Australian Wind Industry & GE Project Update

GE Renewable Energy
Wednesday, May 2nd
Today’s Agenda

- General Introduction
- Australian Wind Industry
- GE Projects
- Technology Update
GE Renewable Energy

Onshore Wind

Offshore Wind

Hydro

LM Wind Power

$10.3B
2017 REVENUE

60+
COUNTRIES

22,000+
GLOBAL EMPLOYEES

400+GW
INSTALLED BASE

25%
OF WORLD’S HYDRO INSTALLED BASE

35,000+
WIND TURBINES INSTALLED GLOBALLY

14,000
TURBINES ON PREDIX

Unleashing limitless energy for our customers and the world
Renewables are Mainstream

Technology driving LCoE reduction

2017 LEVELISED COST OF ENERGY FOR NEW BUILD TECHNOLOGIES IN AUSTRALIA (AUD/MWH)

Source: Bloomberg New Energy Finance
## Evolution of the GE wind portfolio

### Addressing customer needs via a board portfolio

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GE enters the wind industry

Next gen turbine …
+70% rotor swept area in 4Y

Technology is essential to break the scaling laws … driving lower LCOE

Challenge:
Turbines do not scale linearly
Energy $\propto (\text{Radius})^2$
Noise $\propto (\text{Radius} \times \text{RPM})^5$ - (↑ torque, ↑ cost)
Loads $\propto (\text{Radius})^3$ - (↑ mass, ↑ cost)

Impacts logistics, installation, BOP, services & life cycle optimization

Australian Renewables

2017

• Mid 2015: bipartisan commitment to revised 33TWh RET (23% of Electricity)
• 2017 Closed or under construction
• 50 large-scale projects, AUD 9.3 Billion+ investment, 5440 jobs
• 2GW+ of wind
• 2GW+ of solar

Graphic: Green Energy Markets, Renewable Energy Index February 2018

Market Drivers
2018 onwards

• Federal Policy
  • NEG – Coalition target 26% emissions reduction on 2005 levels
  • Labour target 50% Renewables by 2030 – 17GW new build

• State Policy: Renewable Auctions
  • Victoria – 40% Renewables by 2025 – 5.4GW new build
  • Queensland – 50% Renewables by 2030 (currently 7%)

• Coal Plant Closures
  • 20 active coal plants with nameplate of 25GW
  • As of early 2017, 75% were operating beyond their original design life
GE Wind Farms

- **416MW Operating**
- **980MW In Construction**

### GE Wind Farms

<table>
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<th>No.</th>
<th>Site</th>
<th>Capacity (MW)</th>
<th>COD Year</th>
<th>Equipment</th>
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<td>Mumbida</td>
<td>61</td>
<td>2013</td>
<td>22 x GE 2.75-100</td>
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<td>2</td>
<td>Willogoleche</td>
<td>119</td>
<td>2018</td>
<td>24 x GE 3.8-130, 8 x GE 3.4-130</td>
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<td>3</td>
<td>Ararat</td>
<td>242</td>
<td>2017</td>
<td>75 x GE 3.2-103</td>
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<td>4</td>
<td>Boco Rock</td>
<td>113</td>
<td>2015</td>
<td>67 x GE 1.7-100</td>
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<td>5</td>
<td>Crookwell 2</td>
<td>96</td>
<td>2018</td>
<td>28 x GE 3.4-130</td>
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<td>6</td>
<td>Bodangora</td>
<td>113</td>
<td>2018</td>
<td>33 x GE 3.4-130</td>
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<td>7</td>
<td>Silverton</td>
<td>199</td>
<td>2018</td>
<td>58 x GE 3.4-130</td>
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<td>8</td>
<td>Coopers Gap</td>
<td>453</td>
<td>2019</td>
<td>91 x GE 3.6-137, 32 x 3.8-130</td>
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Ararat
Technology Update
4.2-117

A powerful turbine for extreme environments

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<th>50 Hz</th>
<th>4.2-117</th>
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| Specs | Max Vref 57m/s  
        | Vave 9.5m/s    |
| MW rated power | 4.23 MW (variable rating from 3.83 to 4.23) |
| Rotor Diameter | 117m |
| AEP at 8.5m/s | ~17GWh |
| Noise | 107dBA |
| IEC Certificate (type Cert) | 85/100m HH  
                              | (IEC 61400-22 ) |
| Technology | • Low noise trailing edge  
                        | • Lightning enhanced blade |

Strengthened drive train  
Electrical system upgrade  
Strengthened 56.9 blade w/ adapter  
Reinforced Tower
4.8-158: POWER MEETS EFFICIENCY

**GE's Largest, High Efficiency Onshore Turbine**

Innovative Blade Design by LM Wind Power

Captures Low Wind Speeds Like Never Before

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**Pitch System**
Independent blade pitch angle adjustment combined with generator torque enables rotor to regulate speed depending on wind conditions

**Hub**
Mounted on main shaft - can be entered through hatches located on the nacelle to simplify up-tower repairs

**Blades**
158 meter rotor diameter with blades from LM Wind Power

**Tower**
Hub heights available at 101m, 120.9m with tubular tower & 149m, 161m with hybrid concrete tower

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**Nacelle**
Larger nacelle platform brings more comfort to Service personnel and facilitates up-tower repairs

**Generator & Gearbox**
Based on a proven doubly-fed induction generator (DFIG) electrical system, available at 50 Hz & 60 Hz

**Control System**
Control system and digital integration including WindSCADA control system, Asset Performance Management (APM) and cybersecurity modules

**Electrical System**
High power density electrical system for performance and grid integration

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**NOMINAL CAPACITY**
- 4.8 MW

**CAPACITY FACTOR**
- 46%-49%

**ANNUAL ENERGY PRODUCTION**
- ~13.4GWh to ~21GWh

**ROTOR DIAMETER**
- 158 METERS

**WIND CLASS**
- IEC (S)

**TIP HEIGHTS**
- 180m, 199.9m, 228m, 240m

**TOWER HEIGHTS**
- 101m, 120.9m, 149m, 161m

**LIFETIME**
- ~25 years

3.X MW Platform ... 2969+ turbines

- Installed base in America: ~836*
- Largest Wind Farm in NA: Morrow & Gilliam 845 MWs, East-Oregon
- Including ~380 Units from former Alstom ECO 3MW platform
- Installed base in Europe: ~2036
- Largest Windfarm in Europe: Fintinele 600 MWs, Romania
- Installed base in APAC: ~97

* April 2018 Source: internal GE database