Wind Power Economics Modelling

How to create Business Case Certainty
SVP Business Analysis and Performance Management

Johnny Thomsen

- Master in Economics from Aarhus Business School
- In Vestas since 1997 – primarily with responsibilities within finance
- Worked in a Sales Unit in Spain for four years

Current responsibilities at Vestas:
- Performance Management
- Business Analysis
1. **What is wind power economics modelling about**

2. Why is it important?

3. What are the main drivers and what are the challenges?

4. How is Vestas committed to maximising the value of wind?
What is wind power plant economics modelling about?

The key stakeholders in a wind power plant investment

- Happy Owner (Customer)
- Happy Financier
- Happy Vestas
What is wind power plant economics modelling about?

A rational and systematic process, wind power economic modelling sums up the result in terms of cash flow and sensitivity.
Investment – revenue – cost – free cash flow
The basic output parameters to optimize and the impact on value and financing

- Wind Forecast
  - Product Performance
  - X Electricity (& carbon) price

- Available for Debt
  - Interest & Instalments

- Service cost/agreement
- Component repairs

Revenues

Free Cash (Value)

Cost (OPEX)

Investment (CAPEX)

Warranty

AOM 4000+

Years

2  5  10  20
Business Case Certainty
The core of the value which Vestas offers customers is power generation linked to revenue and cost of energy.
Agenda

1. What is wind power economics modelling about?

2. Why is it important?

3. What can it be used for?

4. How is Vestas committed to maximising value of wind?
Vestas: “Are we competitive?”

Wind power modelling is important business knowledge for Vestas

1. Customer understanding

2. Competitiveness of our products and services

3. Markets attractiveness

4. Prioritizing sales efforts
Customers: ”Does it generate cash?”

Wind power modelling is important business decision information

1. Evaluate if the investment will live up to the required cash flow and return on invested capital

2. Evaluate the risk profile

3. Evaluate different supplier offerings

4. Receive equity sponsorship from the Board of Directors

5. Negotiate terms of conditions with the bank to get financing

6. Create a basis for follow-up on the investment (20 year+)
Financiers: ”Is it bankable?”

Wind power modelling is important business decision information for the credit committee

1. Debt sizing and structure according to the free cash flow available

2. Risk evaluation of the debt by sensitivity analysis

3. Risk evaluation of the debt by a project due-diligence proven track records, comprehensive service contracts, twenty-four-seven monitoring
Agenda

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Multiple purpose model
Wind power modelling is used for feasibility assessments on all levels

- **Macro level**
- **Industry level**
- **Market level**
- **Power plant level**

1. Energy political context
2. Competitive context
3. Market attractiveness
4. Specific site and customer
Agenda

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## Vestas value proposition

Our value proposition is focused on creating value

<table>
<thead>
<tr>
<th>DESCRIPTION</th>
<th>WHICH MEANS TO CUSTOMERS</th>
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<tbody>
<tr>
<td><strong>Business Case Certainty</strong></td>
<td>Revenue Certainty&lt;br&gt;• Initiating revenue on-time and producing revenue as forecasted</td>
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<tr>
<td>Increased confidence that the key inputs into the project’s economic model</td>
<td>Cost Certainty&lt;br&gt;• Avoiding unplanned costs</td>
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<tr>
<td>are reliable</td>
<td>Higher Revenues&lt;br&gt;• Improved product performance</td>
</tr>
<tr>
<td><strong>Cost of Energy</strong></td>
<td>Lower Costs&lt;br&gt;• Sourcing activities at lowest price</td>
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<td>Innovation to continually drive down the customer’s cost per MWh</td>
<td>Win-win mentality&lt;br&gt;Flexible offerings, terms, &amp; conditions to match customer strategy &amp; projects</td>
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<tr>
<td><strong>Easy to Work With (Partnership)</strong></td>
<td>Transparency &amp; joint issue resolution</td>
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<tr>
<td>Working openly and flexibly with customers to improve the other value drivers together</td>
<td></td>
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<tr>
<td><strong>Safety &amp; Citizenship</strong></td>
<td>Ensuring the welfare of employees &amp; environment&lt;br&gt;Protecting their brand from imprudent actions</td>
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Drivers of revenue, cost and financing:
With the right knowledge and process – complexity can be managed

- **Revenue (R)**: Incentives, Spot prices, PPA, Hedging
- **Costs (C)**: Building permits, Roughness, Turbulence, Turbine placement, 24-7 monitoring, Specification
- **Finance (F)**: Grid requirements, Legislation, On time delivery, Project lead time, Grid connection, Time to stability, Production loss guarantees

**Wind Power Plant**

- **Public**
  - Terrain
- **Construction**
  - On time delivery
  - Project lead time
  - Grid connection
  - Time to stability
- **Siting**
  - Spot prices
  - PPA
  - Hedging
- **Electricity market**
  - Spot prices
- **Product performance**
  - PPA
  - Hedging
- **Service & Monitoring**
  - Specification
  - Power curve
  - Track records
Wind Power Sensitivities

How much is a 10% improvement worth?
How much does a 10% deterioration lower the value?

10% Change

<table>
<thead>
<tr>
<th>10% Change</th>
<th>Effect on Project IRR after tax</th>
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</thead>
<tbody>
<tr>
<td>Avg. Production</td>
<td>1.7 pct. point</td>
</tr>
<tr>
<td>Investment</td>
<td>1.6 pct. point</td>
</tr>
<tr>
<td>Energy Prices</td>
<td>1.2 pct. point</td>
</tr>
<tr>
<td>TSA</td>
<td>1.1 pct. point</td>
</tr>
<tr>
<td>OPEX</td>
<td>0.2 pct. point</td>
</tr>
</tbody>
</table>
Micro Siting: Matching site with turbine

Understanding the site specifications and matching with the most suitable turbine ensures the best energy production at the lowest risk

1. Computational fluid dynamic computer modelling predicts mean flow and turbulence intensity

2. Combining site data with national high-voltage grid network

3. Turbine modelling software matches the site with the right turbine, and helps positioning them to maximise outputs
Product performance: V112-3.0 MW

Designed for low cost of energy (CoE), through modularization, swept area, increased efficiency and easy serviceability

1. Designed for low and medium speed sites, the V112-3.0 MW turbine delivers a highly competitive cost of energy.

2. At a cut-in wind speed of only 3 m/s the V112-3.0 produces energy even at very low wind speeds.

3. The turbine delivers high productivity due to its large swept 9.852 m² area, higher rotor efficiency and better serviceability and reliability.
Construction: On time within specifications

Delivering on time, installing the turbines, connecting to grid within specification, on time and on budget is crucial for business case certainty

1. We have installed more than 41,000 wind turbines in 65 countries in five continents.

2. When handling heavy equipment on site, installing and performing within specifications on time successful, experience is key.

3. Building on more than three decades of experience, we have developed a finely tuned programme that removes year-to-year variation in wind farm costs.
Service: 24-7 monitoring

Constantly monitoring the turbines, ensures high availability and low operating costs through preventive maintenance

Real time monitoring of 130+ SENSORS IN 16,000+ TURBINES globally

Findings are used to improve predictive models to provide RELIABLE PERFORMANCE AND YIELD MANAGEMENT

Identify performance deviations in the fleet based on predictive models and INITIATE PREVENTATIVE MAINTENANCE

Maintenance plans based on weather forecast to MINIMIZE LOST PRODUCTION while making repairs

Service: 24-7 monitoring
Prevention through prediction
Focus on avoiding costly mechanical failures and revenue loss

**PREVENTATIVE MAINTENANCE**

- **Production level**
- **Corrctive service**
  - **WITHOUT condition monitoring**
  - **Predictive service**
    - **WITH condition monitoring**

**Functional loss**
- Early damage detected
  - Inspect damage
  - Order spare parts
  - Repair work

**Production loss**

Time

Capital Markets Day 2010, Colorado, USA
To sum it up….  

Bankability and value

CASH FLOW

COST & RISK

Happy Owner (Customer)
Happy Financier
Happy Vestas

Business Case Certainty

Predictable REVENUE and COSTS

Business Case Certainty
Questions?

Thank you for your attention

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