

Technical features, innovations and future direction of smart, scalable, structured wind turbines

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Goldwind At A Glance



Since establishing the first wind farm in 1986, our people have spent **30 years** as pioneers in the wind energy business.



Goldwind has more than **38GW** of wind turbine generation capacity installed globally.

More than **25,000** wind turbine installed, including **21,000** units using the permanent magnet direct drive (PMDD) technology.



We have successfully listed on **2 stock exchanges**, in Shenzhen and Hong Kong.



TOP 4 OEM in the world by newly installed capacity in 2016

Operations:

- Mortons Lane, 19.5MW
- Gullen Range, 165.5MW
- White Rock Stage 1, 175MW
 - Turbine installation progressing
- Gullen Range Solar, 10MW
 - ARENA Funded, Under construction

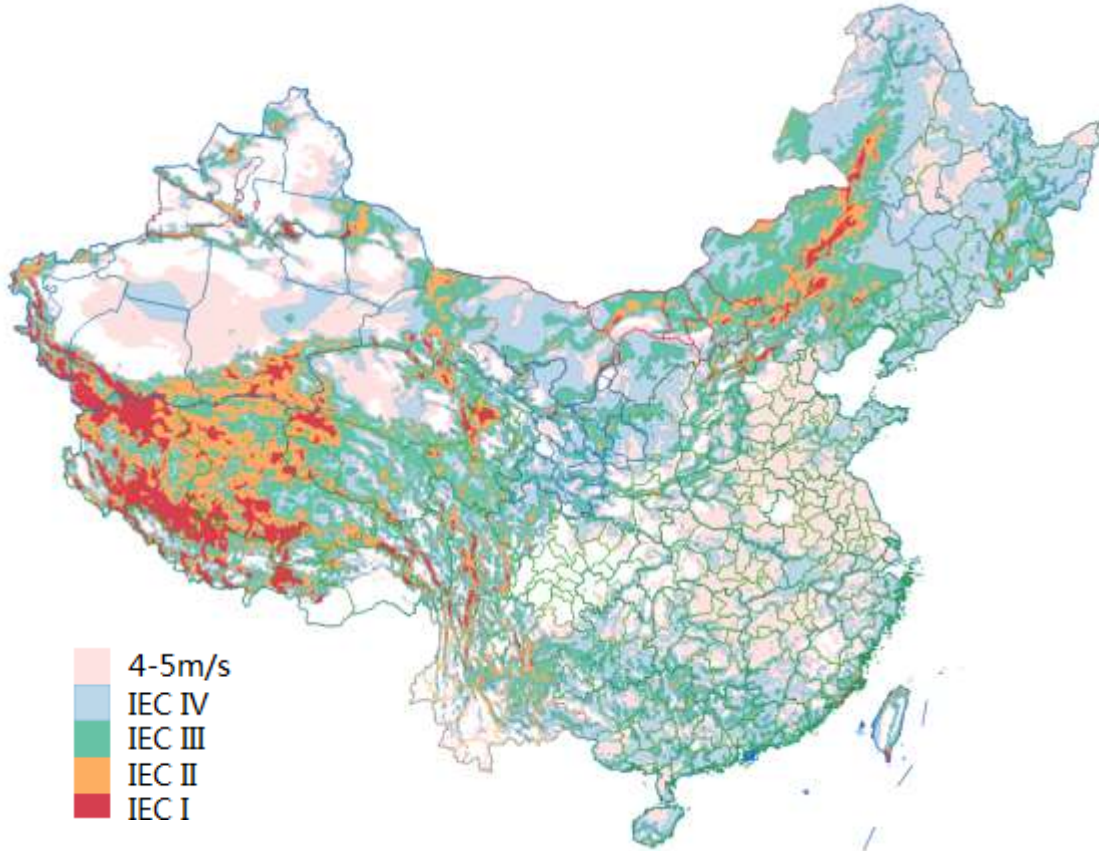


Projects Pipeline:

- White Rock Stage 2, 49 WTGs
- Coppabella, 79 WTGs
- Moorabool North, 50 WTGs
- Moorabool South, 57 WTGs
- White Rock Solar, 20MW
 - ARENA Funded



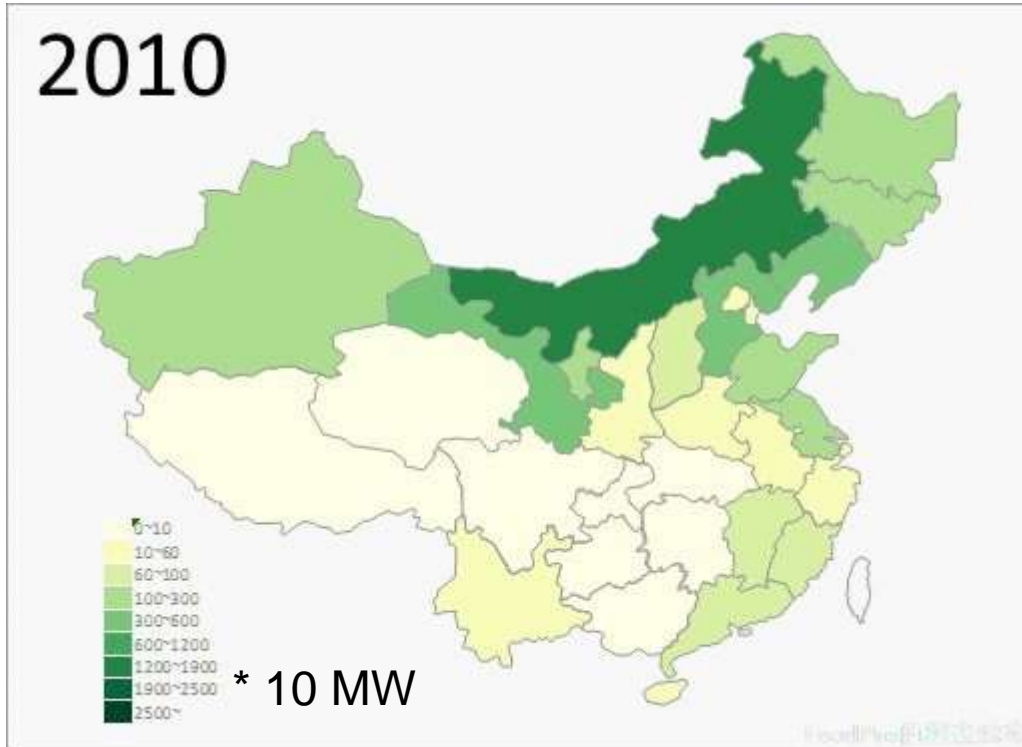
China Market Trends (Resource)



Goldwind has a over 27% Chinese Market Share (a 23GW per year market)

Best wind resource located in Inner Magnolia, Xinjiang, Gansu, Yunnan and the costal area.

China Market Trends (Construction)



(Data from National Energy Bureau).

- Installed capacity evolution of Chinese wind power from 2010 to 2016, and forecast to 2020
- sites becoming scarce in the north.
- Tariffs favor the south.
- Increasing use of Class III and Class IV sites.
- Sites limited;
 - grid capacity
 - high penetration renewables.
 - Limited land
 - Residential areas (noise)
 - Complex terrain
 - Low wind

End of 2016: annual new installation: 23.4GW;
cumulated installation: 169GW; Source: CWEA
End of 2016: cumulated global: 464GW; (36%)
Source: WPM, March, 2017

Increasingly Diverse Sites

Example Project: a project in Hunan province, China

Detailed analysis of wind resource data measured by different met masts.

- **Group 1003#:**

Average wind speed: 5.31 m/s
Wind shear: 0.18
Turbulence intensity: 0.12
Maximum wind speed: 28.4 m/s

- **Group 7003#:**

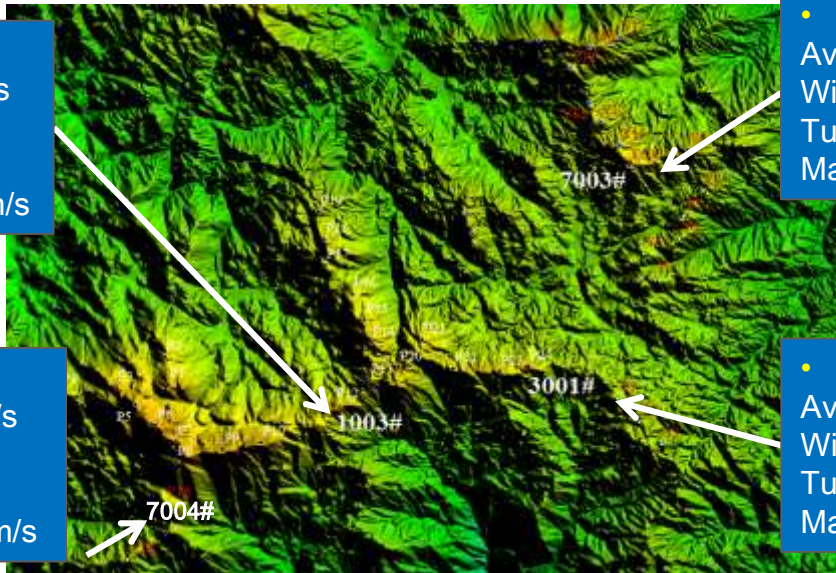
Average wind speed: 6.93 m/s
Wind shear: 0.075
Turbulence intensity: 0.144
Maximum wind speed: 33.2 m/s

- **Group 7004#:**

Average wind speed: 8.11 m/s
Wind shear: 0.132
Turbulence intensity: 0.133
Maximum wind speed: 35.7 m/s

- **Group 3001#:**

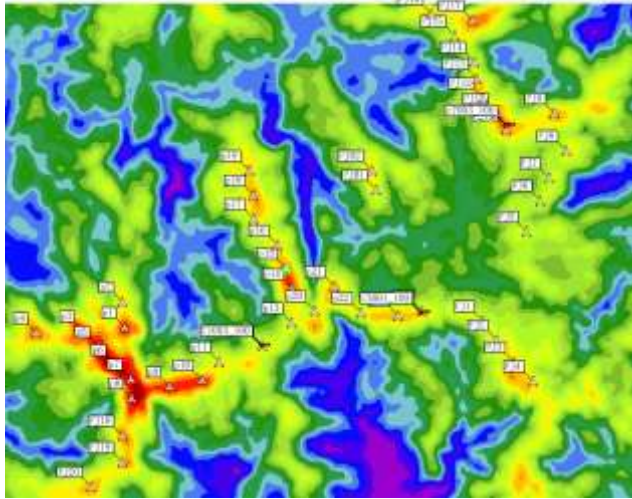
Average wind speed: 6.5 m/s
Wind shear: 0.114
Turbulence intensity: 0.144
Maximum wind speed: 30.9 m/s



Wind Farm Optimisation



The Wind Farm of 40 WTGSs has 6 distinct groups. Looking to maximize the possible WTG capacity for a 20/25 year design life.

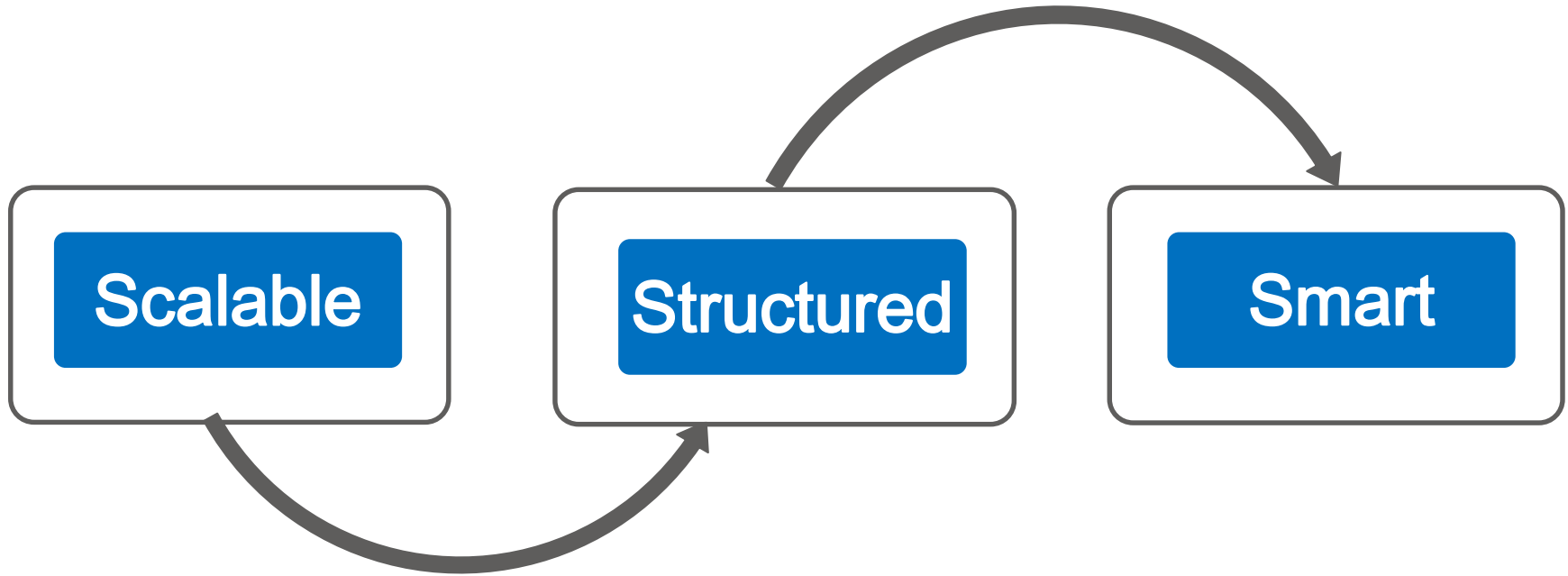


	3000 kW	3200 kW	3400 kW	3600 kW	Group	Qty.
100 m	Group 7003L	Group 7003H			7003H	7
100 m			Group 7004L	Group 7004H	7003L	5
100 m	Group 3001				7004H	8
120 m	Group 1003				7004L	6
					3001	4
					1003	10



Optimized hub height and generator size improved the power generation by approx. 7.1% comparing to single turbine configuration across the project.

WTG Design Trends



Goldwind 3S Platform



	GW140
Rated Capacity	3.0-3.57 MW
Tower	80m - 140m
IEC Design Class	IEC Class IIIA
Design Life	25 years

Scalable

1

Multiple rotor options on same platform:

flexible platform across different wind classes. Benefit of identical parts for O&M and supply chain.

2

Adjustable rated power

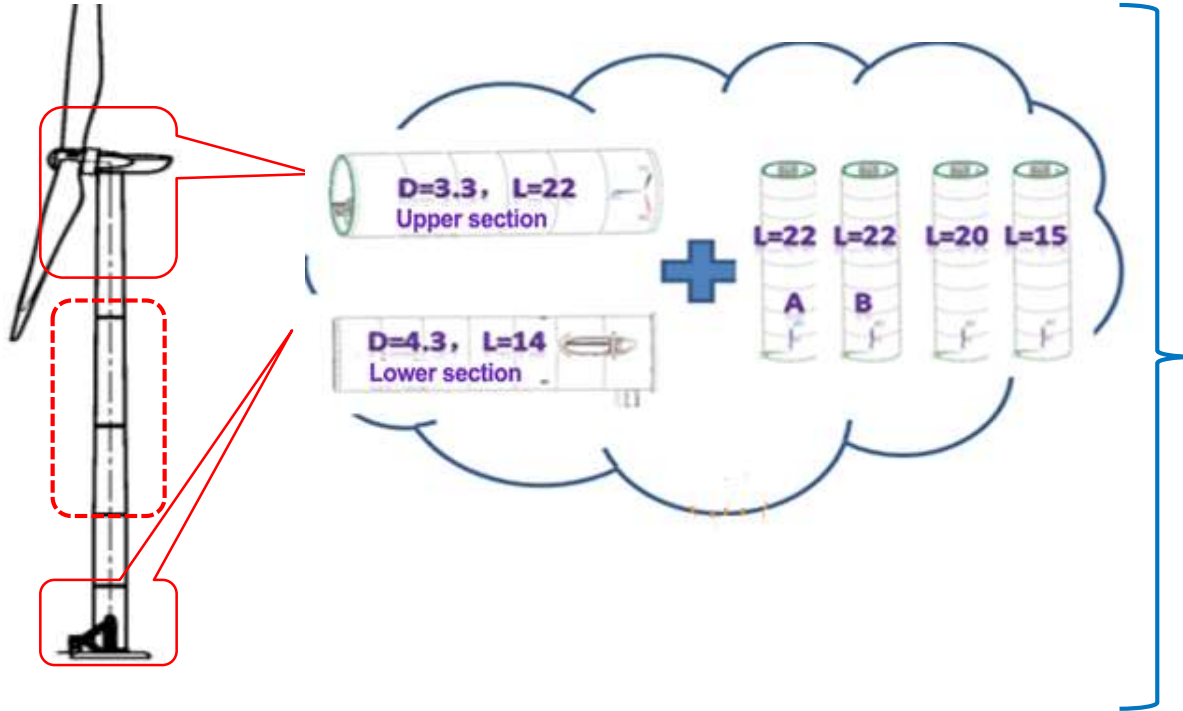
Achieving design life, noise requirements

3

Easily customisable tower heights

Agility and speed in tower design, load calculations and certification

Adaptable approach to tower design GOLDWIND

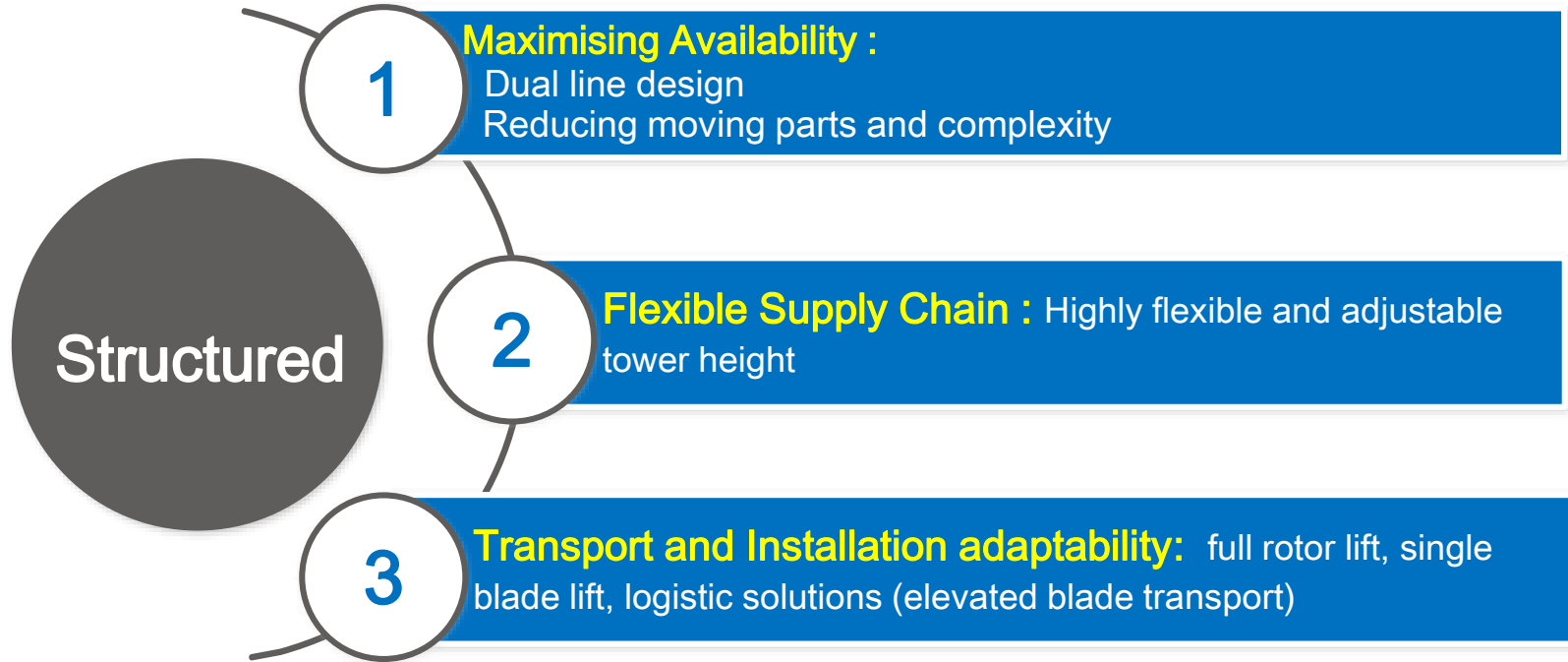


Modular tower design :

- Towers of 100m, 110m, 120m, 130m, and 140m are available by combining the upper and lower sections of fixed lengths and multiple middle sections of different lengths.

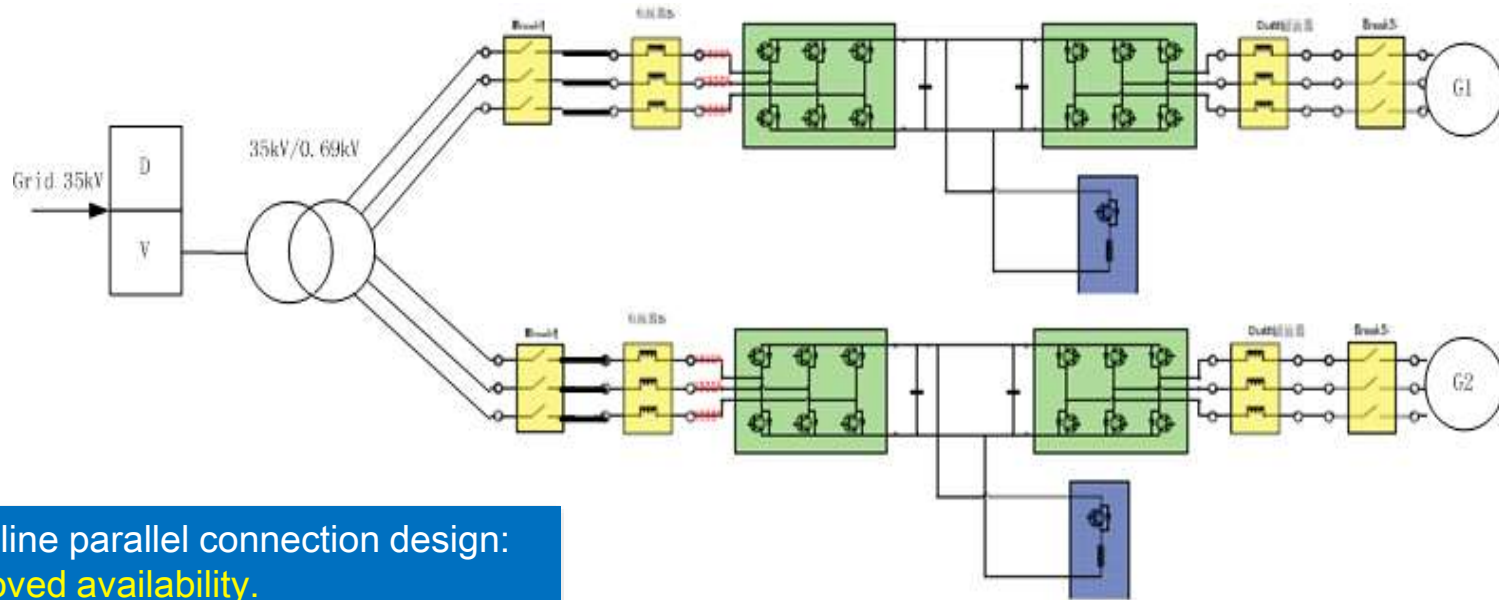
Flexible and adjustable:

- Using towers with flexible adjustable heights reduces costs significantly in various aspects.

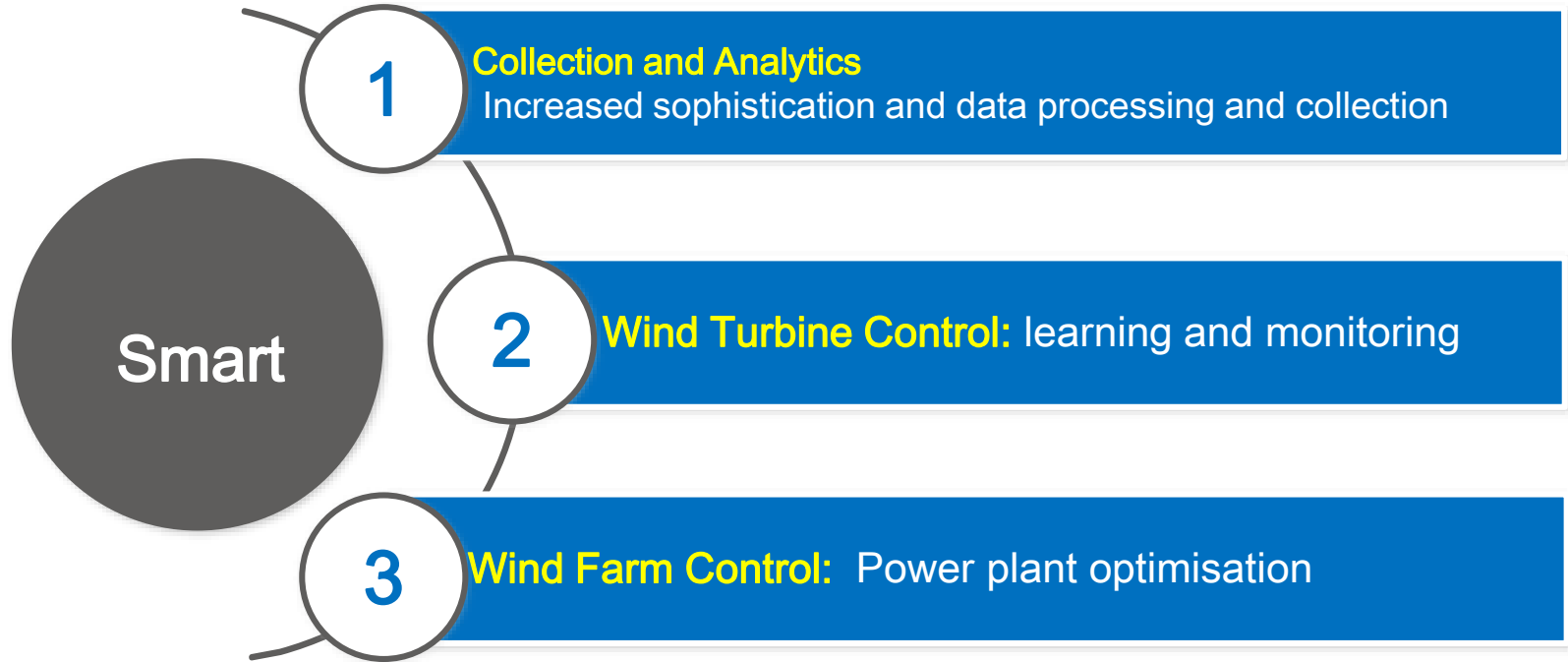


Dual Line System

→ Dual-line design of electrical control system increases the availability and power generation



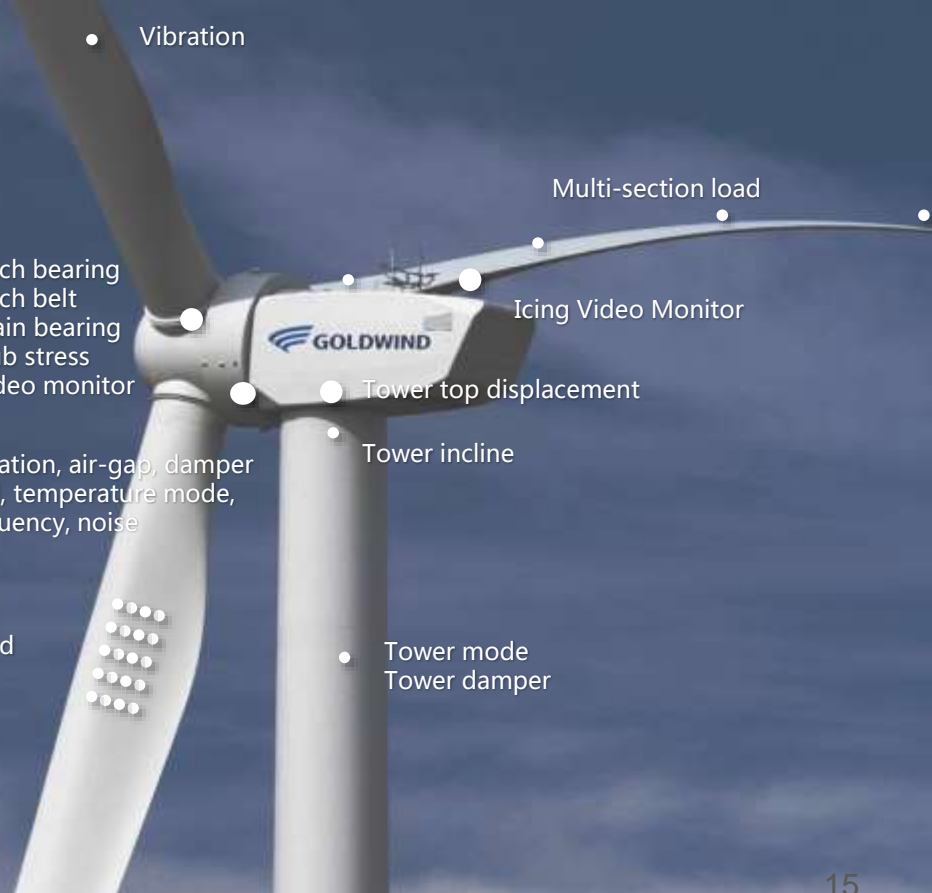
Dual-line parallel connection design:
Improved availability.



New test technology

New sensing technology

New design verification loop



• Vibration

• Multi-section load

• Pitch bearing
• Pitch belt
• Main bearing
• Hub stress
• Video monitor

• Icing Video Monitor

• Tower top displacement

• Vibration, air-gap, damper load, temperature mode, frequency, noise

• Tower incline

• Chord load

• Tower mode
• Tower damper

• Foundation displacement monitor

Power Curve Adjustment

- Noise, temperature, loading,
- Up-rating of power curve in times of favorable wind conditions
- Operating in curtailment in high wind speeds.

Monitoring of components (SCADA, CMS)

- Half-power operation mode of converter
- Fault operation mode of generator
- De-rating for protection rather than shutdown where possible

Performance monitoring and AI

- Self correcting yaw misalignment.
- Self adapting control strategy.

Smart: Wind Farm Control Strategies



Flagship WTGS

Using the key measurement points



- Learning of WTGS model
- Load identification
- Coordinated cluster control

Cluster controller



- Embedding various advanced algorithms
- Coordinated control of WTGs
 - Machine learning and optimal control

Advanced control of single WTGS

Flexible power control technology of wind farm

Corrective and optimized control

Sector management

Capacity increase control

Yawing for alignment with wind

Optimization of pitch angle

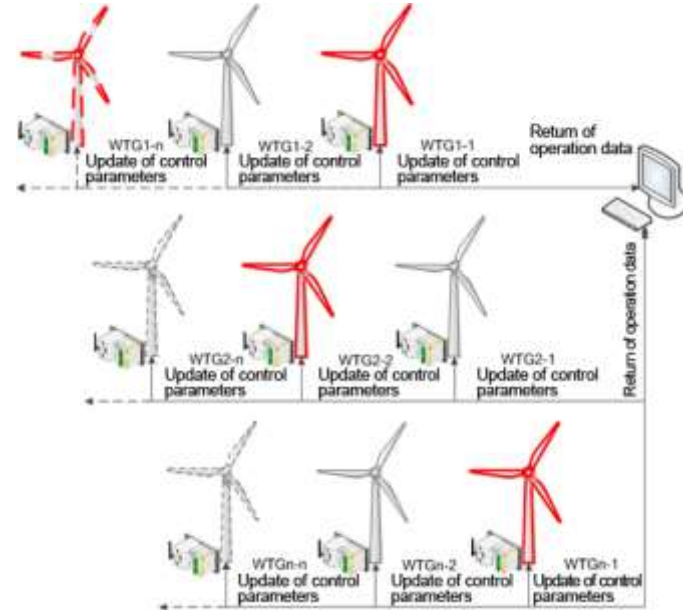
Self-adaptation to complex terrain

Noise control

Wake flow control

Load identification

WTGS capacity



- Agility and speed in the wind farm design stage.
- Adaption of WTG performance and design life.
- Responsive and adaptable supply chain to support customized solutions
- Maximization of AEP & Availability
- Data collection, Data Analytics, learning and the feed-back loop.

Thanks

