Siemens Wind Equipment
Maximum availability and efficiency due to perfect interplay

HUSUM WindEnergy 2012

Version 11.0

Dr. Dan Fodor
September 13rd, 2012
Siemens is the technology partner for wind turbine OEMs, System Integrators and Design Institutes

Siemens equipment for wind turbines

Winds of change
Siemens actively supports the change from manufacturing to industrial series production

Serial production

Powerful Portfolio
Siemens equipment to build individual turbines

Intelligent standardization

Integrated Portfolio
Siemens equipment with perfect interplay

Platform based integration

Prepared for the Future
Siemens equipment for investment security based on turbine reliability and cost reduction

Partnership

Siemens is the acknowledged and solid partner for all products, systems and solutions for the electrical drive train, automation and energy distribution in wind turbines

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Industry Sector
Siemens is fully aligned with the future trend in wind business

Historical development of wind industry and expected development until FY17

<table>
<thead>
<tr>
<th>Landscape of Wind OEMs</th>
<th>Strong European/US Players</th>
<th>Market fragmentation</th>
<th>Consolidated players</th>
</tr>
</thead>
<tbody>
<tr>
<td>5 players for ~80% of market</td>
<td>Biggest Chinese OEM: #8</td>
<td>China OEMs strongly gain market share (&gt;35%)</td>
<td>Strong market consolidation</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Strong export from China OEMs</td>
</tr>
</tbody>
</table>

Yesterday ¹)  

<table>
<thead>
<tr>
<th>Technology</th>
<th>„Availability is key issue“</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Bottlenecks for key components</td>
</tr>
<tr>
<td></td>
<td>Technology transfer from European design offices to China</td>
</tr>
</tbody>
</table>

Today

<table>
<thead>
<tr>
<th>Technology</th>
<th>„Strong quality focus“</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Quality “refocus” due to overcapacities</td>
</tr>
<tr>
<td></td>
<td>Big China OEMs design own turbines</td>
</tr>
<tr>
<td></td>
<td>Quality enters China wind industry ³)</td>
</tr>
</tbody>
</table>

Tomorrow ²)  

<table>
<thead>
<tr>
<th>„Systems shall be preferred“</th>
</tr>
</thead>
<tbody>
<tr>
<td>Systems/packages will induce cost reduction</td>
</tr>
<tr>
<td>High level of industrialization, “serial production” of wind turbines</td>
</tr>
</tbody>
</table>

¹) Before 2007  
²) Until 2017  
³) E. g. Low Voltage Ride Through, Grid Codes
Siemens is fully aligned with the future trend in wind business

Historical development of wind industry and expected development until FY17

<table>
<thead>
<tr>
<th>Sourcing model</th>
<th>&quot;Supplier Market&quot;</th>
<th>&quot;Buyer Market&quot;</th>
<th>&quot;Market for Modules/Solutions&quot;</th>
</tr>
</thead>
<tbody>
<tr>
<td>Yesterday 1)</td>
<td>Under capacity &gt;20%</td>
<td>Overcapacity 40%</td>
<td>Intelligent Standardization - fulfilling specific wind requirements based on industrial standard platforms lead to cost optimization</td>
</tr>
<tr>
<td></td>
<td>Excess demand &amp; purchase for components</td>
<td>OEMs have min. 2 suppliers per component</td>
<td>Trend towards Totally Integrated Automation with open interfaces expected (analogue to Automation Industry development)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>OEMs pick suppliers and mix components individually for each turbine type</td>
<td>High standards and integration as future trend</td>
</tr>
<tr>
<td>Today</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Tomorrow 2)</td>
<td></td>
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</tr>
</tbody>
</table>

1) Before 2007  2) Until 2017
Siemens is fully supporting the power increase of wind turbines

**Power increase of wind turbines**

**We support our partner**
- from today’s main stream 1.5 – 2.5 MW
- through multi-MW class above 2.5 MW
- heading towards 5.0 – 7.0 MW powers

**Turbine size global trend**

1) Source: MAKE Consulting, 2011

**Our value proposition**

**Suitable drive train topology for efficient and reliable operation**
- geared, gearless, new concepts (hybrid)
- scaled customization

**Maximum energy yield**
- wind farm management
- qualified worldwide adjustments/upgrades

**Specialized operation at reduced TCO**
- open turbine control solution based on an embedded platform
- reduced programming effort

2) Total Cost of Ownership

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Components interplay reduce the Total Cost of Ownership

<table>
<thead>
<tr>
<th>Initial Costs</th>
</tr>
</thead>
<tbody>
<tr>
<td>Engineering</td>
</tr>
<tr>
<td>Purchase Price</td>
</tr>
<tr>
<td>Transportation</td>
</tr>
<tr>
<td>Installation</td>
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<tr>
<td>Startup</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Life Cycle Costs</th>
</tr>
</thead>
<tbody>
<tr>
<td>Financing</td>
</tr>
<tr>
<td>Energy</td>
</tr>
<tr>
<td>Operation</td>
</tr>
<tr>
<td>Grid Compliance</td>
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<tr>
<td>Maintenance</td>
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</tbody>
</table>

<table>
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<tr>
<th>Cost of Downtime</th>
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<tbody>
<tr>
<td>Startup</td>
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</tbody>
</table>

Total Cost of Ownership
China Challenges
Wind market and OEM

World’s Top 15 Wind OEMs and current China Challenges

<table>
<thead>
<tr>
<th>Wind OEM ranked by GW installed in FY11</th>
<th>Current China Challenges</th>
</tr>
</thead>
<tbody>
<tr>
<td>Vestas 5,21</td>
<td>7 top China OEMs take in 2011</td>
</tr>
<tr>
<td>Goldwind 3,6</td>
<td>33% of worldwide installed GW</td>
</tr>
<tr>
<td>GE Wind 3,3</td>
<td>Challenge price/kW vs. price/kWh</td>
</tr>
<tr>
<td>Gamesa 3,28</td>
<td>means focus on price per turbine power instead of price per energy</td>
</tr>
<tr>
<td>Enercon 3,19</td>
<td>Uncertain market environment and growth, focus on balanced wind farms development and grid planning</td>
</tr>
<tr>
<td>Suzlon Group 3,11</td>
<td>Strong overcapacity leads to export orientation of Chinese OEM</td>
</tr>
<tr>
<td>Siemens 3,00</td>
<td>Quality focus in order to increase wind energy delivery to national grid</td>
</tr>
<tr>
<td>Sinovel 2,96</td>
<td></td>
</tr>
<tr>
<td>United Power 2,88</td>
<td></td>
</tr>
<tr>
<td>Ming Yang 1,5</td>
<td></td>
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<tr>
<td>Nordex 0,97</td>
<td></td>
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<tr>
<td>Dongfeng 0,95</td>
<td></td>
</tr>
<tr>
<td>Hara XEMC 0,72</td>
<td></td>
</tr>
<tr>
<td>Sewind 0,71</td>
<td></td>
</tr>
<tr>
<td>Enercon India 0,67</td>
<td></td>
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<tr>
<td>Total Wind market 40.5 GW</td>
<td></td>
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</tbody>
</table>
Siemens is technology partner for turbine standardization and platform based integration

Application level
Specific applications for Wind industry

Control level
Wind Toolbox
HMI Turbine & Park SCADA

Integrated drive train, Yaw, auxiliaries
Platform based Products and systems

1) Supervisory Control and Data Acquisition
Siemens three dimensions of integration support the wind industry in the change process

Supplementing the turbine design with products and software that support engineering, commissioning and use along the life cycle

Reduced lifecycle costs through:

- Enhanced reliability
- Increased energy efficiency

Customer benefit

Horizontal Integration

Horizontal

Functional (or physical) drive train integration: generator, modular wind converter, electrical Pitch & Yaw

Integration of systems from turbine control up to the drives system, along the information flow

Vertical

Life Cycle
Siemens three dimensions of integration support the wind industry in the change process.

**Horizontal**
- Functional (or physical) drive train integration

**Vertical**
- Fully integrated Control, Communication and Diagnostics

**Life Cycle**
- Supplement turbine design with products and software optimizing along life cycle

**Customer benefits**

- **Virtual Optimization of design & production:**
  - Team Center e.g. for worldwide similar design
  - Optimized operation e.g. with WinCC OA

- **Automation Design and Safety Integrated:**
  - Lower training & engineering effort
  - Use approved standard products

- **Drive Train Excellence:**
  - Optimized topology based on customer specification – geared, gearless, medium speed
  - Proven Reliability
We support from manufacturing to industrial series production of wind turbines

Industrial software applications in wind turbines

- Computer Aided
  - System engineering
  - CAE
  - CAD
    (mechanical/electrical)

- Collaborative Product Data Management (Team Center)
  - Coordinated product engineering

- Wind Toolbox
- HMI Turbine
- Park SCADA
  1) Supervisory Control and Data Acquisition

Industrial software based integration and operation is our new value proposition for wind customer

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Industry Sector
Real and digital worlds of design and production are converging through PLM software …

… for our customers and us. Benefits for wind customers: worldwide unified/certified design and optimized energy production
Wind vertical broad portfolio focusing on turbine automation as well as electrical components

Siemens Vertical (VMM 1) Wind product portfolio

Pitch

Automation & Turbine Control

Auxiliary Functions

Geared Generator

Converter

Wind Park: SCADA 2 & Communication

Power Distribution

Perfect interplay based on platform experience from industrial fields like e.g. machine building or oil & gas

1) Vertical Market Management  2) Supervisory Control and Data Acquisition

© Siemens AG 2012. All Rights Reserved. Industry Sector
Increased reliability due to “Safety Integrated” as part of operation management:
- unified data management based on industry leader Profisafe bus system integrated in turbine control, Pitch, Yaw, rotation control
- safety concept independent of communication medium (electrical, fiber optic, wireless)

1) Life Cycle Costs
Siemens Wind Farm Management Customer Benefits

Siemens solution for management of wind turbines:
• web-capable SCADA\(^1\) with long-term database
• central service portal

**Long-term investment security** due to:
- open nature and long-term compatibility of WinCC Open Architecture
- central desk access of up-to-the-minute data from all connected turbines
- unrestricted data access to even low bandwidth connections

1) Supervisory Control and Data Acquisition

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Industry Sector
Siemens Vertical Wind Product Portfolio
Customer Benefits Automation & Turbine Control

- Increased reliability in operation due to comprehensive system test of hardware and software interplay
- Less failures & training/engineering effort through standardized communication bus system
- Easy to use due to functional program and safety program with the same tools
Siemens Vertical Wind Product Portfolio
Customer Benefits Totally Integrated Automation

Faster engineering and commissioning, reduced failure risk due to:
- aligned product portfolio for wind turbine applications
- one comprehensive engineering tool
- all components are integrated and pre-configured in Wind Library
Siemens Vertical Wind Product Portfolio
Customer Benefits Totally Integrated Power

**Power Distribution**

- **LV Switchgears**
- **Power Distribution**
- **Power Monitoring**
- **Lightning Protection**

Reliability in operation due to:
- integration of all electromechanical components of the wind turbine – converter, generator, circuit breaker, yaw drives – in a harmonized operation-, maintenance- and service- concept
Higher operational reliability due to reduction of loads and wear through:
- integrated motion functions support turbine controller for load reducing control methods
- smooth drive control reduces loads on gear box and bearings

Reduction of maintenance and life cycle cost due to:
- integrated condition diagnostics enables predictive maintenance
- all components from industrial high-quality production at highest quality standards
Siemens Vertical Wind Product Portfolio
Customer Benefits electrical Drive Train

Reliability in operation and cost optimization due to:
- Performance optimization of generator and converter
- System approach from development through production, test field and certification – bundled from one hand

1) Direct Drive Wind Generator in the specific Blaaster drive line configuration
Siemens Wind Vertical Value Proposition

Central person to support global concepts with local presence

Bundled wind competencies focused on tailored wind concepts

Detailed understanding of customer requirements

“Fast lane” for technical concepts, support and priority setting

Goal of Siemens Vertical Wind:
“One team” offers “one tailored concept” to customer

Central sponsorship
Vertical competence
“Wind language speaker”
“Fast lane”
We offer best technologies for reliable and life cycle cost effective turbines

“Intelligent standardization”: we fulfill specific requirements based on industrial standard platforms for cost optimization

We offer competitive advantages like scaling effects or powerful portfolio e. g. by adapting Automotive experience

We target strong and long-term technology partnership

Siemens Wind Technology: Customer value based on experience, quality and trust

1) Life Cycle Costs
Thank you for your attention!

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