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## Smart is...

### *Pinpointing the optimal location for wind turbines to maximize power generation and reduce energy costs.*

Precise placement of a wind turbine can affect its performance and its useful life. For Vestas, the world's largest wind energy company, gaining new business depends on responding quickly and delivering business value. To succeed, Vestas uses one of the largest supercomputers worldwide along with a new big data modeling solution to slice weeks from data processing times and support 10 times the amount of data for more accurate turbine placement decisions. Improved precision provides Vestas customers with greater business case certainty, quicker results and increased predictability and reliability in wind power generation.

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## Vestas

*Turning climate into capital with big data*

For centuries, sailors have seen how fickle the wind can be. It ebbs and flows like the tide and can allow ships to travel great distances or remain becalmed at sea.

But despite the wind's capricious nature, new advances in science and technology enable energy producers to transform the wind into a reliable and steadfast energy source—one that many believe will help alleviate the problems of the world's soaring energy consumption.

“Wind energy is one of today's most important renewable energy sources,” says Lars Christian Christensen, vice president, Vestas Wind Systems A/S. “Fossil fuels will eventually run out. Wind is renewable, predictable, clean and commercially viable. By 2020 as much as 10 percent of the world's electricity consumption will be satisfied by wind energy and we believe that wind power is an industry that will be on par with oil and gas.”

### **Producing electricity from wind**

Making wind a reliable source of energy depends greatly on the placement of the wind turbines used to produce electricity. The windiest location may not generate the best output and revenue for energy companies. Turbulence is a significant factor as it strains turbine components, making them more likely to fail. Avoiding pockets of turbulence can extend the service life of turbines and lower operating costs, which reduces the cost per kilowatt hour of energy produced.

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*“We can now show our customers how the wind behaves and provide a solid business case that is on par with any other investment that they may have.”*

—Lars Christian Christensen, Vice President, Vestas Wind Systems A/S

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## Business benefits

- Reduces response time for wind forecasting information by approximately 97 percent—from weeks to hours—to help cut development time
  - Improves accuracy of turbine placement with capabilities for analyzing a greater breadth and depth of data
  - Lowers the cost to customers per kilowatt hour produced and increases customers' return on investment
  - Reduces IT footprint and costs, and decreases energy consumption by 40 percent—all while increasing computational power
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Selecting wind turbine sites is a science that Vestas understands well. Since 1979, this Danish company has been engaged in the development, manufacture, sale and maintenance of wind power systems to generate electricity. The company has installed more than 43,000 land-based and offshore wind turbines in 66 countries on six continents. Today, Vestas installs an average of one wind turbine every three hours, 24 hours a day, and its turbines generate more than 90 million megawatt-hours of energy per year—enough electricity to supply millions of households.

“Customers want to know what their return on investment will be and they want business case certainty,” says Christensen who heads the company’s division responsible for determining the placement of wind turbines. “For us to achieve business case certainty, we need to know exactly how the wind is distributed across potential sites, and we need to compare this data with the turbine design specifications to make sure the turbine can operate at optimal efficiency at that location.”

What happens if engineers pick a sub-optimal location? According to Christensen, the cost of a mistake can be tremendous. “First of all, if the turbines do not perform as intended, we risk losing customers. Secondly, placing the turbines in the wrong location affects our warranty costs. Turbines are designed to operate under specific conditions and can break if they are operating outside of these parameters.”

For Vestas, the process of establishing a location starts with its wind library, which incorporates data from global weather systems with data collected from existing turbines. Combined, this information helps the company not only select the best site for turbine placement, but also helps forecast wind and power production for its customers.

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## Smarter Energy:

## Increases wind power generation through optimal turbine placement

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### Instrumented

Determines the optimal turbine placement using weather forecasts and data from operational wind power plants to create hourly and daily predictions regarding energy production.



### Interconnected

Combines turbine data with data on temperature, barometric pressure, humidity, precipitation, wind direction and velocity from the ground level up to 300 feet.



### Intelligent

Precisely models wind flow to help staff understand wind patterns and turbulence near each wind turbine and select the best location to reduce the cost per kilowatt hour of energy produced.



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## Solution components:

### Software

- IBM® InfoSphere® BigInsights Enterprise Edition

### Hardware

- IBM System x® iDataPlex® dx360 M3
  - IBM System Storage® DS5300
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– Lars Christian Christensen

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“We gather data from 35,000 meteorological stations scattered around the world and from our own turbines,” says Christensen. “That gives us a picture of the global flow scenario. Those models are then cobbled to smaller models for regional level called mesoscale models. The mesoscale models are used to establish our huge wind library so we can pinpoint a specific location at a specific time of day and tell what the weather was like.”

The company’s previous wind library provided detailed information in a grid pattern with each grid measuring 27x27 kilometers (about 17x17 miles). Using computational fluid dynamics models, Vestas engineers can then bring the resolution down even further—to about 10x10 meters (32x32 feet)—to establish the exact wind flow pattern at a particular location.

However, in any modeling scenario, the more data and the smaller the grid area, the greater the accuracy of the models. As a result, Christensen’s team wanted to expand its wind library more than 10 fold to include a larger range of weather data over a longer period of time. Additionally, the company needed a more powerful computing platform to run global forecasts much faster. Often company executives had to wait up to three weeks for feedback regarding potential sites—an unacceptable amount of time for Vestas and its customers in this competitive industry.

“In our development strategy, we see growing our library in the range of 18 to 24 petabytes of data,” says Christensen. “And while it’s fairly easy to build that library, we needed to make sure that we could gain knowledge from that data.”

## Turning climate into capital

Working with IBM, Vestas today is implementing a big data solution that is slicing weeks from data processing time and helping staff more quickly and accurately predict weather patterns at potential sites to increase turbine energy production. Data currently stored in its wind library comprises nearly 2.8 petabytes and includes more than 178 parameters, such as temperature, barometric pressure, humidity, precipitation, wind direction and wind velocity from the ground level up to 300 feet, along with the company’s own recorded historical data. Future additions for use in predictions include global deforestation metrics, satellite images, historical metrics, geospatial data and data on phases of the moon and tides.



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## Journey to Smarter Computing

### **Designed for Data**

Implementing a big data solution enables Vestas to create a wind library to hold 18 to 24 petabytes of weather and turbine data at various levels of granularity and reduce the geographic grid area used for modeling by 90 percent for increased accuracy.

### **Tuned to the Task**

Working with IBM, Vestas can increase computational power while shrinking its IT footprint and reducing server energy consumption by 40 percent. Today, twice the number of servers can be run in each of its supercomputer's 12 racks.

### **Managed for Rapid Service Delivery**

Processing huge volumes of climate data and the ability to gain insight from that data enables Vestas to forecast optimal turbine placement in 15 minutes instead of three weeks. This in turn shortens the time to develop a wind turbine site by nearly a month.

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“We could pose the questions before, but our previous systems were not able to deliver the answers, or deliver the answers in the required timeframe,” says Christensen. “Now, if you give me the coordinates for your back yard, we can dive into our modeled wind libraries and provide you with precise data on the weather over the past 11 years, thereby predicting future weather and delivering power production prognosis. We have the ability to scan larger areas and determine more quickly our current turbine coverage geographically and see if there are spots we need to cover with a type of turbine. We can also assess information on how each turbine is operating and our potential risk at a site.”

IBM® InfoSphere® BigInsights software running on an IBM System x® iDataPlex® system serves as the core infrastructure to help Vestas manage and analyze weather and location data in ways that were not previously possible. For example, the company can reduce the base resolution of its wind data grids from a 27x27 kilometer area down to a 3x3 kilometer area (about 1.8x1.8 miles)—a nearly 90 percent reduction that gives executives more immediate insight into potential locations. Christensen estimates this capability can eliminate a month of development time for a site and enable customers to achieve a return on investment much earlier than anticipated.

“IBM InfoSphere BigInsights helps us gain access to knowledge in a very efficient and extremely fast way and enables us to use this knowledge to turn climate into capital,” says Christensen. “Before, it could take us three weeks to get a response to some of our questions simply because we had to process a lot of data. We expect that we can get answers for the same questions now in 15 minutes.”

For customers, the detailed models mean greater business case certainty, quicker results and increased predictability and reliability on their investment.

“Our customers need predictability and reliability, and that can only happen using systems like InfoSphere BigInsights,” says Christensen. “We can give customers much better financial warranties than we have been able to in the past and can provide a solid business case that is on par with any other investment that they may have.”



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## **Smarter Computing by design**

### **Tackling big data challenges**

Vestas and IBM worked together to implement IBM InfoSphere BigInsights software, designed to enable organizations to gain insight from information flows that are characterized by variety, velocity and volume. The solution combines open source Apache Hadoop software with unique technologies and capabilities from IBM to enable organizations to process very large data sets—breaking up the data into chunks and coordinating the processing across a distributed environment for rapid, efficient analysis and results.

“IBM gave us an opportunity to turn our plans into something that was very tangible right from the beginning,” says Christensen. “IBM had experts within data mining, big data and Apache Hadoop, and it was clear to us from the beginning if we wanted to improve our business, not only today, but also prepare for the challenges we will face in three to five years, we had to go with IBM.”

### **Maintaining energy efficiency in its data center**

For a company committed to addressing the world's energy requirements, it's no surprise that as Vestas implemented its big data solution, it also sought a high-performance, energy efficient computing environment that would reduce its carbon footprint. Today, the platform that drives its forecasting and analysis comprises a hardware stack based on the IBM System x iDataPlex supercomputer. This supercomputing solution—one of the world's largest to date—enables the company to use 40 percent less energy while increasing computational power. Twice the number of servers can be run in each of the system's 12 racks—reducing the amount of floor space required in its data center.

“The supercomputer provides the foundation for a completely new way of doing business at Vestas and combined with IBM software delivers a smarter approach to computing that optimizes the way we work,” says Christensen.



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### ► The inside story: Getting there

According to Christensen, the idea for this project began with the collaboration among his team, the company’s global research department and its sales business units.

“We needed to know where the goldmines of wind are hidden, and we needed to have more information to aid our decisions,” says Christensen. “We quickly formed a project group that took the idea forward and set out some key performance indicators that had to be met in order to proceed to the stage where we are today.”

For Vestas, the opportunity that a big data solution could provide made the decision easy. “Once we had the business potential of having these capabilities, it was fairly easy to gain acceptance,” says Christensen. “We were able to show the cost of a system alongside the near-term and long-term benefits, so it was really a no brainer.”



Let's build a smarter planet

### **For more information**

To learn more about how IBM can help you transform your business, please contact your IBM sales representative or IBM Business Partner.

To learn more about big data solutions from IBM, visit:

[ibm.com/software/data/bigdata](http://ibm.com/software/data/bigdata)

To learn more about IBM InfoSphere BigInsights, visit:

[ibm.com/software/data/infosphere/biginsights](http://ibm.com/software/data/infosphere/biginsights)

To increase your big data knowledge and skills, visit:

[www.BigDataUniversity.com](http://www.BigDataUniversity.com)

To get involved in the conversation:

[www.smartercomputingblog.com/category/big-data](http://www.smartercomputingblog.com/category/big-data)

For more information about Vestas Wind Systems A/S, visit:

[www.vestas.com](http://www.vestas.com)



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