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OFFICIAL SHOW DAILY

Global Wind Summit 2018

Produced by
RECHARGE | rechargenews.com

25 September 2018

**DAY
ONE**

‘Wind to be leading source of power in Europe after 2030’

BERND RADOWITZ

Wind energy could install more than 20GW per year from 2030-50 and cover 36% of Europe’s power generation by 2050 under an electrification scenario that is compatible with the Paris climate goals, according to a report unveiled today by WindEurope.

Under this scenario, the share of electricity in total energy consumption would rise from 24% today to 62% in 2050 — and 78%

of that electricity would come from renewables, says the study, entitled *Breaking New Ground — Wind Energy and the Electrification of Europe’s Energy System*.

“Wind is the leading source of renewable power generation [today], but soon after 2030 it will be the leading source of power generation overall in Europe, according to figures from the IEA [International Energy Agency],” WindEurope chief executive Giles Dickson tells *Recharge*. “We will be the principle



WindEurope’s new report also explains that electrification of heating, transport and industrial processes will be key to decarbonising the continent’s energy system

source of driving this electrification. That gives us huge responsibility.”

As wind increases its share in the energy mix, it will also become cheaper, the report finds.

Investment costs for onshore wind would average €1.1m (\$1.3m) per

megawatt by 2050, a 30% drop from today, while offshore wind costs

CONTINUED on Page 3

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➤ N149 / 4.0-4.5 INSTALLED AUGUST 2018, NORTHERN GERMANY

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KARL-ERIK STROMSTA

GE Renewable Energy has launched a new onshore wind platform known as Cypress that will for the first time push its onshore turbine product lineup beyond 5MW, including a two-piece blade design that will help with the logistics of transporting and installing such large machines.

The Cypress platform includes the 4.8-158 model that GE launched last year, but adds a new 5.3MW machine with a 158-metre rotor diameter that the company says will be able to generate 20GWh per year — a 50% boost in annual energy production compared to GE's 3MW platform.

GE and other turbine manufacturers continue to push the envelope on turbine sizes, with higher hub heights and longer blades allowing developers to unlock more power at lower wind speeds. Logistics have been one of the chief challenges of such large turbines in the past. But GE says its novel two-piece blade design will allow developers to access previously inaccessible sites.

The blades were developed in collaboration between GE's onshore wind business, the



A rendering of GE's new Cypress turbines

GE launches 4-5MW onshore platform

company's Global Research Center, and blade maker LM Wind Power, which was acquired by GE last year.

"Our team used a disruptive design methodology and customer feedback to re-examine our entire design and manufacturing process," said Duncan Barry, chief executive

of LM Wind Power.

A prototype of the Cypress 4.8-158 is currently under production in Salzbergen, Germany, near the Dutch border. The first prototype will be deployed and commissioned by the end of this year at Wieringermeer, the Netherlands, a spokesperson tells *Recharge*. □

'Wind will play key role in electrification'

FROM Front Page would fall by 23% to €2.2m/MW.

A renewables-based electrification is key to the decarbonisation of Europe's energy system, which will drastically reduce dependence on imported fuels, improve living standards by limiting air pollution and cut energy bills, WindEurope says.

The report also presents a less ambitious "accelerated electrification scenario", which would speed up policy changes, but fail to reach Europe's commitments under the Paris climate deal, which attempts to limit global temperature rises to 2°C.

Under this scenario, the share of electricity in energy use would

only rise to 51% by 2050, and its energy-related emissions would be reduced by only 74% (when compared to 1990 levels) by 2050 as opposed to the 90% cut under the Paris-compatible scenario. Wind would make up 33% of power generation in the accelerated electrification scenario.

To decarbonise Europe's industrial economies by 2050, the penetration of renewables must go beyond the power sector and reach other parts of energy consumption, Dickson explains.

"We can only achieve that if we significantly increase the penetration of electricity in heating, transport and industrial processes and thereby increase the penetration of renewables in those

sectors of the economy as well"

The Paris-compatible scenario means reaching an 86% share of electricity in industrial processes by 2050, the report finds, or 62% in the accelerated electrification scenario. Under the Paris scenario, electrification in commercial buildings by 2050 would reach 78% (or 62% under the less ambitious scenario), and 59% in households (compared to 39%).

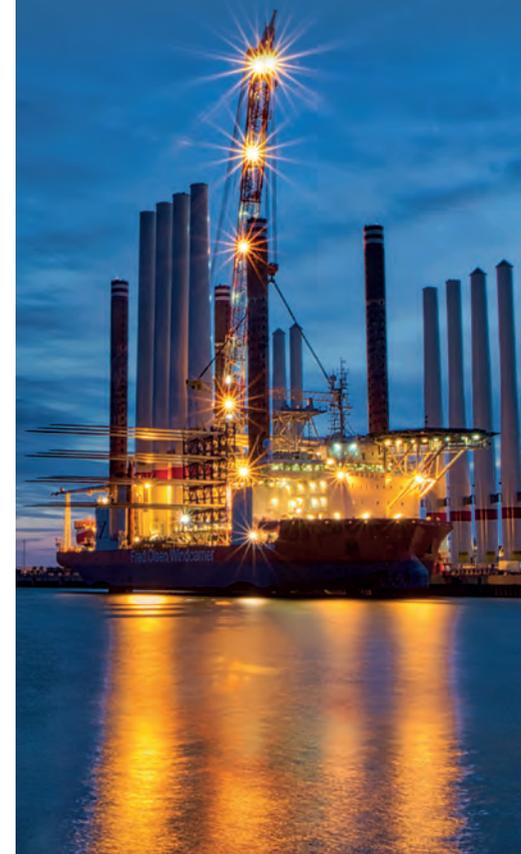
"We believe that wind has a particular role to play in the electrification of industrial heating and industrial processes, because the consumers there need large volumes of energy, which wind can provide," Dickson says. □

More on electrification: p22

Lifting Offshore Wind

56 8MW turbines installed at Borkum Riffgrund 2.

Job done and ahead of schedule!



Energy ministers pledge to boost hydrogen

CHRISTOPHER HOPSON

U energy ministers have pledged to increase research into the use of hydrogen in power and transport as part of the bloc's target of cutting emissions by 40% by 2030.

The non-binding "Hydrogen Initiative" will see 25 signatory states boost spending and cooperation over the potential for hydrogen in areas including energy storage, which Austrian energy minister Elisabeth Kostinger said is one of the key areas that needs addressing to integrate renewables into Europe's energy system.

Renewable energy can be used to split water molecules and hydrogen and oxygen in an electrolyser, with this "green hydrogen" being converted back into electricity — either by burning it or in fuel cells — at a later date. So-called seasonal storage — where



Hydrogen tanks at a power plant in New Jersey

excess solar energy is stored as green hydrogen in the summer months and converted back into electricity during the dark winter months — is said to be one of the only routes to a 100% renewable-energy future. Green hydrogen could also be used to

power vehicles, including trucks, trains and cargo ships, and as a replacement for natural gas in heating systems.

Aurelie Beauvais, policy director of industry body SolarPower Europe, said "green hydrogen makes perfect sense in an energy

system with high shares of renewables and constitutes a new opportunity to support the full decarbonisation of our economy.

"The EU should therefore pioneer the development of such technologies, which will support an even greater penetration of renewables into the energy system."

Miguel Arias Cañete, European commissioner for climate action and energy, said: "Green hydrogen offers significant potential for the decarbonisation of the European economy. The commission warmly welcomes the Hydrogen initiative as it will further harness the innovative drive across the EU."

Canete added that energy ministers had also clarified their positions on the outstanding issues on the EU's long-gestating Clean Energy Package, including on electricity market design.

"I remain confident that we can reach a conclusion by the end of this year," he said. ☐

Photograph | Getty

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Borkum Riffgrund 2

Project Facts

Location: 57 km off the North-west coast of Germany, in approx. 30 m water depth

Turbines: 56 x V164-8.0 MW, utilising MAX Power to take each turbine to 8.3 MW

Capacity: 450 MW, the largest offshore wind power plant in Germany

Completion year: 2019
Powering up to 460,000 households



The rise of renewables cannot be guaranteed, *Recharge* summit told

ANDREW LEE

Renewables cannot take their future dominance of the global energy sector for granted in the face of unprecedented political opposition, ongoing pressure on costs and unanswered questions about variable output.

That was among the key messages from the annual invitation-only *Recharge* Thought Leaders Summit, held in Hamburg yesterday. The event brought senior figures from wind, solar and related 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 past 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 industry, which was advised to fight back by stressing jobs and other economic benefits.

The role of “national champions” in bringing



Delegates at the event in Hamburg yesterday

governments onside with renewables was highlighted by another delegate, noting 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 large-scale

storage represents the “missing link” of renewables but would need bold technical solutions — and, for a few years 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 predicted. ☒

Photograph | John Macdonald-Fulton/Recharge

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Ørsted sells half of Hornsea 1 for \$5.9bn

CHRISTOPHER HOPSON

Ørsted has agreed to sell a 50% stake in its 1.2GW Hornsea 1 offshore wind farm to Global Infrastructure Partners (GIP) for about £4.46bn (\$5.86bn).

The deal includes a commitment by GIP to fund half of the payments under an EPC contract for the entire wind farm, including the transmission assets.

Hornsea 1, under construction in the North Sea off the east coast of England, will be the world's largest offshore wind farm when commissioned in 2020. It is being developed with 174 Siemens Gamesa 7MW turbines.

Ørsted will build the wind farm under a full-scope EPC contract, offer long-term O&M services and provide a route to market for the power generated. ☐

MAKE cuts 5GW off ten-year outlook



The Santa Vitoria do Palmar complex in Brazil, where the recent wind tender was disappointing

ANDREW LEE

Consultancy MAKE shaved more than 5GW off its ten-year global wind capacity additions forecast as auction-related wrinkles prompted a downgrade to its latest quarterly outlook.

MAKE's third-quarter analysis suggests almost 670GW will be

added to the global wind fleet in 2018-27, a cut on the figure it released in Q2.

Drivers behind the revised forecast include the low volume of power contracted in Brazil's latest tender, prompting a downgrade of almost 7% for the key Latin American wind market.

MAKE's predictions for India were trimmed after concerns

over grid infrastructure hindered participation in recent auctions, while the outlooks for Japan and South Korea were also reduced.

MAKE pointed out that the adjustments are mainly concentrated in 2018-20, and the overall ten-year outlook suggests "relative stability globally".

The consultancy's ten-year projection for the US market is largely unchanged since Q2, despite the cancellation of the 2GW Wind Catcher onshore project.

China's outlook was also unaltered, while MAKE raised its forecast for Western Europe by 1%, helped by positive policy indicators from Germany, Belgium and Poland.

The Wood Mackenzie-owned consultancy said global firm turbine orders totalled more than 27GW in the first half of 2018 — the best figure for five years — with demand from the offshore sector contributing to a strong second quarter for OEMs. ☐

Photograph | Actis Group

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BERND RADOWITZ

The Asia-Pacific (APAC) region will lead global wind-power expansion in the 2020s, onshore and offshore, while the German market will stabilise after a lull next year, finance giant Commerzbank says.

“We continue to observe a solid global expansion of renewable energies amid a still falling levelised cost of energy [LCoE],” says Berthold Bonanni, head of the energy unit at the German bank.

In a study released ahead of the Global Wind Summit, Commerzbank estimates that onshore wind additions in the APAC region will increase from 24.3GW this year to 36.2GW in 2026. That compares with global expansion of an expected 52.2GW this year and 63.7GW in 2026.

APAC is expected to add 1.2GW offshore this year out of a global total of 4.1GW, with most expansion of wind at sea still driven by Europe.

Commerzbank expects that to reverse in 2026, when 6.1GW out of a total of 11.1GW of new offshore wind is predicted to come on line in APAC, against 4.6GW in Europe and 400MW in the Americas.

In the key German market, which has represented a large part of the European sector’s total, Commerzbank sees onshore installations dropping to 1GW next year from an estimated 3.3GW in 2018. That compares with a forecast by Germany’s wind-energy federation, BWE, of 3.5GW this year and less than 2GW in 2019.

The expected lull in German onshore expansion is because



Turbines off Rudong, China. Asia-Pacific will be the new epicentre of wind in the decade ahead

Asia-Pacific to lead global wind growth in 2020s: Commerzbank

most winning bids in last year’s auctions went to community power projects, which were allowed to participate without holding a permit relating to noise-emission rules, and which were granted two years longer to build their wind farms.

BWE says the reduction in the onshore market caused by this delayed build-out has already led to thousands of job losses in the national wind industry.

German onshore additions will



Berthold Bonanni

rise again in 2020 to 2.15GW, then surge to more than 4GW in 2021 and 2022, Commerzbank estimates, levelling off between 2.75GW and 2.9GW in the remaining years to 2027.

The bank also believes LCoE will continue to fall, driven by a switch to auction-based support regimes.

Globally, it adds, the number of countries using renewables tenders rose from 64 in 2015 to 84 last year. ☐

Photography | Recharge | Commerzbank

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KARL-ERIK STROMSTA

By 2021, more money will be spent maintaining existing North American wind farms than building new ones, a shift with big implications for this maturing market and who makes money in it.

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, market researcher IHS Markit predicts.

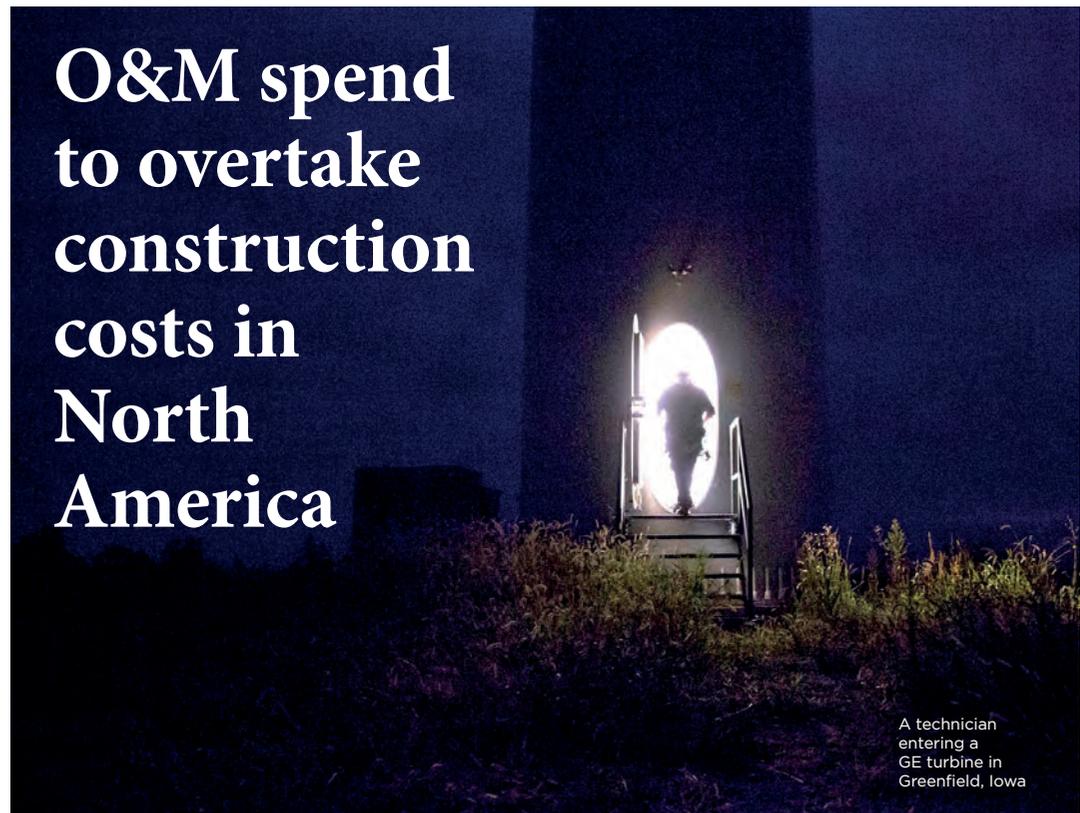
The shift towards operating expenditure (opex) will be spurred by the planned expiration of the wind production tax credit, which is expected to dent the US market for new projects in the early 2020s.

“The wind 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.

North American wind farm owners are adopting a variety of strategies for cutting O&M costs. Some, such as Pattern Energy, are shifting O&M work in-house. Others continue to outsource — such as TerraForm Power, which recently hired GE to perform O&M for more than 900 operating turbines.

“There’s no ‘one size fits all’ solution,” Cohen tells *Recharge*. “The top-performing quartile of operators who self-perform O&M do get lower costs than if they used another service or some other party — but there’s a long tail.

“It depends on whether you



A technician entering a GE turbine in Greenfield, Iowa

O&M spend to overtake construction costs in North America

have the knowledge and expertise, access to spare parts, the right relationships, economies of scale. It depends on where you’re located, which turbines you use, how old they are.

“It’s not a clear-cut situation where one strategy’s always going to get you the lowest costs.”

The shift towards opex and away from capital expenditure has important implications for wind farm 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 spinning in the US and Canada is still fairly young. At

next decade, the average age of US projects will rise steadily, reaching 14 years by 2030, according to IHS Markit’s latest North American wind O&M research report.

Although the wind industry is taking O&M far more seriously these days, it has a long way to go in catching up with the highly sophisticated oil & gas sector, Cohen says.

Oil & gas companies are accustomed to sharing their O&M data anonymously to help the broader industry benchmark and reduce its costs, he says.

“Folks in the wind industry are still learning the importance of that. It’s something older and more established industries are a little more comfortable with.”

It depends whether you have the knowledge and expertise, access to spare parts, the right relationships, economies of scale

the end of last year, 27% of the US wind 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

Photograph | Sisse Brimberg & Cotton Coulson

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Hamburg, 25 – 28 September 2018



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- B1.UF National Pavilions**
Nationenpavillons
- B1.OG National Pavilions**
Nationenpavillon Dänemark
- B1.GF Danish Pavilion**
Nationenpavillon Dänemark
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Tomorrow: 7th German Renewables Award 2018

The cluster Renewable Energy Hamburg presents the German Renewables Award 2018 for the seventh time in five categories: Product innovation of the year, Project of the year, Lifetime achievement wind energy, Student thesis of the year wind energy and for the first time: Journalism.

The award ceremony will take place at the Intercity Hotel Dammtor-Messe at 6pm, close to Hamburg Messe and Congress.

The German TV journalist Andrea Thilo will present the event.

Intercity Hotel Dammtor-Messe, St.Petersburger Str. 1, 20355 Hamburg

Tue 25 September

SPEAKERS' CORNER

UPPER FLOOR BETWEEN HALLS B1 AND B2

10.00 – 10.10

Softwaregestütztes Maßnahmenmanagement für Off- und Onshore Windparks

Thomas Zapp, Sales Engineer, Greengate AG

10.15 – 10.25

Helicopters in the Offshore-Wind industry – their unexploited benefit

Oliver Fokken, Sales Manager, Airbus Helicopters

10.30 – 10.40

Blackout im Windpark: In Zukunft Dauerschlagzeile!?

Klaus Mochalski, CEO, Rhebo GmbH

10.45 – 10.55

The Future of Power Cable Maintenance

Yates Hamish, Business Development Executive, CWind

11.00 – 11.10

Das Deutsche Patent- und Markenamt – als Arbeitgeber!?

Iris Beyer & Dörthe Moeller, Patentprüferinnen, Deutsches Patent- und Markenamt

11.15 – 11.25

Elektrische Sicherheit für Windenergieanlagen

Jens Bickel, Vertriebsingenieur, Bender GmbH & Co. KG

11.30 – 11.40

Smart Gearbox

Alexander Rhode, Manager, Nanjing High Speed Gear Manufacturing Co., Ltd

11.45 – 11.55

PPAs – A strong market instrument for the renewable industry

Bassam Darwisch, Head of Wholesale and Origination Germany, Vattenfall BA Markets

12.00 – 12.10

Protect Your Investment with TCM® Monitoring

Zabihullah Alefi, COO, Leader Condition Monitoring Division; Engineer, Vibration Analyst, Gram & Juhl

12.15 – 12.25

Why size matters in new and emerging markets

Nicolai Andersen, Global Sector Head, Renewable Energy at DHL Industrial Projects

12.30 – 12.40

Gebrauchte Windkraftanlagen - Zugang zu neuen Märkten

Bernd Weidmann, Geschäftsführer, wind-turbine.com GmbH

12.45 – 12.55

New innovative Insurance packages from end warranty to year 20 and beyond

Shavkat Mingaliev, CEO and Founder, Ventus Engineering GmbH

13.00 – 13.10

Blackout im Windpark: In Zukunft Dauerschlagzeile!?

Klaus Mochalski, CEO, Rhebo GmbH

13.15 – 13.25

First commercial offshore wind project in Taiwan

Peter De Pooter, Offshore Renewables Manager, Jan De Nul NV

13.30 – 13.40

Grid connection, the umbilical cord of wind farms

Christian Derrien, Senior Sales Account Manager, GE Grid Solutions, GE Renewable Energy

13.45 – 13.55

Reduzierung der Anlagenkosten durch Funktionale Sicherheit im Pitchsystem

Detlef Schlüter, Branchenmanager Wind Energie, LTI Motion

14.00 – 14.10

Profitabler Weiterbetrieb nach Ablauf der EEG-Förderung - Lösungsangebote der EnBW

Matthias Laub, Referent Energiewende, EnBW Energie Baden-Württemberg AG

14.15 – 14.25

Leistungssteigerung durch optimierte Parkregelung

Babette Bode, BSC Mathematik/ Systementwicklerin, Silver Atena Electronic Systems Engineering GmbH

14.30 – 14.40

Vestas Product Innovations

Kristina Feldmann & Johanna Zastrau, Senior Product Manager & Senior Manager, Technical Sales & Siting Solutions, Vestas Deutschland GmbH

14.45 – 14.55

Low-Speed Shaft Coupling

Alexander Kari, Product Manager, Geislinger GmbH



15.00 – 15.25

Suction Pile Jackets - Fast and Efficient

M.E. Riemers, Managing Director, SPT Offshore B.V

15.30 – 15.55

Opportunities and challenges of China's offshore wind power

Huang Dong Ming, Director of the Intelligent Energy Research, Ming Yang Smart Energy Group

16.00 – 16.25

Training & authorization program for cable accessories installers

Kavanagh Ronan, Senior Manager Grid Reliability, TE Connectivity

16.30 – 16.40

End to end IT security for the wind industry

Christian Garske, Associate Director, IT Security & Privacy Consulting, Lufthansa Industry Solutions

16.45 – 16.55

A Breakthrough in Predicting Bearing Failure – SeerWorks™ Reliability

Jeff S. Guerin, CEO & President, 4LinesFusion

17.00 – 17.10

An Overview of China's offshore wind power development – opportunities and technical challenges

Endi Zhai, Chief Engineer and GM offshore, Goldwind

17.15 – 17.25

Combi Lifting Spread

Henk Van Vessem, Product Manager. IHC IQIP

17.30 – 17.40

Double Slip Joint (DSJ)

Boudewyn Van Gelder, Manager R&D at KCI, IHC IQIP (KCI)

Tuesday 25 September

PROGRAMME HIGHLIGHTS

The WindEurope 2018 Conference is happening right now!

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DAY 1: Electrification & sector-coupling

9:30 – 11:00, Room: Brussels

Ministerial session - Breaking new ground: the wind industry and the global energy transition.

This session will bring together policymakers and industry leaders to discuss how the wind industry can make an even greater contribution to a stronger economy, a cleaner environment, and a more sustainable energy system, while supporting communities across Europe and beyond.

11:30 – 12:45, Room: Brussels

The role of wind in electrifying and decarbonising the wider economy. WindEurope will present a report featuring scenarios for the electrification of transport, heating

& cooling, and energy-intensive industrial processes, showing possible paths to achieve the decarbonisation objectives set by the European Union for 2050.

14:00 – 15:00, Room: Brussels

The current outlook for wind in Europe. This session will bring together a panel of industry leaders to discuss the current outlook for wind in Europe.

15:30 – 16:30, Room: Brussels

Longer term perspectives for wind in Europe. This session brings together senior industry leaders to look at the financial, political and technological trends at work today and discuss the longer term perspectives for wind in Europe.



WindEurope has two stands in Hall B1.

WindEurope Stand B1.OG.311

- Meet the WindEurope team and pick up your copy of our new flagship report on wind energy and electrification in Europe and explore our wide range of industry-leading publications.
- Get a taste of our business intelligence tools.
- Book your stand or sponsorship package for our upcoming events.

WindEurope Stage B1.OG.211

11:30 – 12:00 WindEurope events: what's coming next? (2018-2019)

12:30 – 13:00 Spanish market update.

13:30 – 14:00 Offshore Wind Energy in Germany: Status Quo and positions of the Offshore Wind Industry.

14:30 – 15:00 InnoEnergy – An innovation ecosystem for the wind sector.

15:30 – 16:00 Research & Innovation – shaping Europe's funding priorities for wind energy.

Agenda subject to alteration.

SEE FULL AGENDA:

windeurope.org/stage

SOCIAL & SIDE EVENTS

9:30 – 12:00, Where: Marseille 2

Women of Wind Energy Networking Event and Annual Meeting.

14:30 – 17:30, Osaka

Offshore Wind Opportunities in India.

Global Ambassadors



Global Wind Summit



For more information, visit the WindEurope stand – we're in Hall B1 on the upper level at **B1.OG.311!**

DARIUS SNIECKUS

France's first offshore wind installation, the FloatGen floating prototype, has exported its first kWh to the grid, developer Ideol reports.

After connection of the export cable and a final series of tests, the EU-backed €25m (\$29.2m) project became fully operational on 18 September.

"This is a highly symbolic step for the partners involved in this project. This wind turbine is the first operational unit of the floating foundation concept patented by Ideol and built in concrete by Bouygues Travaux Publics," Ideol said.

"This announcement is also symbolic for France, since FloatGen lays the foundation for an industrial offshore wind-energy sector and represents a unique opportunity to become the global leader in floating wind."

Hook-up of the Ideol flagship, a first-of-a-kind concrete "damping pool" platform topped with a 2MW Vestas V80 turbine, was done in the summer at the SEM-REV test site, 22km off the Brittany coast.

FloatGen will supply electricity to 5,000 people in northwest France.

A second Ideol unit, manufactured from steel rather than concrete and topped with a 3.2MW Aerodyn two-bladed turbine, is scheduled to be operational off Japan soon.

Beyond these prototypes, Ideol is partnering on the 24MW EolMed array due to be installed in the Mediterranean in 2020-21, and its platform concept is in the frame for the world's first commercial-scale floating wind plant, a

Photograph | Ideol



A maintenance boat at FloatGen. Below: the unit flows power to the grid

France's first offshore wind power flows — from floating turbine

"multi-hundred gigawatt" project off Japan being financed via a deal signed in May with global investment giant Macquarie.

Ideol is also working with contractor STX on a new-look floating substation designed to be compatible with both bottom-fixed and deeper-water wind farms in 30-metre-plus depths.

Floating wind has mushroomed

from a single experimental turbine installed off Norway in 2009 — Equinor's 2.3MW Hywind demo unit that served as the basis for the world's first array, the 30MW Hywind Scotland — into a sector now planning for more than 12GW of installed capacity within the coming decade, with projects in the pipeline off Asia, Europe and the US, including California. ☐

MHI Vestas poised to make UK market its 'spinal column'

ANDREW LEE

Offshore wind turbine maker MHI Vestas said the prospect of a government-backed "sector deal" and long-term volume visibility have prompted preparations for a major ramp-up of its UK industrial footprint.

Chief executive Philippe Kavafyan and newly appointed country manager Julian Brown told *Recharge* that the scale of its UK pipeline — including firm orders for the 860MW Triton Knoll, its biggest yet, and a conditional deal for the 950MW Moray East — already means Britain is set to remain its "centre of gravity", even amid the emergence of new markets such as Taiwan and the US.

Kavafyan said Contracts for Difference auction rounds planned every two years during the 2020s could make Britain the "spinal column" of MHI Vestas's global activity, with industrial investments to match. "We are due to increase our capacity globally. With proper visibility in the next auction [due in spring 2019], we could do it in the UK," he said.

Brown added that the company was "poised and ready" to boost its operations accordingly, upon the conclusion of a sector deal — a partnership with government that the wind industry is in the closing stages of negotiating. ☐

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WIND ENERGY 2018

26 September, room B6.1

- DNV GL's Energy Transition Outlook report 2018 (9.30-11.00)
- Joint Industry Project: Standardized test method for concrete fatigue (11.30-12.30)
- Joint Industry Project: BLARE - Blade Repair (12.45-13.45)
- LCoE based turbine and wind farm design (14.00-15.00)
- MyCertificate - the interactive certification configurator for wind turbines (15.15-16.15)
- Latest trends in offshore wind markets and technology (16.30-17.30)

27 September, stand 330, hall B4

- Certification goes digital (10.30-10.45)
- Certification of Energy Storage Systems (10.45-11.00)
- German Renewable Energy Assets for Asian-Pacific Investors (14.00-14.15)
- Power Price Forecasting
- The benefits of wind farm control in pre- and post construction phases (14.30-14.45)
- Prototype Testing of Floating Offshore Wind Turbines (16.00-16.15)
- Artificial Intelligence in Renewables - what is it and how can we use it? (16.15-16.30)
- Issues for energy storage co-located with wind (16.30-16.45)

www.dnvgl.com/windenergy

Shell: Wind farm operators underestimate the importance of lubricants

CHRISTOPHER HOPSON

Research by Shell has found that while 84% of wind-power executives recognise that effective wind turbine lubrication can improve the bottom line, 38% say that lubrication is rarely a priority — and that 40% say their companies experience regular breakdowns because of ineffective lubrication.

In its *Investing in Peak Performance* report into wind turbine maintenance, which it compiled in partnership with certification body DNV GL and WindEurope, the oil giant explains that a lack of training about lubricants may be the problem. It adds that 83% of executives responding to the company's survey said maintenance staff would benefit from more training on the subject.

"High-quality lubricants and greases... protect the heart of the wind turbine — the gearbox — and the strong thermal stability of synthetic lubricants allows them to optimally protect equipment in the extreme temperatures faced," the report explains.

"By minimising deposit wear and ultimately friction, wind turbines can run smoothly, contributing to extended equipment life." □



Team Jungle AI receives one of the prizes at Hack the Wind 2017

Second Hack the Wind takes off

ANDREW LEE

The Global Wind Summit (GWS) will see the leading industry companies and European technology development agency InnoEnergy again join forces to stage the second annual Hack the Wind innovation "hackathon".

Running today and tomorrow, the hackathon will award winners a share of a €20,000 (\$23,410) prize for "innovative and implementable solutions" to key challenges facing the wind industry.

For 2018, event partners

Siemens Gamesa Renewable Energy and EDP Renewables are focusing on blockchain applications for hybrid systems, and optimising predictive maintenance and O&M, respectively.

WindEurope deputy chief executive Malgosia Bartosik said: "Last year's Hack the Wind was a brilliant way of not only giving attendees something to learn from but of fostering innovations and creating new start-ups. We are tremendously excited to see this year's event build on that success."

InnoEnergy chief executive Diego Pavia added: "Last year's

hackathon was a real milestone on our journey to making European sustainable energy the world's most innovative industrial sector. This year we want to go one better with challenges set around two trends that will really shape the future of our industry: improved operations and maintenance and effective integration with blockchain."

The contributions will be assessed by "C-level" representatives from the event partners as part of an expert judging panel that includes *Recharge* editor-in-chief Darius Snieckus. □

Photograph | InnoEnergy

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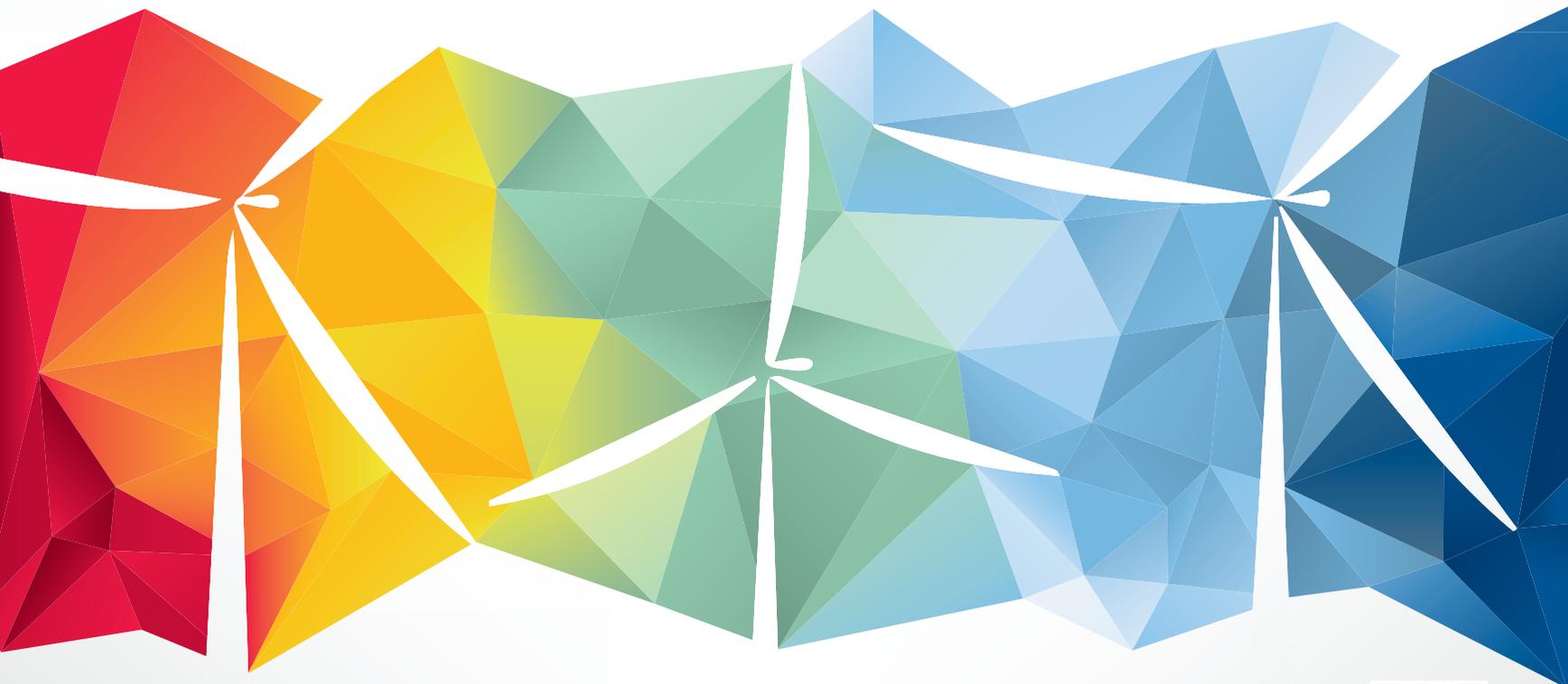
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Representation of a GE digital wind turbine

Digitalisation to open new revenue streams and drive new efficiencies

JILL SZPYLMAN

Around 20 years after the dot-com boom changed the way that we shop forever, we're now at the beginning of a second wave called the Industrial Internet. Industrial equipment is being digitalised to change behaviours — think Uber and AirBnb's transformative shift in the taxi and hotel industries — driving new efficiencies and new conveniences that we now take for granted.

In the wind industry, data science hasn't provided the needed value to make a dent in the levelised cost of energy yet. But by combining materials science with data science, we're able to drive new efficiencies between operators and suppliers. The overlap between the two sides is the digital Bill of Materials, a digital representation of all components in a wind turbine.

By understanding the performance and expected life of major and minor components, operators can move away from buying on price and delivery and begin to buy turbines and parts on life span. We call this "Buy on Life," which will transform the wind industry and force cost reductions and performance improvements. ☑

Jill Szpylman is director of IR, PR and communications at Sentient Science

Digital O&M could save wind operators hundreds of millions

DARIUS SНИЕCKUS

Early returns from an online wind farm operations competition launched this month by the US's Sentient Science point to huge future potential for digitally driven cost reduction and life extension projects in the global onshore fleet.

The more than 1,000 players currently playing The Wind Challenge in countries around the world, including the US, Germany, Spain and China, have so far saved some €100m (\$116m) by extending the productive lives of 2,336 assets by an additional 6,753 months,

Sentient reports, noting too that the knock-on impact on supply and inventory, asset and risk management translated to a further reduction of €421m.

The game, in which players work with anonymised data sets for a fictional wind farm in Greenland to test out life-extension strategies using different turbine technologies, is being run with WindEurope, Tower Climbing Grease Monkeys and *Recharge*, with winners to be announced tomorrow at the Global Wind Summit.

"As more LifeX [life extensions] actions are taken on the turbines, the Wind Challenge is expected to demonstrate

the potential financial and operational impact that would occur if every wind turbine in the industry became fully digitalised for life extension," says Ed Wagner, Sentient Science's chief marketing officer.

The game has been built around Sentient Science's materials science/data science digital models of Vestas, GE and Siemens Gamesa wind turbines with "fictitious operational and loading conditions" to feed into gamers' life extension and financial calculations.

Winners of the Wind Challenge will be announced at 4pm tomorrow at WindEurope's stand in Hall B1. ☑

Image | GE

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DARIUS SNEECKUS

Electricity's share of total global energy demand will more than double to 45% by 2050, with a rapidly expanding fleet of renewables plants accounting for an estimated 80% of production worldwide, according to DNV GL's *Energy Transition Outlook 2018* (ETO) report.

Rapid worldwide electrification will be driven by rising demand from buildings (heating, cooling, cooking, lighting and appliances), manufacturing and transport, not least due to an uptake of electric vehicles (EVs) that will continue to "escalate rapidly", with 50% of all new cars sold in 2027 in Europe expected to be EVs — a market penetration due to be reached globally by 2033.

The shift to electrification and away from fossil-fuel production will see PV and offshore wind experiencing 85-fold growth to 2050, when they will account for 19TW and 1TW respectively, with onshore wind adding 6.1TW and hydro 2.3TW.

Electricity demand will increase by 170% from 21 petawatt hours per year (PWh/yr) in 2016 to 57 PWh/yr in 2050 — with renewable energy supplying 80% of the latter.

The 2018 report reiterates many of the forecasts in DNV GL's first ETO, launched last year, including oil and gas swapping primacies in 2022-23 and renewables outpacing fossil fuels from the early 2030s. However, electrification of the global energy system looks to be picking up the pace from the 40% forecast in 2017.

"There will always be slight

variations year on year, but overall if you look at the main findings from 2017, most of these can be seen in this year's," DNV GL Energy chief executive Ditlev Engel told *Recharge*. "We do, however, believe that energy consumption overall will be 6% higher in 2050 than we forecast last year due to rising demand from manufacturing... and we do foresee there being less oil in the

global energy mix and more gas by 2022-23.

"And then, of course, our headline figure: we do see a more rapid electrification — last year we said 40% and this year we think it will be more like 45% by 2050. There are variations, but the trends are the same."

Though onshore wind's current installed base of 600GW will continue to be the bedrock of

production in the short term, DNV GL's calculations point to offshore wind and PV showing breakaway growth in the coming decades.

"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," said Engel.

"After Europe, the US has a huge pipeline for offshore wind, and

Electricity demand to more than double by 2050

Electrification of heat, transport and manufacturing will drive 170% increase in demand, with renewables supplying 80% of global power, according to DNV GL report



Photography | Getty

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Asia is difficult to read beyond our broad sense that the growth there will be exponential. Scaling [of offshore wind] will be self-reinforcing: the more you expand, the better you are able to expand further," he adds, pointing to the development of a regional supply chain and port infrastructure.

The role of EVs in the energy transition is in rapid evolution, as battery prices crater, and the

number of vehicles on the streets grows, he notes, meaning their use as a vast decentralised energy storage for the renewables build-out is hard to predict.

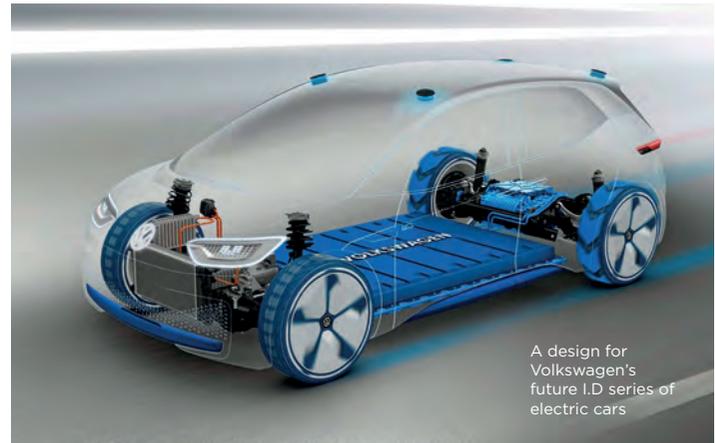
"The uptake of private EVs will continue to escalate rapidly, with 50% of all new cars sold globally in 2033 expected to be EVs and with Europe reaching that point in 2027. So, what this will make up of overall energy storage capacity is yet to be seen," said Engel.

"The whole discussion around EVs and energy storage is moving a lot. And seeing how automobile manufacturers are changing their view of the role of EVs in the last 12 months, and investments going into charging stations by different companies, the renewable-energy industry will need to be more and more [cognisant] of the role EV batteries will have to play in the energy transition."

Renewables-heavy electrification will also lead to major expansion of electricity transmission and distribution systems, the ETO forecasts, with total installed power-line length and capacity expected to "more than triple by 2050".

The ETO calculates that by the early 2030s, global primary energy supply will peak and cease to be dominated by coal, oil and gas, with the world's energy mix "split equally" between fossil and non-fossil fuels by 2050. But Engel 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 power to grid parity in recent years — but instead be found in governments' regulatory systems.

"One of the central challenges



A design for Volkswagen's future I.D series of electric cars

we do have [in making the shift from fossils to renewables] is how government regulation is going to be adapted. We look at the levelised cost of energy [LCOE] but we don't look at taxation, for instance. And how governments will have to address these matters in a way that allows renewables to



Ditlev Engel

take over from fossils gradually via the regulatory systems that are being adapted to this new world," he said.

"If you look at the energy transition from a technology point of view, things are running at full throttle — wind and solar LCOE going lower and lower, the cost of batteries dropping —but the 'black swan' really will be down to whether regulatory

systems can be developed at a disruptive pace."

Despite mushrooming expansion of high-capital-cost renewable power plants and electricity networks, energy will become more affordable, the report forecasts. DNV GL calculates the total cost of energy capital expenditure (capex), as a share of global gross domestic product, will fall from 5.5% to 3.1%, a drop of 44%, with more capex flowing into grids and wind and solar than fossil-fuel projects from 2030.

Absolute energy expenditure will still grow by 30% over the forecast period, to \$6trn a year, with the ETO foreseeing a shift in costs from operational expenditure, principally fuel, to capex.

Though the report gives a largely positive outlook on the renewables build-out and wider electrification of key sectors, Engel notes that the energy transition is not "happening fast enough" to meet the target set by the Paris Agreement in 2015, with DNV GL calculations finding that a first emissions-free year will not

CONTINUED on Page 25

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RICHARD A KESSLER

California Governor Jerry Brown has signed into law a statewide 100% clean-power goal by 2045, an historic raising of the bar in a state whose \$2.7trn economy recently eclipsed the UK as the world's fifth-largest.

SB 100 received its final approval in California's legislature late last month after several years of debate over the impact of such an ambitious target on the state's energy market and broader economy.

Brown, a staunchly pro-renewables Democrat, had appeared to be reserving his full support until passage had also been secured for a separate bill, known as AB 813, that would have authorised California's participation in a regional power market in the Western US.

That grid-expanding bill failed to move forward before the closure of the state legislature's 2018 session at the end of August, effectively calling Brown's bluff.

In the end, Brown embraced SB 100 anyway, and trumpeted his signature to coincide with the Global Climate Action Summit this month in San Francisco.

Importantly, Brown also signed an executive order for California to achieve total carbon neutrality by 2045 and move to net-negative greenhouse gas emissions in the years beyond. California's renewables-heavy power sector accounts for only 16% of the state's total emissions.

"This bill and the executive order put California on a path to meet the goals of Paris and beyond," Brown said.

"California is committed to doing whatever is necessary to



California passes law for 100% clean energy by 2045

meet the existential threat of climate change. But have no illusions, California and the rest of the world have miles to go before we achieve zero-carbon emissions."

California joins Hawaii as the only other US state with a 100% carbon-free energy supply mandate, with identical target dates of 2045. That's where any

similarity ends; California has almost 40 million people versus 1.4 million for Hawaii.

In an era of global warming, California's new mandate may be the most ambitious effort to eliminate greenhouse gas emissions from electric power generation in a major advanced economy.

SB 100 does not stipulate how California would attain the 100%

target. California law previously required investor-owned and municipal electric utilities to derive 33% of their retail sales from eligible renewable resources by the end of 2020; 40% by 2024; 45% by 2027; and 50% by 2030.

SB 100 advances the 50% mandate to 2026, and sets the renewable energy goal to 60% by 2030. The remaining 40% to reach

Photograph | Getty

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Governor Jerry Brown signed the bill into law earlier this month

DNV GL: ‘Transition not fast enough to meet Paris goals’

CONTINUED from Page 23
be achieved before 2090 “if the energy transition continues at the pace predicted in [this] report”.

“The *Energy Transition Outlook* has some very encouraging findings, and the good news is that the energy transition is achievable and affordable. However, the rapid transition we are predicting is still not fast enough to achieve the goal of the Paris climate agreement,” said Engel.

“If we are to decarbonise the world’s energy system at the required speed, we need to adapt and automate our electricity grids, and regulators and politicians will need to re-think, re-shape and take major policy decisions about market models.”

Engel added that the onus was, in some large part, on oil & gas majors and utilities to accelerate their own transitions to speed up progress towards the Paris goals.

“These companies’ ability to provide knowledge and capital, and work across the value chain, will be fundamental to their acceleration of the energy transition — especially because, as our report confirms, we are still not at a trajectory where we will reach [the target of keeping global temperatures to an increase of 2°C over pre-industrial levels]. We are coming up short. We need all hands on deck to change this.”

full decarbonisation would come from both renewable and “zero-carbon” sources.

This would leave a possible window open for nuclear and fossil fuels with carbon sequestration technology — if either becomes cost-competitive in the future. Presently, large hydro and nuclear do not qualify under existing renewables mandates.

In 2016, California was a net importer of roughly one third of its power from generators in northwestern and southwestern states, according to the California Energy Commission. Last year, it derived 29% of its electric power from renewable energy — mainly geothermal, solar and wind.

Even attaining the present ambitious renewables mandates

will pose challenges for the state. Geothermal and wind have shown little growth in recent years, and solar either produces too much or too little power at the wrong times of the day.

However, the state also has a mandate for its three investor-owned utilities to together own 1.3GW of battery storage by 2020. ☐

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Benjamin Franklin

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EDWIN HAESEN

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

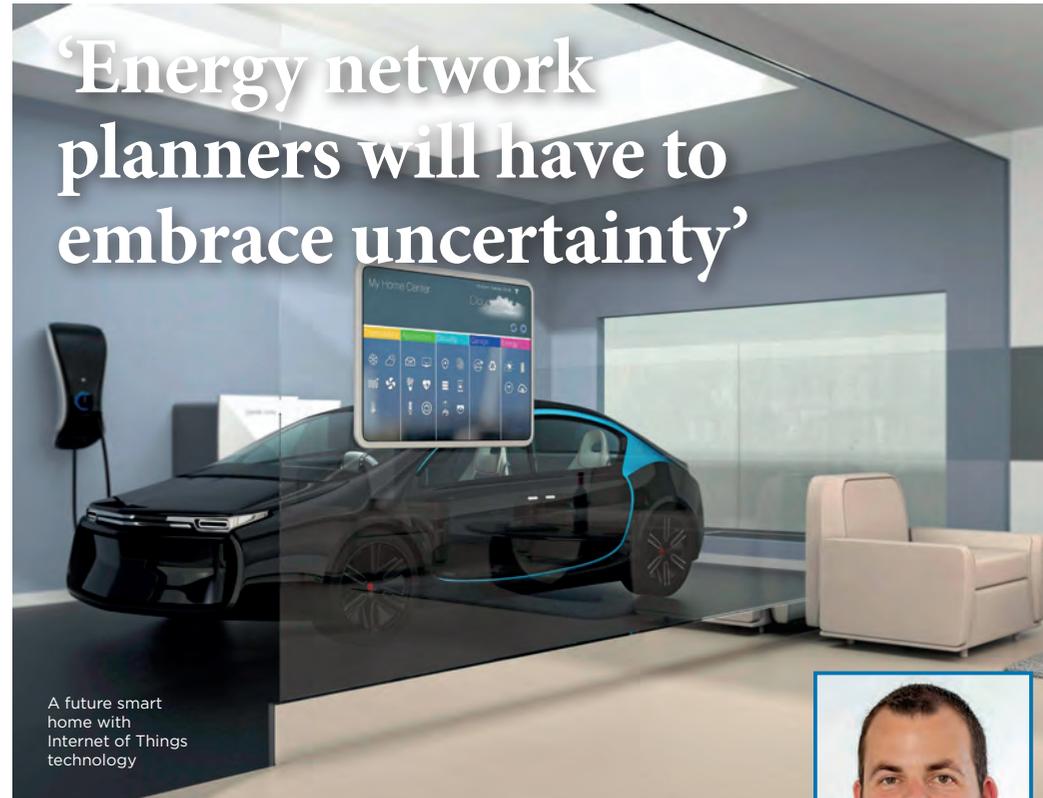
The developments in decarbonisation, decentralisation and digitalisation — combined with the overarching goals of a reliable, secure and affordable energy system — bring specific threats and opportunities. Transmission planning is shifting from a simple development of assets to cover peak capacity towards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

The largest uncertainty for system planning may not be technology innovation, financing, or regulation, but rather 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 residential homes (heat pumps, EVs) and industrial facilities (electromagnetic processing of materials, hydrogen feedstock) and policies of gas phase-outs creates significant uncertainty for system planners of gas and electricity systems.

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

The expected pipeline from 2021-30 adds up to about €229bn (\$267bn) of investments. About 66% is on electricity transmission, 18% on gas corridors, and the remaining 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 unclear future gas demand.

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



out. Electricity transmission plans generally underline the need for more capacity. National annual expenditures on new and upgraded transmission investments will likely be much higher in 2021-30 compared to today (about 29% on average increase), especially in Western European countries 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 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 (transmission overhead lines) or 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 which share of the present corridors would remain functional in such a scenario, or how many new investments will be needed. Pilots and further studies are necessary to understand the potential.

There are numerous 2040-50 studies that have endeavoured to assess 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 predict, ranging from lower demand based on energy-efficiency drives to higher demand based on more electrification, with uncertain estimates on how much would be flexible in either case.

It is crucial that all stakeholders adopt a flexible, robust planning approach. For market actors in a specific country and market segment (eg, suppliers/aggregators looking at a specific flexibility products), 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 significantly more time to materialise.

Uncertainty should not result in postponement — which increases the risk of grid access barriers in the long run. System planners must cover both short-term system needs, where economic viability and local stakeholder acceptance are key, and long-term system needs where shifts in the energy ecosystem must be well understood and innovation projects need 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. ☒



Edwin Haesen is an associate director at Navigant Consulting, working on electrical power systems, with a particular focus on the challenges of flexibility and renewables-dominated systems



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