Global Wind Power Acceleration
Ben Backwell, GWEC

REVision - Tokyo, 6 March 2019
Ben Backwell - CEO of GWEC
Author of *Wind Power, the Struggle for Control of a New Global Industry* (Taylor and Francis, 2017)
Former industry consultant (FTI Consulting, Wind Europe)
Former energy journalist and analyst, covering energy policy and markets for 15 years.
CO Members

• Acciona
• LM Wind Power
• DNV-GL
• Envision
• Iberdrola Renewables
• Shell

C1, C2, and C3 Members

• Mainstream Renewable Power
• Ingeteam
• Vaisala
• Bachmann
• NRG Systems
• The Switch
• PfE Wind
• WKN AG
• Mita-Teknik

Associations

• ABE Edifica
• AWEA
• Anev
• amdeer
• audee
• BWE
• Canadian Wind Energy Association (CanWEA)
• CREIA
• CEA
• DWEA
• DWEA
• JWEA
• JWPA
• Korea Wind Power Association
• SAWEA
• VDMA
• Wind Europe

GWEC
Wind energy is a maturing and competitive industry

Decreasing turbine pricing
Onshore, USD/ MWh

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, Envision, Mingyan, UP

* Siemens and Gamesa combined for 2014 and 2016
Source: GWEC Market Intelligence, BNEF H2 2018 Wind Turbine Pricing Index
Decreasing LCOE secures competitive position for wind

**Onshore - Forecasted LCOE**  
USD/ MWh, Examples Japan and Germany, onshore

**Offshore - Forecasted LCOE**  
USD/ MWh, global offshore

Source: BNEF H2 2018
Market-based mechanisms dominate the global wind market

**Support scheme and capacity allocation mechanism**
Status Jan 2019

- Technology-specific auctions and tenders (“Wind only”) dominate to allocate onshore and offshore capacity
- Several markets have or plan to move to neutral or joint technology auctions to increase competition and reduce cost even further

**Auction capacity for wind**
MW, capacity captures by wind during auctions

<table>
<thead>
<tr>
<th>Year</th>
<th>Offshore</th>
<th>Onshore</th>
</tr>
</thead>
<tbody>
<tr>
<td>2016</td>
<td>3</td>
<td>6</td>
</tr>
<tr>
<td>2017</td>
<td>9</td>
<td>19</td>
</tr>
<tr>
<td>2018</td>
<td>3</td>
<td>15</td>
</tr>
<tr>
<td>2019e</td>
<td>~20</td>
<td></td>
</tr>
</tbody>
</table>

Source: GWEC Intelligence, National sources
Competitive pressure due to decreasing bids and prices

Average winning auction bids – Example Germany
EUR/ MWh, onshore wind

Global turbine prices – excluding China
USD/ MWh

Despite recovering auction bids and adapted auction rules, support level is 30% below FIT

Source: GWEC Intelligence, BNEF Wind Turbine Pricing Index Dec 2018
Innovation and efficiency are key growth drivers

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

Rotor size (m)

0.75-1MW
1.5MW
2MW
3MW
4MW
5MW

Power (MW)

Year


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

Global average (excluding China)
China national average
Weighted average (including China)

* Average turbine size
Source: GWEC Market Intelligence, WindEurope, BNEF
## Modularization to improve cost competitiveness of wind energy

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

Source: GWEC Market Intelligence, WindpowerMonthly, Enercon, Vestas
Digitalization – potential to revolutionize wind energy

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

Unlocking potential

- 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
Growing wind industry leads to OEM consolidation and new asset owners

Recent merger/acquisitions of leading turbine manufacturers

Examples

**Y2015**
- Acciona Group takes over Nordex and **Nordex** integrates Acciona’s wind turbine business
- As part of a larger acquisition, **GE Renewables** integrates Alstom’s wind business

**Y2016**
- Siemens Wind and Gamesa form **Siemens Gamesa Renewables**
- **GE Renewables** buys leading blade manufacturer LM Wind Power
- **Enercon and Lagerwey** build a strategic partnership

**Y2017**
- **Vestas** buys energy analytics company **Utopus**

**Y2018**
- Acquisition rumors concerning **Suzlon, Senvion**

Changes among the leading wind asset owners

Examples

Since 2015, corporates have signed 14GW of PPA for wind assets

<table>
<thead>
<tr>
<th>Year</th>
<th>Leading wind asset owners are utilities</th>
</tr>
</thead>
</table>
| 2012 | - Guodian  
- Iberdrola  
- NextEra |

**Table 3: Top 20 wind asset owners (cumulative capacity YE 2018)**

<table>
<thead>
<tr>
<th>Rank</th>
<th>Owner</th>
<th>Cumulative Capacity 2018 (GW)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>China Guodian Corporation</td>
<td>13.7</td>
</tr>
<tr>
<td>2</td>
<td>Iberdrola</td>
<td>13.3</td>
</tr>
<tr>
<td>3</td>
<td>NextEra</td>
<td>10.3</td>
</tr>
<tr>
<td>4</td>
<td>China Gamesa Corporation</td>
<td>9.7</td>
</tr>
<tr>
<td>5</td>
<td>China Sinovel</td>
<td>8.1</td>
</tr>
<tr>
<td>6</td>
<td>China Suzlon</td>
<td>7.4</td>
</tr>
<tr>
<td>7</td>
<td>GE Renewable Energy</td>
<td>6.9</td>
</tr>
<tr>
<td>8</td>
<td>Gamesa</td>
<td>5.7</td>
</tr>
<tr>
<td>9</td>
<td>Vestas</td>
<td>5.5</td>
</tr>
<tr>
<td>10</td>
<td>GE</td>
<td>5.0</td>
</tr>
<tr>
<td>11</td>
<td>Senvion</td>
<td>4.8</td>
</tr>
<tr>
<td>12</td>
<td>Repower</td>
<td>4.0</td>
</tr>
<tr>
<td>13</td>
<td>Iberdrola</td>
<td>3.7</td>
</tr>
<tr>
<td>14</td>
<td>NextEra</td>
<td>3.3</td>
</tr>
<tr>
<td>15</td>
<td>Enel</td>
<td>3.0</td>
</tr>
<tr>
<td>16</td>
<td>SSE</td>
<td>2.0</td>
</tr>
<tr>
<td>17</td>
<td>China Three Gorges</td>
<td>1.9</td>
</tr>
</tbody>
</table>

Large corporates, investors and financial companies steadily increase their ownerships of wind assets – leading to changes in return expectations

* Preliminary
Source: GWEC Market Intelligence, BNEF
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
GWEC’s outlook on the growth of the wind industry

New installations

GW

<table>
<thead>
<tr>
<th>Year</th>
<th>Offshore</th>
<th>Onshore</th>
</tr>
</thead>
<tbody>
<tr>
<td>2018</td>
<td>51.3</td>
<td>46.8</td>
</tr>
<tr>
<td>2019e</td>
<td>64.2</td>
<td>57.6</td>
</tr>
<tr>
<td>2020e</td>
<td>67.3</td>
<td>60.6</td>
</tr>
<tr>
<td>2021e</td>
<td>59.9</td>
<td>49.2</td>
</tr>
<tr>
<td>2022e</td>
<td>62.6</td>
<td>52.3</td>
</tr>
<tr>
<td>2023e</td>
<td>60.4</td>
<td>47.2</td>
</tr>
</tbody>
</table>

CAGR: 3.3%

Source: GWEC Market Intelligence
Asia, Latin America and offshore will drive future growth

<table>
<thead>
<tr>
<th>Total new capacity between 2019 to 2023 (MW)</th>
<th>Key growth drivers</th>
</tr>
</thead>
<tbody>
<tr>
<td>LatAm onshore* 16,000</td>
<td>➢ Stable auction schemes and government commitment</td>
</tr>
<tr>
<td>SE Asia onshore 4,500</td>
<td>➢ Strong government commitment and competitiveness of wind vs. fossils</td>
</tr>
<tr>
<td>Global offshore 47,000</td>
<td>➢ Cost competitiveness, efficiency increases and strong government commitment</td>
</tr>
<tr>
<td>China onshore 100,000</td>
<td>➢ Progress towards market-based mechanisms and competitiveness of wind</td>
</tr>
<tr>
<td>Europe onshore 63,000</td>
<td>➢ Stable auction, support schemes and competitiveness of wind</td>
</tr>
<tr>
<td>N America onshore 47,000</td>
<td>➢ Competitive economics of onshore wind</td>
</tr>
</tbody>
</table>

* Including Mexico
Source: GWEC Intelligence
**Offshore wind growing globally**

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

<table>
<thead>
<tr>
<th>Year</th>
<th>Installations</th>
<th>Share (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>2008</td>
<td>0.5</td>
<td>2.0%</td>
</tr>
<tr>
<td>2010</td>
<td>1.0</td>
<td>2.9%</td>
</tr>
<tr>
<td>2015</td>
<td>3.4</td>
<td>5.3%</td>
</tr>
<tr>
<td>2018</td>
<td>4.5</td>
<td>8.8%</td>
</tr>
</tbody>
</table>

New installations 2018

- Per cent
- 100% = 4.5GW

- China*: 37%
- Germany: 10%
- UK: 30%
- Other European: 10%

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

- CAGR: +24%

<table>
<thead>
<tr>
<th>Year</th>
<th>European offshore</th>
<th>Asian offshore</th>
<th>N. American offshore</th>
</tr>
</thead>
<tbody>
<tr>
<td>2018</td>
<td>4.5</td>
<td>1.8</td>
<td>1.8</td>
</tr>
<tr>
<td>2019e</td>
<td>6.7</td>
<td>2.4</td>
<td>2.5</td>
</tr>
<tr>
<td>2020e</td>
<td>6.8</td>
<td>4.3</td>
<td>2.5</td>
</tr>
<tr>
<td>2021e</td>
<td>7.4</td>
<td>3.2</td>
<td>4.2</td>
</tr>
<tr>
<td>2022e</td>
<td>10.3</td>
<td>6.1</td>
<td>4.8</td>
</tr>
<tr>
<td>2023e</td>
<td>13.2</td>
<td>7.6</td>
<td>0.8</td>
</tr>
</tbody>
</table>

* Preliminary
Source: GWEC Market Intelligence
Thank you!

For more information please contact:

Ben Backwell | ben.backwell@gwec.net

Karin Ohlenforst | karin.ohlenforst@gwec.net