Global Wind Development Update

Ben Backwell, GWEC

Vietnam Wind Power,

Hanoi, 12 June 2019

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GWEC – Representing the global wind energy industry

- GWEC is **the trade association for the global wind energy industry**
- It's membership is made up of **the leading international wind developers, turbine and other equipment manufacturers and service companies**
- GWEC also groups together all the **leading wind energy associations** around the world (e.g. Wind Europe, AWEA, ABEEOLICA, IWTMA etc)
- It is **the most active lobbying body for the sector**, and plays a leading role in opening up and developing new markets for the wind industry
- It works with the **leading global institutions which influence policy for the wind industry**, eg IRENA, IEA-RIAB, UNFCCC, World Bank IFC, and has good relationships with adjacent technologies such as solar PV and storage

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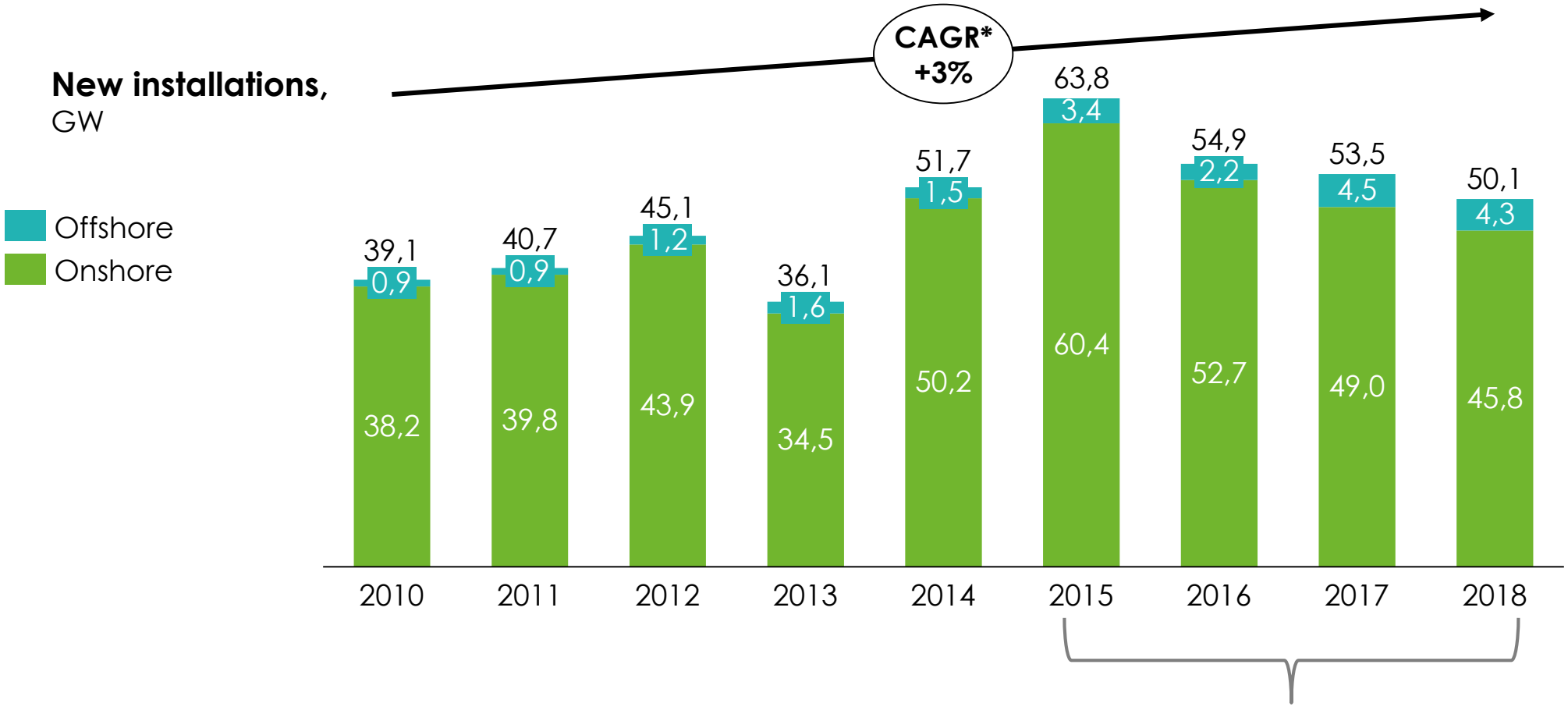
Impressive growth for the wind energy industry



- Over **200 GW new capacity** added during the last four years
- That is **over two-thirds of the total** installed capacity of 600 GW

* CAGR - Compound Annual Growth Rate
Source: GWEC Market Intelligence Global Wind Report 2018

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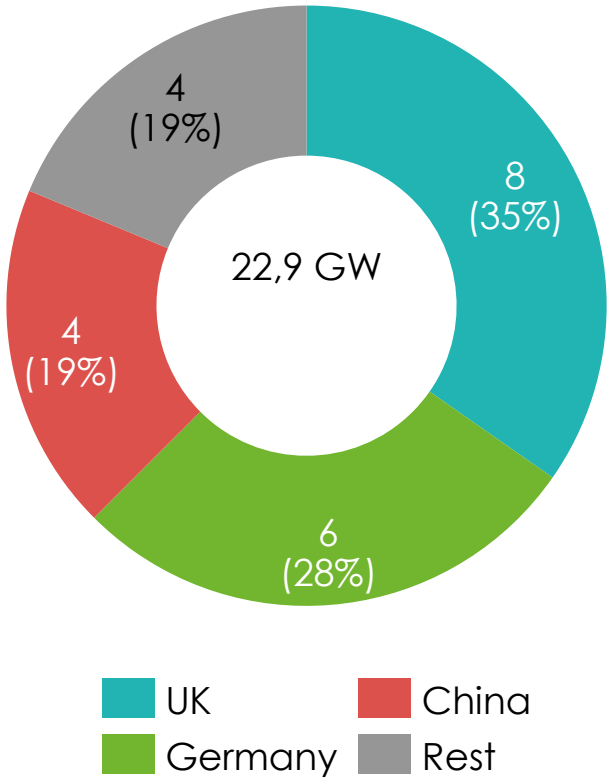
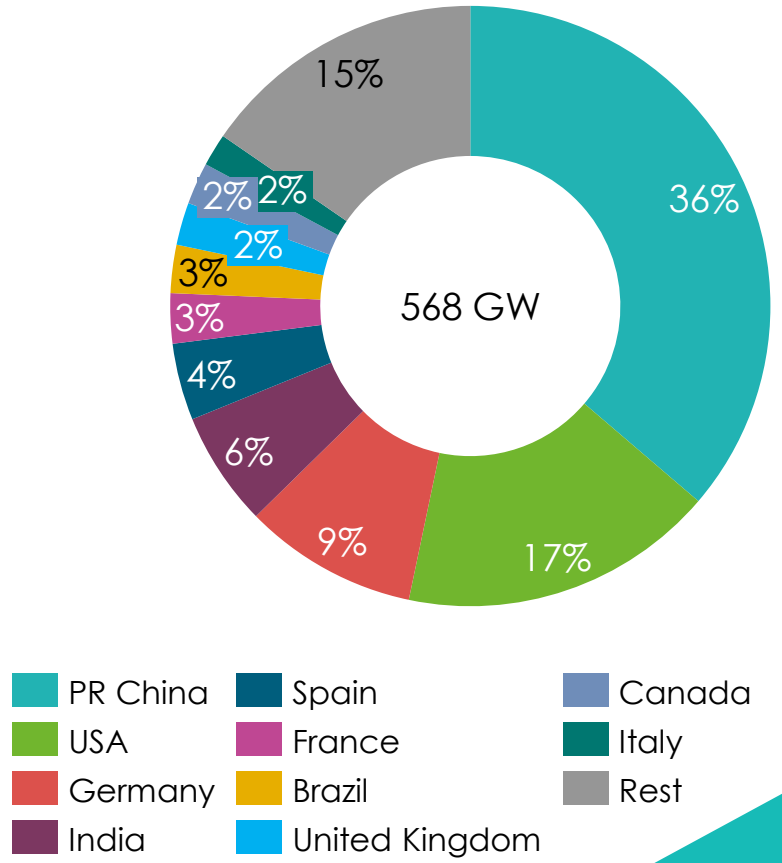
Wind energy is a truly global market

Total offshore installations,
GW and per cent



Total onshore installations,
GW and per cent



Source: GWEC Market Intelligence Global Wind Report 2018

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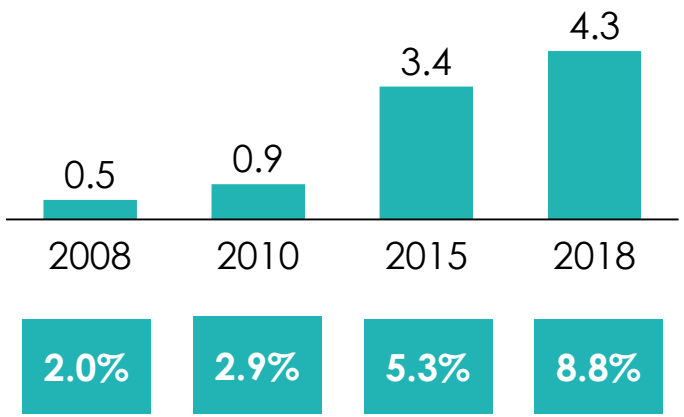
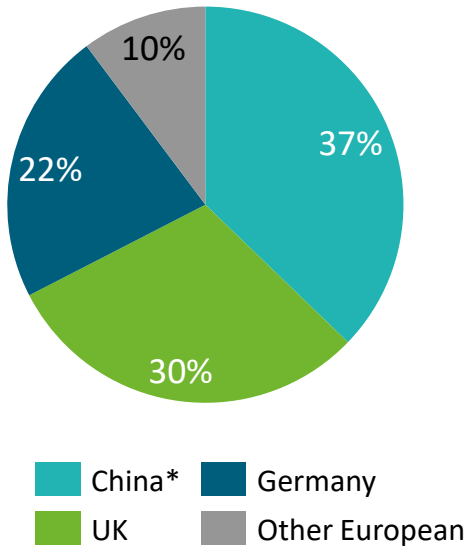
Offshore wind growing globally and gaining ground

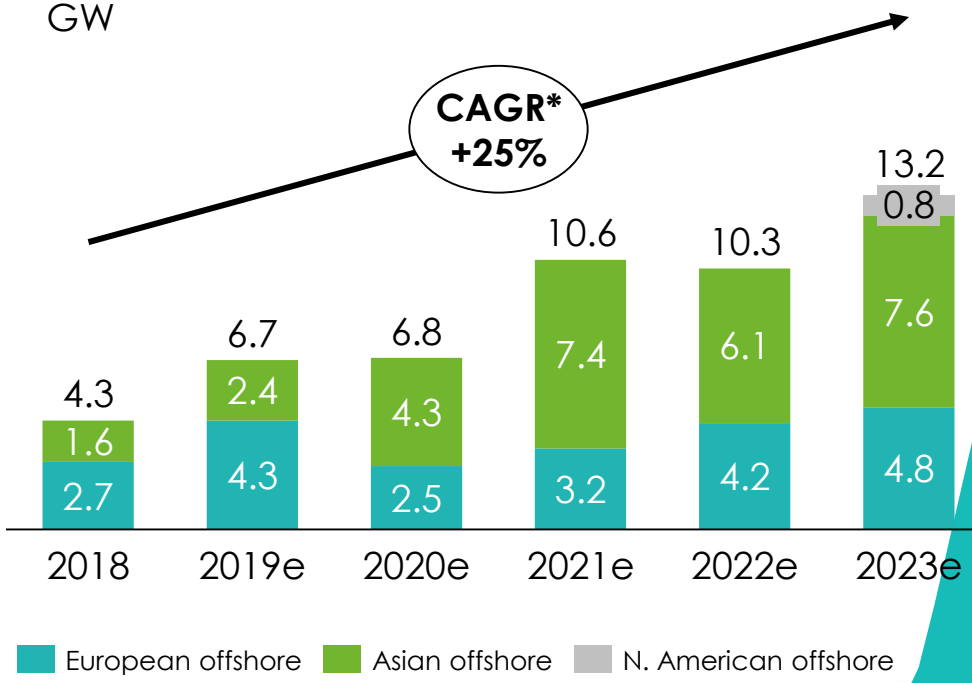
New offshore installations and offshore share of total installations,
GW and per cent



New installations 2018
Per cent
100% = 4.3GW



New installations - GWEC's Market Outlook on the global offshore market,
GW



* Compound Annual Growth Rate
Source: GWEC Market Intelligence

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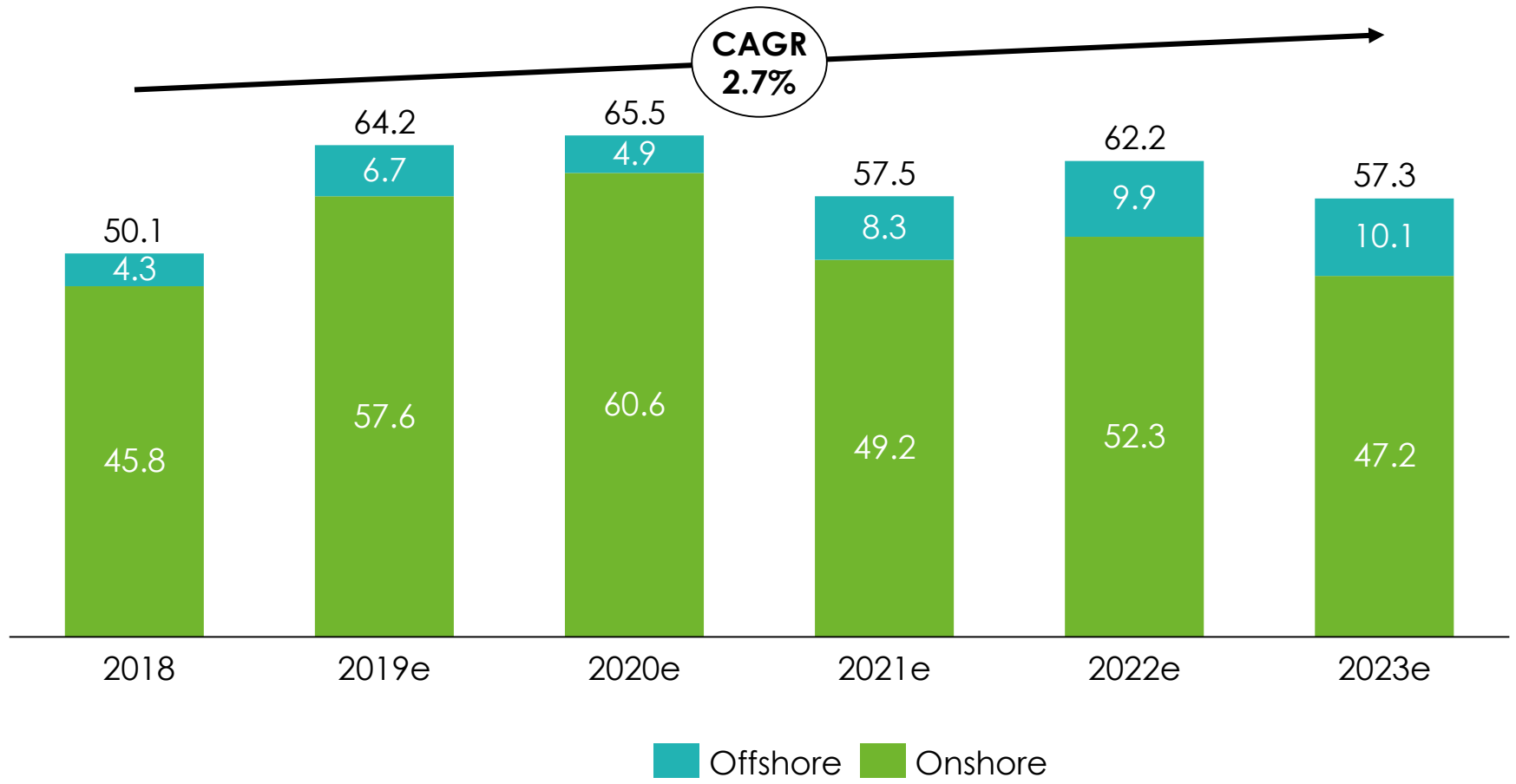
GWEC's outlook on the growth of the wind industry

New installations
GW



* Market size for 2018 adjusted based on updated installation figures for China as of April 2019
Source: GWEC Market Intelligence

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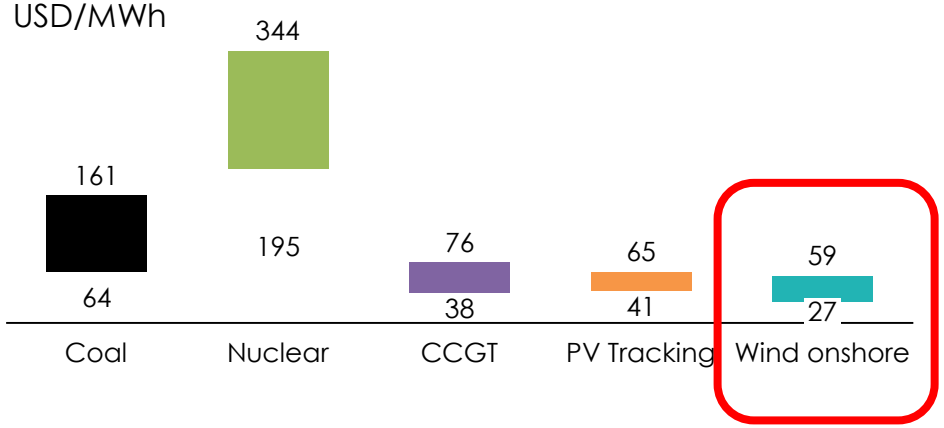
Wind energy is cost-competitive vs other power sources

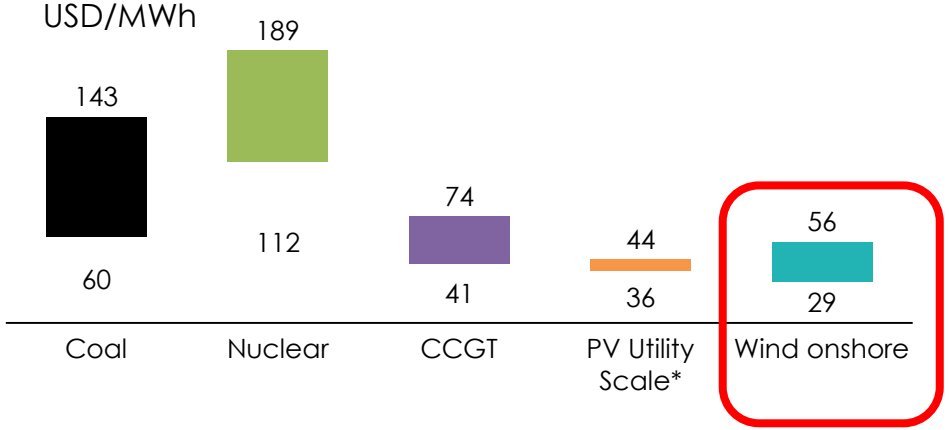
BNEF – LCOE for key energy sources in the US

USD/MWh



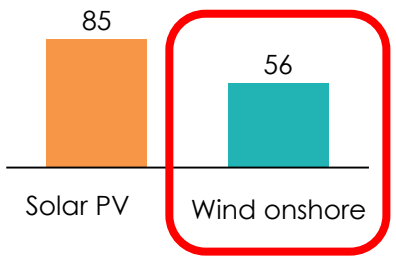
Lazard – LCOE for key energy sources in the US

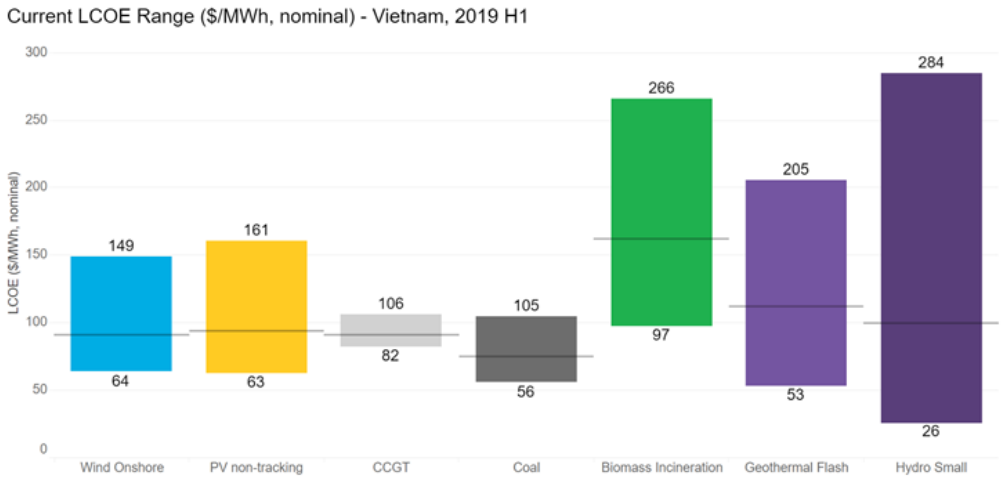
USD/MWh



IRENA – Weighted-average cost of electricity

USD/MWh





* Lower end refers to tracking, higher end refers to fixed system

Source: Lazard November 2018, BloombergNEF LCOE Update Q1 2019

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Wind energy is a maturing and competitive industry

Decreasing turbine pricing

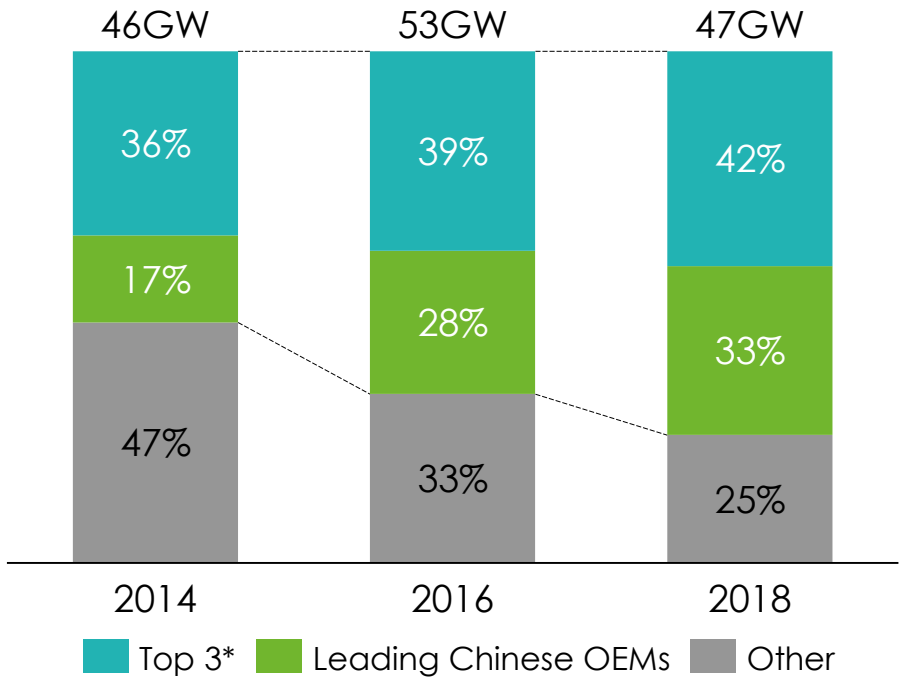
Onshore, USD/ MWh

* Siemens and Gamesa combined for 2014 and 2016

Source: GWEC Market Intelligence, BloombergNEF H2 2018 Wind Turbine Pricing Index

Market shares of top 3 and Chinese OEMs show market dominance

Onshore, per cent



Top 3 – Vestas, GE Renewables, Siemens Gamesa Renewables*

Leading Chinese OEMs – Goldwind,Guodian Mingyang, Envision

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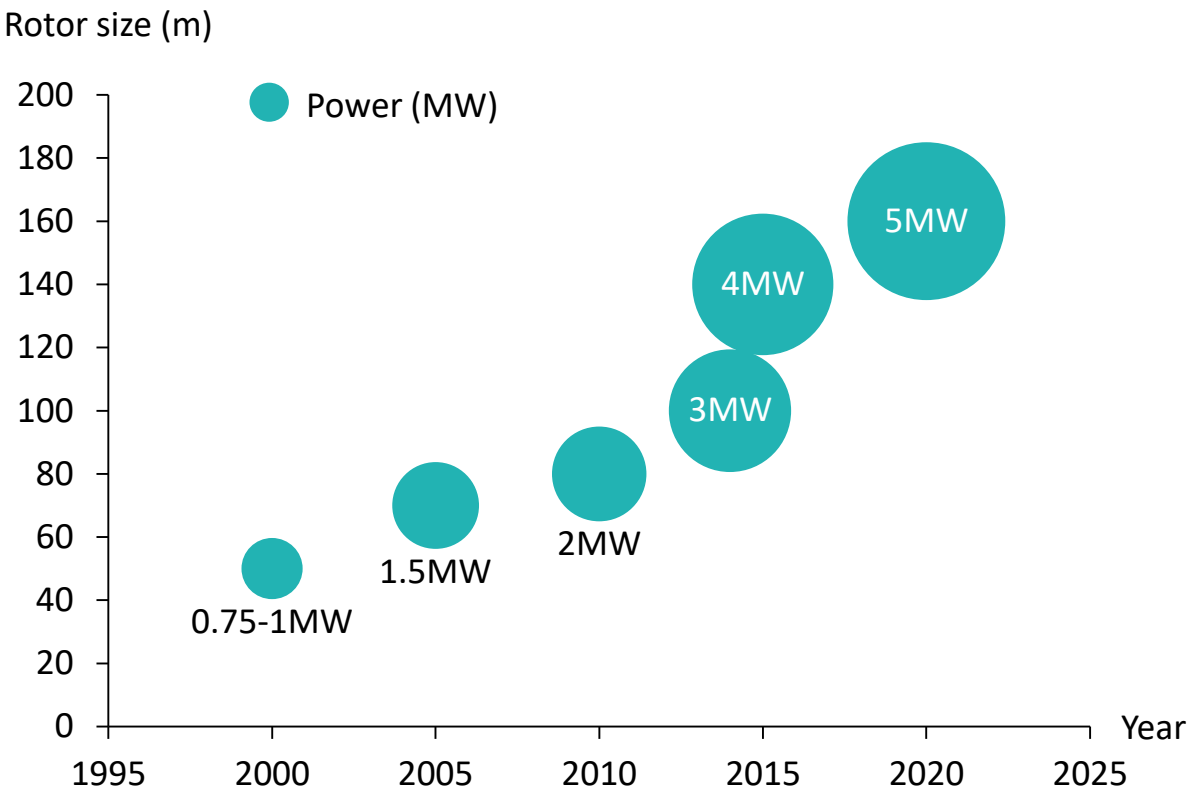
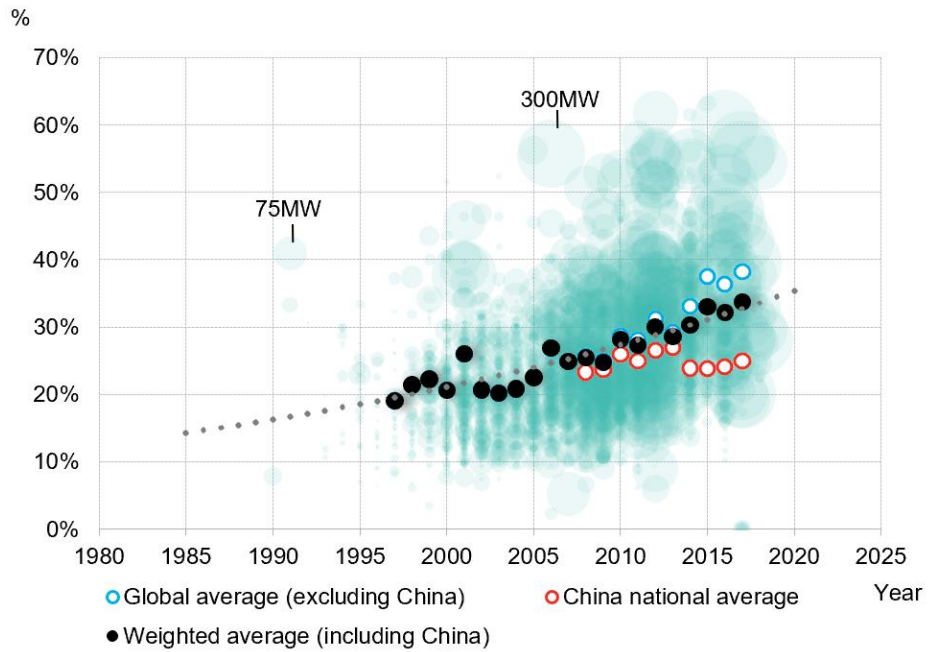
Innovation and efficiency are key growth drivers

Turbine sizes and power rating to increase
Onshore wind turbine size development*



Capacity factors continue to improve
Development of onshore wind capacity factor, per cent



* Average turbine size
Source: GWEC Market Intelligence, WindEurope, BNEF

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Vietnam's economic growth needs competitive power

- Vietnam's GDP is growing by 7% per year, with population reaching 100mn
- Vietnam's power demand is growing at a rate of 10% per year and installed capacity is set to reach 12.5GW by 2030 from 47GW at present, overtaking that of the United Kingdom, by the mid 2020s
- This growth in generation capacity requires **$150bn in new investment over the coming decade - almost twice the $80bn Vietnam has spent on its power sector since 2010**
- Vietnam has abundant and strong wind resources both onshore and offshore and is an attractive investment destination, so the sector has a huge opportunity to develop and build the capacity that the country needs

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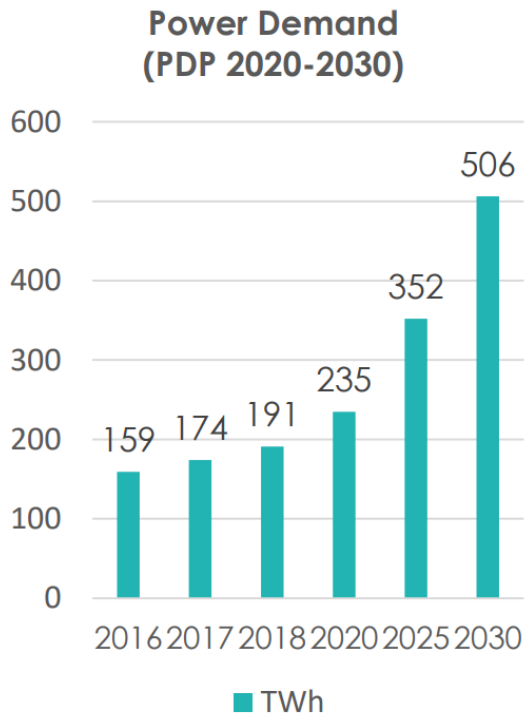
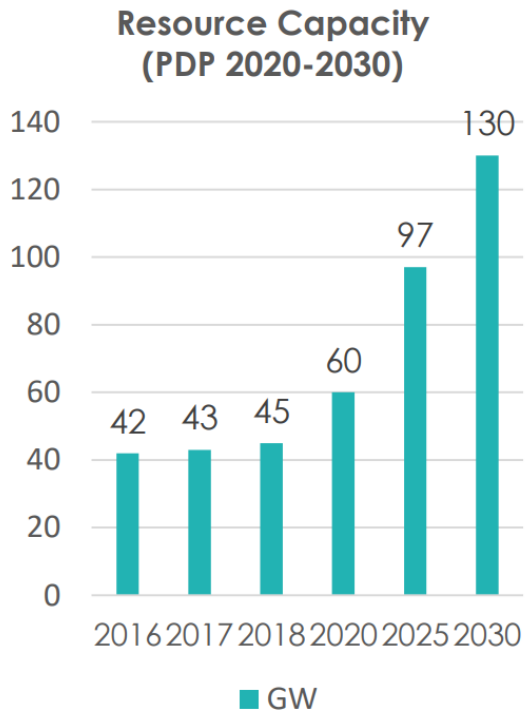
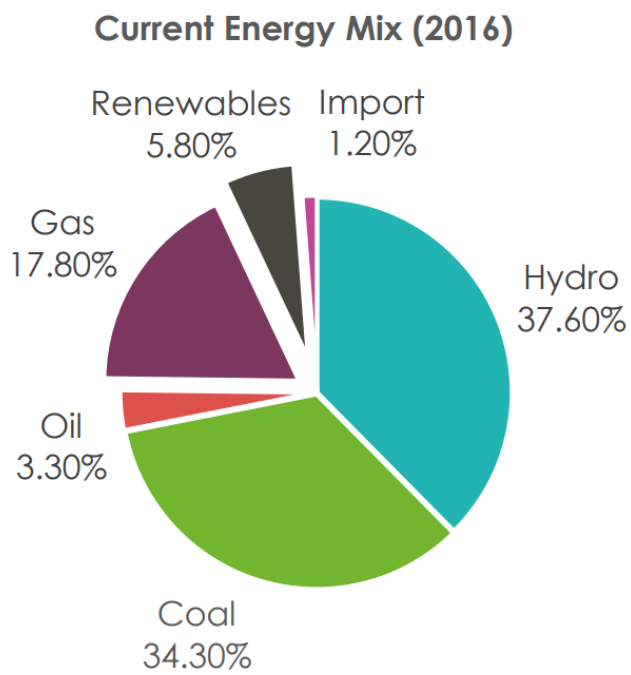
Huge potential for onshore and offshore wind in Vietnam







Source: GWEC Market Intelligence "Insights on Vietnam" June 2019

Vietnam's wind revolution is underway…

- Vietnam has installed wind power capacity of 327 MW at present according to GWEC figures, and is set to hit 1GW of capacity in 2021 and 6GW of capacity by 2030.

- There are around 80 further wind projects are registered with the Ministry of Industry and Trade (MOIT), as developers seek to benefit from FITs for projects operational by 2021.

- Large-scale offshore projects are also advancing – although outside of those already in advanced permitting stages, offshore projects face a narrow margin of time to get commissioned ahead of the 2021 deadline.

- **This is based on what is already planned. But we think Vietnam can and must go a lot further in developing its wind resources**

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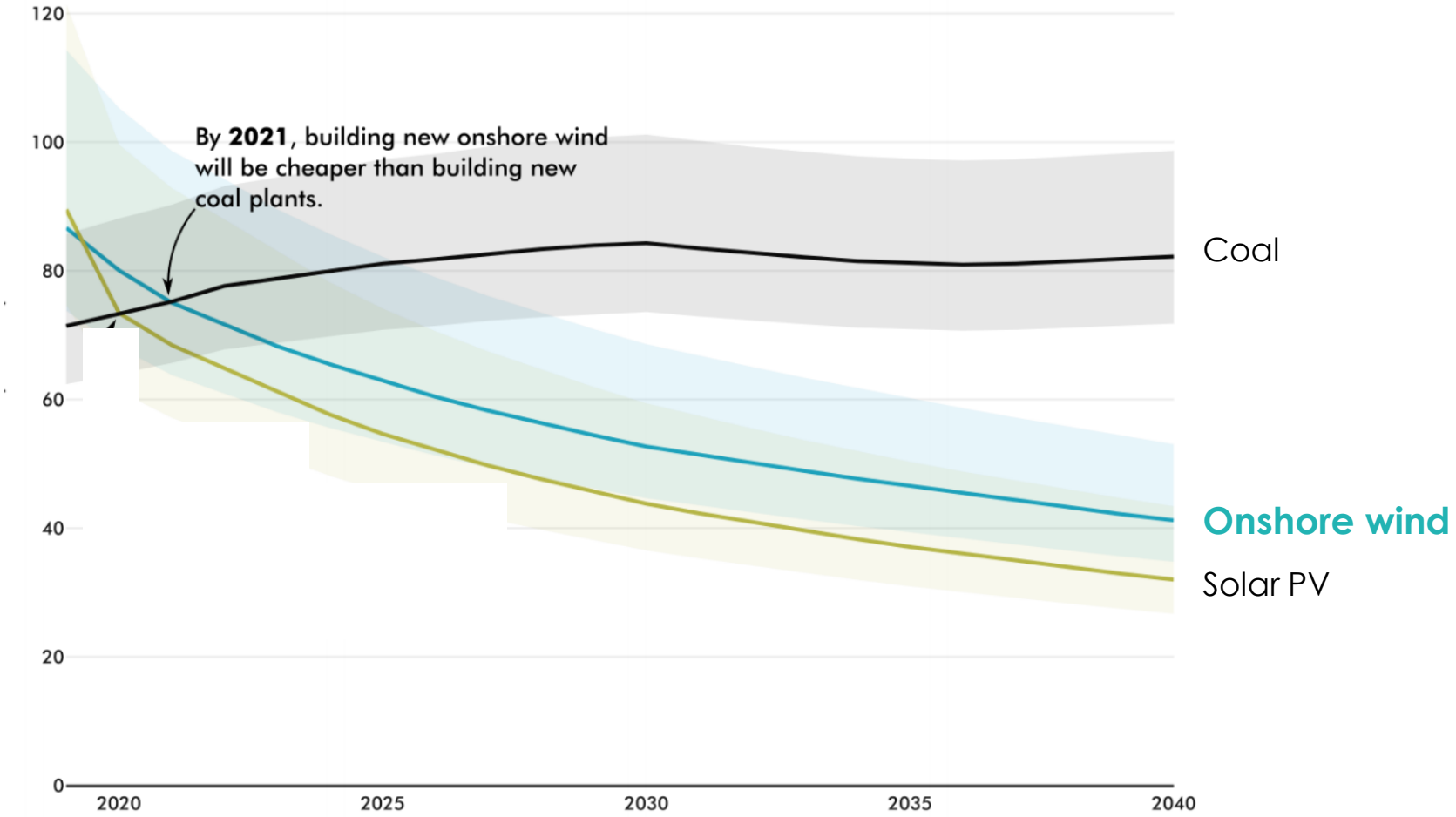
LCOE forecast for Vietnam shows costs will decrease steadily

LCOE for coal, onshore wind and solar PV in Vietnam

USD/MWh



Source: GWEC Market Intelligence, Carbon Tracker "Here comes the sun and wind" June 2019) based on BloombergNEF 2018/19

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Current trajectory for coal use is unsustainable

- Coal use rose by 75% in the five years to 2017, **faster than any other country in the world**.
- So while power demand is set to double, coal's share would growth from 33% to 56% under the current scenario, putting Vietnam on an **unsustainable path in terms of its carbon emissions, in terms of national security, and in terms of the health impact on its people**
- IEEFA estimates that Vietnam already spends each year 1.3bn USD on coal imports. If the present course continues, imports could reach as high as 110mn tonnes per year between 2030-2040, compared to current annual demand of 63mn tonnes
- Meanwhile, the cost of wind power and solar continues to fall undermining the investment case for new capacity. If Vietnam continues to invest in coal, the government will need to subsidize coal in order to prevent rising cost of coal from impacting consumer prices
- **Coal is a technology of the 19th and 20th centuries, while wind power is a technology of 21st Century, that will allow Vietnam to continue to industrialise efficiently and compete in the digital economy**

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Wind and renewables are set to play an increased role….

- **We believe the level of new build coal capacity currently foreseen will not be built, given the risk of creating tens of billions of dollars of stranded assets and the impacts on Vietnam that we have outlined**

- The revised PDP 7 already marked a significant change of emphasis towards renewable energy when it was published in 2016, foreseeing 10.7% of power demand to be supplied by renewables in 2030, including 6GW of wind power.

- And we are confident that PDP 8, when it is published this year, will continue to shift emphasis towards the installation of more new renewable energy capacity

- As the benefits of joining the wind energy revolution become ever clearer, the government and people of Vietnam will move decisively to build its wind energy industry and phase out reliance on coal

"One of Vietnam's priorities is to develop renewable energy sources to gradually reduce its reliance on traditional sources of electricity to protect the environment," Deputy Minister of Industry and Trade Cao Quoc Hung

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Addressing risks to deploy wind energy in Vietnam

1	**Land Risk**	• Challenges around **land ownership** and **acquisition** • Unclear **processes** to mark land as usable for wind energy
2	**Financial Risk**	• **Local processes** not in place to **mitigate financial risk** due to lack of experience
3	**Technical Risk**	• Lack and poor **quality of wind data** • Inexperienced **balance of plant contractors** • Insufficient **grid capacity** and **transmission upgrades**
4	**PPA Risk**	• Credit risk of **national offtakers** • Falling below **international contractual standards** (e. g. arbitration, force majeure)
5	**Construction Risk**	• Lack of qualified **local workforce**

Source: GWEC Market Intelligence "Insights on Vietnam" June 2019

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Wind sector will develop quickly to create conditions for accelerated growth

- There is of course, still lots to do to create a dynamic sustainable wind industry in Vietnam
- Market design for the period following the expiry of Feed-in-Tariffs in 2021 needs to be defined
- And crucially **we need to build the supply chain and create the skills and jobs that will allow the wind sector to grow and put down strong roots in Vietnam**

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GWEC – working with you to build a new energy system

- GWEC is very committed to partnering with Vietnam to build a future energy system and attract large amounts of investment to the sector – collectively the industry invested $204bn in 2018 alone
- We have experience of working with governments around the world on policy issues and technical issues and taking the best experiences and knowledge from countries that have already built successful wind industries.
- And we have experience of setting up trade associations and industry forums which play a vital role in creating a local supply chain and jobs.
- Working together, we can create a sustainable energy future for Vietnam
- Thank you!

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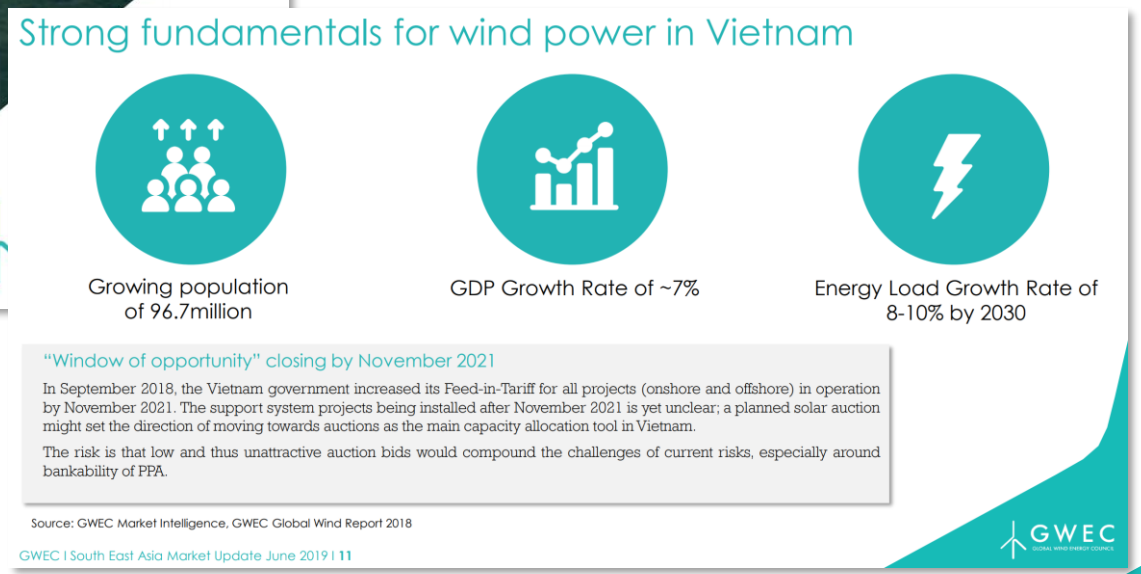
GWEC Market Intelligence “Insights on Vietnam”

Full report available on GWEC’s Market Intelligence website



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Back-up

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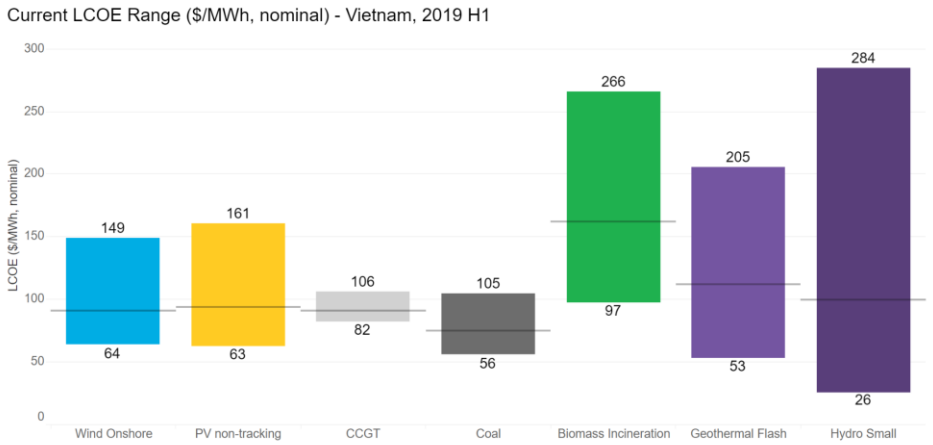
Benefits of wind energy in South-East Asia

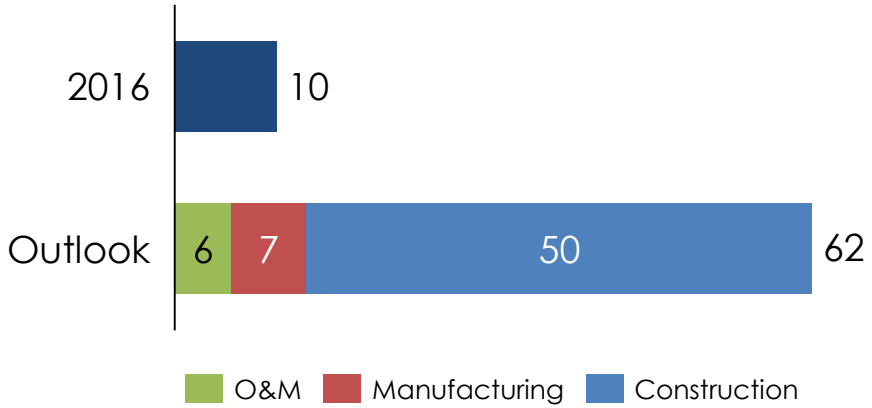
Onshore wind is a cost-competitive solution – Example Vietnam



Source: BloombergNEF LCOE Update H1 2019

Steady job growth expected for wind energy

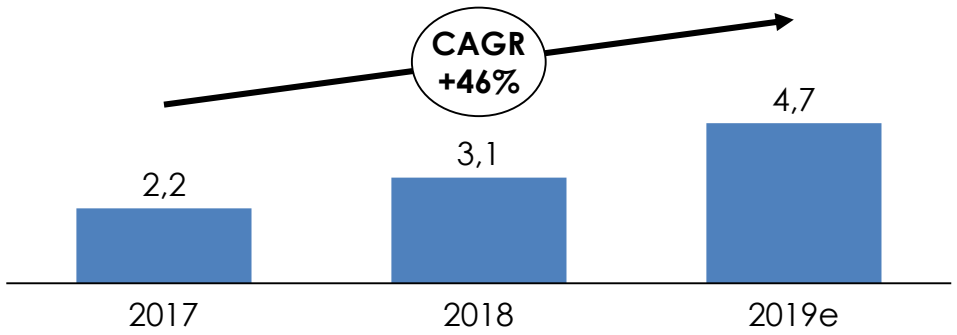
'000 jobs



Source: IRENA Renewable Energy Market Analysis – South East Asia

Over the past three years, onshore wind was able to double its generation

TWh, Indonesia, Philippines, Thailand, Vietnam



Source: IEA Renewable 2018

Investment in wind energy in SEA during 2016

Despite large investment in fossil fuels, during 2016 almost 600bn USD were invested in wind energy in SEA markets

Wind is the third largest investment area for renewable energy in SEA

Source: IRENA Renewable Energy Market Analysis – South East Asia

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Modularization to improve cost competitiveness of wind energy

Areas impacted by modularization	Rational for modularization	Expected cost reduction
• Product design • Component Sourcing • Manufacturing/ Assembly • Transport/ logistics • Installation • Service/ maintenance	• Better and faster response to changing market conditions • Increased options for configuration • Easier scalability (e. g., rotor extension) without major design changes	• Standardization of components and larger production volume for large components • Reduced installations time • Reduced logistic and transportation cost

Source: GWEC Market Intelligence, WindpowerMonthly, Enercon, Vestas

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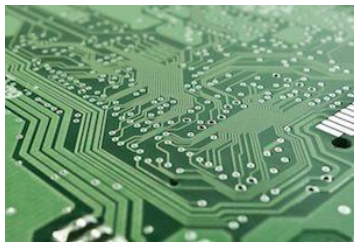
Digitalization – potential to revolutionize wind energy

Technical applications/ Internet of Things



Data analytics

- Improved **reliability** and **availability**
- Better **predictability** of maintenance needs
- More data insights for better **asset management** across fleets

Unlocking potential

Performance | **Risk Mgmt.** | **Productivity**

⇒ **Increased Annual Energy Production, increased return opportunities**

⇒ **Better risk management, improved maintenance**

⇒ **Safe return opportunities increase attractiveness to invest in wind energy**

Source: GWEC Market Intelligence, IEA, Envision, GE Renewables

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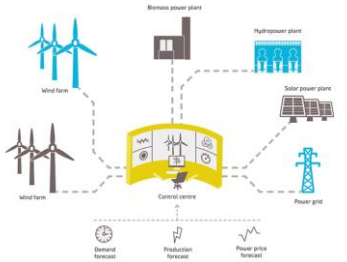
Increased focus on system integration an opportunity for wind

Co-location, Hybrid solution

- Wind energy plus another energy source and/ or a storage solutions
- Fully integrated or combination of several projects
- Sharing of grid access as key element

Complementary solution/ virtual power plant

- Two wind energy projects in different locations
- Virtually managed as complementary solution



Financial solution
(Corporate Sourcing models, free market mechanism/ trading)

- Financial solution with or without physical delivery of electricity
- Includes tools like corporate PPAs, risk management and revenue swaps

Onsite provision, off-grid solutions

- Micro-grid or decentralized solution
- Can include storage or complimentary energy source to secure supply

Source: GWEC Market Intelligence, Industry experts, Windlab, Equinor (Statkraft), Gamesa

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Thank you!

For more information please contact:

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