Wind generation innovation…the LCOE Revolution

Peter Cowling, Country Head Vestas Australia and New Zealand

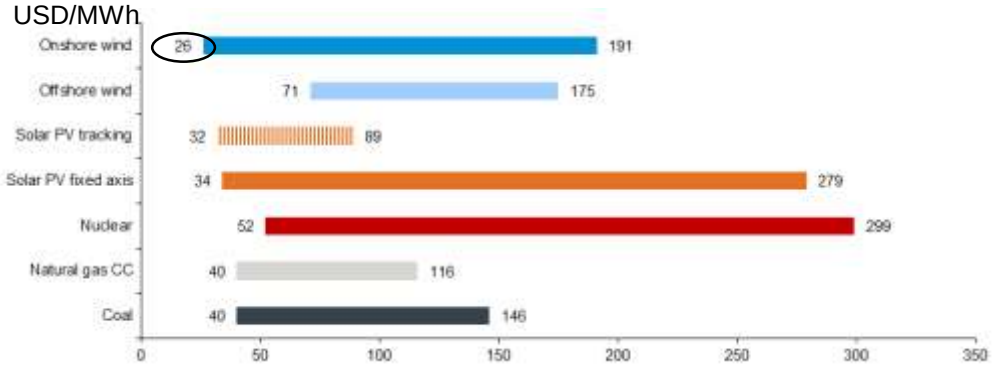
From niche…to leading the mainstream

Onshore wind now among the most cost-effective sources of electricity

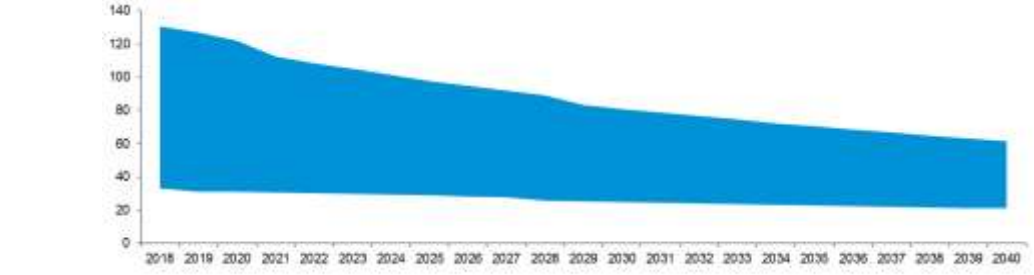
Key highlights

- Global average LCOE of onshore wind declined from USD96/MWh in 2009 to USD55MWh in 2018 – a reduction of 43%
- Onshore wind often has to today the lowest LCOE of all technologies in a given market
- The decline of onshore wind's LCOE is set to continue based on continued economies of scale and technology improvements
- OEMs also take more risk to allow reduction in cost of capital:
  - Longer design life
  - Lifetime availability guarantees at higher levels
  - Variable maintenance fees
  - Whole wind farm availability guarantee
  - Hybrid availability guarantee
  - Faster construction

Present: Onshore wind LCOE often most cost-efficient new power source

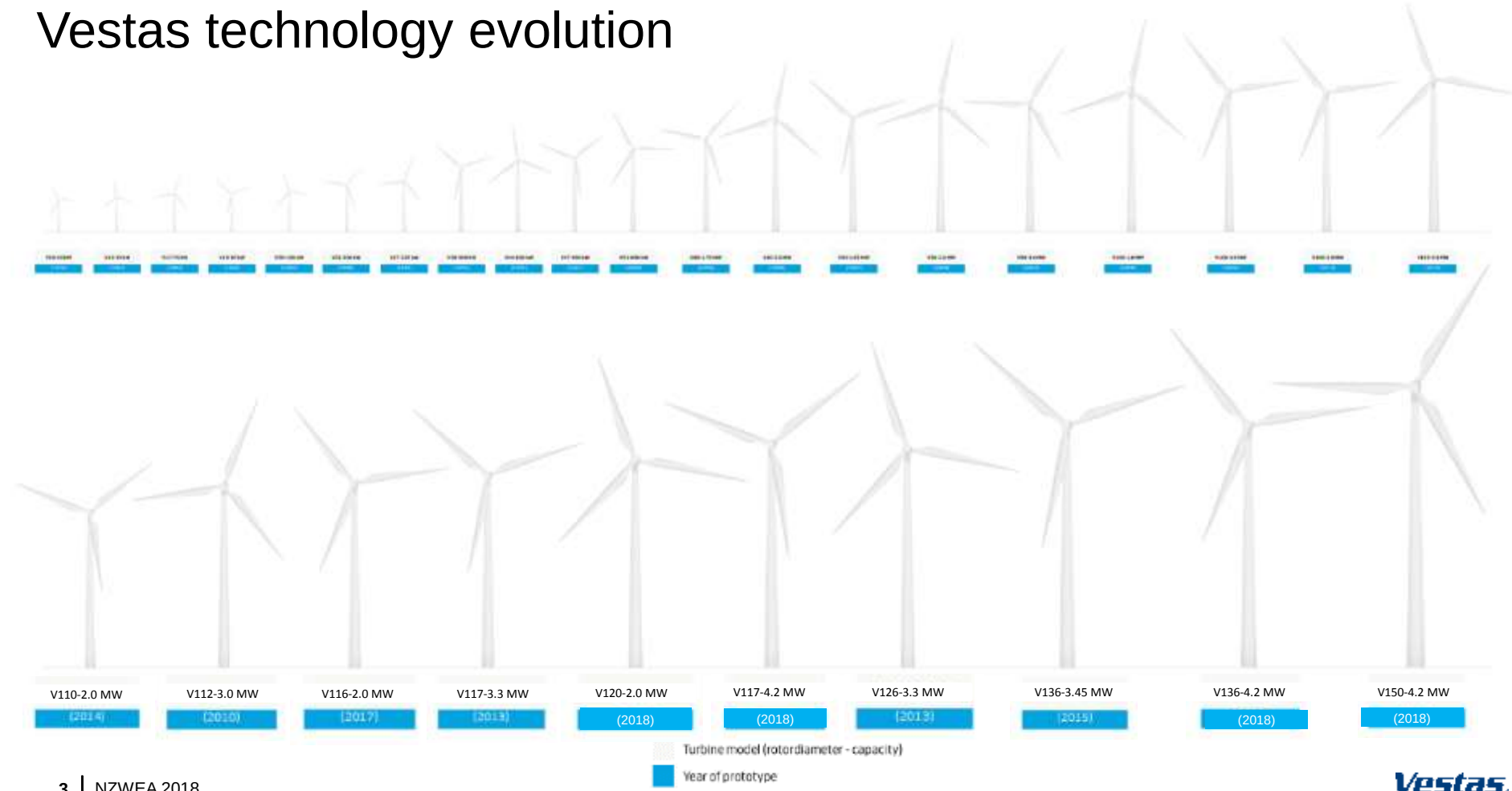


Future: Downward trend of onshore wind LCOE set to continue



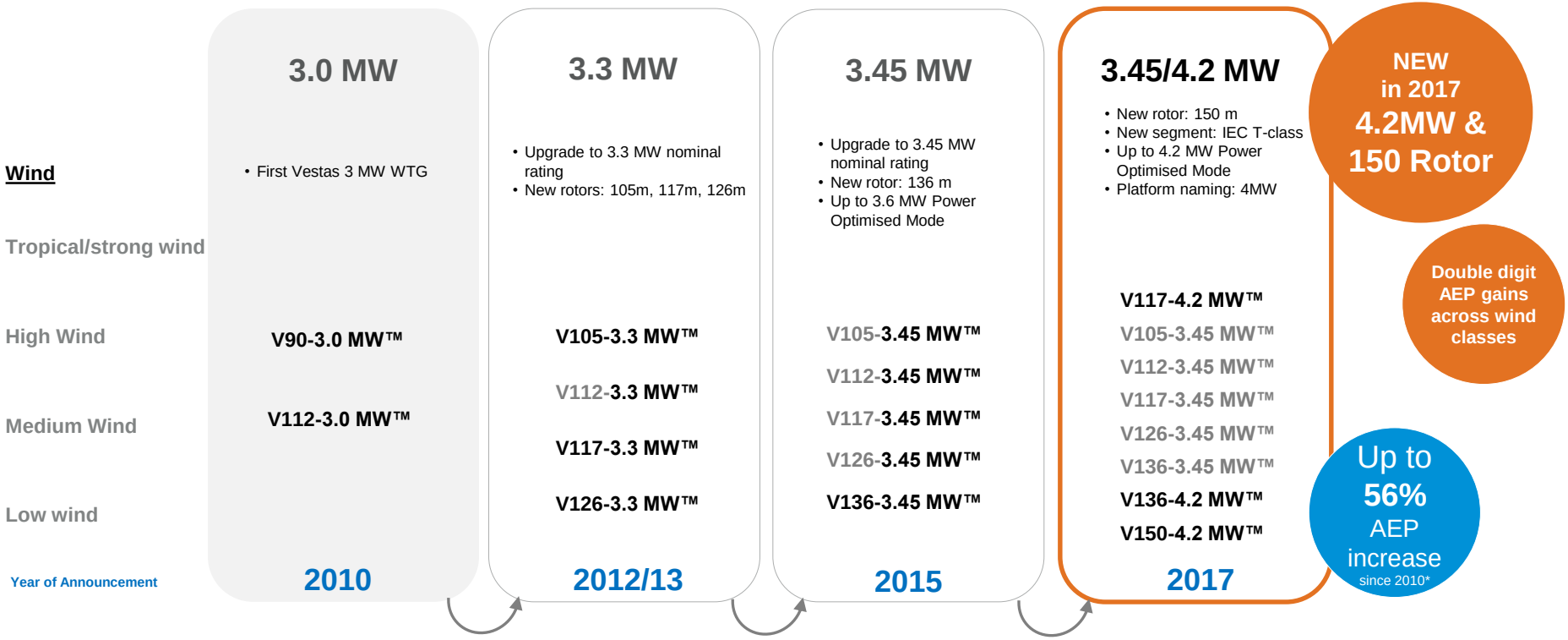
Source: BNEF, 1H 2018 Wind LCOE Update, 03/2018; BNEF, 1H 2018 Solar LCOE Update, 03/2018; BNEF 1H 2018 LCOE Global Report, 03/2018; BNEF, LCOE comparison and visualisation (assessed on April 4, 2018)

Vestas technology evolution



Successful evolution of a proven platform

More annual energy production from same trusted platform



4 MW platform installed worldwide

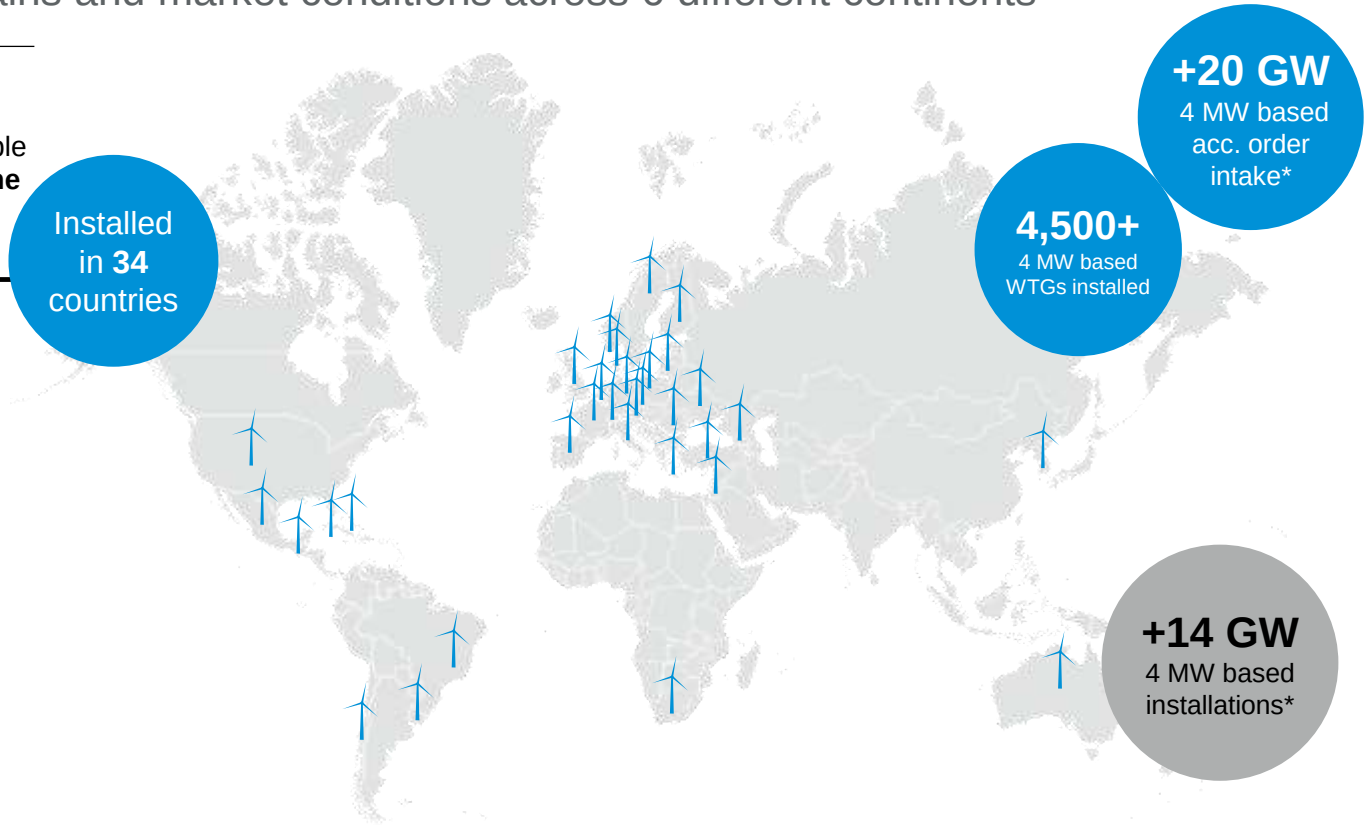
Installations in various terrains and market conditions across 6 different continents

Operational data, generated every 10th minute from more than **3,000 turbine sites*** across the globe, providing valuable insights for Vestas' engineers to **fine-tune performance** - in unrelenting pursuit of **lower cost of energy**.

Americas
Brazil
Chile
Dominican Republic
Guatemala
Jamaica
Mexico
Uruguary
USA

Europe/Middle East/Africa
Austria
Belgium
Czech Republic
Croatia
Denmark
Finland
France
Georgia
Germany
Greece
Italy
Jordan
Netherlands
Norway
Poland
Romania
Serbia
Spain
Sweden
Switzerland
Turkey
Ukraine
United Kingdom
South Africa

Asia-Pacific
Australia
South Korea



*All Vestas turbines, not specific to 4 MW

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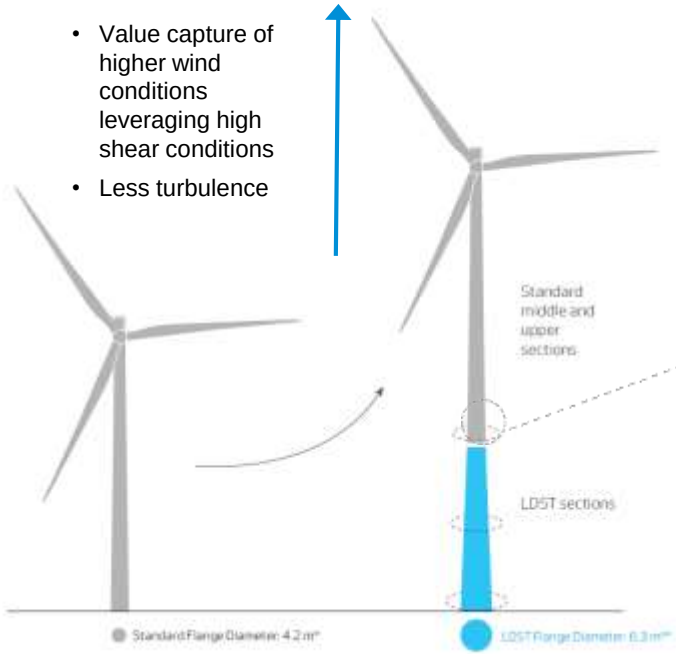
Product innovation: tower design

- Value capture of higher wind conditions leveraging high shear conditions
- Less turbulence



Vestas **InteliLight®**

- Going higher (>150mTH / 180mTH) also comes with challenges

Up to **+20%** AEP*

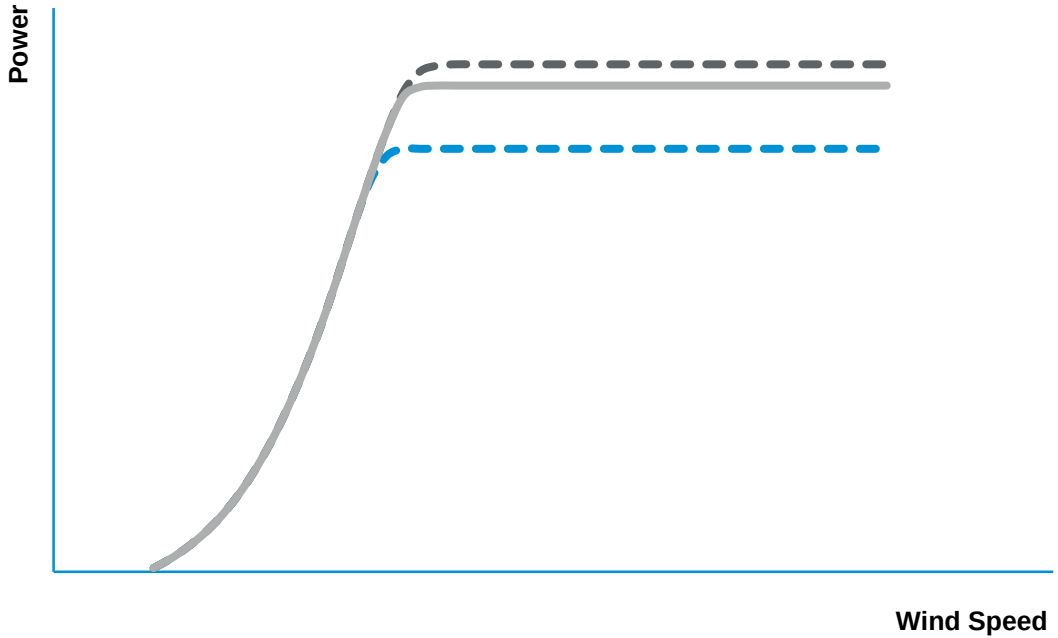
Site-specific height, harvest wind resources

Integrated, proven and safe system certified

* Going higher can result in AEP gains of up to 20%. Based on V126-3.45 MW™, hub height: 166 m (LDST tower) compared to hub height: 117 m (standard tubular steel tower) on a typical low-wind site.

Power/Load/Acoustic optimised modes

Adjustment of active power generation given site specific constraints



Power modes

- To achieve higher output
- Some operational limitations on temperature and reactive power

Load modes

- Load mitigation

Acoustic modes

- Sound mitigation as required given acoustic compliance requirements

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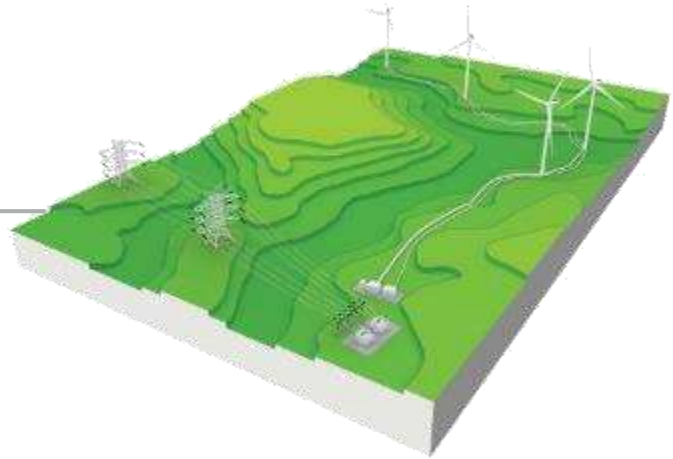
Grid connection

Optimised grid compatibility and customised output control

Accurate Electrical Pre-Design simulates can ensure plant performance and can help to ensure any additional equipment required is kept to a minimum

Optimised Power Plant Controllers can accurately control the output of the wind power plant at the Point of Common Coupling, ensuring curtailment and WTG reliability is optimized.



Future development

Cable Stayed Tower Technology

Efficient steel tower based on proven cable technology - enabling higher hub heights while improving transportability.

Challenging the scaling rules

The world’s first on-grid, utility-scale hybrid project

Vestas partners with Windlab to help accelerate the transition to a renewable energy mix

Located in Queensland Australia, Kennedy Energy Park Phase I is a hybrid wind / solar / storage project that will help accelerate the transition to an energy mix led by renewable energy while complying with Australia’s strict grid requirements.

The project features 43.2 MW of Vestas’ V136-3.6 MW wind turbines, while a customised Vestas solution will provide power plant control that enable wind, solar and storage to work together as an integrated power plant.

“*Kennedy Energy Park places Vestas at the forefront of sustainable energy solutions and is a testament to how we are providing solutions that make renewable energy more cost-competitive and grid compliant,*” said Johnny Thomsen, Senior Vice President, Product Management for Vestas.

Announced Q3/2017

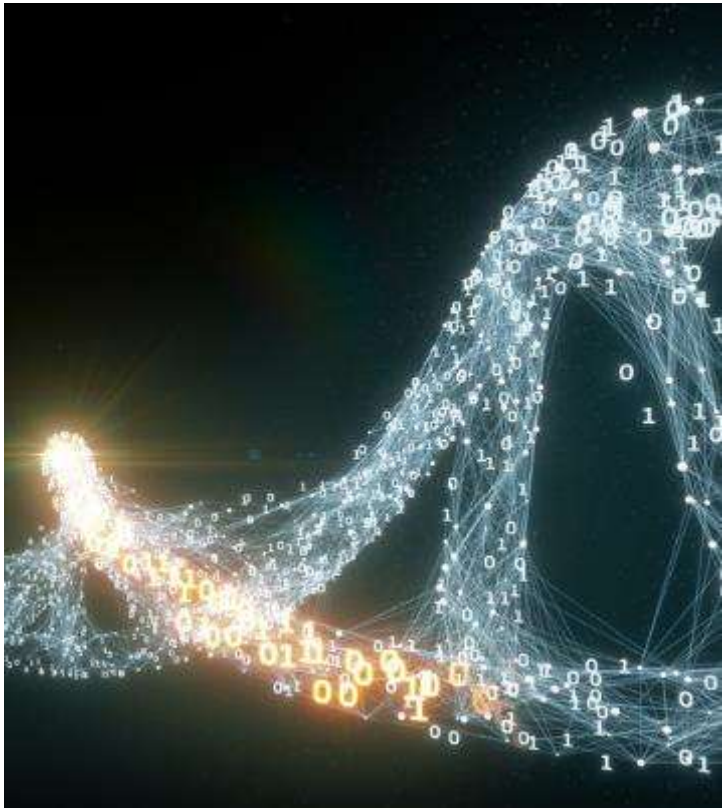
Vestas acquires energy analytics and digital solutions provider

Vestas is creating a digital powerhouse with acquisition of Utopus Insights

Vestas is taking a big step in meeting the digital needs of its customers with the acquisition of Utopus Insights, a leading energy analytics and digital solutions provider.

The acquisition directly supports Vestas' aim to provide customers with digital solutions that add additional value to our service offerings, leverage Vestas' industry-leading inventory of data and lead the industry in supporting the uptake of more renewable energy.

"By joining our unequalled experience and data repository with Utopus Insights' incomparable data analytics expertise, we are creating a digital solution powerhouse that will enable us to meet and exceed our customers' needs," says Christian Venderby, Group Senior Vice President and Head of Service at Vestas.



Announced Q4/2017