind market, in which more than 1GW has so far been installed; and 500MW a year in Colombia.

"[The countries in the region] have very good wind speeds and this region is going to be the best for renewable energy in the world," the 60-year

electrical engineer and Chinese wind-power pioneer told *Recharge*.

Goldwind will also develop its own projects in Argentina, where it is building the first 100MW of the 350MW pipeline it acquired recently.

"For Argentina, the policies support project development. So far we have

## More than just wind turbines

For Goldwind, an additional positive outcome of its presence in Brazil is that it will allow the company to import its mini- and micro-grid solutions, which it is starting to sell in Nigeria.

"We are ready for this project. In Brazil, a lot of beach cities have constant wind speeds. We have developed a low-wind-speed turbine that can be suitable for city wind. We can install the solar panel on roof, the wind turbine and chose from different batteries. We have one battery with a superconductor and when there is variability on the grid, they quickly react to keep the frequency stable," says Goldwind chairman Wu Gang.

Wu acknowledges that Goldwind will have to build its first foreign factory in Brazil in the coming years, and is generally supportive of local-content policies, believing that they bring jobs and income to their host countries.

His company was able to grow to become the world's second largest turbine maker due to China's own form of local-content requirements. But he still has doubts over the Brazilian market, mainly due to the current market conditions and the recent economic and political turmoil since President Dilma Rousseff was controversially impeached.

"When we enter some market, our next goal is internationalisation — this means we do the best to work with domestic manufacturers, we look for domestic services suppliers as well as investing in R&D. But if we open a manufacturing facility we have to check if it can also bring value," he says.

"Brazil has one of the lowest [wind] prices in the world. It can't be like that because the renewable industry has a lot of R&D expenses and [requires a lot of] investment in manufacturing. [In the end] wind turbines are complex products that contain a lot of high-tech components."

"So it's just the beginning [of the industry] and since [Brazil] is in the beginning they need to learn, they need to practise and they need to invest in R&D and so on... It's better to find a reasonable price for the electricity that encourages the domestic manufacturer and that grows the domestic economy as well as creating jobs."

So when does he think Goldwind will build its long-awaited Brazilian factory?

Wu replies as if he has all the time in the world. "It depends on the market requirements, so we will see," he says. "We will try our best." □





## WALKING TO WORK AT ARKONA

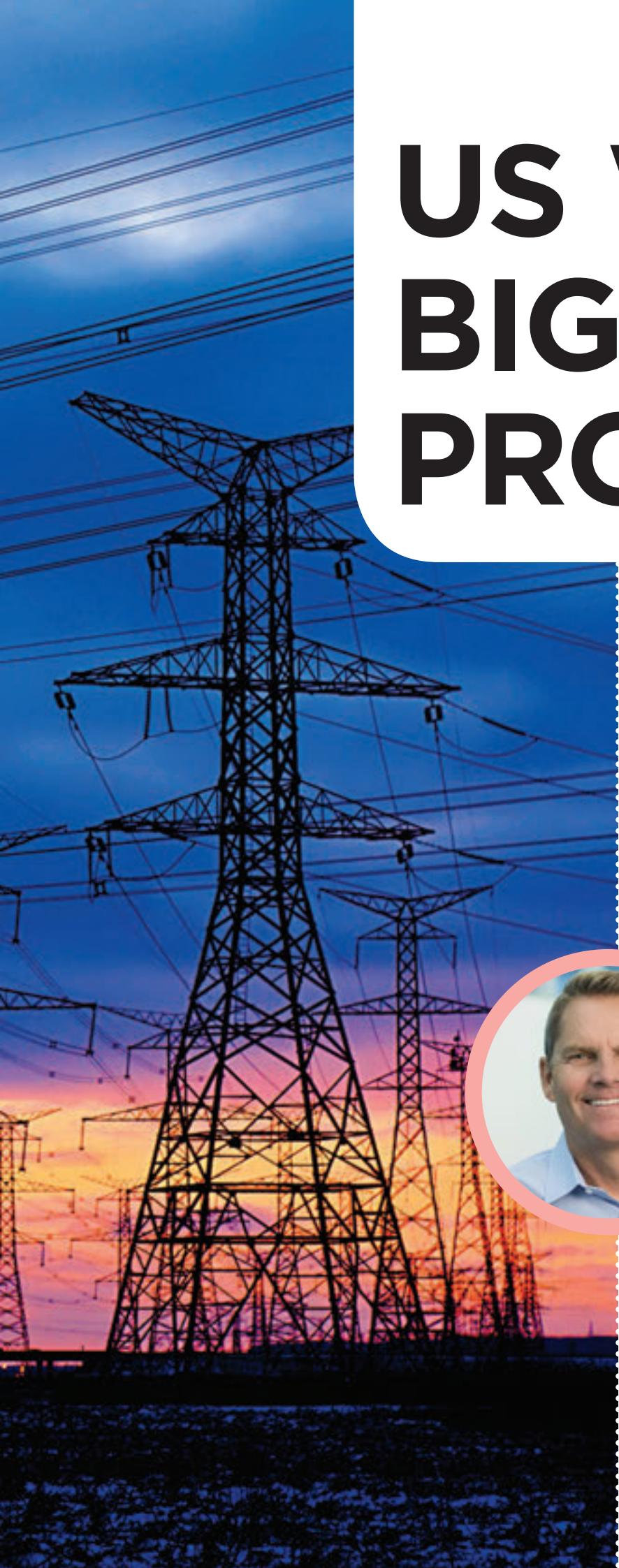
⌚ A worker crosses a personnel transfer bridge at the 385MW under-construction **Arkona project** in the German Baltic Sea, while, in the background, work takes place at the neighbouring Wikinger project. Arkona exported its first power in late September, with the project due to be completed in the first quarter of 2019

Photograph | DPA/PA





**ON THE LINE:**  
Pylons and  
transmission  
cables are often  
not popular with  
communities,  
but are vital for  
the renewables  
build-out. *Inset:*  
Tradewind  
Energy boss Rob  
Freeman



# US WIND'S BIGGEST PROBLEM

Transmission networks cannot keep up with the expansion of US renewables, raising serious questions about future sector growth, writes Karl-Erik Stromsta in Kansas City

Fragmented, ageing and designed for a bygone era, the US grid is one of the renewables industry's defining challenges for the decade ahead; the energy transition is hurtling forward and the grid is woefully unprepared.

Transmission networks are increasingly congested, threatening to undercut key new growth markets such as corporate off-take deals.

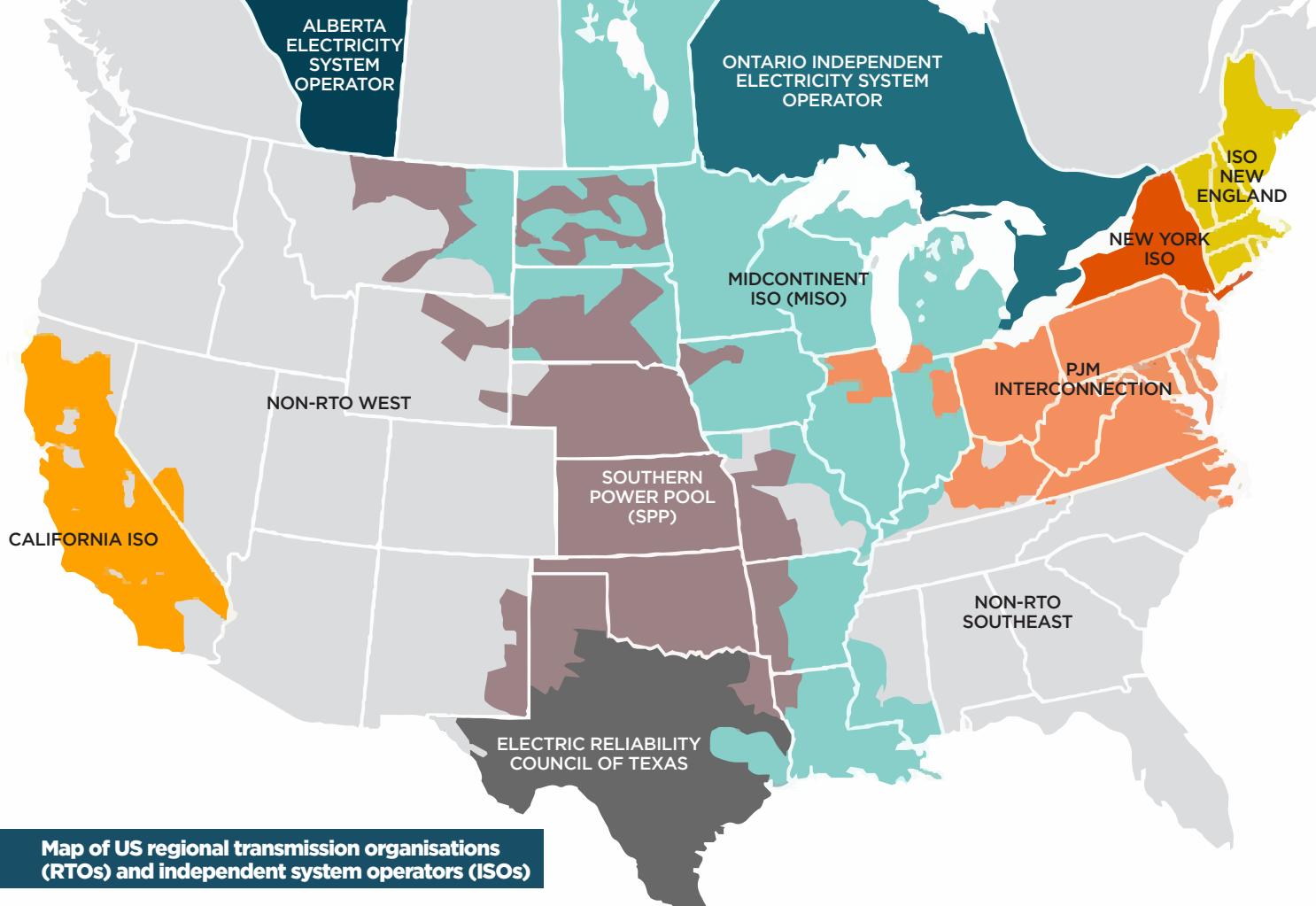
This congestion makes it difficult for regional grids to export power when the supply of wind and solar is high, increasingly pushing wholesale spot markets into negative prices, which in turn makes it harder for existing renewables projects to make money.

"If there's something that's kept me awake at night over the last five years, it's been my anticipation of transmission and wholesale market-related issues becoming a real obstacle to growth at some point," says Rob Freeman, chief executive of leading US wind developer Tradewind Energy. "And it's happening now. We're seeing it."

Meanwhile, the recent collapse of high-profile transmission projects like Clean Line Energy Partners' Plains & Eastern and Eversource's



Photography | Ian Muttuo | Tradewind Energy



**Map of US regional transmission organisations (RTOs) and independent system operators (ISOs)**

Northern Pass has put a spotlight on the difficulty and risk of developing modern grid infrastructure in this country.

With the production tax credit (PTC) seemingly secure in its multi-year phase-down, concerns around transmission and market design have become the “number one priority” for the American Wind Energy Association, chief executive Tom Kiernan says.

Few in the renewables business see the grid as an immediate crisis, and federal regulators are starting to give the issue more attention. And there are many potential solutions — from battery storage, to market reforms, to high-voltage direct-current (HVDC) power lines that could leapfrog congested grids altogether.

But any of these is a partial solution at best. And America’s grid woes are largely beyond the control of the renewables industry itself, a frustrating reality for a sector accustomed to blazing its own trail.

“The renewables industry will continue to eke it out and find incremental solutions, and storage will help,” says Jayshree Desai, president of developer ConnectGen.

“But at some point the eking out and incremental solutions will stop working. They already have stopped working in some markets.

“You have to figure out longer-haul,

bulk transmission to really change the fundamental supply-demand balance of renewables in this country,” she tells *Recharge*.

### SOS to the RTOs

If the US were to design its grid from scratch today, it should be continental in scope, allowing wind and solar energy to flow from where they are most cheaply generated to where they’re most highly valued.

Unfortunately, the American grid looks like a parody of that principle. It has evolved over the past century into a bewildering hodgepodge of more than 3,000 utilities, from vertically integrated giants like NextEra Energy to tiny rural co-operatives, many of them monopolies, some of them effectively islands.

In the absence of a national grid, the best hope for stitching this patchwork together has been the regional transmission organisations (RTOs) and independent system operators (ISOs).

These non-profit, voluntarily joined groups bind disparate utilities and patches of the grid into coherent power markets, smoothing out supply and demand across regions. The largest of these RTOs — the PJM Interconnection — manages the grid for 65 million people.

The good news is that RTOs have done an impressive job absorbing and dispersing the country’s first 150GW

of variable wind and solar capacity. The bad news is that these days even the most pro-renewables RTOs are struggling to keep up.

The US generates a modest 8% of its electricity from wind and solar today. But zoom in on particular regions and the scale of the challenge becomes apparent.

On the solar side, the extreme example is California ISO, whose “duck curve” of baseload power demand — showing an extreme dip during daylight hours — is famous among energy experts.

On the wind side it’s Southern Power Pool (SPP), which oversees the bulk grid for a dozen thinly populated states in the Great Plains and upper Midwest that contain some of the best wind resources on the planet.

These days SPP is bursting with grid-connected wind power, and it happened quickly. In 2012, wind accounted for 6% of its total generation. This spring the figure stood at 29%, including a brief spike in April to 64% — a record for an American RTO.

In markets like SPP and the neighbouring Midcontinent ISO (MISO), the list of projects waiting to plug into the grid — known as the interconnection queue — has become alarmingly long.

SPP has 18GW of installed wind today, compared to a peak summertime load of 50GW. But there’s another

**CONNECTED:**  
Opposite page:  
a transmission  
line in Manhattan,  
northeast Illinois,  
inside the PJM  
Interconnection.  
Inset: GE  
Renewables'  
onshore wind  
boss, Pete  
McCabe



80GW of proposed solar and wind projects looking to plug into SPP's grid.

"The queues are just jam-packed with projects — tens of thousands of megawatts, way more than can be built in any reasonable time frame," Freeman says.

Beyond queue reform, the US simply lacks the bulk transmission capacity it needs to absorb all the renewables set to come online in the coming years, and the build-out of new lines is happening much too slowly.

There have been notable examples of RTOs making far-sighted transmission investments for renewables. Most famous are the so-called CREZ lines built in Texas earlier this decade, unlocking many gigawatts of new capacity and helping transform Texas into a global wind leader.

But Texas is an unusual example, as one of just three states with its own grid operator. That self-contained, single-state RTO structure comes with limitations, but also makes it easier to get ratepayers to pay for the cost of transmission investment. And even in Texas, it would be difficult to replicate the CREZ initiative today (*see panel, above right*).

The combination of surging renewables output and worsening transmission congestion is resulting in



depressed — and frequently negative — locational marginal prices (LMPs) in wholesale spot markets. In SPP, for example, the incidence of negative prices doubled in 2017 to around 7% of all real-time intervals, although they have eased up a bit so far this year.

The flourishing US corporate renewables market could be one victim of grid congestion. That's because increasingly sophisticated corporate buyers now often insist that wind farm owners assume what's known as basis risk, or the transmission risk associated with bringing power from where it's generated to the nearest market hub.

If a virtual PPA is set at \$20/MWh, but it costs three times as much to transmit the power to the point of financial settlement at times of congestion, the economics of such deals can quickly fall apart. Projects are increasingly left curtailing their output, wasting clean power that would fetch a good price elsewhere in the country.

"I'd say that in most markets — without market reform, and assuming [corporations' financial] objectives stay the same — the equation probably doesn't work post-PTC," Freeman warns.

Without the PTC, wind prices may edge upwards enough to make them unattractive to some corporate buyers

## ERCOT running out of room

The CREZ lines built in Texas earlier this decade added 18.5GW of new long-haul transmission capacity and acted as jet fuel for the wind market, but more capacity is now needed in some regions.

"Wind developers have blown through all the CREZ improvements," George Hardie, vice-president at Pattern Development, told an industry conference recently in Austin. "The CREZ programme has been an enormous success."

Yet while ERCOT continues to authorise power line additions and upgrades, most legislators in the state capital oppose another CREZ-type sweeping expansion — for cost and ideological reasons.

Baseload power producers in Texas do as well, fearing more wind will depress electricity prices even more, further undercutting their plant economics.

*Richard A Kessler*

— deals that currently make up about half of the wind market.

"You can't just lose 50% of your market," says Freeman.

## Not as easy as it seems

Most of the necessary fixes to the US grid are progressing, just nowhere near as quickly as the renewables industry would like.

To begin, RTOs need to speed up the construction of interconnectors between their networks, bridging what are known as the grid's "seams" to allow for more interregional trading of power. Inevitably, institutional inertia slows this process down.

"It doesn't take an engineer or a power-flow model to look at SPP and MISO's seam and determine there are projects to be built," says Casey Cathey, SPP's manager for operations, engineering, analysis and support.

"We're putting up artificial barriers," Cathey told a recent industry

## GRID CONGESTION



conference in Kansas City (*see panel*).

At the same time, the RTOs must continue expanding geographically, with about two-thirds of the nation's electricity load served by them today.

Since the emergence of modern RTOs two decades ago, this expansion has been fairly consistent, with MISO, for example, growing to include a four-state region along the Gulf Coast a few years ago.

Recent events, though, have not been encouraging. Earlier this year Xcel Energy, among the most pro-wind US utilities, shocked the industry by pulling its Colorado subsidiary out of talks to join SPP, citing uncertainty over costs.

In August, a push to expand California ISO to include more western states once again failed to pass in the state's legislature, despite the strong support of the governor and a glaring need to find new markets for California's surplus solar and wind power. Opposition stemmed in part from fears that the state would have to cede control over its energy market to more conservative and coal-friendlier Western states — or, worse, to Donald Trump's federal government.

For consumers and many utilities, RTOs bring obvious benefits — from better price transparency and beefed-up cybersecurity to the cheaper integration of renewables. By 2020, Iowa utility MidAmerican Energy will generate enough wind and solar power

to meet 100% of its load, a feat made possible by its integration within MISO.

Bigger RTOs allow project developers to tap distant markets without having to pay multiple grid tariffs — a perversion known as transmission “pancaking”.

For some utilities, however, the case for joining an RTO can be complicated. “RTO integration is a sea change for any entity — it impacts the culture of a company, it impacts the skills and technologies required,” Pat McGarry, managing director at consultancy Energy Authority, told the Kansas City conference.

Several other factors may also be giving utilities and states cold feet about signing up to RTOs. One is uncertainty over how markets will be reshaped to accommodate distributed-energy resources and storage. Another is the growing divergence of state-level energy policy — even in ostensibly like-minded regions such as New England.

## Distribution seams

The utility-scale renewables sector is concerned about bulk transmission, but the tougher challenges arguably lie at the distribution level — effectively an entirely separate grid.

While not perfect, the RTOs and ISOs that operate the high-voltage grid in most parts of the country are non-profits without any intrinsic conflict of interest with renewables.

On the other hand, many distribution-level utilities have “a financial model that runs contrary to high penetrations of renewables”, namely behind-the-meter solar, says Kerinia Cusick, co-founder of the Center for Renewables Integration.

“We’re actually seeing more pushback at the distribution level than from the RTOs and ISOs,” Cusick tells *Recharge*.

More investment is needed to stitch together the “seams” between various RTOs, Cusick says, “but the seam we see being a greater challenge is actually between the ISOs and the distribution utilities”.

## Potential solutions

For wind developers in the Great Plains, nothing has looked more like a potential silver bullet than the crop of HVDC transmission projects that arose over the past decade, led by Houston-based developer Clean Line.

HVDC technology itself is not in question: though too expensive for use over short distances, such lines pay for themselves over longer routes through their very-low power losses — making them an increasingly popular means of transmitting vast amounts of renewable power in places as diverse as China, Brazil and the North Sea.

Just a few years ago, the US seemed on the cusp of an HVDC boom. In 2016 the energy department formally backed Clean Line’s 4GW Plains & Eastern project, which would have brought low-cost energy from Oklahoma’s “wind alley” to the Southeast. The 720-mile (1,200km) project was even included on a list of high-priority infrastructure projects circulated by Trump’s transition team in the run-up to his inauguration.

Yet here, too, recent events have been troubling. Last year the wheels came off Plains & Eastern, with Clean Line apparently struggling to find off-takers in the Southeast — which has become a hotbed of solar development in recent years.

One portion of Plains & Eastern was sold to NextEra, and Clean Line has since retrenched around a single project — the 4GW Grain Belt Express originating in Kansas, whose future also remains uncertain.

Big transmission projects take many years to develop, and in the meantime energy technologies and markets

change quickly, says Desai, who served as Clean Line’s chief operating officer before leaving this July to join ConnectGen.

“When we started as a transmission company, solar was far more expensive and storage wasn’t even on the map,” he says. “Eight years later, it’s a completely different market.”

The biggest wild card for renewables on the grid is battery storage, whose costs continue to drop — and possibly, the emergence of thermal storage technology.

Cheap enough batteries or thermal storage could, for example, allow a wind farm owner to store its output until grid congestion clears, then sell at a better price.

On the other side of the grid, an energy user could store power at times of cheap or even negative pricing, then discharge it as prices come up. At a large enough scale, such concepts could prevent or delay the need for some new transmission lines altogether.

What some perceive as dysfunction in wholesale markets is actually a useful price signal for storage, says Kerinia Cusick, co-founder of the Center for Renewables Integration.

“People refer to negative pricing as the energy-storage happy hour — everybody come on up, and get your free power,” Cusick tells *Recharge*.

“Price signals are part of the solution” in markets like ERCOT, the grid operator for most of Texas, where the lack of a capacity market means wholesale prices can shoot above \$1,000/MWh at times of extreme demand. “Those prices encourage

energy storage to be there so it can discharge and get compensated at those high levels,” Cusick says.

More ominously, the promise of cheap storage could create enough uncertainty to hold back transmission investment when it is desperately needed. Taken to an extreme, the pairing of behind-the-meter solar and storage could undercut the need for utility-scale renewables projects.

The reality is there’s no one answer to the challenges renewables face on America’s grid. That’s a bad thing in the sense that there’s no clear-cut finish line to run towards, no single policy for the industry to rally behind, like the federal tax credits in the past.

But it’s a good thing in the sense that broad progress will continue almost inevitably, even if it stalls in one particular area.

“If you ask me to paint the picture on how the problem gets solved, I couldn’t do it,” Pete McCabe, chief executive for onshore wind at GE Renewable Energy, tells *Recharge*. “But I feel optimistic.”

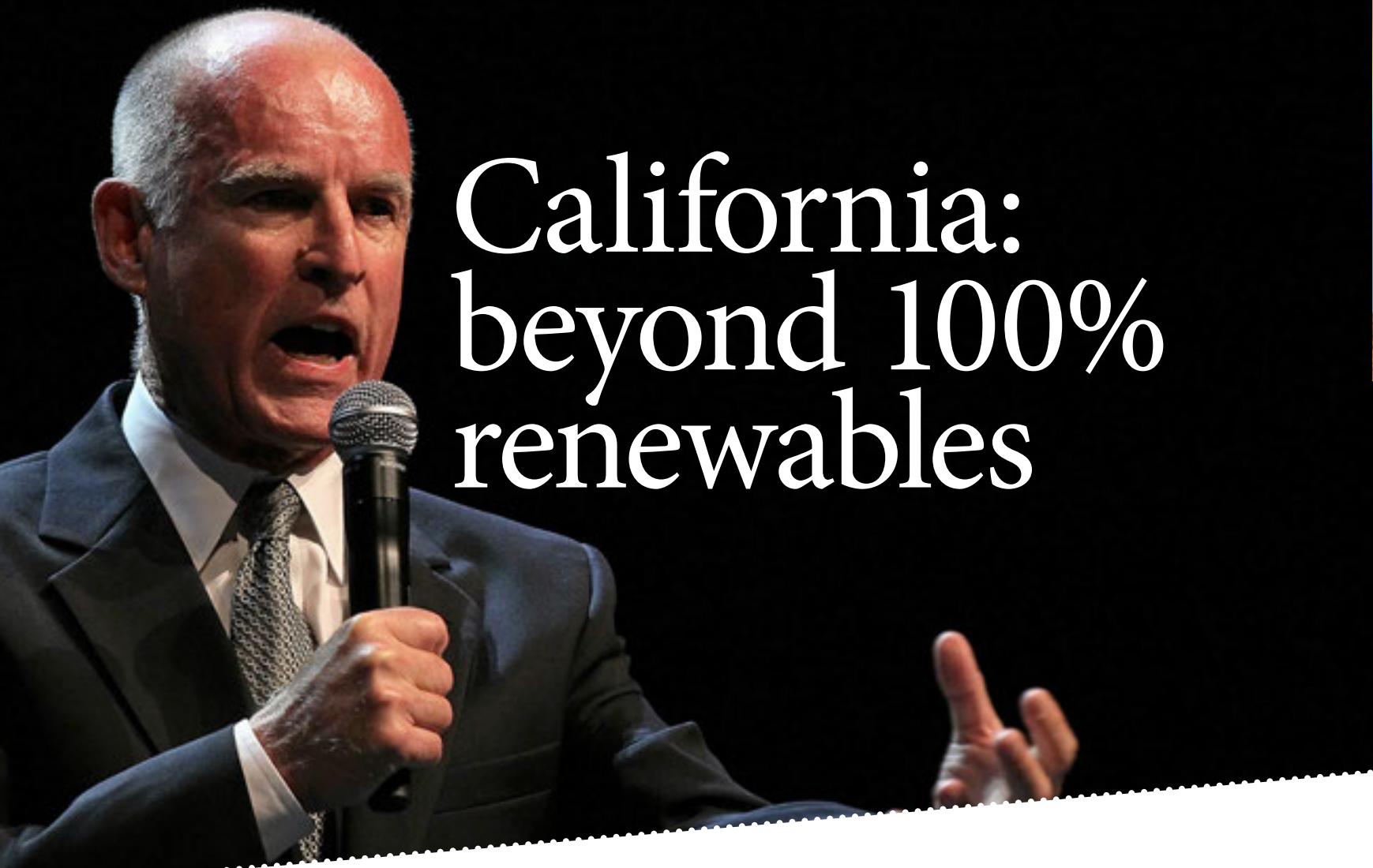
He points to the big transmission lines that would have been built to accompany the 2GW Wind Catcher project in Oklahoma, which hit the buffers this summer under regulatory delays.

“I don’t know that the industry is ready to give up on those kinds of things,” McCabe says. “I’d expect that you get a handful of those, and you get some more storage out there, and you’re in good shape.”

He adds: “You’d love for the government to help. But to be perfectly honest, I’m not counting on that.”

**ELECTRIC POWER:**  
Lightning strikes at an unidentified distribution station. Top left: a planned line fault test at the Ben-Hay HVDC transmission line in New Zealand; bottom left: turbines near the community of Nolan, Texas, which is surrounded by wind farms. Inset: Kerinia Cusick





# California: beyond 100% renewables

California passes law for 100% carbon-free power by 2045, but the next governor is likely to raise the bar further, writes John Anderson in Santa Clara

Last month, California passed its most ambitious renewables mandate yet. Senate Bill (SB) 100, recently signed into law by Governor Jerry Brown, requires the state to obtain 100% of its retail electricity from carbon-free sources by 2045. It sets one of the nation's strongest clean energy goals, while further bolstering California as a global leader on emissions reduction.

"SB 100 is among the most consequential energy policies adopted in the United States," David Hochschild, California energy commissioner, tells *Recharge*. "By setting the fifth-largest economy in the world on a path to 100% clean energy by 2045, the governor and the legislature are sending a powerful message that the electric grid will be the backbone of our clean-energy economy."

California follows Hawaii, which last year became the first US state to commit to carbon-free energy. But as the most populous state, the move by California will make a larger impact on the renewables industry,

while spurring greater investment. And while the mandate is certainly monumental for a state and economy of its size, California has been on a steady path towards a non-carbon future since 2002, creating regulatory certainty and thus a stable and predictable business environment along the way. The state has often met emissions and renewables targets ahead of schedule, and currently draws over a third of its energy from renewables.

SB 100 moves the previous goal of 50% electricity from renewables from 2030 to 2026, with a new 60% requirement by 2030.

"We will certainly be scaling up our work to ensure that the regulatory process for SB 100 is as friction-free as possible," says Hochschild. "In addition, we'll continue to advance clean-energy technology development through the Epic [Electric Program Investment Charge] R&D program, that the Energy Commission administers." Epic has so far funded projects on microgrids and renewables forecasting.

When asked if the new mandate will favour any particular type of renewable energy, Hochschild adds: "Diversity of renewables is very important, and so we expect over time many technologies to participate, including new technologies such as offshore wind."

It should be noted that the wording of SB 100 calls simply for "carbon-free" energy by 2045. That flexibility allowed the bill to receive widespread support among otherwise opposing stakeholders, but opens the door for energy sources such as hydro, nuclear power and natural gas with carbon capture and storage (CCS).

Perhaps the biggest impact of the 100% renewables mandate is the effect it will have on other states or countries with similar ambitions, setting a new bar for other governments to match. California has long led on issues of renewable energy and carbon emissions in a role it often relishes. Or as former governor Arnold Schwarzenegger recently tweeted: "I am endorsing #SB100. To the Legislature: We are Californians.



We don't wait. We build the future economy here."

At the signing of SB 100, Brown announced an executive order for the state to reach carbon neutrality also by 2045, upping the previous goal of reducing carbon emissions to 80% below 1990 levels by 2050.

The order could be rescinded by the next governor after Brown leaves office in 2019.

However, that seems highly unlikely if current lieutenant (ie, deputy) governor Gavin Newsom wins the election in early November. He holds a 12-point lead over his Republican rival John Cox, according to September polls. Newsom's positions on renewables are even more progressive than his predecessor, though it's a thoroughly safe political stance.

According to a survey from the Public Policy Institute of California, a majority of the state's voters support higher standards on fuel emissions, while over 70% say California's global leadership on climate issues is important to them.

And if renewable-energy stakeholders are worried the state may cave under pressure from the Trump administration and loosen its regulations around emissions and carbon-generated energy, over 60% of voters want the state to set its own policies with issues touching on global

warming, separate from the federal government.

Newsom has vowed to do just that, previously stating that his first day in office will include a directive putting California on the path to 100% renewables. And he's also pledged to go beyond that goal and make California a net exporter of clean energy to other states and countries, promoting it in part as a source of revenue for the state.

"We will continue to diversify our energy supply, increasing our output of green alternatives like solar, wind, geothermal, hydro and ocean-based energy, all the while improving our energy efficiency through stronger green building standards, construction codes and efficiency standards for electronics and appliances," Newsom says in a statement.

With the transport sector accounting for 40% of greenhouse gas emissions, Newsom plans to modernise and electrify the state's transit systems and enormous ports. As part of that, he'll also set a goal of zero diesel pollution by 2030, while upholding Brown's current goal of five million zero-emission vehicles on California's roads by 2030.

All of these measures and the rapid growth of electric vehicles will add enormous demand on California's energy system. Though he didn't offer

specifics, Newsom stated he'll turn to the state's tech sector in Silicon Valley and elsewhere to come up with solutions for a modernised, reliable grid that integrates renewable energy and electrified transport. On that front, he plans to launch the California Advanced Research Projects Agency-Energy (CARPA-E), modelled on the innovative federal agency ARPA-E, to research and develop next-generation energy solutions.

For Newsom to achieve his vision of exporting clean energy, he's stated he'll push for a regional grid idea that the state has been debating for several years, and was strongly advocated by Brown.

By linking with neighboring states, the renewable energy that California is forced to curtail during peak hours — over 270GWh so far this year — could more easily be sold throughout the region. Others believe more distributed energy resources, storage and microgrids are the best way to accomplish the flexibility required of an energy system heavily reliant on renewables.

Whether California pushes for grid regionalisation remains to be seen. But the changes to its energy system in the years ahead will be watched closely — and imitated — by states and regions throughout the country and beyond. R

**THE GOLDEN (AND GREEN) STATE:** Clockwise from far left: California governor Jerry Brown, whose term of office runs out on 7 January 2019; a rainbow follows a storm over an old wind farm in Palm Springs; Gavin Newsom, California's current lieutenant governor and the strong favourite to become the next governor, plays with an electric-vehicle charger; solar panels on top of Los Angeles' Staples Center, the home of the city's two basketball teams, the Lakers and the Clippers

# ANOTHER SELF-INFILCTED WOUND?

A three-year hiatus on renewables procurement and new coal-fired capacity could spell disaster for a sector that had only recently got back on track, writes Andrew Lee



**S**outh Africa's renewables sector hopes intensive lobbying can persuade its government to avoid another self-inflicted policy wound, just when it seemed the country's clean-energy ambitions were back on course.

The South African wind and solar industries fear a three-year renewables procurement gap proposed in a draft version of the government's Integrated Resource Plan (IRP) could seriously undermine supply chains already rattled by a policy-related market lockdown that was only lifted earlier this year.

The issue risks taking the gloss off an IRP — South Africa's overarching ten-year road map for matching power supply and demand in 2020-30 — whose headline figures look highly favourable for the renewable energy sector and were widely welcomed when the draft document was unveiled in August.

The draft IRP foresees 8.1GW of additional wind power and 5.67GW of new PV in the next decade. By 2030 that would bring the two renewable

sources to 11.44GW and 7.96GW respectively, and a projected 25% combined share of South Africa's total power fleet by capacity. The draft IRP also kicked into touch South Africa's new-build nuclear programme, marking a decisive break by newly appointed President Cyril Ramaphosa with the energy policy of his predecessor, Jacob Zuma.

However, examination of the proposed timetable soon set alarm bells ringing over the Department of Energy's suggestion that no procurement of renewables would take place in the three years covering 2022-24, with the additional wind and solar capacity taken forward only in the final five years of the decade.

Commentators told *Recharge* the prospect of another halt to procurement is the last thing the wind and solar supply chains need. They are only just preparing to ramp back up again after the three-year stand-off with state utility Eskom that froze the market when it refused to sign power-purchase agreements

(PPAs) previously awarded under South Africa's Renewable Energy Independent Power Producers Procurement Programme (REIPPPP).

Eskom's intransigence seriously dented international investor confidence in the South African renewables programme until Ramaphosa's newly appointed energy minister, Jeff Radebe, ended the impasse and swiftly ensured signing of the PPAs soon after the new government took power in early 2018. Radebe's action unblocked about 2.2GW of mainly wind and solar projects and billions of dollars worth of investment. His subsequent announcement of a new 1.8GW REIPPPP procurement round scheduled for November appeared to confirm the good times were back for South African renewables.

The South African Wind Energy Association (SAWEA) fears the procurement hiatus contained in the draft IRP means the sector would effectively run out of steam again, once the crop of projects

## THE RIGHT DIRECTION?

South African president Cyril Ramaphosa. Opposite page from top: Energy minister Jeff Radebe; Eskom's Hendrina coal-fired power station in eastern South Africa; Nordex turbines in South Africa

commissioned under the current REIPPPP awards have worked their way through to commissioning over the next three years or so.

Along with others in the renewables lobby, it hopes the 60-day consultation window that opened after the publication of the draft IRP can be used to show Radebe and his officials the perils of the plan as it currently stands and persuade them to change it — or risk undermining the industrial benefits wind has already brought to the economy via the 2.1GW installed by the end of 2017.

"Boom and bust procurement can be very damaging to the development of a localised supply chain," SAWEA tells *Recharge* in a statement. "Attracting investors — whether domestic or international — requires reasonable certainty of a pipeline or demand."

Independent industry analysts agree that a three-year hole in activity would spell trouble for the South African sector — and potentially for the overall renewables capacity ambitions set out in the IRP.

"A three-year gap period for wind power would cause commercial losses for local manufacturers, particularly those with limited export opportunities," says Sohaib Malik, an analyst at consultancy Wood Mackenzie. "Moreover, as more and more governments compete over international capital to support renewable-energy development in their countries, international investors, who have contributed substantially to the success of South

Nuclear may have vanished from South Africa's plans but coal remains centre stage, and will still account for 46% of South Africa's power fleet by capacity in 2030 under the scenario set out in the draft IRP document. Coal capacity dominates the installed generation fleet of financially troubled Eskom — accounting for 36GW out of 43.5GW in 2017 — and coal mining is a major employer and source of exports for South Africa, with all the political sensitivities that creates.

Malik points out that the IRP proposes adding 6.7GW of new coal capacity between 2019 and 2024 — time that he argues would be better spent "optimising the benefits of renewable energy and improving the overall economic stability of its electricity market".

As it stands, the bad and worsening economics of coal-fired generation compared to ever-cheaper renewables mean the inclusion of new capacity in the IRP will add 20bn rand (\$1.35bn) of unnecessary costs for consumers, according to calculations by Greenpeace Africa.

Chris Ahlfeldt, a South African energy specialist for consultancy Blue Horizon, tells *Recharge* that Eskom needs reforming by the government to allow it to focus on managing the grid rather than generation.

In any case, according to Ahlfeldt, Eskom will increasingly be forced to recognise the interests of bill-payers by prioritising renewable IPP projects that are producing some of the cheapest power on the market.

"In addition, the smaller-scale distributed generation market projects are continuing to grow rapidly, especially for solar PV as more customers are opting for less expensive rooftop solar solutions to reduce their risk exposure to Eskom's rising tariffs," he says. "This trend is expected to continue, especially as battery prices continue to decrease."

SAWEA, which told *Recharge* it began work on a "strong submission" over the procurement gap issue as soon as the draft IRP was published, adds: "We are reasonably hopeful that government will recognise the need to urgently reassess the assumptions that have resulted in the draft plan, particularly given the readily available evidence of the many socio-economic risks associated with a continued investment in coal."

The IRP is expected to be finalised in the first quarter of 2019. □



## II The inclusion of new coal capacity will add \$1.35bn of unnecessary costs for South African consumers

Africa's renewable-energy industry, may find the market less attractive.

"If the South African government does not introduce a concrete renewable power development plan to support market growth between 2020 and 2025, it may have difficulty in achieving its ambitious target of 14GW of wind and solar PV capacity from 2025 to 2030."

The root of the problem facing renewables in the early part of the next decade under the IRP as it currently stands can be summed up in one word — coal.

# Corporate buyers see the light in Brazil



Power from wind projects won at Brazilian tenders is increasingly being sold on the non-regulated market, which offers a better deal for both developers and their corporate off-takers, writes **Alexandre Spatuzza** in São Paulo

**G**overnment tenders have been the backbone of growth in Brazil's wind industry over the past decade, with their 20-year power-purchase agreements (PPAs) providing stable, healthy returns on investment. But after two years of economic and political crisis, this is no longer true: PPAs in the non-regulated market are becoming just as — or more — important in maintaining the momentum of the wind industry; it is a new landscape that developers, investors, off-takers and financiers will have to adapt to.

Almost all of the 48 projects — 1.3GW of capacity — contracted in the most recent tender on 31 August will only sell half (or even less) of the energy they generate to distributors on the regulated market. The remainder will be sold to corporate

buyers or on the spot market, in the so-called non-regulated market.

"This is something everybody was talking about and that now is becoming reality," says Giovanni Bosco Fernandes, executive director of project finance at the Brazil unit of Spanish bank Santander. "We advised several of these projects and are preparing financing for some of them."

Behind this trend is a rush by large and medium-sized businesses to buy the cheaper power in the non-regulated market. Even in the current economic crisis, monthly power bills have been rising by about 15% per year. For example, a business in the state of São Paulo large enough to opt into the non-regulated market — that is with demand equivalent to 3MW a year or more — pays between R\$400 (\$99)

and R\$700 per MWh in the regulated sector. By comparison, wind power sold on the non-regulated market is priced from R\$160-200/MWh.

"I am starting to see small businesses pooling together to buy power in the regulated market, but most are large industries such as paper mills, metal works and chemical companies that are coming back to the non-regulated market," says José Roberto Oliva, a partner at law firm Pinheiro Neto who specialises in the energy sector.

If opting for the non-regulated market is advantageous for off-takers, for generators it's a mixed blessing. The upside is that it is a chance to shun the low prices on offer at the government tenders. In the August A-6 tender for example, wind power was sold at record low prices of R\$90.45/MWh, with 20-year

PPAs to large investor-grade power distributors. The two main reasons for the low prices were the competition from the 25GW of projects and low demand projection from power distributors.

But the downside is that non-regulated market contracts are not as long and off-takers do not have such good credit ratings. Tenures are much smaller, ranging mostly from four to seven years, although there is talk within the industry of non-regulated market PPAs edging up to ten or 15 years.

But rather than adopting an all-or-nothing approach, generators are splitting their energy between the regulated and non-regulated markets, calculating that they would complement each other and guarantee strong returns.

The strategy of mixing these two kinds of contracts became more apparent in the tiny A-4 tender held in April this year when French utility EDF Renewables secured a deal for a 114MW project at a record low price, reserving around half the power for the non-regulated market.

"We developed this new strategy

when we weren't successful in the 2017 tender [in April]," Paulo Abranches, Brazil country manager at EDF Renewables, told *Recharge*.

So EDF repeated the same strategy in August's A-6 tender — reserving around 50% of the power for the non-regulated sector — and its lead was followed by five of the seven bidders.

Only Rio Energy — Denham Capital's renewables arm in Brazil — and Elecnor's Enerfin sold 100% and 90% respectively of the available power to the regulated market in this tender, although this doesn't mean they won't seek bilateral contracts, a source from one of the companies told *Recharge*.

The most aggressive in the split strategy were Brazilian developer Casa dos Ventos and China State Grid-controlled CPFL Renováveis: both sold only 30% of the power to the regulated market. Others allocated 40-50% of total power available for the regulated market in this A-6 tender.

As winners have six years before they start supplying to the grid,

several of them are planning to kick off commercial operations in two or three years so they can sell their energy to their non-regulated off-takers and on the spot market, where prices are even higher — around R\$300/MWh on average and, in some weeks, peaking at R\$800/MWh when there is a scarcity of hydropower.

France's Voltalia, for example, said it will start operating the 115MW it contracted in 2021, three years ahead of the 2024 PPA start date. Casa dos Ventos also said it would start the 33.6MW São Januário wind farm in 2020 and the 58.8MW Santa Martina in 2021.

Most of the projects are extensions of existing complexes, so will be able to use existing electrical infrastructure and grid connections, significantly reducing construction costs.

## Financing

Although this all makes sense commercially, there is still the problem of financing the projects.

Since the start of Brazil's wind industry in 2009, the National

**BRIGHT IDEA:**  
A light bulb with a filament shaped like the outline of Brazil; the 27MW Xangri-lá wind farm, which was built by Japanese car maker Honda to supply power to its assembly line in São Paulo; Inset: José Roberto Oliva



**CONCRETE PLANS:** EDF Renewables' Ventos da Bahia wind farm, which will be expanded to incorporate new capacity won at tender this year; *below:* the depleted reservoir at Brazil's Funil hydro plant — when water is scarce, spot market prices rise, offering higher returns for wind farms on the non-regulated market



Development Bank (BNDES) has financed most of the R\$60bn invested so far. The 16-year loans, with a two-year grace period, are granted after the confirmation of guarantees from project sponsors based on solid, long-term PPAs from the regulated-market tender, where the off-taker is a recognised power distributor with a consolidated consumer base and very good risk ratings.

So that begs the question: will 30-50% of the power from a wind farm be enough to raise the roughly \$2m per megawatt needed to build the project?

Probably not. The BNDES has said it is ready to finance projects in the non-regulated market, but the amount financed and the cost of the loan will vary according to the quality of the off-taker and the PPA.

"This is uncharted territory, it's not been done before in Brazil and financing will be studied case by case depending on how much will go to each market and the difference in tenures," says Fernandes.

With BNDES financing and regulated market PPAs including inflation, double-digit returns on investments used to be the norm, but now this may not be the case.

In a one-day seminar promoted earlier this year by the Brazilian wind-power association, ABEEólica, bankers, financiers, developers and power traders discussed the issue and identified the two biggest hurdles for non-regulated market projects as the length of the contract and the quality of the off-taker.

Due to the shorter nature of non-regulated contracts, developers will have to manage several contracts, probably setting up a commercial back office to ensure constant renewal or replacement of expiring PPAs, specialists say.

But there is another inherent risk, because spot market prices are much more volatile. If prices surge when there is a scarcity of water, the opposite is true when reservoirs are full, with spot market prices falling to under R\$50/MWh for weeks on end.

There are also other complex contractual issues that need to be ironed out, including how to guarantee supply when the wind is not blowing, and other more technical details. All of this points to higher financing costs, says Oliva.

So far, none of the tender winners have identified their off-takers in the non-regulated market, an important



part of the equations for closing financing.

Casa dos Ventos, for example, held a private tender for wind power days before the A-6 process. But it has kept quiet about who bought the power and how much was actually sold. Abranches declined to comment on the company's non-regulated market contracts.

Voltalia said in a release it will sell the power in the non-regulated market but also didn't disclose to whom.

CPFL Renováveis, by contrast, invested in a non-regulated wind project in 2016, which was financed by the BNDES, but the off-taker was its sister power-trading company CPFL Brasil. The developer may also be doing the same for the 69MW project it won in August.

This could also be a solution for EDP Renewables' 428MW contracted at the tender, since Portuguese utility EDP also controls large power distributors in Brazil.

Oliva points out that in addition to the traditional off-takers, there is a growing interest by large industrial groups to become equity shareholders

in wind projects in order to supply power to their own factories.

"These large industries used to invest in large hydro projects and are now investing in wind, not only because they want to have cheap power, but because they have to comply with sustainability requirements for clean power in the statutes," he adds, declining to name possible investors.

On the other hand, for OEMs Vestas, Siemens Gamesa, GE and Nordex Group — said to be the largest winners in this tender — closing the financing equation is no small matter. Until now, they have been producing 2-3MW models, but have been offering newer 3-4.8MW machines in Brazil.

If financing is secured on these projects, and many orders are placed for the larger turbines, the manufacturers will then upgrade their local factories, as well as their transport logistics, to fulfil the orders — a move that would require major investment. Their suppliers may also have to adapt their own plants to build larger components.

So not only are OEMs looking at the quantity, but also the quality of the projects' financing, to ensure that

developers will definitely have the funds to make their purchases.

For Renato Mendes, partner at the Thymos Energia consulting firm, comfort is taken from the names of the contract winners. Most are large groups with access to cheaper, foreign capital: EDF Renewables, EDPR, Voltalia, Rio Energy and Enerfin, while the two Brazilian companies are among the biggest local players in renewables: CPFL Renováveis and Casa dos Ventos.

"These companies are large enough to back these projects if they need to," he says, indicating that he believes that not only will they obtain the financing in the end but that the projects will start construction before they close financing for the project, or if only part of the project is financed.

The coming weeks and months will reveal if Brazil's wind industry has managed to wean itself off government contracts and diversify into the uncharted territory of non-regulated market contracts and financing.

Fernandes, for one, is optimistic. "There's no reason not to finance a good project," he says. □

**'CASE BY CASE':**  
Dyogo Oliveira,  
president of the  
BNDES, which  
is having to  
re-evaluate its  
policies due to the  
rise of the non-  
regulated wind  
market

**ENERGETIC:**  
WindEurope chief executive Giles Dickson gives an emphatic speech at our Thought Leaders Summit in Hamburg, as Recharge editor-in-chief Darius Snieckus looks on. Below: Rasmus Nedergaard, founder of corporate renewables advisory firm, Act Renewable, speaking at the invitation-only summit



# RECHARGE THOUGHT LEADERS SUMMIT

## HAMBURG | 2018



**R**enewables can't take their future dominance of the global energy sector for granted in the face of protean political opposition, ongoing pressure on costs and unanswered questions about variable output.

That was among the central messages from the annual invitation-only Recharge Thought Leaders Summit, held in Hamburg on the eve of the Global Wind Summit. The event brought senior figures from wind, solar and other renewables sectors together with developers, financiers and policy experts to discuss the key issues facing

the energy transition, and what *Recharge* editor-in-chief Darius Snieckus described as its three main drivers —

“digitalisation, decentralisation and decarbonisation”.

The event, held under non-attributable “Chatham House” rules, heard several delegates warn that despite its spectacular growth of the last few years, the renewables industry must work harder than ever to carry political and public opinion with it.

Well-organised opposition to clean-energy projects and grid infrastructure, and a growing number of populist politicians willing to fuel it, were flagged up as increasing threats to renewables, which were advised to fight back by stressing jobs and other economic benefits.

The role of “national champions” in bringing governments onside with renewables was highlighted by



one delegate, who noted how the involvement of Shell in the sector “totally changed the dynamic of the discussion” around offshore wind in the Netherlands.

There was plenty of discussion of how innovation can help renewables answer ongoing concerns about variable output. One delegate said storage represents the “missing link” of renewables but would need bold technical solutions for large-scale deployment — and, for a while at least, subsidies. Another explained how hybrid plants can use multiple generation sources to make maximum use of expensive transmission investments. “We’ve only scratched the surface [of hybridisation],” the speaker said.  *Andrew Lee*

Photography | John Macdonald-Fulton/Recharge

## The speakers

Welcome

**Claus Ulrich Selbach**

Business Unit Director | Hamburg Messe

**Giles Dickson**

Chief executive | WindEurope

**Ditlev Engel**

Chief executive | DNV GL - Energy  
“Energy Transition Outlook 2018”

**Philippe Kavafyan**

Chief executive | MHI Vestas  
“Offshore Wind: Global Engine of the Energy Transition”

**Danielle Merfeld**

Chief technology officer | GE Renewable Energy  
“How Technology Innovation Will Drive the Energy Transition”

**Henrik Stiesdal**

Founder | Stiesdal AS  
“Maximising the global wind build-out with energy storage”

**Stefan Degener**

Managing Director | First Solar GmbH  
“The Impact of Dispatchable PV”

**Gunnar Groebler**

Senior vice-president, wind | Vattenfall  
“Green steel and concrete”

**Rasmus Nedergaard**

Founder | Act Renewable  
“Renewables-Powered Multinationals: What’s Required to Succeed”

**Jan Röfer**

Head of business development, grids | Siemens  
“DC Grids in the Energy Transition”

**Ed Hesse**

Founder | Energy Web Foundation  
“Next-Wave Blockchain”

**Peter Müller-Brühl**

Chief operating officer | GreenCom Networks  
“Energy will be free, so the business is in services”

**Adam Rasheed**

Chief product officer | Sentient Science  
“Where Next for Digitalisation in the Energy Transition?”

**Oliver Riedel**

US Managing Director | Innogy Consulting  
“The New American Utility”

**Jan-Christoph Hinrichs**

Head of R&D | Aerodyn  
“The Coming Two-Bladed Turbine Revolution”

**Karl Ove Ingebrigtsen**

Director, Low Carbon Power Generation | Lloyds Register  
“Subsidy-Free Future: Cutting The Cost Offshore Wind on a Global Scale”

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Hamburg  
The global on & offshore expo



The global on & offshore conference





Photography | John Macdonald-Fulton/Recharge

## Off the record and on the level

1) MHI Vestas chief executive Philippe Kavafyan; 2) DNV GL Energy chief executive (and former Vestas boss) Ditlev Engel; 3) Lars Bondo Krogsgaard, co-chief executive of MHI Vestas; 4) Adam Rasheed, chief product officer at digitalisation experts Sentient Science; 5) Oliver Riedel, US managing director at Innogy Consulting; 6) chief executive of Vattenfall Wind, Gunnar Groebler; 7) Danielle Merfeld, chief technology officer at GE Renewable Energy; 8) Stefan Degener, managing director of First Solar; 9) Peter Müller-Brühl, chief operating officer at Internet of Things specialist GreenCom Networks; 10) Anders Rebsdorf, director

of Envision Energy's Global Innovation Centre; 11) Jeremy Sainsbury, director at renewables consultancy Natural Power; 12) Karl Ove Ingebrigtsen, director, low-carbon power generation at Lloyds Register; 13) Jan-Christoph Hinrichs, head of R&D at wind turbine designer Aerodyn; 14) Wind power pioneer Henrik Stiesdal, chief executive of Stiesdal AS; 15) Jan Röfer, head of business development, grids, Siemens; 16) Dana Younger, chief renewable energy specialist at the World Bank's International Finance Corporation; 17) R V Ahilan, joint group chief executive at marine and engineering consultancy LOC Group, as Goldwind's

Wei Ling looks on; 18) Claus Ulrich Selbach, business unit director, Hamburg Messe (WindEnergy Hamburg); 19) Bruce Douglas, chief operating officer at SolarPower Europe and chairman of the Global Solar Council makes a point; 20) Ed Hesse, founder of the non-profit Energy Web Foundation and chief executive of distributed-energy blockchain services provider Grid Singularity (*left*), in discussion with Konstantin Staschus, secretary-general of Europe's transmission system operator association, Entso-E, over lunch; 21) The conference room at the Literaturhaus cafe in central Hamburg, an early 19th-century villa overlooking Lake Alster.



# 'Nothing is a given — we have to fight for every new turbine'

GILES DICKSON



Giles Dickson is chief executive of WindEurope

Is there anything inevitable about the further expansion of renewables? You've all seen the charts that show us rising to 55% of Europe's power mix by 2030 and 80% by 2050. You will have read the reports that say we can help electrify heating, transport and industry. You see the amazing numbers in the International Energy Agency (IEA) *World Energy Outlook* each year that show a trebling if not quadrupling in wind and solar output.

And yes, it's tempting to think we are riding some unstoppable wave. Hell, we're the cheapest. We bring energy security. Loads of jobs. Our technology is getting more powerful and efficient. Storage and demand response are going to solve our system integration issues. And all the opinion polls show people want more renewables.

But let's step back and look at the reality out there.

In Germany, the rate of successful permit applications for wind farms is 70% down on two years ago. And new solar installations are running well below the government's own target.

Across Europe, hub height, tip height, distance rules and radar regulations are making it harder to develop wind projects. And we're set to lose 4-6GW of existing wind in Europe over the next five years, because the sites cannot be extended or repowered.

The European supply chain (at least we still have one in wind) is under huge pressure from low auction prices and Chinese competition. Two years ago, the gearboxes in Europe's new wind turbines were 100% made in Europe. Today, 50% come from China. Outside of Europe we still beat the Chinese in quality and often on price. But we lose every time on the terms of finance.

And let's go back to public opinion. Local opposition to new renewables is better organised and funded. Not to mention the opposition to the grid investments we need.

Okay, but isn't there a higher political consensus around renewables now the EU has agreed a 32% share of the energy mix by 2030? Well, let's hear what our mainstream politicians are saying...

"I used to think Russia was the

**AGAINST THE WIND:** Parliamentarian Jens Köppen wants a moratorium on wind farms in Germany, where the rate of successful permit applications for projects is already 70% down on two years ago



bigger threat to energy security in Europe. Now it's the rising penetration of intermittent renewables." That was Álvaro Nadal, Spain's then energy minister, at last year's IEA ministerial meeting in Paris. He is out of power now, but his party has far more seats in parliament than the current minority government.

"There should be no new wind farms built in Germany for the time being." That's Jens Köppen, energy spokesman

I could also talk about the continued expansion of coal in Asia. But I think you've got the answer to the original question. No, there is absolutely nothing inevitable about the further expansion of renewables.

Sorry, I don't want to depress you. But I want to impress on you the mindset we are trying to bring to the wind industry. Humility. Modesty. That nothing is a given. That we have to make a huge effort to carry people

with us. To show people we will reduce their energy bills. That they'll still have power on dark, windless days. That we bring local jobs and growth to non-metropolitan areas in our societies that feel the most left behind by globalisation.

And if we do manage to keep expanding, then don't forget the physical reality of all the land and sea we're going to be occupying. And all the other economic and societal interests that depend on that space and are going to feel threatened by us. Fishing, shipping, the military, biodiversity.

Happy co-existence is what we call it in our industry. But again, it's only with modesty and humility that we will achieve it. And with a clear recognition that nothing is inevitable — and we have to fight for every new turbine and panel. ☐

## There are major political forces out there now that really do not like us

in the Bundestag for the ruling Christian Democratic Union (CDU), speaking a few weeks ago.

And then of course there are the populists. For most of them, renewables are part of the modern, global liberal order they're attacking. There are exceptions, such as Five Star in Italy. And many US states are minimising the impact of Donald Trump. But there are major political forces out there that really do not like us. And even if we keep them out of power, they are contaminating policy in the mainstream parties, as we've seen in the CDU.



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**NOT ON MY WATCH:** Chairman Teruo Asada, pictured at the Eastern Economic Forum in Russia last month, is leading Marubeni's march away from coal



# Japanese giant turns its back on coal



## Current state

### Key



Positive for renewables



No change



Setback for renewables

CHRISTOPHER HOPSON

Japanese conglomerate Marubeni says it will not build any more coal power plants, and plans to halve its ownership in 3GW of coal-fired energy assets by 2030. "As a general principle, Marubeni will no longer enter into any new coal-fired power generation business," the giant trading house says.

It will also deploy innovative technologies to increase the efficiency of its portfolio assets and reduce its environmental impact.

The goal will be achieved by selling or transferring some of its coal-fired power assets and by not renewing contracts when they expire, said a spokeswoman, quoted by Reuters.

But Marubeni added that it might still consider pursuing coal-fired projects that adopt the best available technology

and are compliant with government policies, leaving leeway for new deals.

The move is one of the biggest stories of 2018 in terms of the transition away from fossil fuels.

Marubeni had continued investments in coal even as it spent heavily on renewables. It owned more than 3.5GW of coal power plant in 2017, and had plans to build 13.6GW more, according to German NGO Urgewald.

The conglomerate, which has a total net power-generating capacity of about 12GW worldwide, aims to double the power it generates from renewables to 20% by 2023.

Foreign banks and financial institutions have put pressure on Marubeni and other similar companies to drop their coal-related investments by refusing to finance them. Other trading houses in Japan are also shifting their energy focus towards renewables. □

### Fossil fuel poised to peak

Global fossil-fuel demand will peak in 2023, resulting in a significant risk to financial markets with trillions of dollars of coal, oil and gas assets left worthless, according to a projection from the Carbon Tracker think-tank.

"Fossil-fuel demand has been growing for 200 years, but is about to enter structural decline. Entire sectors will struggle to make this transition," says Carbon Tracker strategist Kingsmill Bond.

The International Energy Agency and oil & gas firms mostly expect demand to peak in the mid-2030s.

### India salutes the sun



India is to target 40% of its electricity generation from non-fossil-fuel sources by 2030, to reduce its reliance on coal, says Prime Minister Narendra Modi (*pictured*).

Speaking at the first assembly of the 121-country International Solar Alliance (ISA), he said solar will play the same role that oil has played over the past few decades in meeting global energy needs. Modi describes the ISA as the "future Opec for meeting the energy needs of the world".

### Poles' coal goal

Poland aims to cut its electricity generation from coal-fired power stations to half of its energy mix by 2040, a senior government official says.

Reuters reports that around 80% of the country's power production is provided by coal now.

Renewables and nuclear will fill much of the gap when coal is cut, with gas-fired generation providing back-up.

Poland and Germany are jointly responsible for more than half of the EU's CO<sub>2</sub> emissions from coal.

### High standards



Standard Chartered will stop financing new coal-fired power plants to help meet its commitment to the Paris climate agreement.

The UK-based bank will not directly finance any new coal-fired power projects, including expansions, anywhere in the world. The decision "is a first step in a set of more substantive actions to which we are now committing, in order to understand the CO<sub>2</sub> emissions our financing supports", says chief executive Bill Winters (*pictured*).



# AN INVESTMENT IN KNOWLEDGE ALWAYS PAYS THE BEST INTEREST

*Benjamin Franklin*

**RECHARGE** has been reporting from the front lines of the renewables industry on five continents since late-2008 led by an editorial mission to bring depth and dimension to coverage of the news that matters, with the accent on analysis, opinion and relevant in-depth features.

Worldwide-webbed readers today access information in a medium where free is the norm. But pause and question the value of this 'news', especially in the speeding evolution

of the renewable energy industry, where only the 'what' is reported, not the 'why' not the 'how', not the market insight or intelligence.

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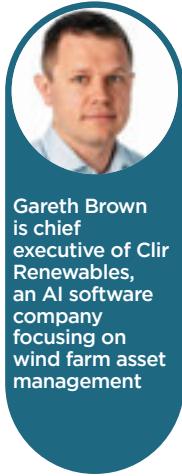


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# Turbine design standards have not kept pace with industry's growth

**GARETH BROWN**



Gareth Brown is chief executive of Clir Renewables, an AI software company focusing on wind farm asset management

The wind industry has grown incredibly quickly in a short period, from small turbines on Denmark's hillsides in the 1980s to the machines of today installed on every continent, with large offshore units now passing the 10MW threshold.

Yet there are still key challenges to ensure these assets perform to their potential.

Fundamentally, wind turbine performance is difficult to assess, because the inflow conditions are not well defined, and they are spread over sometimes hundreds of machines, all with varying inflow and operating states. The lack of understanding of inflow conditions means large variations of normal production performance hide underlying systemic issues from the owner's view.

The issue is compounded by an industry obsession with availability rather than performance, the application of a broad power industry supervisory control and data acquisition (Scada) structure that is not suited for wind farm performance management, and design standards that lag behind the pace of growth.

Leading-edge erosion of blades — an increasingly critical concern for the industry — has been difficult to address because of these issues. In particular, the rapid expansion of our sector means design standards have not kept pace. Wind turbine standards were developed over time and rely on information derived from smaller machines manufactured earlier in the industry's history. Learning from these small early units does not necessarily translate well to ultra-large modern turbines and the different environments in which they are deployed.

Turbines are now designed with less margin for error because we have better design tools and lighter, more advanced materials.

The problem is that the underlying assumptions of environmental conditions that drive loading are outdated. A 50-metre-diameter rotor had a lot of room in the design for error — after 20 years of operational life, you might be able to refurbish the blades, put in a new gearbox and



update the controller, and potentially enable the turbine to run for 15 more years. Can the same be said for a new 100-metre-diameter rotor built today that has been designed right to the operational edge?

Many turbine blades are suffering from early-life leading-edge degradation as they are much lighter, to enable larger sweep areas. There is minimum room for error in the manufacturing process or in the operational environment. Tip speeds on modern turbines have also increased with the growth in rotor diameter, leading to design standards that do not accurately consider the impact loads of rain droplets on leading-edge erosion at these higher speeds.

The good news is the issue has already been solved in aviation and our industry has started to take note, with some designs implementing the learnings in the manufacturing process.

For new and existing assets, the impact of leading-edge erosion can be monitored and measured through visual inspection and/or data science. The hard part of detecting leading-edge erosion in an automated manner is creating a statistically significant result from noisy data when the inflow conditions are not easy to infer.

However, we have seen some fantastic results in the industry as the latest data science, machine learning and artificial intelligence (AI) are being applied with the most up-to-date domain expertise.

It means wind farm data streams can be put in the context of the turbine's operational condition, along with inflow conditions and what drives them, such as atmospheric stability, wake effects and forestry, terrain and bodies of water.

If owners take advantage of more advanced data architecture and enrichment, the new forms of analytics, machine learning and AI have the potential to detect leading-edge erosion issues early. That leads not only to better-supported warranty claims — where erosion caused by poor design may be more difficult to separate from general wear and tear if the claim is made at the end of a service or warranty period — but also stronger evidence for a business case to support undertaking expensive repairs and retrofits.

The potential is huge for automation and AI to get the information to the industry's fingertips, driving up performance and managing technical risk. □

**ON THE EDGE:**  
The aviation industry has already solved the problem of leading-edge erosion, and the latest technology can show the way for wind turbine blade manufacturers



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# Energy network planners will have to embrace uncertainty

**EDWIN HAESEN**

To facilitate the energy transition and enable cross-border trade flows, European policies promote higher interconnection levels and more efficient use of capacity. Looking forward to 2030 and beyond, the continuing shift in the energy ecosystem highlights several challenges that require urgent consideration by transmission system operators (TSOs) and authorities.

Developments in decarbonisation, decentralisation and digitalisation — combined with the overarching goals of a reliable, secure and affordable energy system — bring specific threats and opportunities. Transmission planning is shifting from a simple development of assets to cover peak capacity towards the implementation of a smarter set of tools that allow the more effective use of existing assets.

The greatest uncertainty for system planning may not be technology innovation, financing or regulation, but the shift in energy consumption that Europe will face in the coming decades. The combination of decentralised renewables (PV, wind), local flexibility (smart meters, batteries), demand electrification for homes (heat pumps, electric vehicles) and industrial facilities (electromagnetic processing of materials, hydrogen feedstock), as well as gas phase-out creates huge uncertainty for planners of gas and electricity systems.

A study for the European Commission provides a pan-European inventory of all planned transmission expenditure in electricity, gas and large-scale storage up to 2030.

The expected pipeline from 2021–30 adds up to €229bn (\$263bn) of investment: two thirds on electricity transmission, 18% on gas corridors and the rest on pumped-hydro storage, underground gas storage and liquefied natural gas facilities. After 2023, the number of foreseen gas projects drops significantly, due to unclear profitability driven by uncertain demand.

However, across countries the trends differ strongly. Some see a strong need for gas-grid reinforcements based on security of supply and flexibility, while



Edwin Haesen is associate director at Navigant Research



others clearly expect a phase-out. Electricity transmission plans generally underline the need for more capacity. National annual expenditures on new and upgraded transmission will probably be much higher in 2021–30 compared to today (an average increase of about 29%), especially in Western Europe and the North Sea region.

TSOs have a legal obligation to provide national and pan-European development plans that look ten years ahead. Europe's system of Projects of Common Interest also provides the

Many 2040–50 studies have assessed the need for pan-European transmission capacity with high shares of renewables and the technical solutions such shares require for operational stability. However, the shifts in end-consumer demand remain difficult to project, ranging from lower demand based on energy efficiency drives to higher demand based on more electrification.

It is crucial that all stakeholders adopt a flexible, robust planning approach. For market actors in a specific country and market segment, the difference between early adopter and follower is often a matter of a few months or years. On the other hand, grid investments to enable more decentralised, digitalised and decarbonised demand and supply take much longer to materialise.

Uncertainty should not result in postponement — which increases the risk of grid access barriers in the long run. Planners must cover both short-term system needs, where economic viability and local stakeholder acceptance are key, and long-term needs, where shifts in the energy ecosystem must be well understood and innovation projects have to be well selected. There remains a need (and thus an investment opportunity) for transmission infrastructure to strengthen the internal market, support low-carbon energy solutions and provide security of supply.

## II The greatest uncertainty for system planning may be the shift in energy consumption

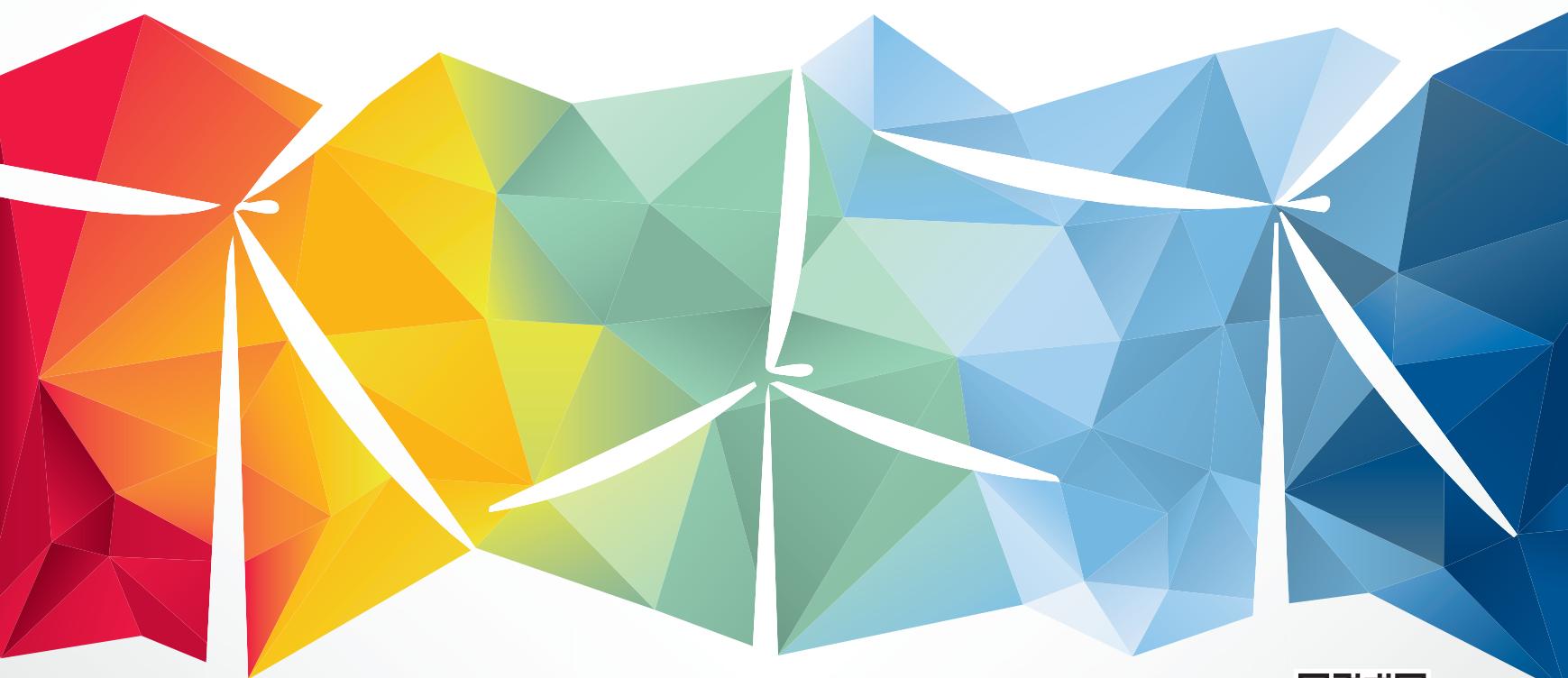
financial support of fast-track permitting processes mainly to projects with relatively short-term commissioning. Even with this time frame, projects face pushback because of public acceptance (overhead transmission lines) or for geopolitical and sustainability reasons (gas transit corridors).

For the existing gas system assets, long-term viability may depend on low-carbon solutions, including biomethane or hydrogen injection. It remains unclear what share of the present corridors would remain functional in such a scenario, or how many new investments will be needed.

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