

The Vestas logo is positioned in the top left corner of the image. It features the word "Vestas" in a bold, blue, sans-serif font, with a registered trademark symbol (®) to its upper right.

Wind. It means the world to us.™



A new era for offshore wind power

Presenting Vestas' V164 – 7.0 MW Turbine for Offshore Power Plants

30 March, 2011. South Bank Centre, London, UK.

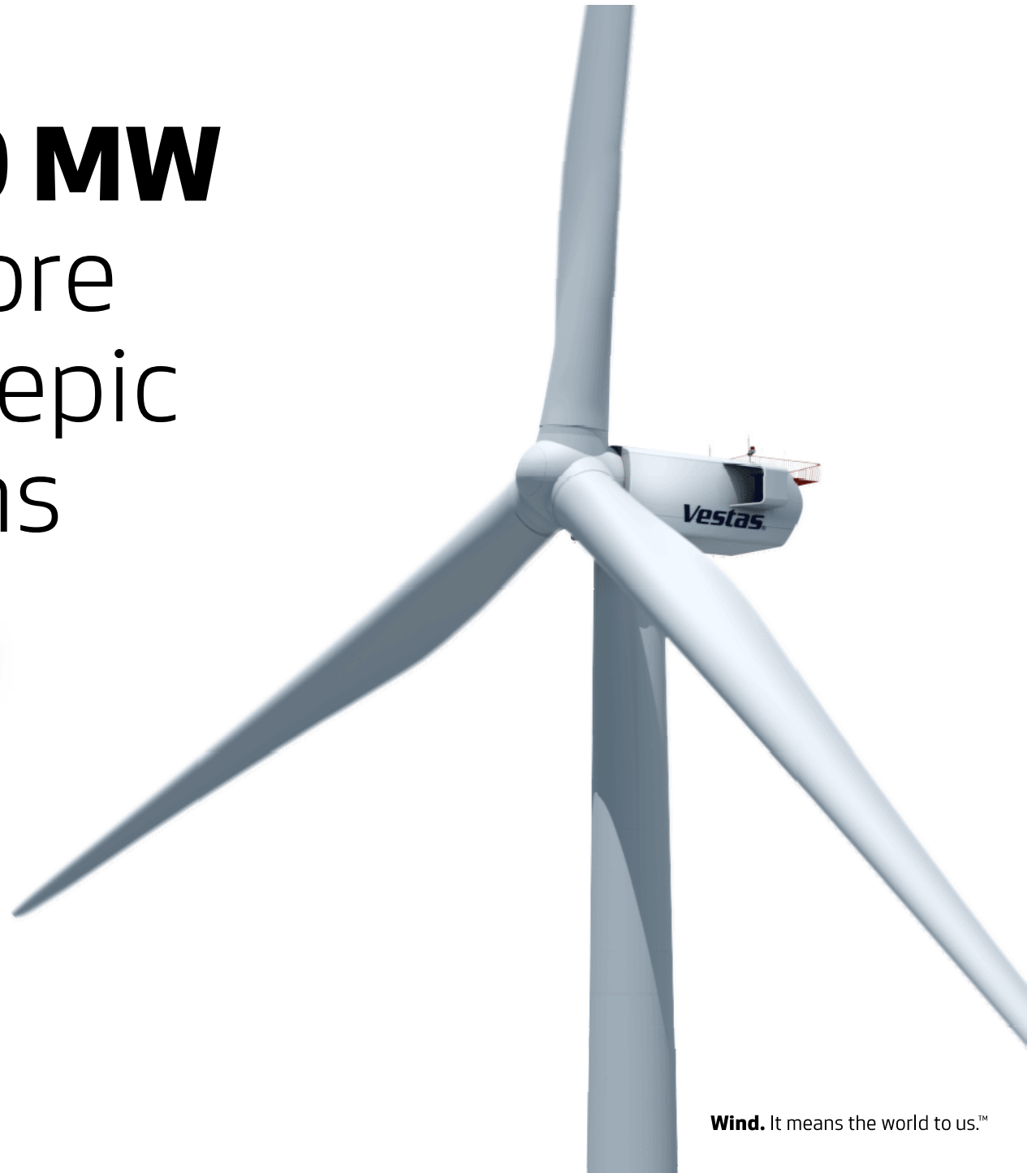
Agenda

1. Ditlev Engel, Group President & CEO
2. Anders Søe-Jensen, President, Vestas Offshore
3. Finn Strøm Madsen, President, Vestas Technology R&D

V164-7.0 MW

- An offshore turbine of epic proportions

- no longer **TOP SECRET**



An **energy challenge** of epic proportions

Our future need for energy

...while reducing CO₂ emissions

Electricity Mix in the 27 EU member states 2009-2020:

2/3 of added **capacity**
in EU is renewable.

MW	2009	Net capacity 2020	Added 2010-20	Decommissioning 2010-20
Coal Power generation	188,278	133,780	20,600	75,098
Oil Power Generation	41,415	12,893	804	29,326
Gas Power Generation	211,320	217,514	59,824	53,630
Nuclear Power Generation	131,987	127,811	11,614	15,791
Hydro Power generation	133,001	144,416	11,756	341
Renewables Power Generation	120,776	333,731	213,384	429
CCS Power Generation	20	3,419	3,399	0
Total	826,798	973,564	321,381	174,615

Source: EER and National Renewable Energy Action Plan (NREAP)

Electricity Mix in the 27 EU member states 2009-2020: (2)

'Legally binding' in 2020: 13% electricity **from wind**

MW	Added 2010-20	Generation GWh - 2020	Share 2020
Coal Power generation	20,600	595,365	17%
Oil Power Generation	804	21,085	1%
Gas Power Generation	59,824	917,412	26%
Nuclear Power Generation	11,614	871,835	25%
Hydro Power generation	11,756	333,940	9%
Renewables Power Generation	213,384	760,381	22%
CCS Power Generation	3,399	24,763	1%
Total	321,381	3,524,782	100%
Onshore wind energy	99,477	314,587	9%
Offshore wind energy	35,334	132,094	4%

Source: EER and National Renewable Energy Action Plan (NREAP)

Global Electricity Mix:

Wind is less than
2 % today.

Vestas vision:
10 % in 2020



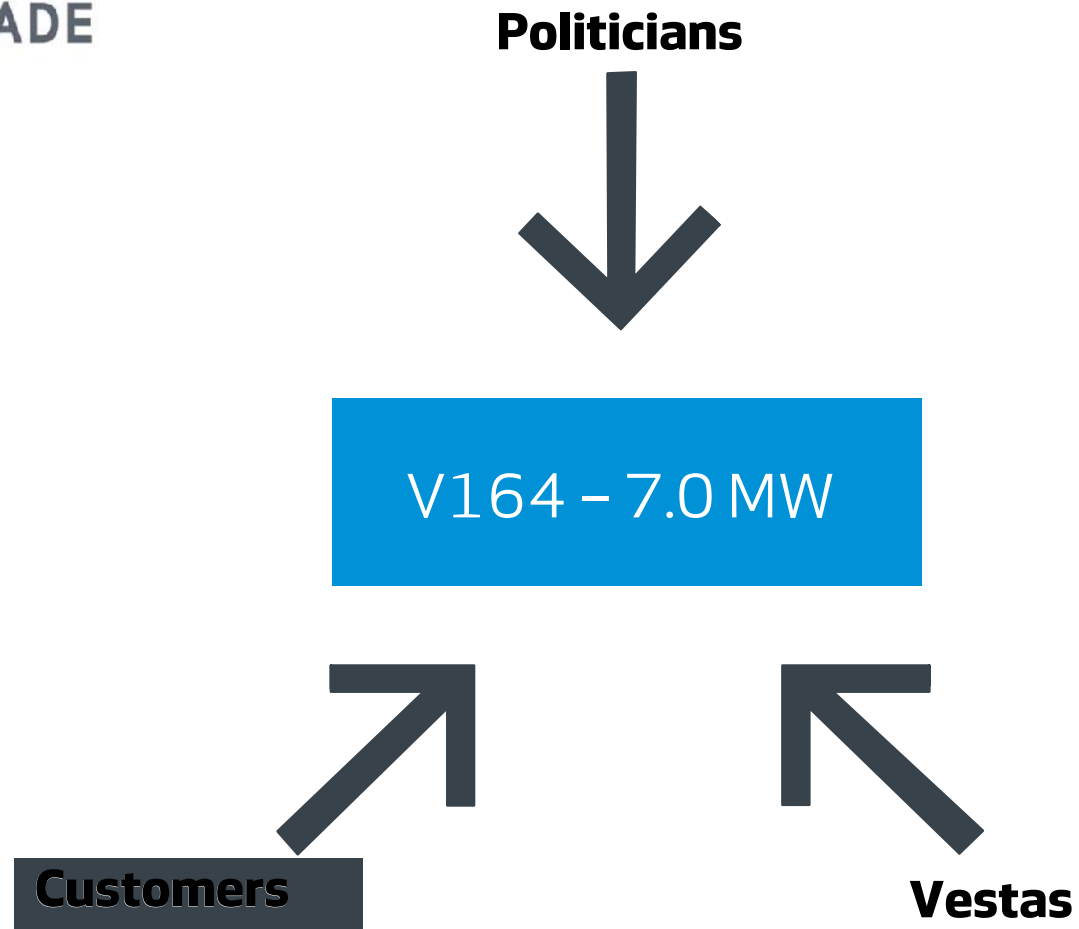
IEA World Energy Outlook - Global Electricity Mix 2035:

“Government support remains the **key driver**”

	Current Policies Scenario	New Policies Scenario	450 Scenario (temp. increase = 2%)
Power mix 2035	Coal: 43 % Oil: 2 % Gas: 22 % Nuclear: 11 % Hydro: 13 % Biomass and waste: 3 % Geothermal: 1 % Solar PV: 1 % Wind: 5 %	Coal: 32 % Oil: 1 % Gas: 21 % Nuclear: 14 % Hydro: 16 % Biomass and waste: 4 % Geothermal: 1 % Solar PV: 2 % CSP: 1 % Wind: 8%	Coal: 18 % Oil: 1 % Gas: 16 % Nuclear: 20 % Hydro: 19 % Biomass and waste: 6 % Geothermal: 1 % Solar PV: 4 % CSP: 3 % Wind: 13 %

Source: International Energy Agency (IEA)

What does it take?



What it takes from all...

-
- Involvement
 - Commitment
 - Investment
-

V164-7.0 MW

– a 100 % 'made to order' turbine.

The future of offshore wind is in the hands of our customers, politicians and Vestas.

Agenda

1. Ditlev Engel, Group President & CEO
2. Anders Søe-Jensen, President, Vestas Offshore
3. Finn Strøm Madsen, President, Vestas Technology R&D

Offshore conditions:

- High growth
- Strong forces
- Europe as pioneer
- Long term planning

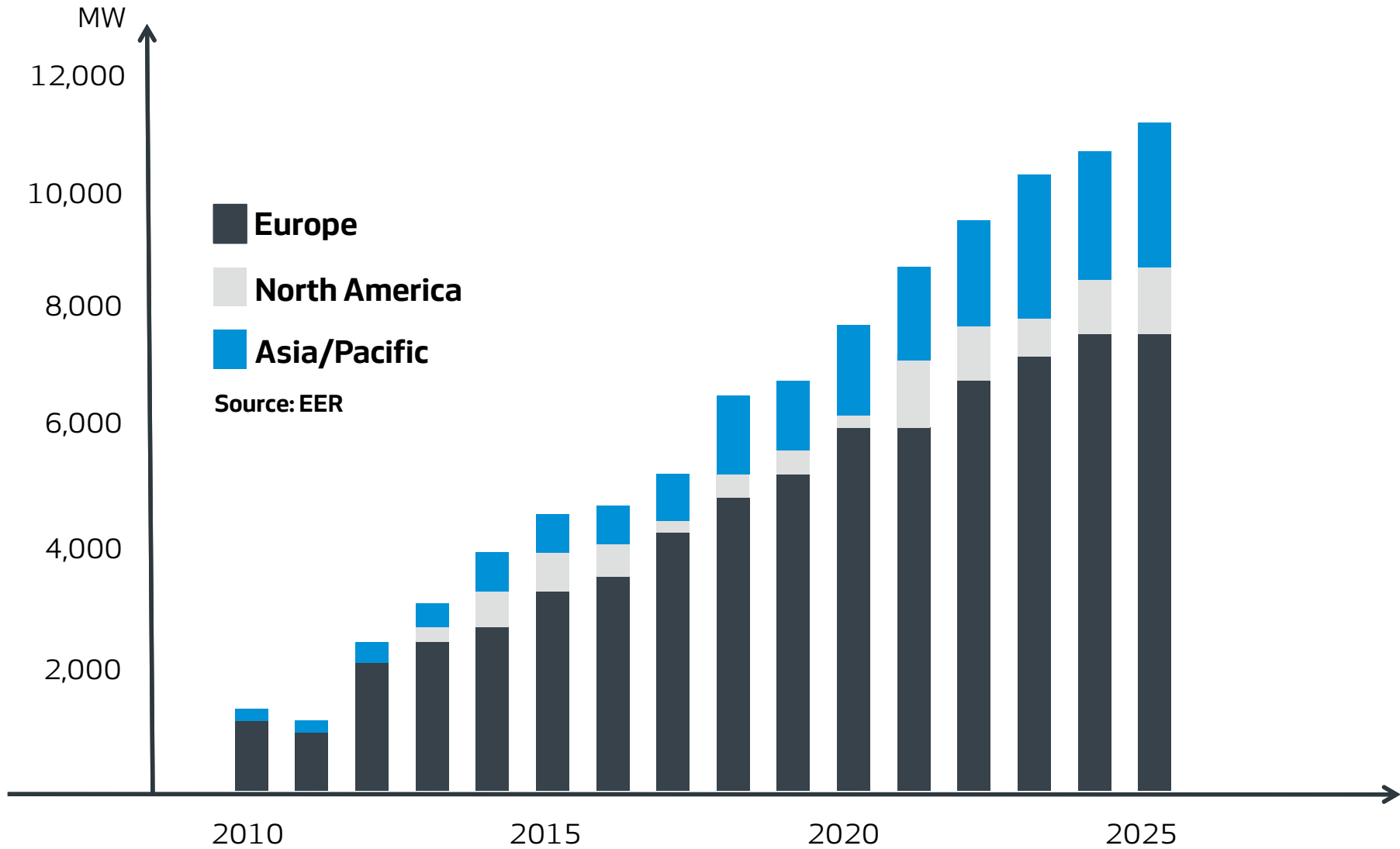



Offshore market
2015-2025
+63.000 MW
8,4 % growth.
A year*

* CAGR
Source: EER



Global Offshore Wind Megawatts - added by region 2010-2025





The V164-7.0 MW

- built to last

Based on 10 years
of true offshore
experience.

Purpose built :

Designed for
true offshore
environment

Vestas has installed **25 %** of
global accumulated capacity
Onshore.

A photograph of an offshore wind farm at dusk or dawn. The sky is a gradient of blue and grey, and the water is dark. Numerous wind turbines are visible, their silhouettes against the horizon. The text is overlaid on the top half of the image.

Vestas has installed **43 %** of
global accumulated capacity
Offshore.

- Bligh Bank (B)
- Robin Rigg (UK)
- Thanet (UK)

In fact **63%**
in 2010

The offshore **Pioneer**

V39

0.5 MW Platform

V80

2.0 MW Platform

V90

3.0 MW Platform

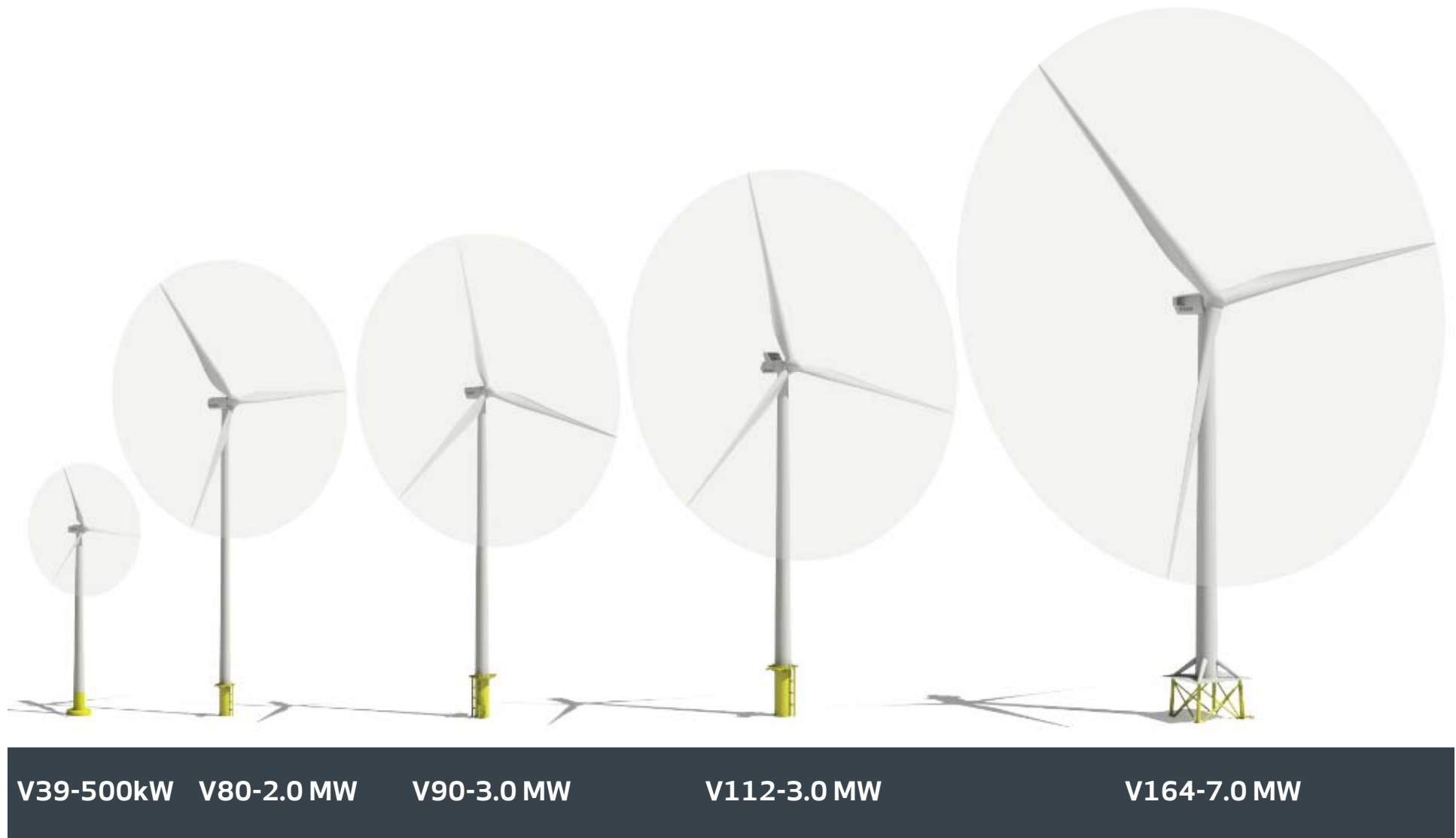
V112

3.0 MW Platform

V164

7.0 MW Platform

The Vestas offshore evolution



V39-500kW

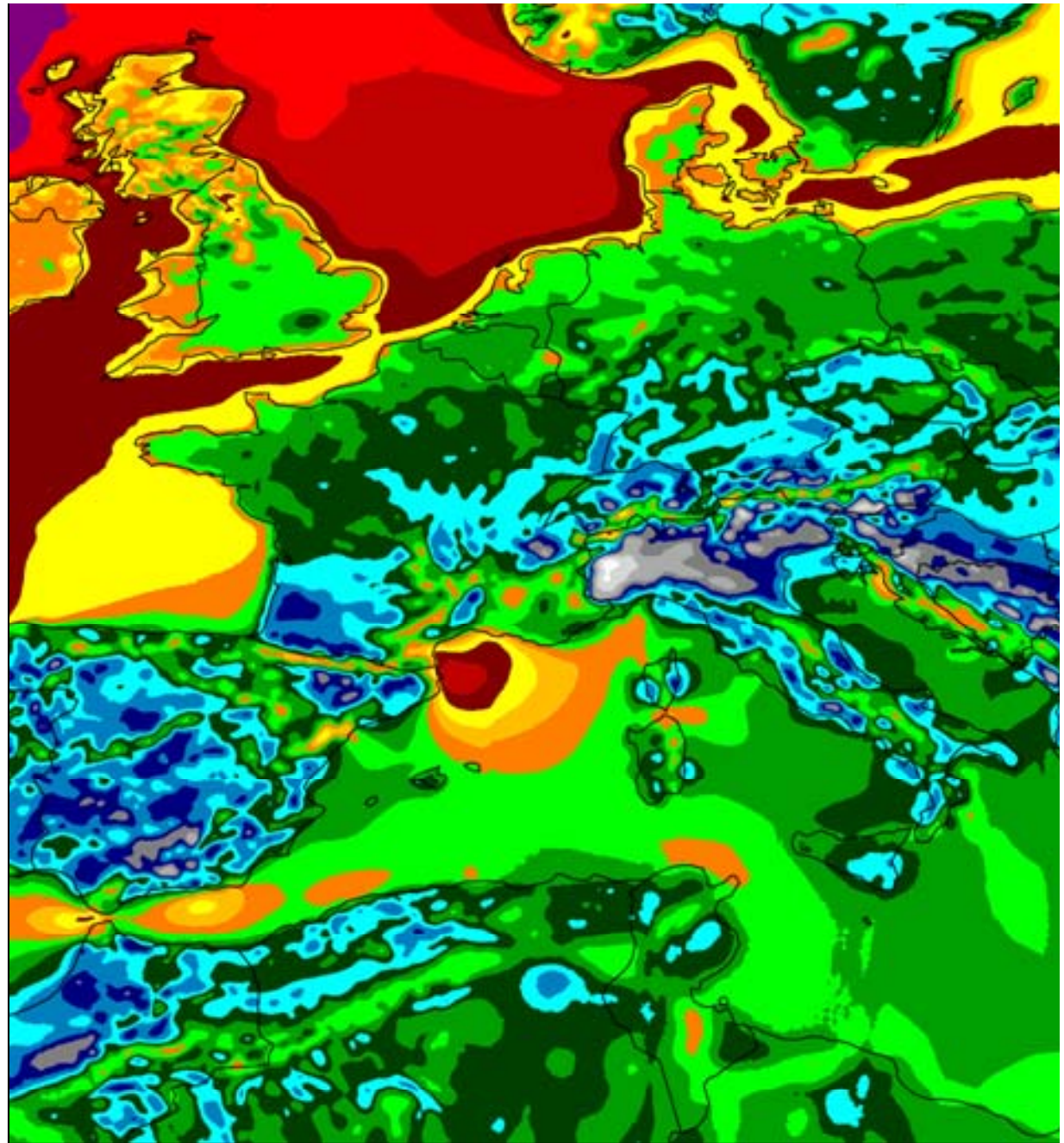
V80-2.0 MW

V90-3.0 MW

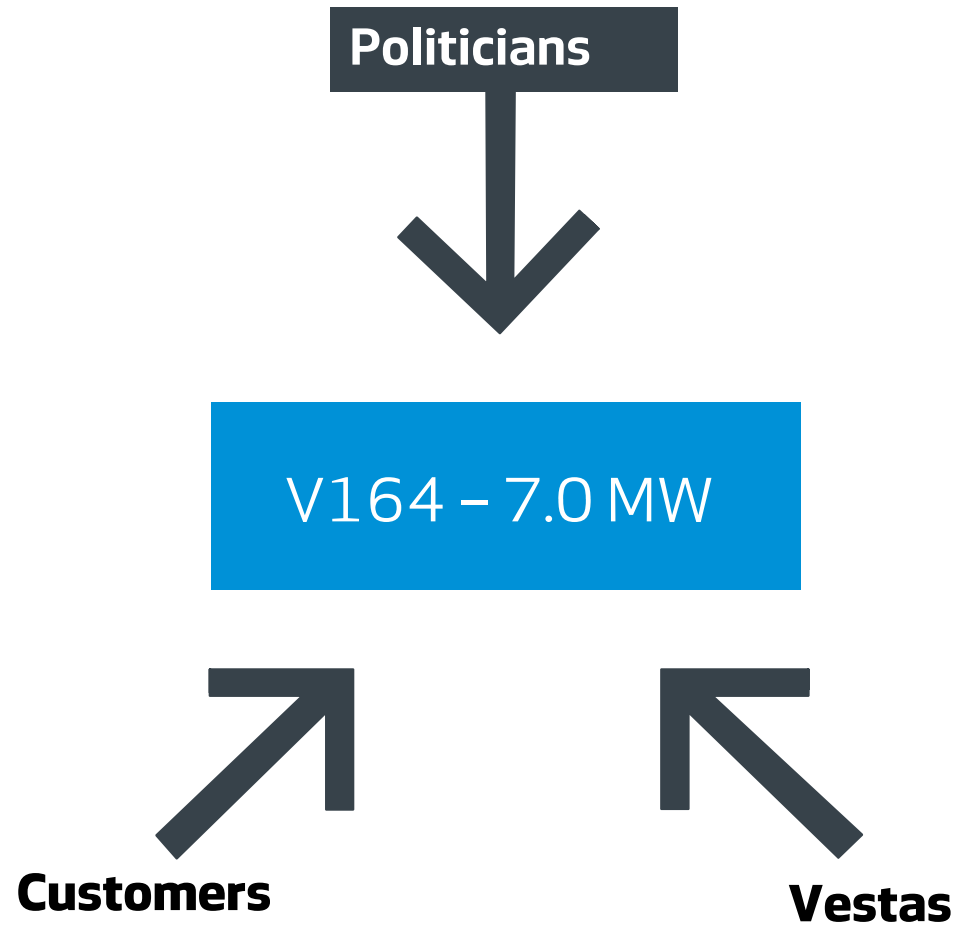
V112-3.0 MW

V164-7.0 MW

Average wind speeds at **80 meters'** height



What does it take?



Offshore in the electricity mix in Europe

Ambitious climate and energy targets.

Europe cannot reach targets without (offshore) wind. **Period.**



Every 3rd MW installed in 2015 is offshore!

Source: EER

Right now is indeed
a defining moment
for offshore wind.

- Involvement
- Commitment
- Investment

Offshore in the UK

32,000 MW offshore

Millions of people benefitting from offshore wind.

Better balance in future energy mix and energy security.

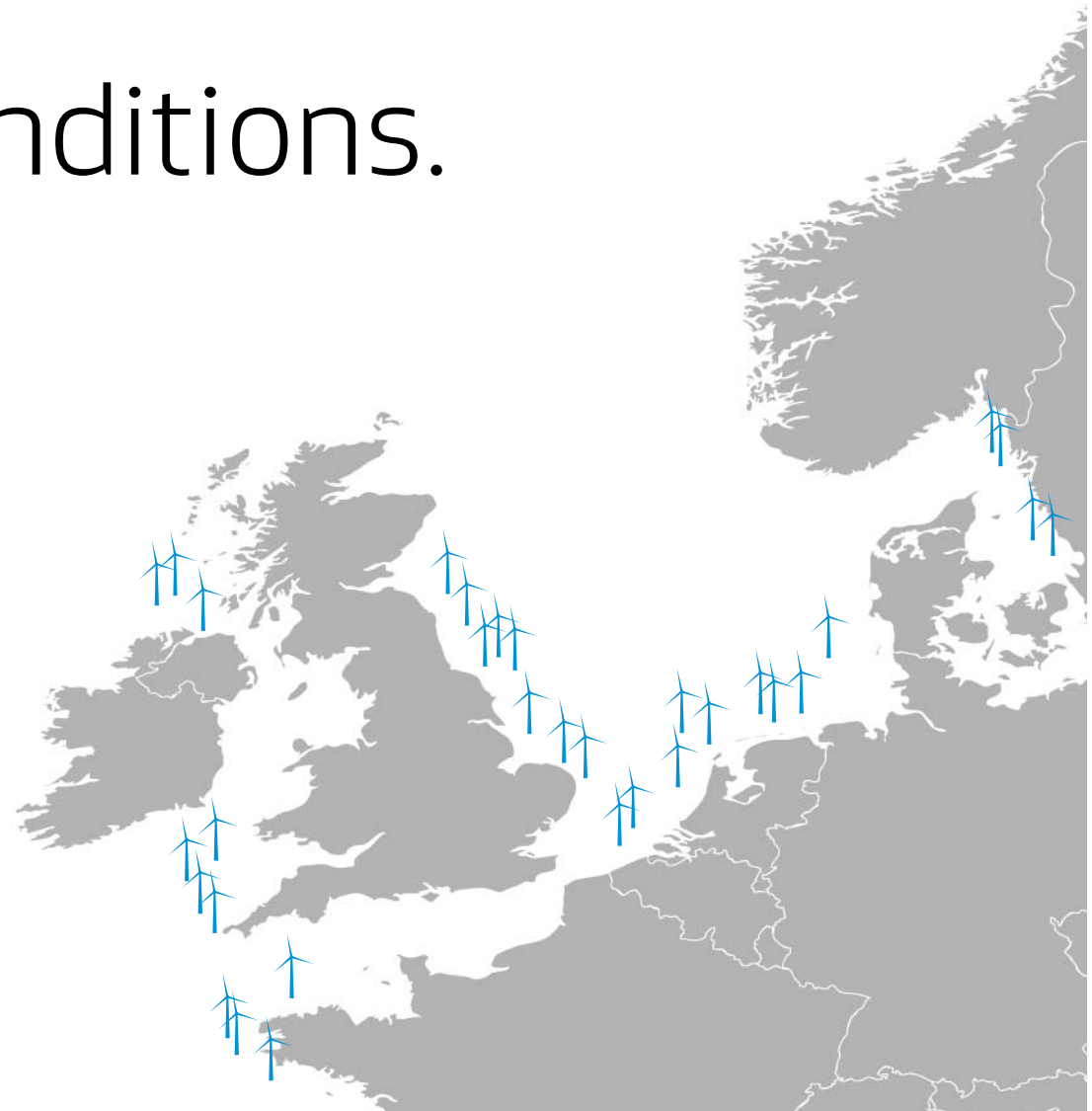
Helps close gap between available energy and future demand.



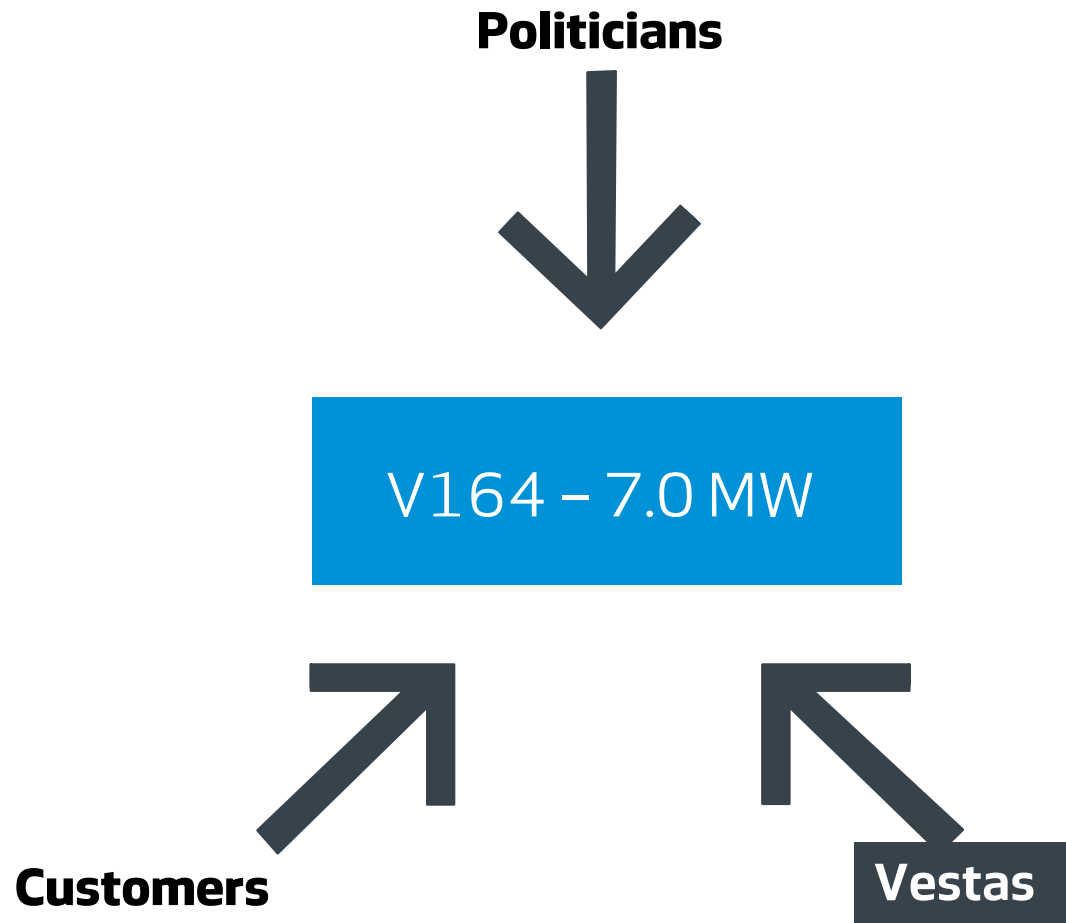
V164 - 7.0 MW

Designed for
North Sea conditions.

- UK
- Ireland
- Germany
- Denmark
- Netherlands
- Belgium
- France
- Sweden



What does it take?



Green jobs in several European countries.

- Suppliers
- Manufacturing
- Research & Development
- Years of Operation & Maintenance

Isle of Wight, Vestas Technology R&D centre

Approx. 200 employees.

Total of 577
employees in UK.



Technology R&D centre opening in September 2011

Agenda

1. Ditlev Engel, Group President & CEO
2. Anders Søe-Jensen, President, Vestas Offshore
3. Finn Strøm Madsen, President, Vestas Technology R&D

V164 – 7.0 MW.

A game changer
in offshore wind.

Based on
proven
technology.



Why 7.0 MW instead of earlier announced 6.0 MW?

Analysis have documented that we can reduce Cost of Energy while maintaining risk profile and time to market.



V164-7.0 MW

- Sustainability
- Cost of Energy
- Reliability



Sustainability

Health & Safety

Designed for highest customer and service crew standards.

Environment

80 % recyclable.

As green as it gets

Life Cycle Assessment: Energy to produce turbine paid back in approx. 10 months.



Cost of Energy

Turbine efficiency

Approx. 30 pct more production
pr. ton turbine.

Rotor

Swept area. Aerofoil with efficiency
and performance.

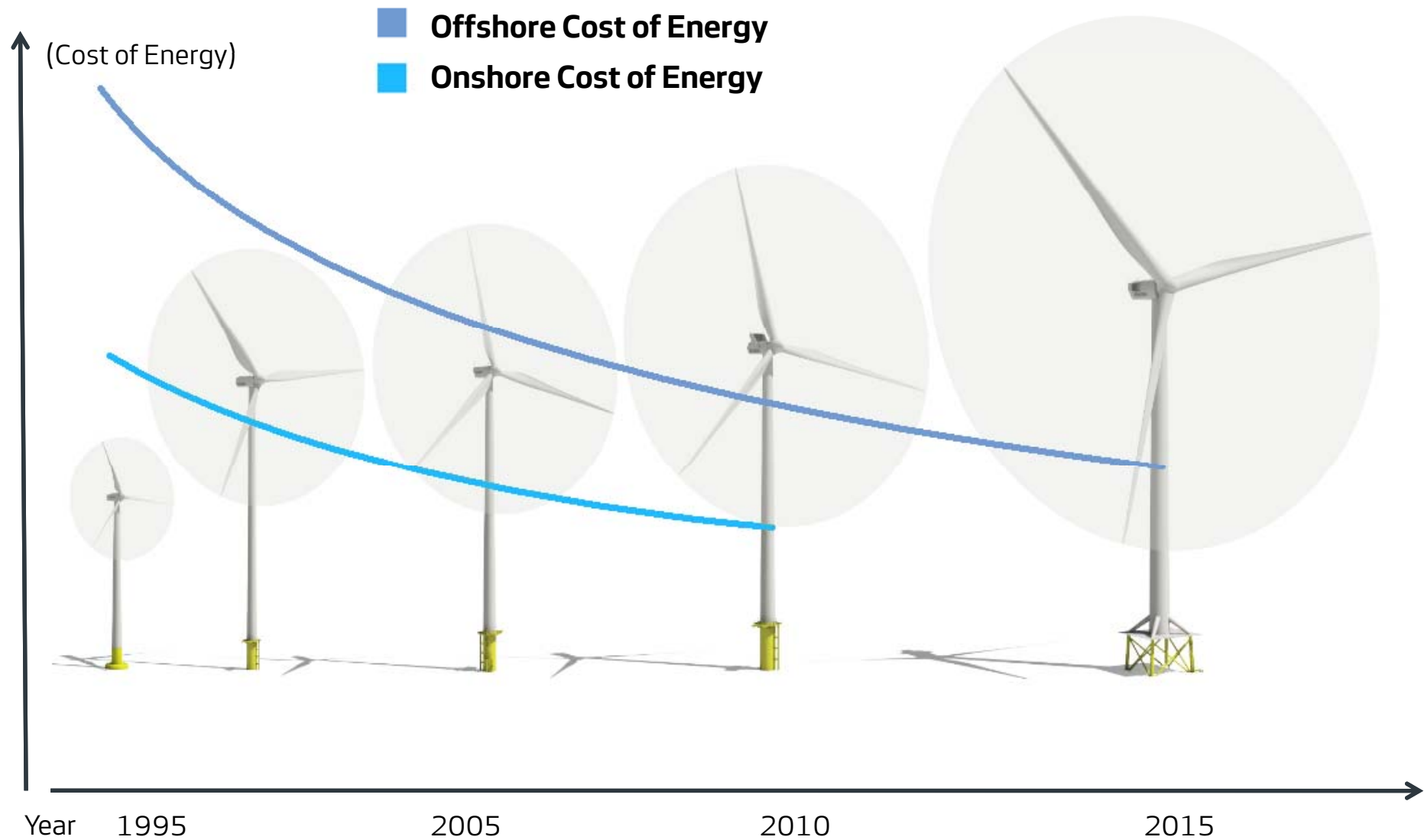
Purpose built power plant

Designed for supply chain, transportation,
construction & serviceability.

Wind park takes up 15 pct. less sea area.



Onshore vs. Offshore Cost of Energy: Significantly narrowing the gap



Onshore vs. offshore

Onshore:

~70 pct.

Offshore:

~35 pct.

Total cost of turbine compared to total cost of wind park including balance of plants etc.

The turbines are still 100 pct. of business case success.
Fewer turbines to pay back offshore investment.

Reliability

Design verified

Tested product

Thoroughly tested in Vestas state-of-the-art test centre.

Supplier excellence

Intelligent controls & advanced diagnostics

Forecast longevity of components.

Critical systems backup.

'Neighbouring Info Sharing'



Bankable: The equation

$$\begin{aligned} & \text{Sustainability} \\ + & \text{Cost of Energy} \\ + & \text{Reliability} \\ \hline = & \text{Predictable Cash Flow} \\ \hline \hline \end{aligned}$$

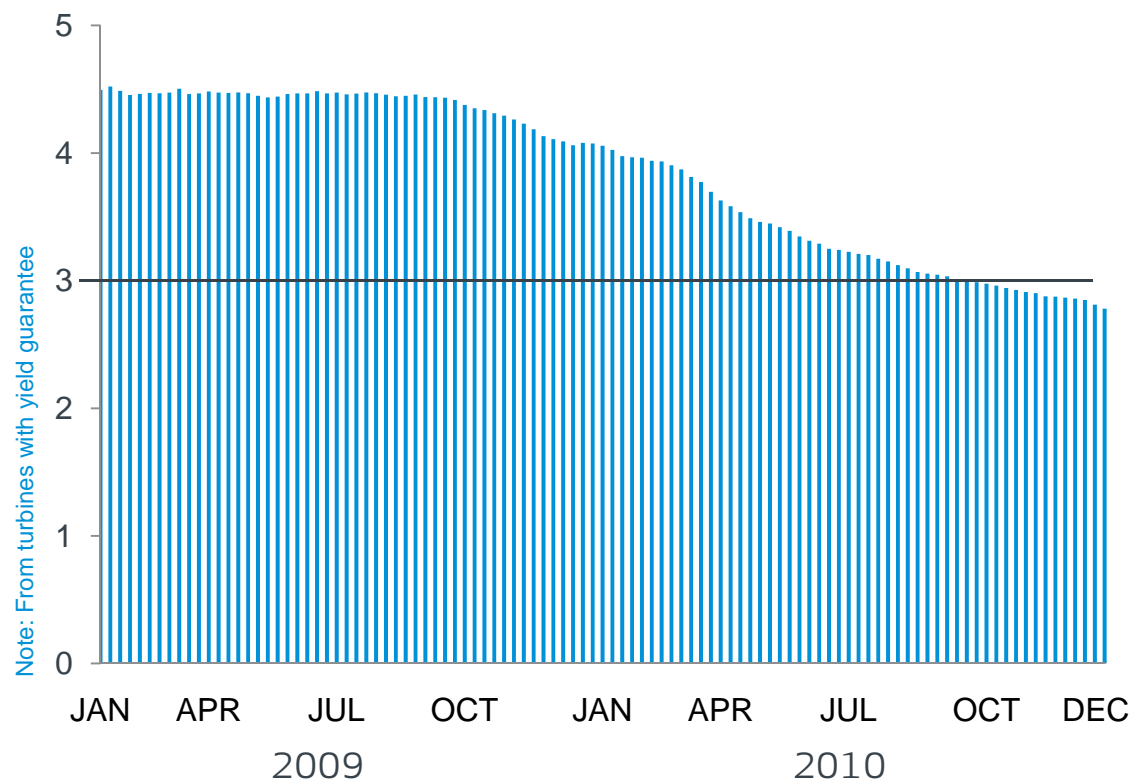
Vestas is **not** married to
a particular technology.

We trust proven concepts – e.g. from
automotive and aerospace industries
– for improved reliability

Still better performing turbines

Lost Production Factor

Per cent



The lower, the better.

Why a geared drive-train solution?

- Several parallel development tracks involving customers.

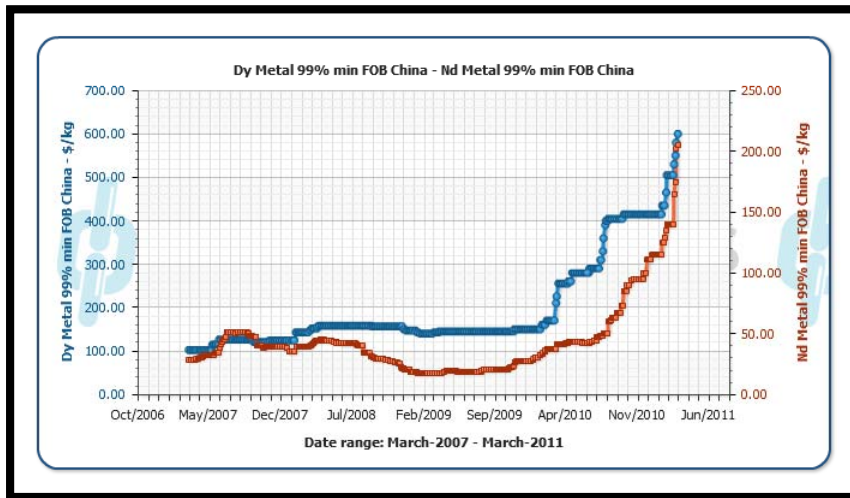
Six key focus areas:

- ✓ 1. Energy Density (MWh/ton)
 - ✓ 2. Sustainability (MWh/ton)
 - ✓ 3. Strategic raw materials
 - ✓ 4. Reliability (moving parts/interfaces)
 - ✓ 5. OPEX (Serviceability/tools)
 - ✓ 6. CAPEX (Weight/transportation)
-

Conclusion: choice of proven technology

Why not a direct drive solution?

- Several parallel development tracks involving customers.



4x

No. of electrical components in direct drive compared to geared drive train.

Price and availability?

V164-7.0 MW

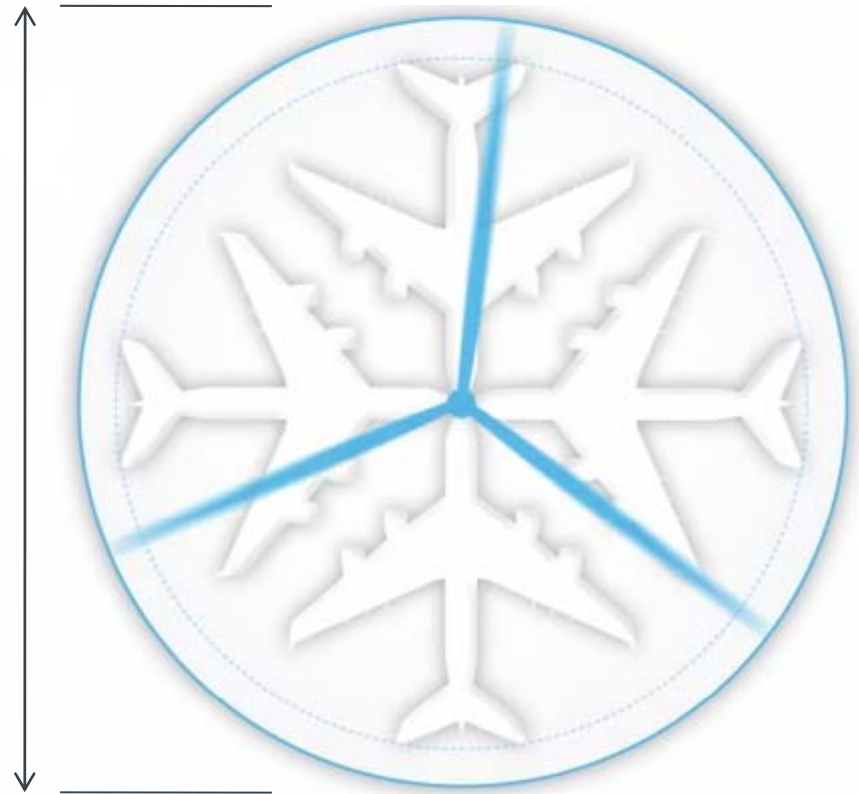
- Dimensions



The rotor is the motor

Compared to four
Airbus A380
– the world's largest
passenger airplane.

164 meter



21,124 sq meters = 25,263 sq yards

Dimensions

Vestas V164 – 7.0 MW Offshore Turbine

Swept Area: **21,124 m²**

Mega Watt: **7.0**

Blade Length: **80 m**

Min. Hub Height: **105 m**

Rotor Diameter: **164 m**

Tip Height: **187 m**

Weight: **~800 ton**



Dimensions

Vestas V164 – 7.0 MW Offshore Turbine

Swept Area: **21,124 m²**

Mega Watt: **7.0**

Blade Length: **80 m**

Min. Hub Height: **105 m**

Rotor Diameter: **164 m**

Tip Height: **187 m**

Weight: **~800 ton**



Dimensions

Vestas V164 – 7.0 MW Offshore Turbine

Swept Area: **21,124 m²**

Mega Watt: **7.0**

Blade Length: **80 m**

Min. Hub Height: **105 m**

Rotor Diameter: **164 m**

Tip Height: **187 m**

Weight: **~800 ton**



Dimensions

Vestas V164 – 7.0 MW Offshore Turbine

Swept Area: **21,124 m²**

Mega Watt: **7.0**

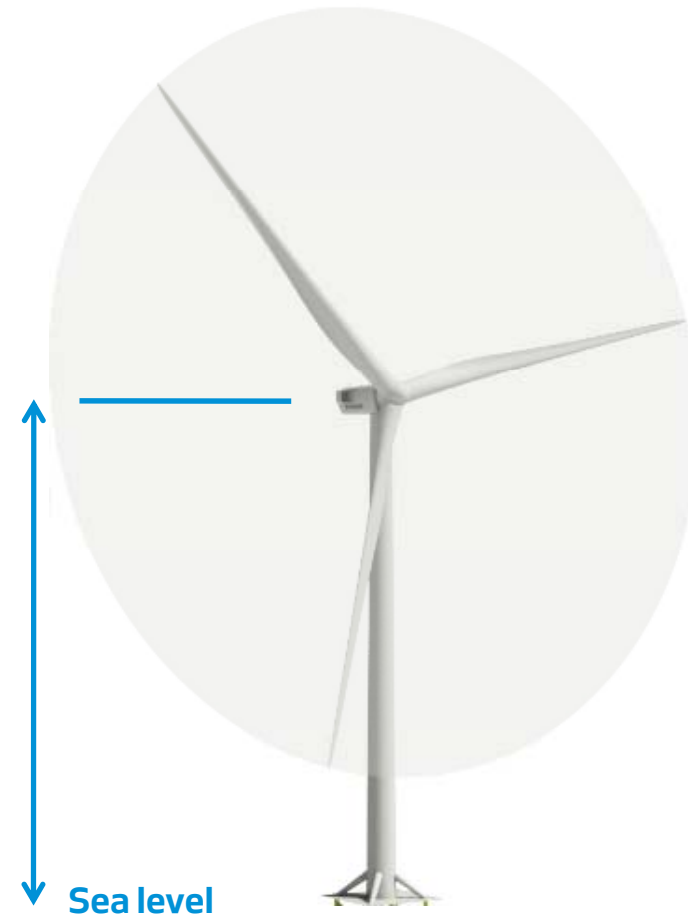
Blade Length: **80 m**

Min. Hub Height: **105 m**

Rotor Diameter: **164 m**

Tip Height: **187 m**

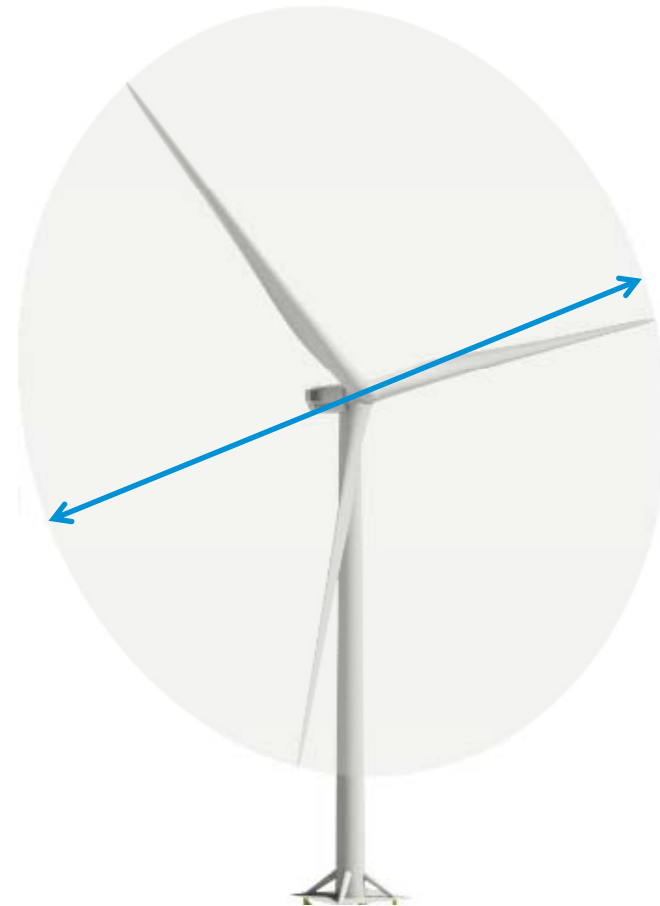
Weight: **~800 ton**



Dimensions

Vestas V164 – 7.0 MW Offshore Turbine

Swept Area: **21,124 m²**
Mega Watt: **7.0**
Blade Length: **80 m**
Min. Hub Height: **105 m**
Rotor Diameter: **164 m**
Tip Height: **187 m**
Weight: **~800 ton**



Dimensions

Vestas V164 – 7.0 MW Offshore Turbine

Swept Area: **21,124 m²**

Mega Watt: **7.0**

Blade Length: **80 m**

Min. Hub Height: **105 m**

Rotor Diameter: **164 m**

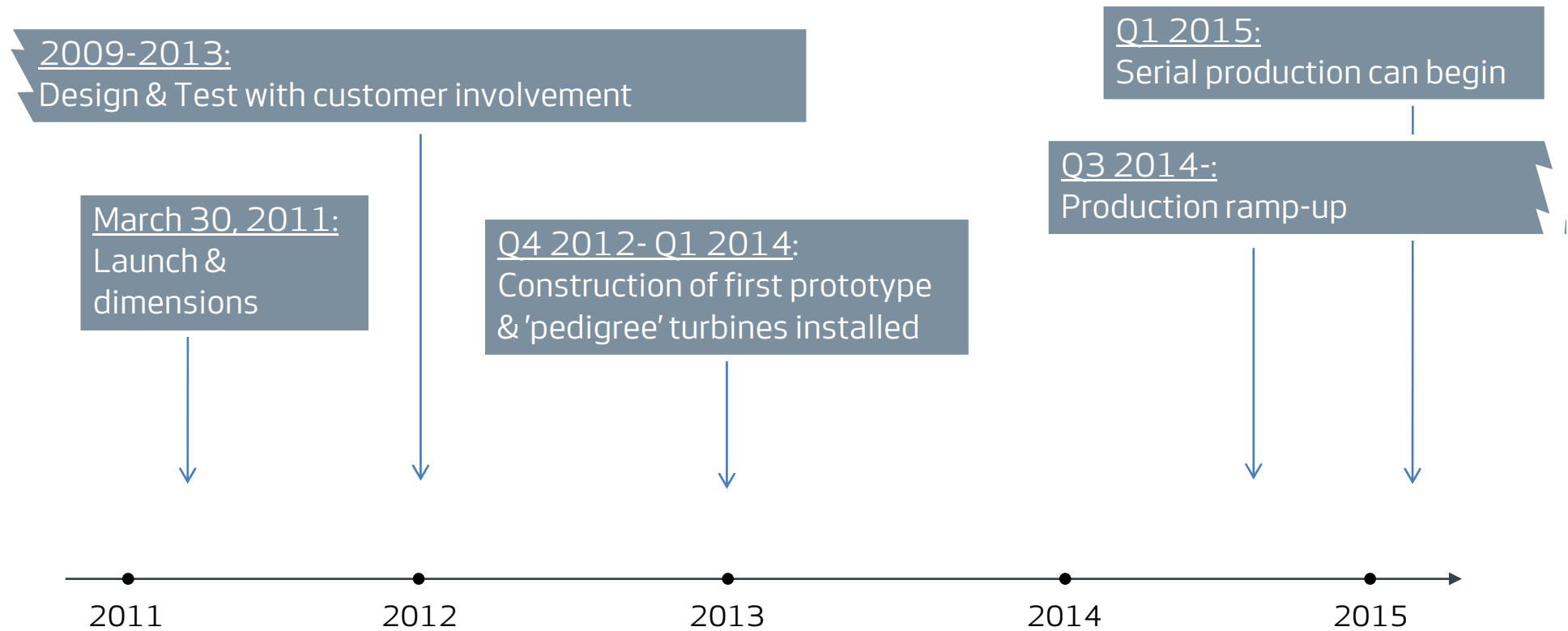
Tip Height: **187 m**

Weight: **~800 ton**



From today to offshore wind park in 2015

Given the right commitment, involvement & investment



A photograph of an offshore wind turbine's blades against a backdrop of a turbulent, dark blue ocean under a stormy sky. The blades are white and curved, positioned on the right side of the frame. The water is choppy with white foam from the waves.

Q & A

Questions & Answers

The Vestas logo is displayed in white, italicized font against a blue sky background with wispy clouds. The logo consists of the word "Vestas" followed by a registered trademark symbol (®).

Wind. It means the world to us.™

Thank you for your attention

Copyright Notice

The documents are created by Vestas Wind Systems A/S and contain copyrighted material, trademarks, and other proprietary information. All rights reserved. No part of the documents may be reproduced or copied in any form or by any means - such as graphic, electronic, or mechanical, including photocopying, taping, or information storage and retrieval systems without the prior written permission of Vestas Wind Systems A/S. The use of these documents by you, or anyone else authorized by you, is prohibited unless specifically permitted by Vestas Wind Systems A/S. You may not alter or remove any trademark, copyright or other notice from the documents. The documents are provided "as is" and Vestas Wind Systems A/S shall not have any responsibility or liability whatsoever for the results of use of the documents by you.

In case we have unintentionally violated copyrighted material, we want to be informed immediately in order to straighten things out and thus to honour any obligatory fees.