A new era for offshore wind power

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

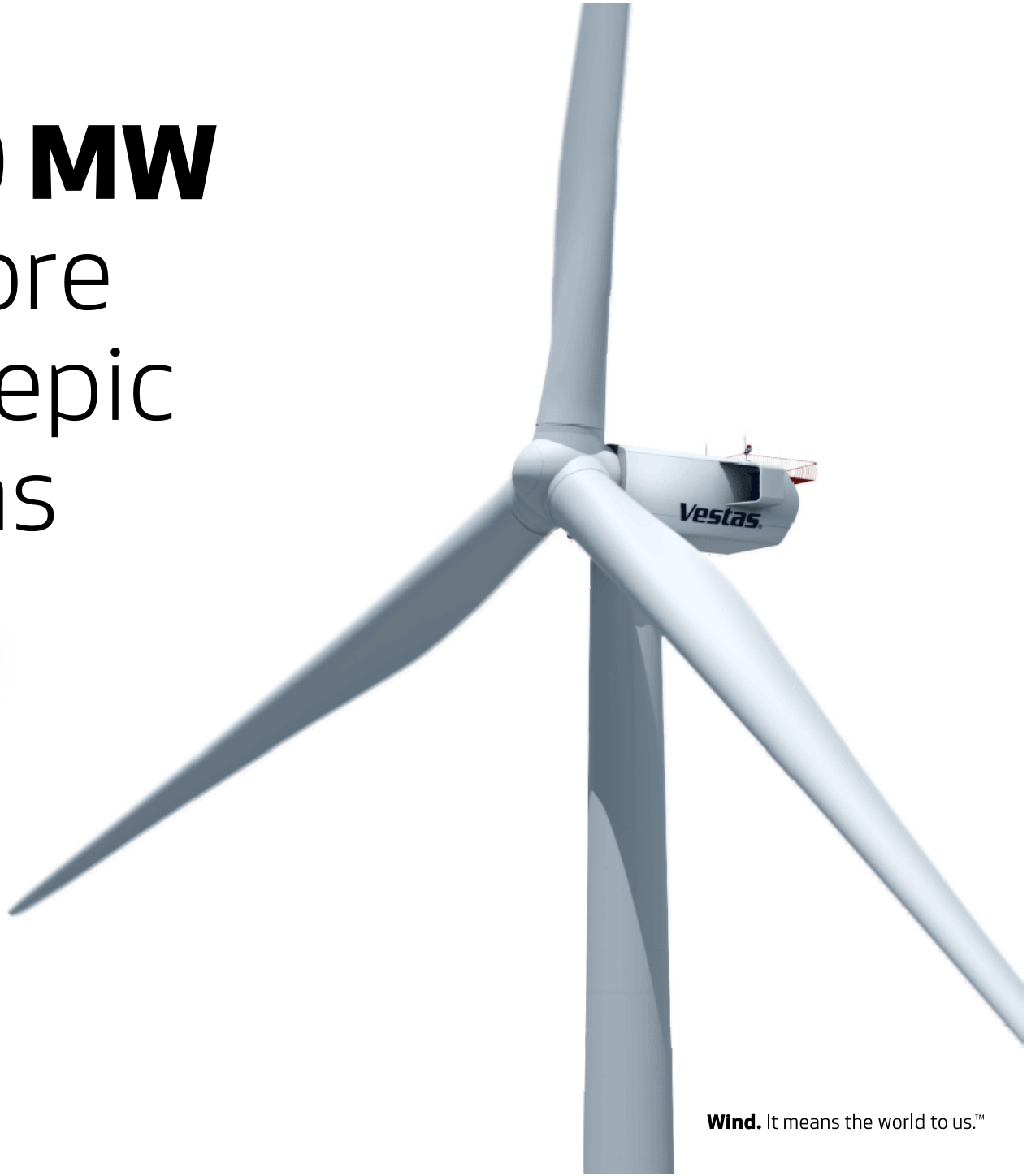
30 March, 2011. South Bank Centre, London, UK.

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 CO_2 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)

‘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)

Wind is less than
2 % **today.**

Vestas vision:
10 % in 2020

IEA World Energy Outlook - Global Electricity Mix 2035:

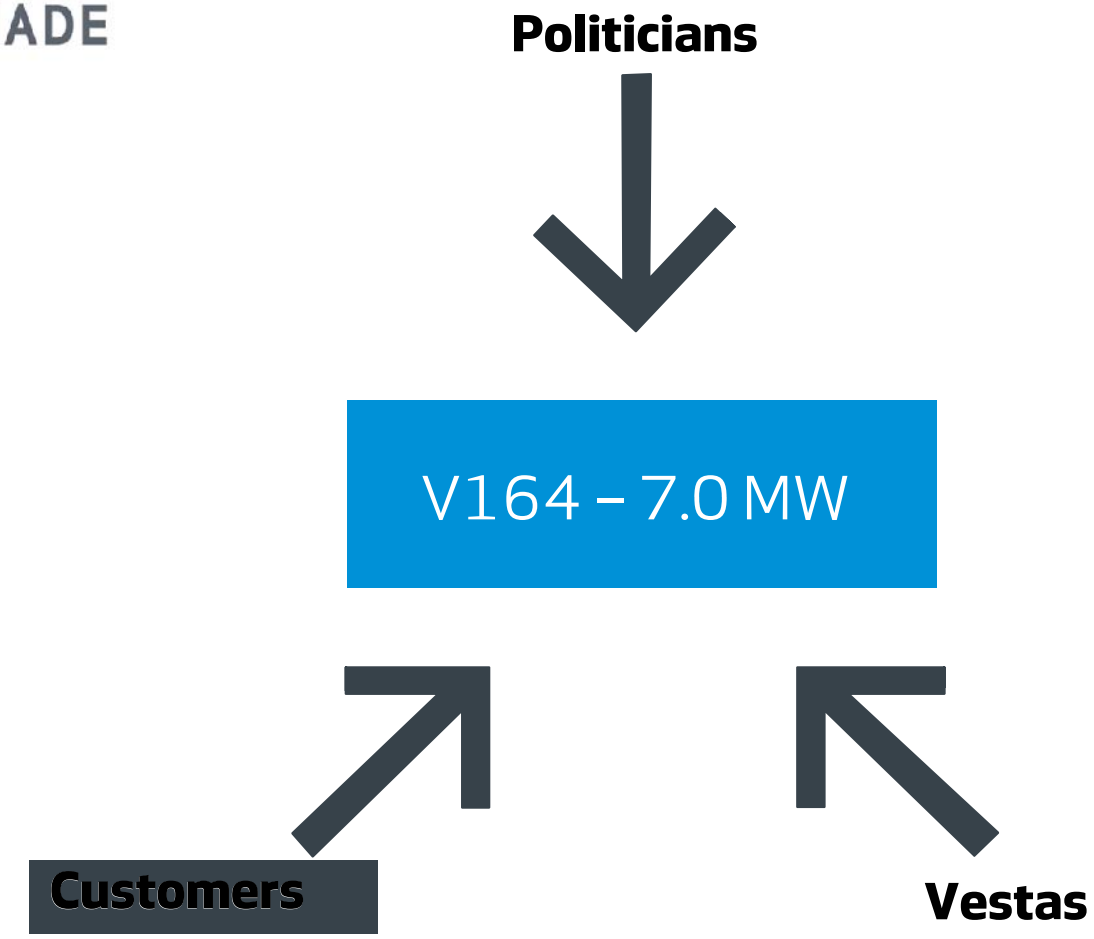
"Government support remains the **key driver**"

	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?

WINDMADE



- 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.

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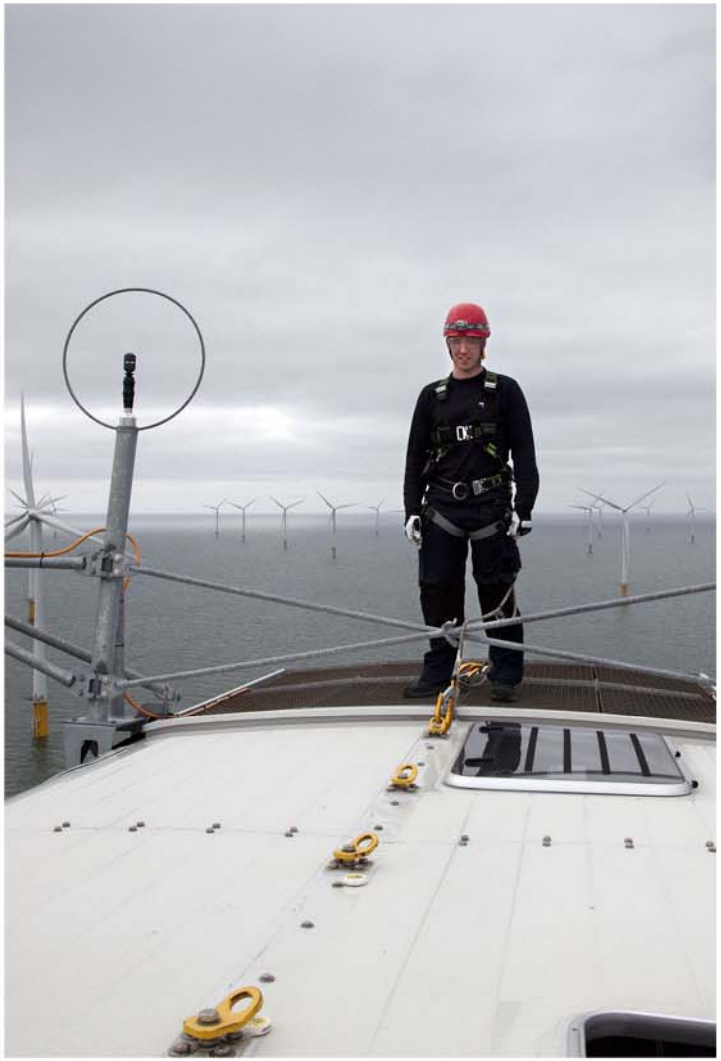
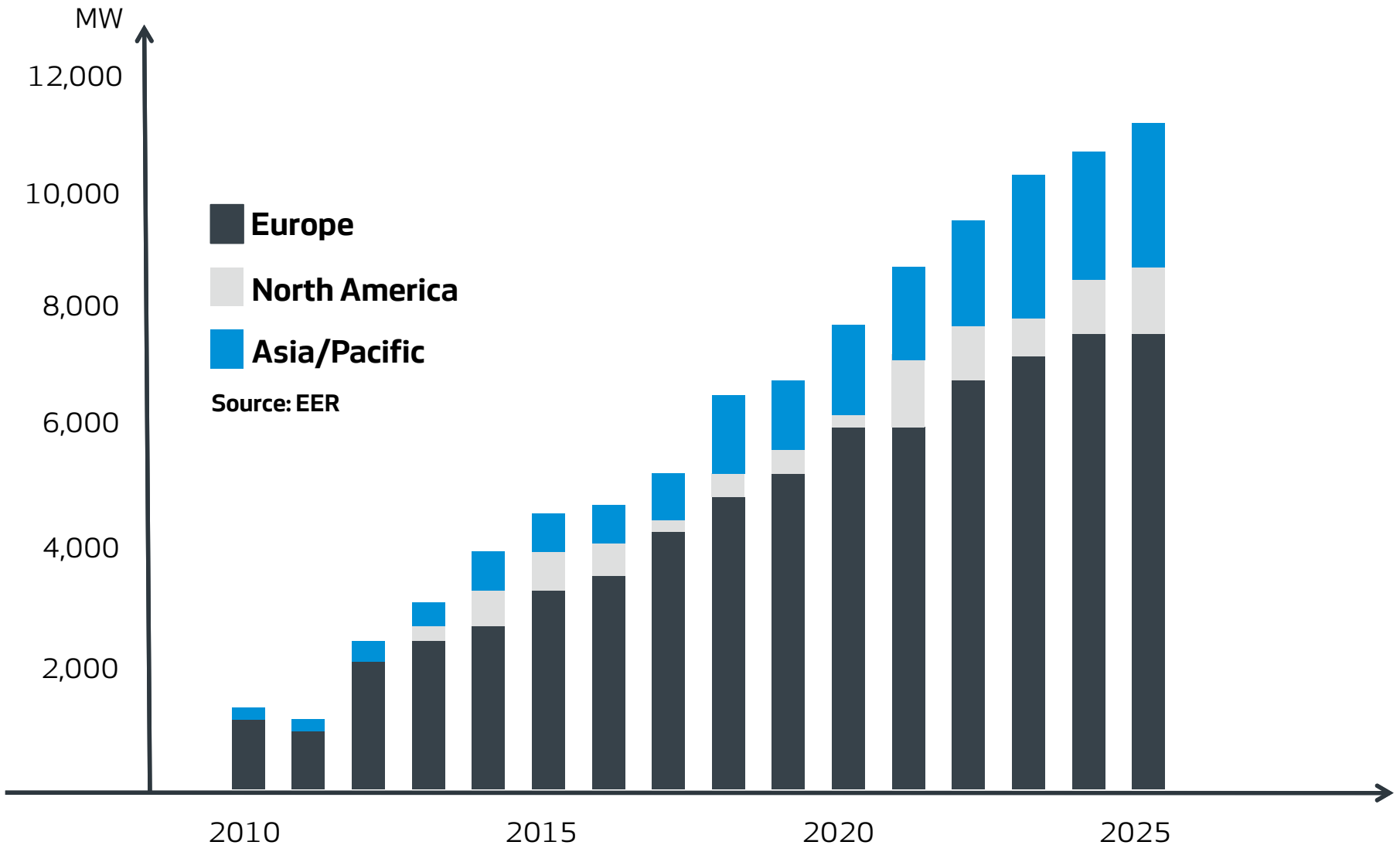
Offshore conditions:

- 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.
16 V164 – 7.0 MW


Vestas has installed **43 %** of global accumulated capacity **Offshore.**
- Bligh Bank (B)
- Robin Rigg (UK)
- Thanet (UK)
In fact **63%** in 2010
17 V164 – 7,0 MW

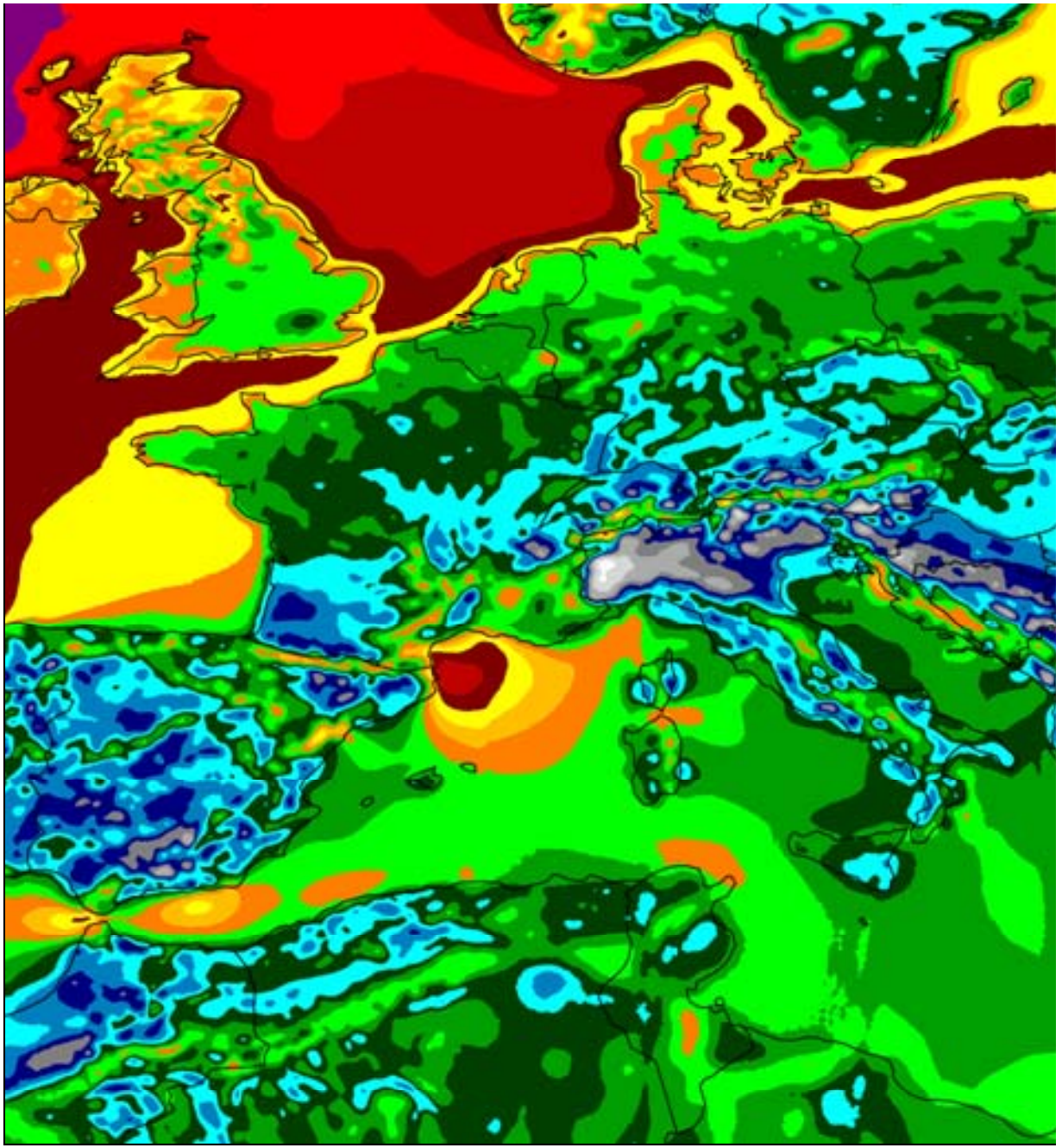
The offshore **Pioneer**

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

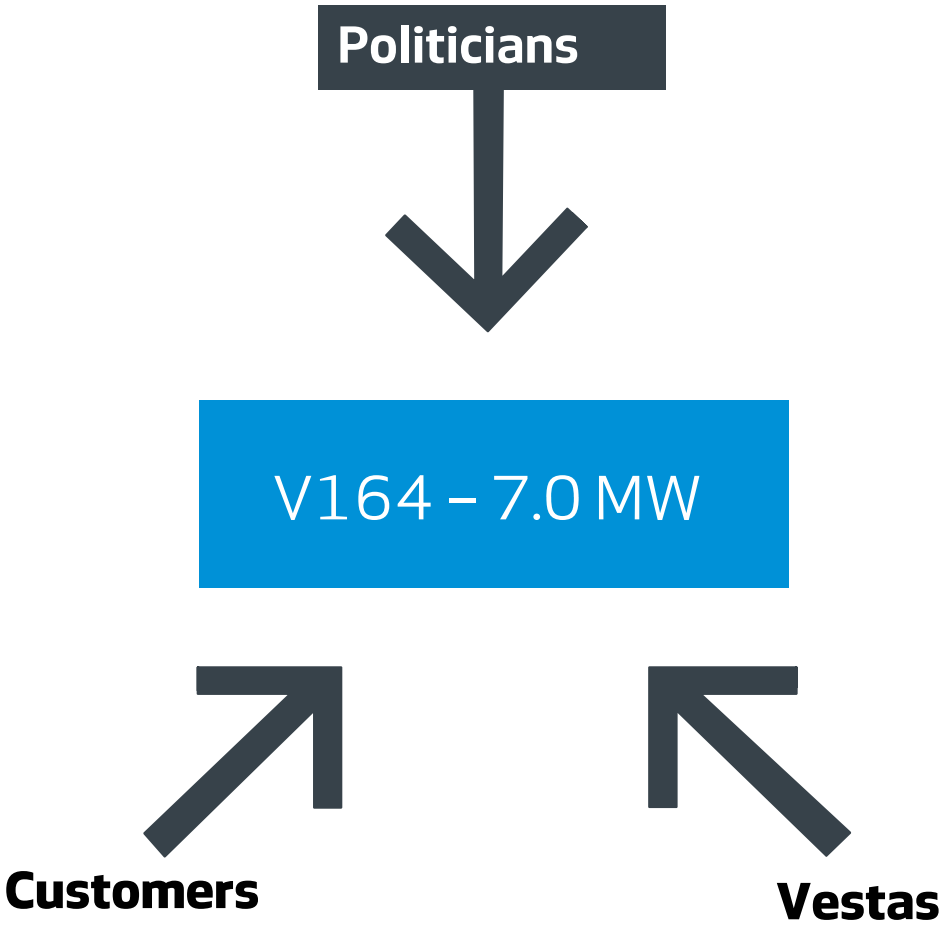
V39-500kW	V80-2.0 MW	V90-3.0 MW	V112-3.0 MW	V164-7.0 MW

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



Low wind **Medium** **High**

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.

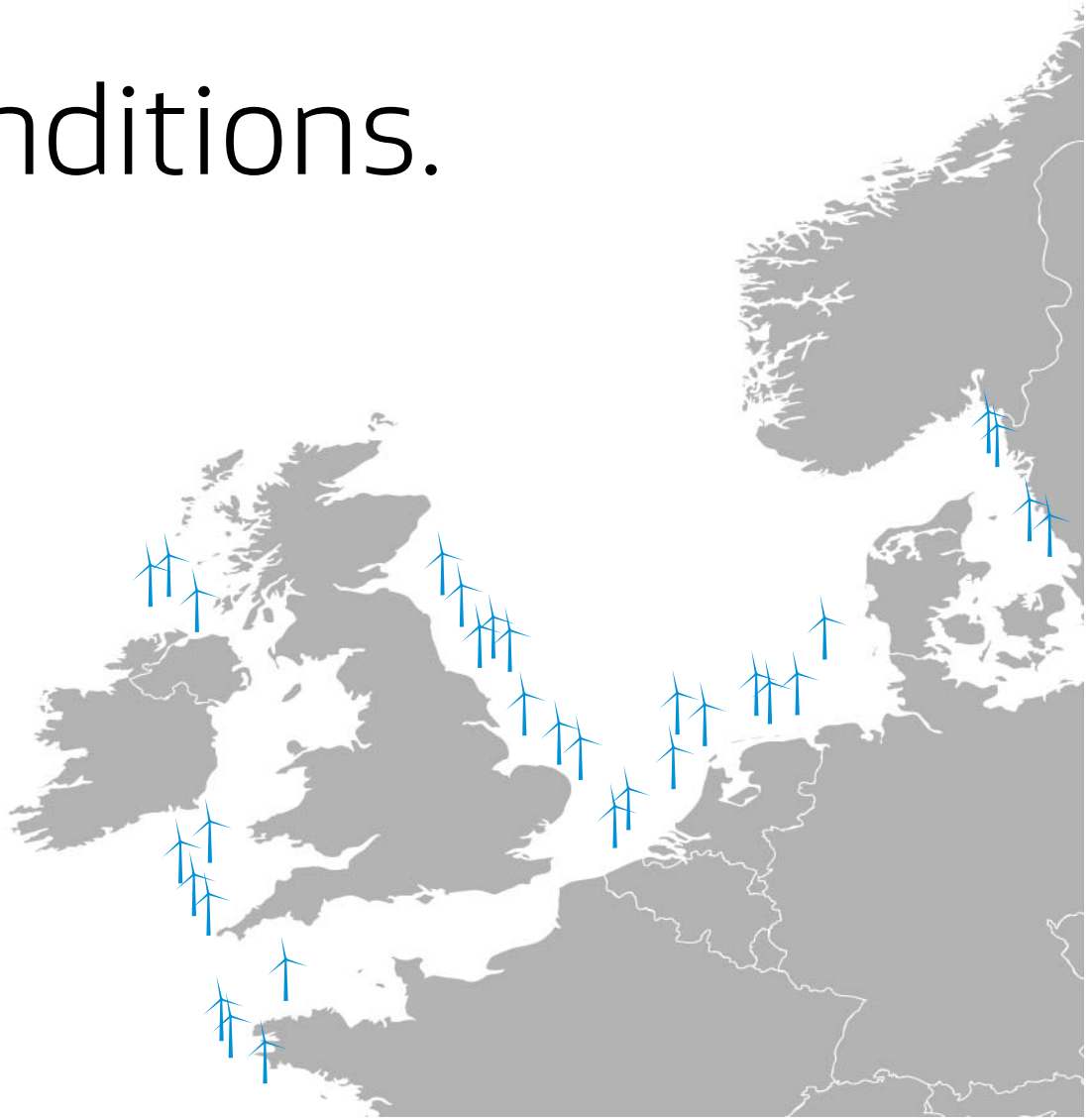
Better balance in future energy mix and energy security.

Helps close gap between available energy and future demand.

24 V164 – 7.0 MW

V164 – 7.0 MW
Designed for North Sea conditions.

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



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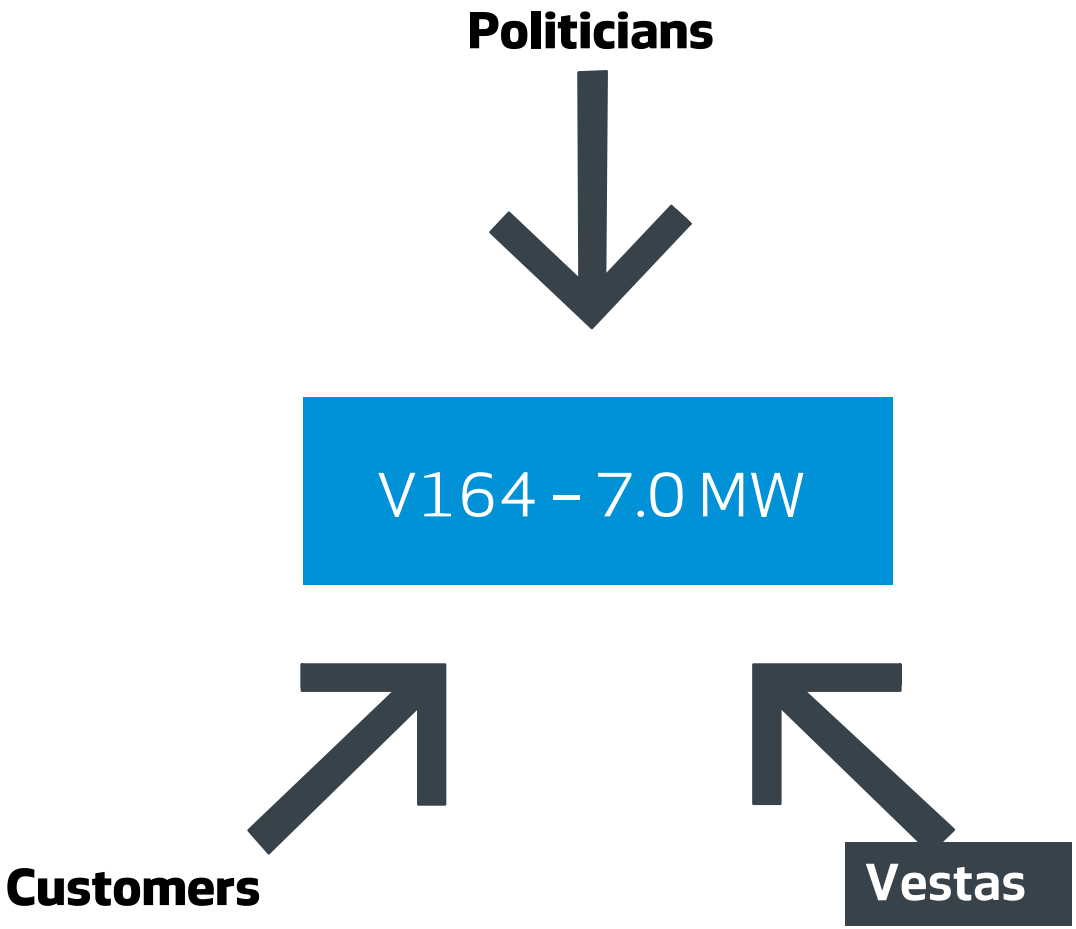

Green jobs in several European countries.

- 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

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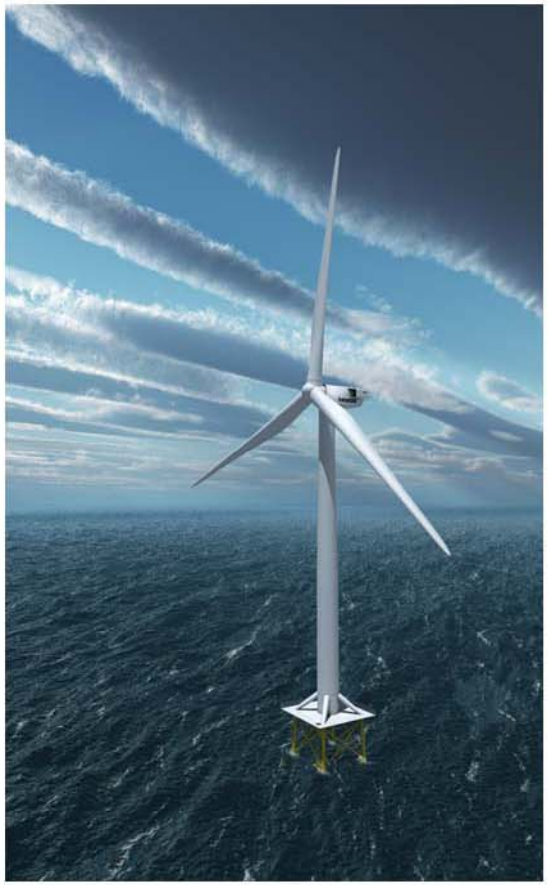
V164 – 7.0 MW.
A game changer
in offshore wind.
Based on
proven
technology.

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

Health & Safety
Designed for highest customer and service crew standards.

Environment
80 % recyclable.

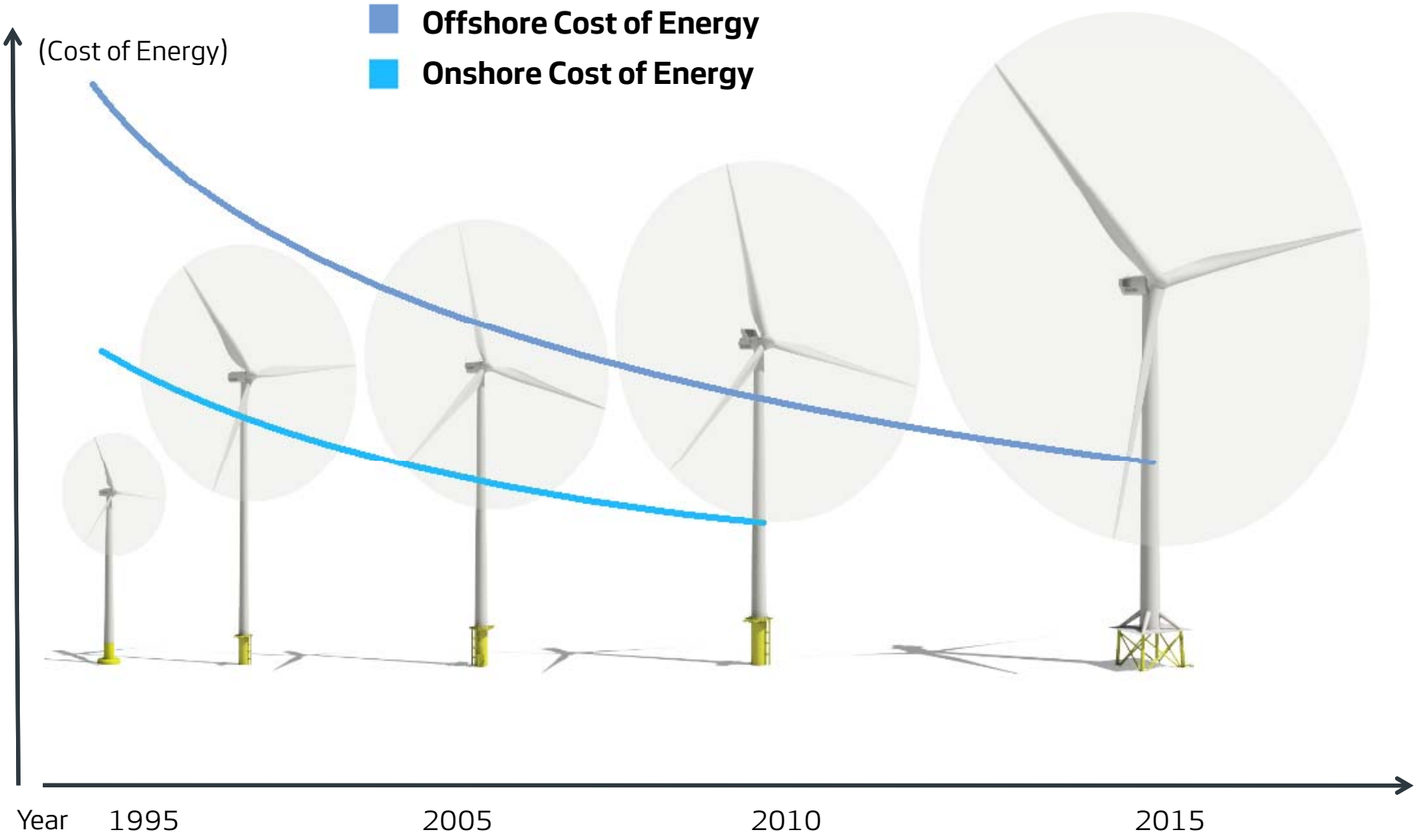
As green as it gets
Life Cycle Assessment: Energy to produce turbine paid back in approx. 10 months.

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:

~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.

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

Sustainability

\+ Cost of Energy

\+ Reliability

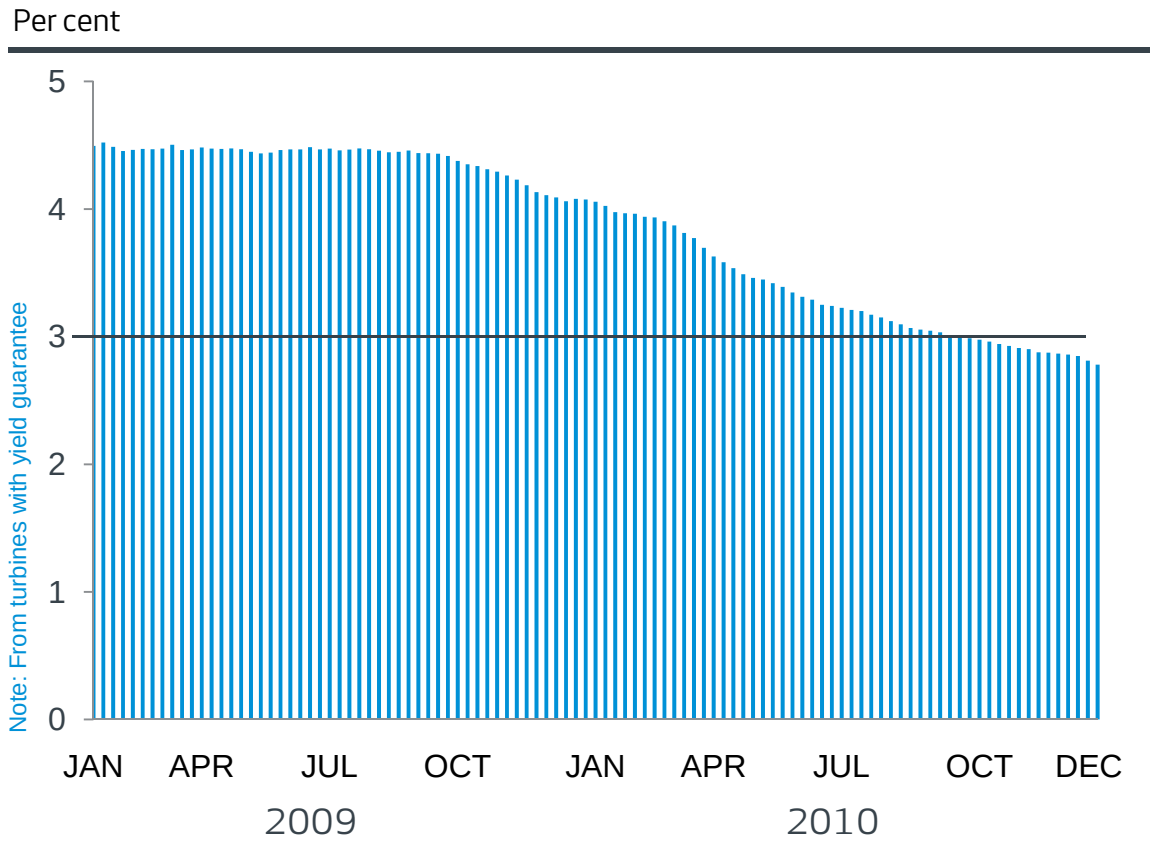
= **Predictable Cash Flow**

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



The lower, the better.

Why a geared drive-train solution?

- Several parallel development tracks involving customers.

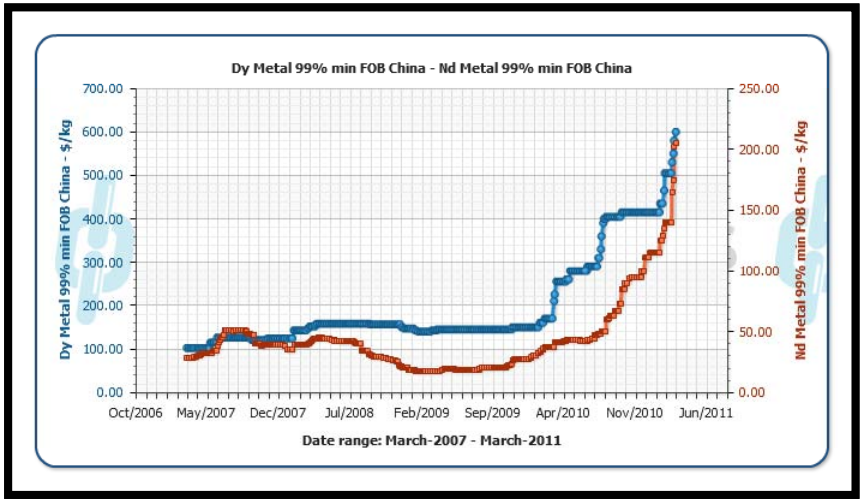
Six key focus areas:

- ✓ 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

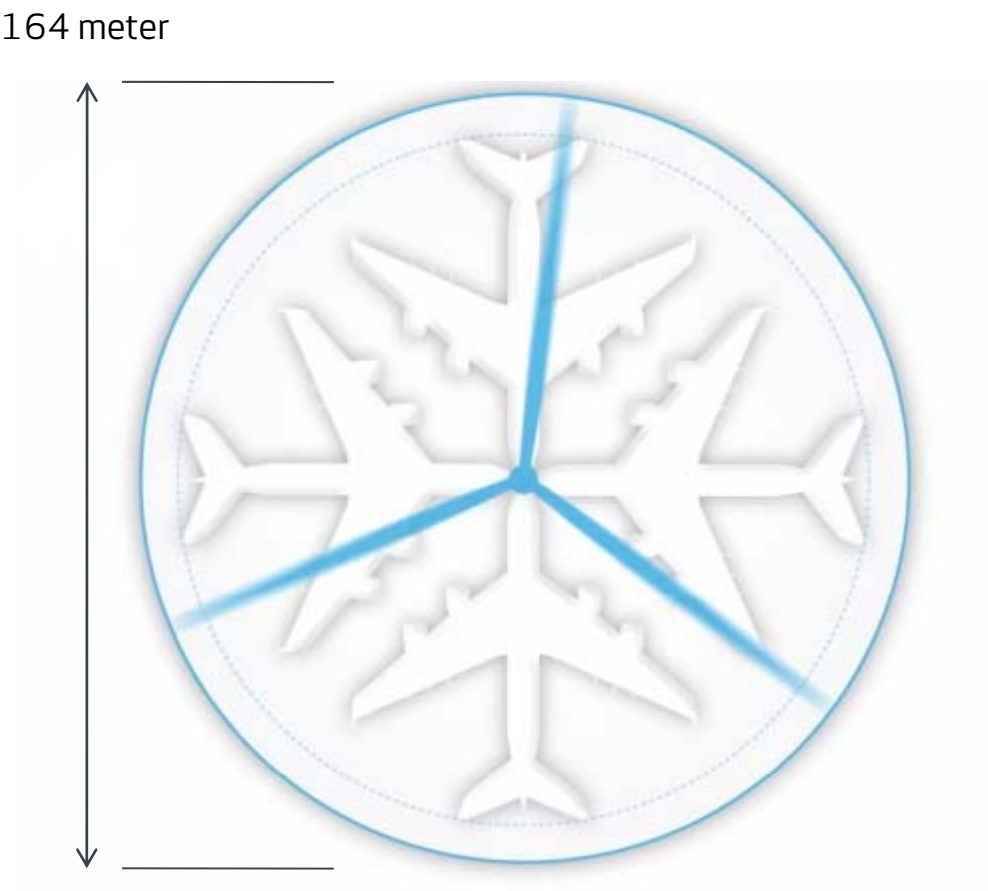
No. of electrical components in direct drive compared to geared drive train.

Price and availability?

V164-7.0 MW

- Dimensions

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



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**

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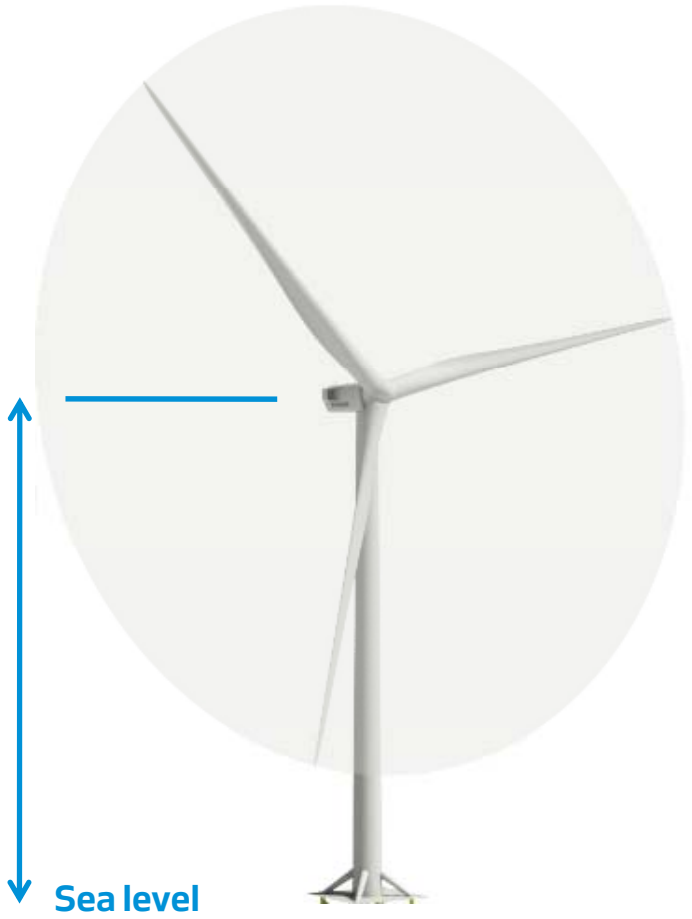

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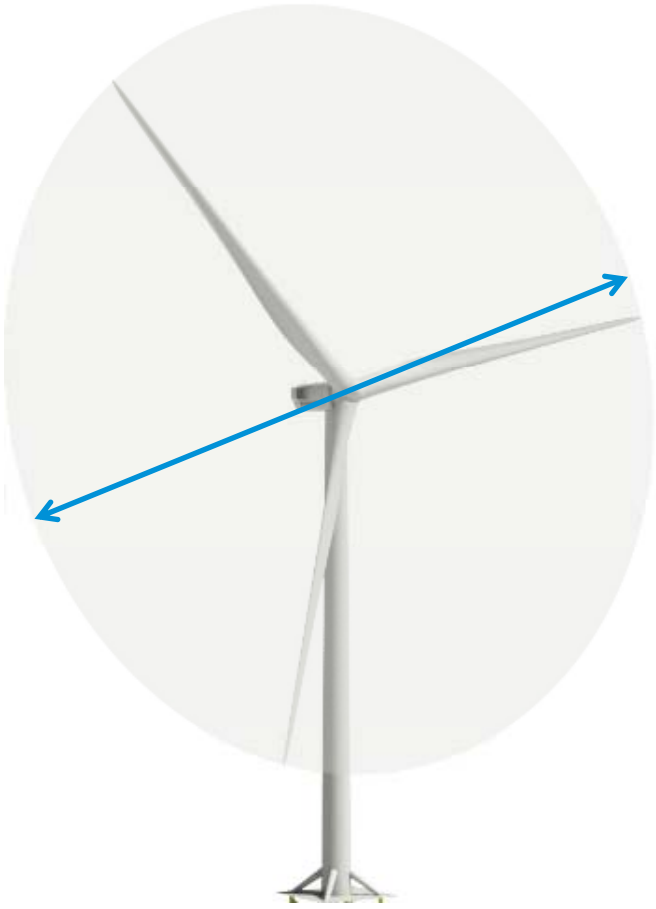

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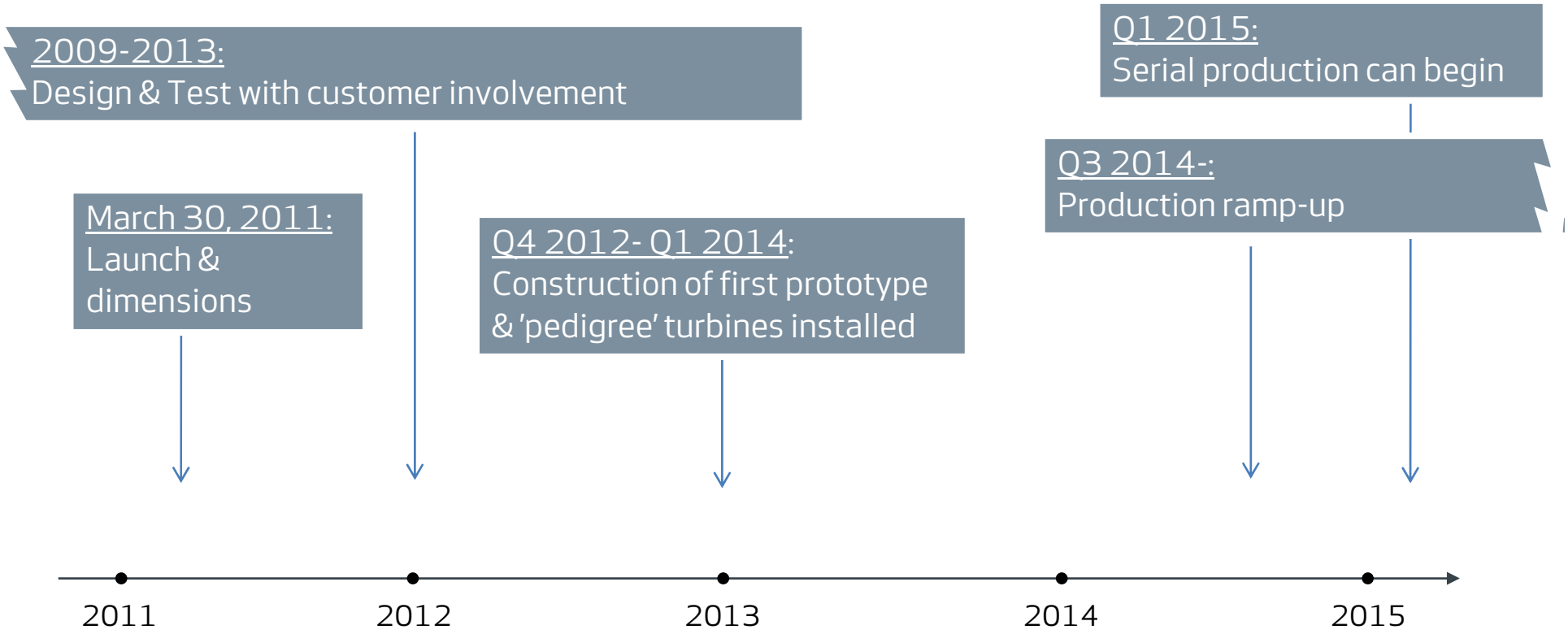
From today to offshore wind park in 2015

Given the right commitment, involvement & investment




Q&A
Questions & Answers

Thank you for your attention