



Vestas Turbine Portfolio – Class I/II Wind Speeds

New Zealand Wind Energy Conference 2015

Nick Summers – Vestas Sales Engineer Asia & Pacific; Anthony Webster – Vestas NZ Service Manager

Content

- Vestas Turbine Range
 - New 3MW Turbines
 - V105-3.3MW®
 - V112-3.3MW®
 - V117-3.3MW®
 - V126-3.3MW®
 - Turbine Options
 - Global LPF and Implications for NZ Market
 - Summary
-

Our vision

Bringing wind on par with oil and gas

To achieve this, our turbines must;

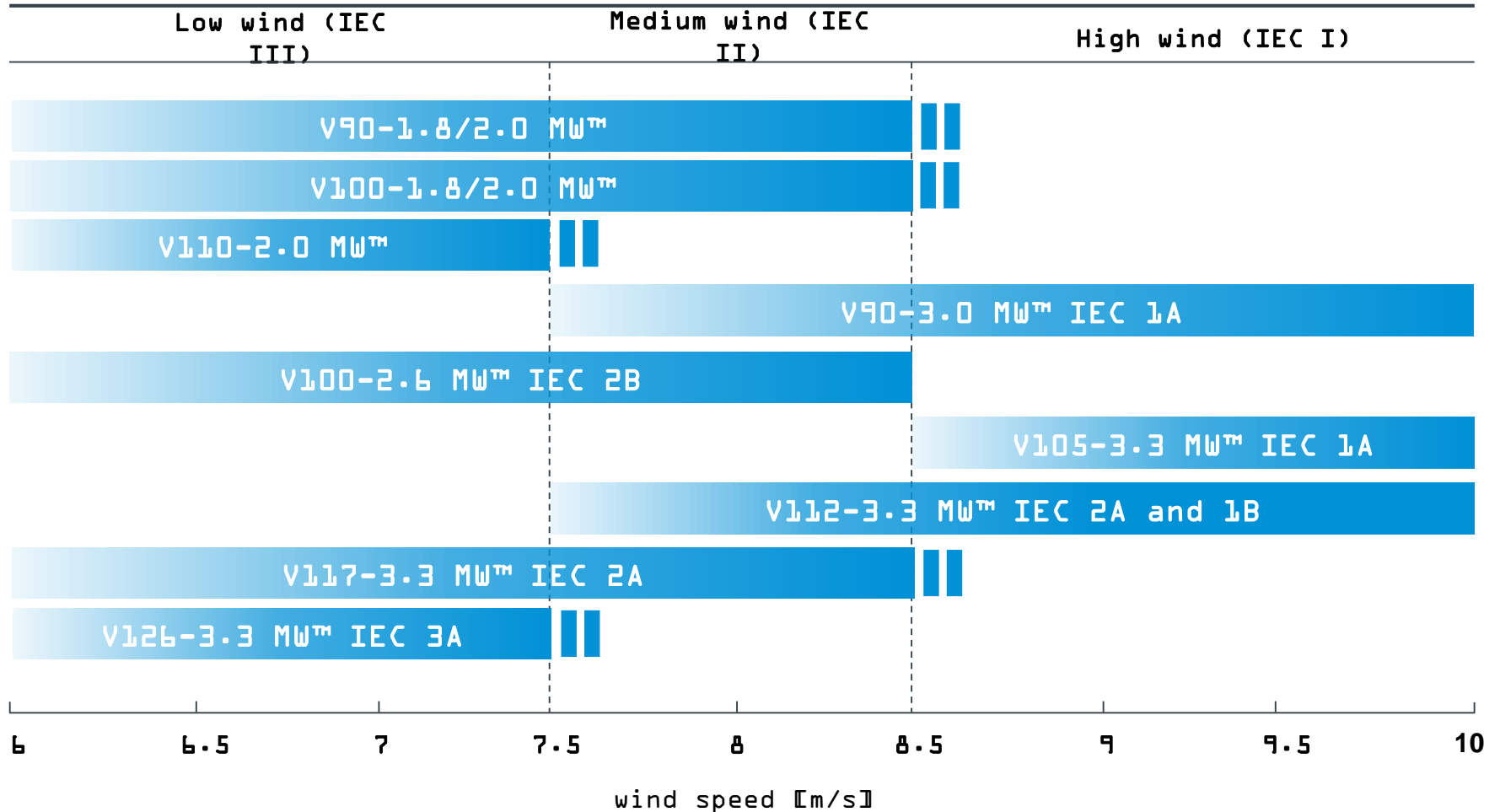
- Deliver Business Case Certainty
- Reduce the Cost of Energy
- Optimise Customer Service Strategies

Vestas Turbine Range



Turbine overview

Vestas® turbines cover across wind classes



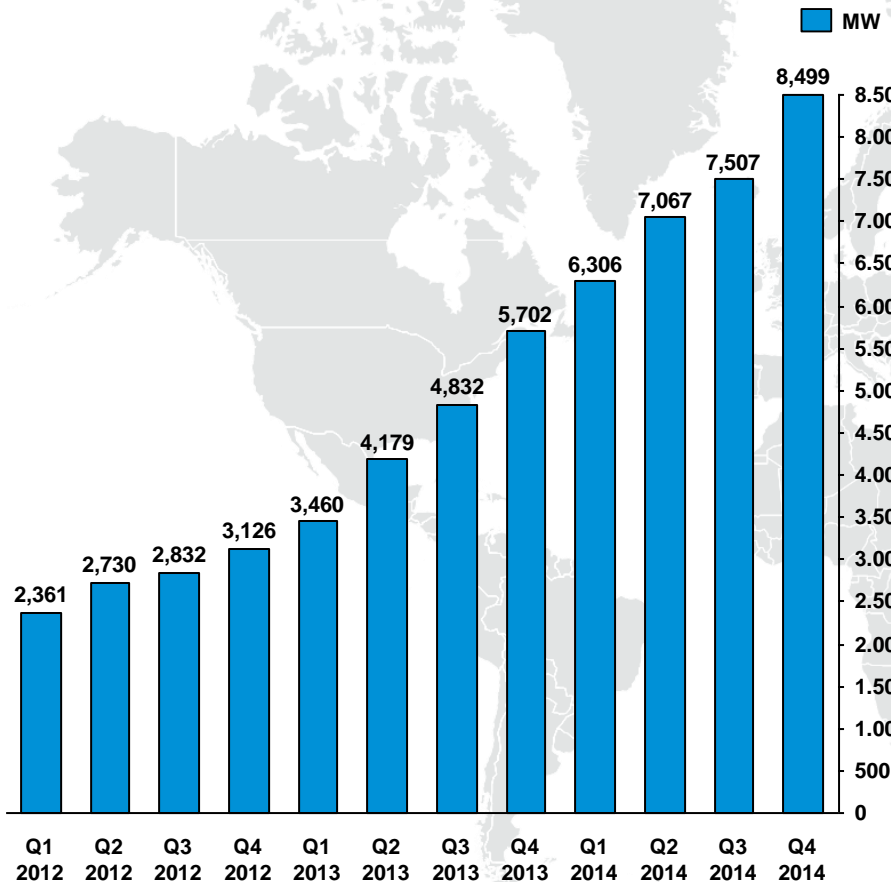
All turbines can be deployed on sites with lower wind speeds than indicated. Furthermore the turbines can also go into a higher wind speed if other parameters allow i.e.

temperature, turbulence, grid

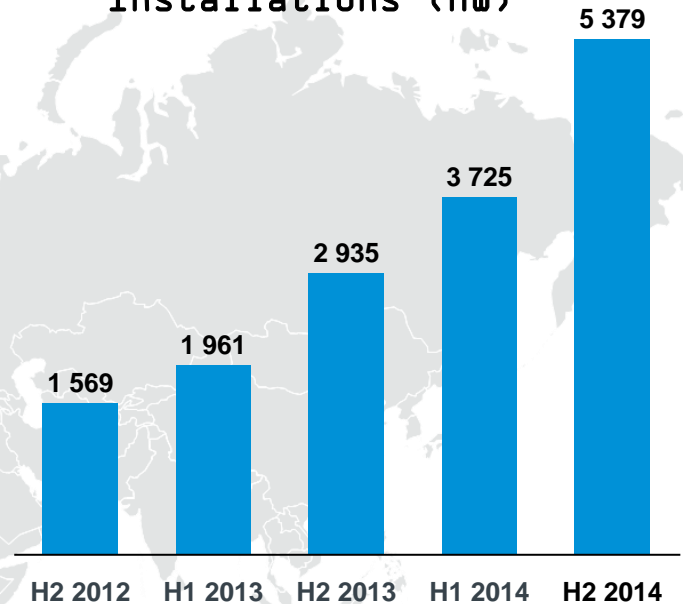
A trusted investment: More than 8.5 GW ordered

The 3MW platform is well received in the market

Accumulated Order Intake for the 3MW platform (MW)

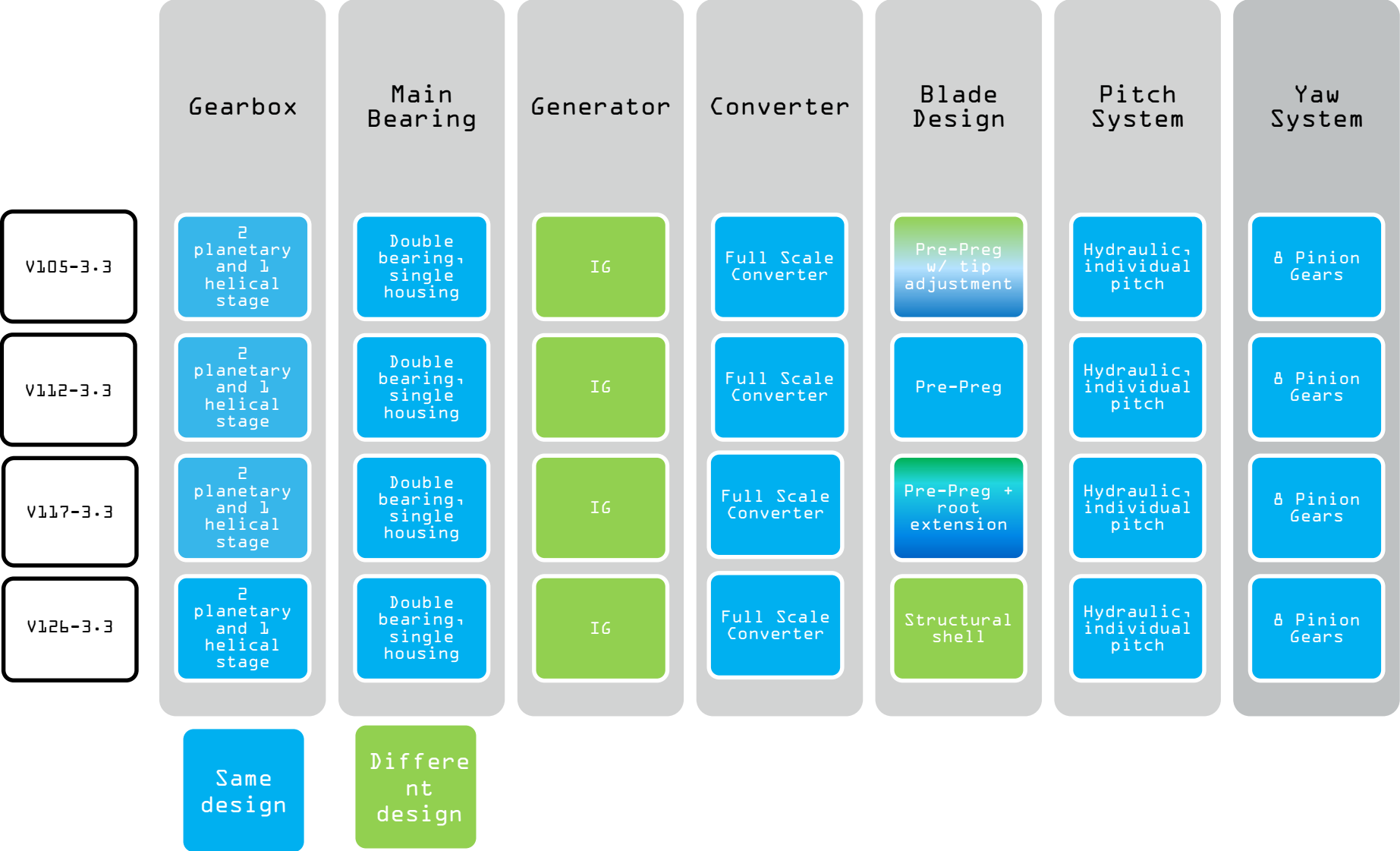


Accumulated 3MW platform Installations (MW)



3MW Platform – Component Overview

Evolution of proven turbine technology



3MW New Variants – Certification

V105-3.3MW

Design Evaluation Certificate Received

V112-3.3MW

Full Type Certificate received for Class 2A and Class 1B

V117-3.3MW

Full Type Certificate received

V126-3.3MW

Full Type Certificate Received



3MW Platform

Increased rating and rotor diameters – improved yield for your project

Wind speed	Turbines	Increased AEP
------------	----------	---------------

+8.5 m/s	V90-3.0 MW → V112-3.3 MW	30%*
----------	--------------------------	------

+7.5 m/s	V112-3.0 MW → V117-3.3 MW	7.1%*
----------	---------------------------	-------

Turbine Type	Rotor Diameter	Tower Height	Tip Height
--------------	----------------	--------------	------------

V90-3.0 MW	90m	80m	125m
------------	-----	-----	------

V112-3.3 MW	112m	84m	140m
-------------	------	-----	------

V117-3.3 MW	117m	91.5m	150m
-------------	------	-------	------

*Assumptions: 1 WTG, 100% availability, 0% losses, K factor = 2, Standard air density = 1.225, Wind speed at hub height

3MW Platform – Noise Performance

- Wind turbine sound is a key design criteria for Vestas
- Aim to find a balance between production and amenity/compliance with approvals
- A range of noise modes are being developed for the new 3MW variants, including use of Serrated Trailing Edges (STE's) to further reduce noise emissions
- Maximum sound power levels with STE's are shown below
- All new variants will be tested by 3rd parties according to IEC 61400-11
- Vestas works closely with its customers to develop layouts to meet approval

IEC III	IEC II	IEC I
V126-3.3 MW™ Maximum SPL = 106.0 dB @ 10m/s 117m HH (with STE)		
V117-3.3 MW™ Maximum SPL = 106.5 dB @ 10 m/s 91.5m HH (with STE)		
	V112-3.3 MW™ (IIA) Maximum SPL = 104.5 dB @ 10 m/s 84m HH (with STE)	V112-3.3 MW™ (IB) Maximum SPL = 108 dB @ 9.8m/s 84m HH (without STE)
		V105-3.3 MW™ (IA) Maximum SPL = 105dB @ TBD m/s

Verification testing of complete nacelles

Vestas assess reliability based on facts - not specifications

COMPONENTS



Testing of +20 main components, incl.

- ✓ Generator
- ✓ Gearboxes
- ✓ Blade & main bearings
- ✓ Yaw gear
- ✓ Converter

SYSTEM



Testing of +15 systems, incl.

- ✓ Drivetrain
- ✓ Wind park control
- ✓ Rotor & Hub
- ✓ Pitch actuation
- ✓ Conditioning & cooling
- ✓ Power conversion system

INTEGRATION



Testing of integration, i.e.

- ✓ Nacelle assembly test
- ✓ Generator & converter integration
- ✓ Drivetrain system integration

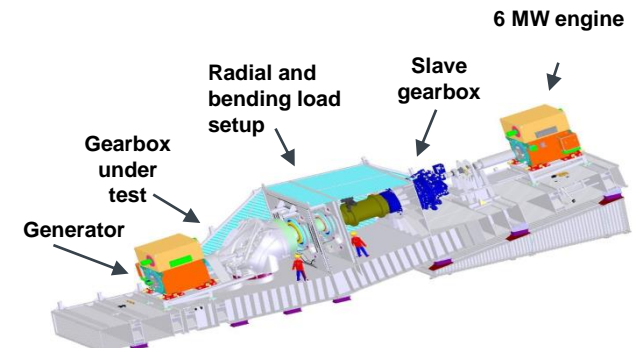
FIELD



Field testing, i.e.

- ✓ Run in tuning
- ✓ Power curve
- ✓ Grid compliance
- ✓ Loads
- ✓ Noise
- ✓ System validation

- ✓ Vestas validate the reliability on our turbine components by using accelerated life time tests.
- ✓ Three international Vestas Test Centers uses field data to replicate real-life conditions.
- ✓ Bottom-up testing strategy with several test types to measure robustness, reliability and performance



Offerings to further improve your investment

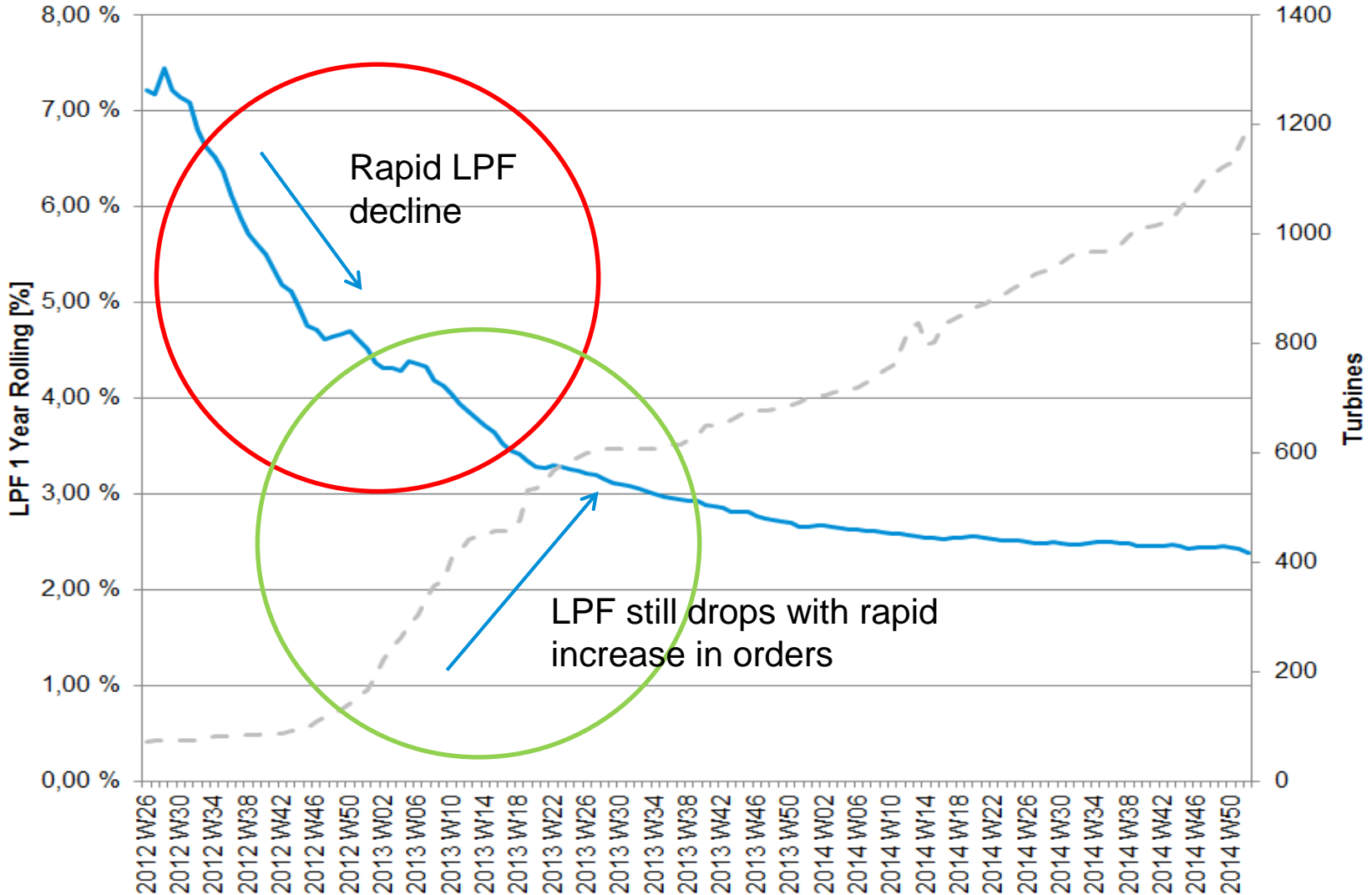
Turbine options available - examples

- Serrated trailing edges
- De-icing
- Vestas Ice Detection
- Low Temperature Option
- Yaw power backup
- Increased cut-in
- Shadow detection
- Obstacle Collision Avoidance System (OCAS™)
- Smoke and heat detection
- Aviation marking



3 MW LPF decreases as turbine count increases

LPF continues to decrease even as turbine count increases



Vestas New Zealand

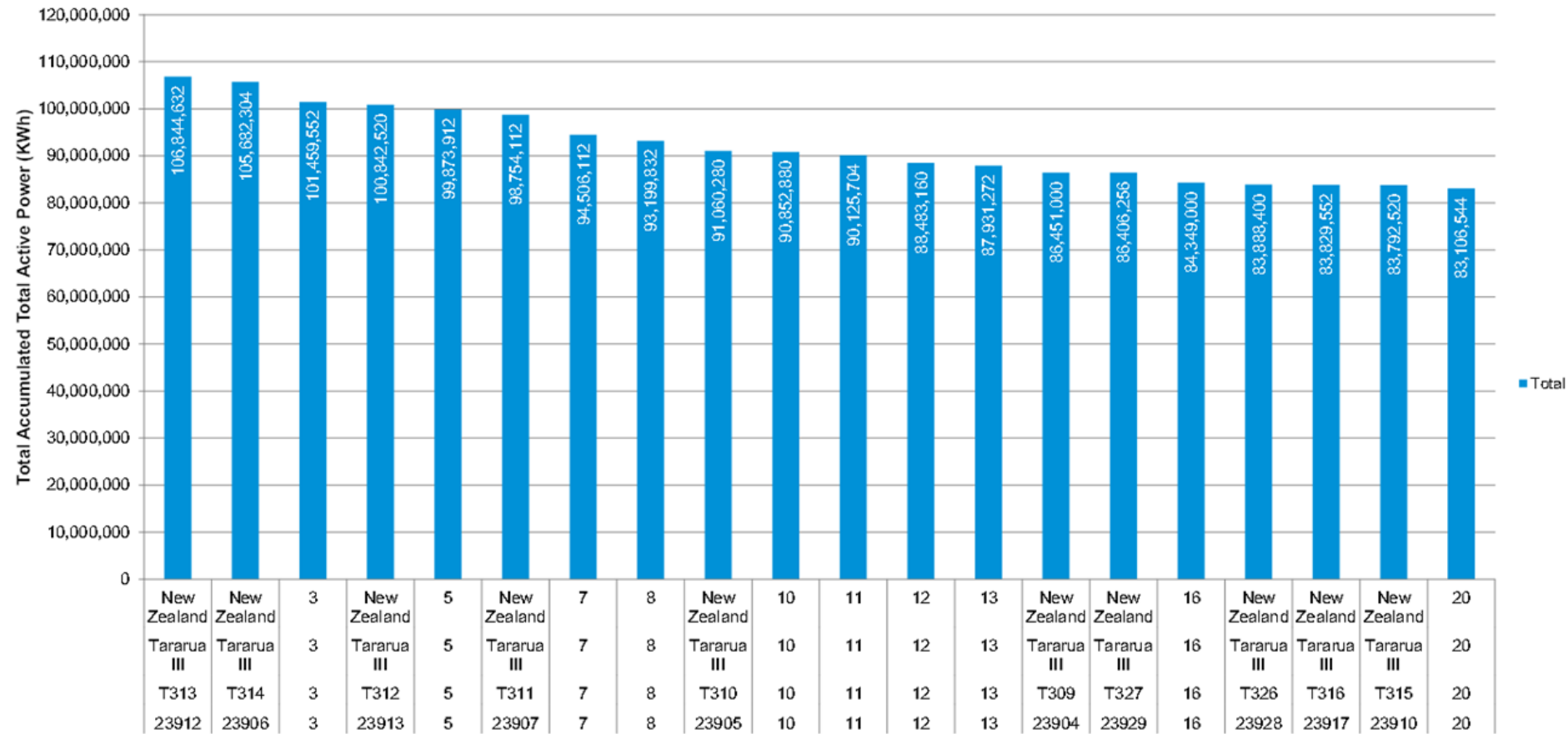
- Service V47-660kW, V80-2MW and V90-3MW Turbines for Trustpower, Meridian & Dominion Salt
 - Tararua Stage I & II – 103 x V47 Turbines
 - Av LPF achieved over 2 years : 4.73
 - Tararua Stage III – 31 x V90 Turbines
 - Av LPF achieved over 2 years : 1.8
 - Mahinerangi – 12 x V90 Turbines
 - Av LPF achieved over 2 years : 1.1
 - White Hill – 29 x V80 Turbines
 - Av LPF achieved over 2 years : 1.4
 - 26 Vestas Staff in NZ (21 Service/Engineering & 5 Logistics/Admin)
-

Note: Vestas internal KPI LPF target is 1.8

Vestas New Zealand

Sum of Prod_TotAccumulated_TotActPwr

Vestas V90 3MW Top 20 turbine production total



Unit ID · Unit Location · Park Name · Country

Summary

By building on and evolving existing platforms, Vestas is leveraging its proven and reliable technology - delivering improved Business Case Certainty for our customers and reducing the cost of energy through greater efficiency

In New Zealand, our latest range of 3MW Platform turbines are ideally suited to the Class I/II conditions expected and will enhance the business case of existing and proposed developments into the near future.

Vestas remains committed to the New Zealand market and look forward to continuing involvement for both new projects and existing operations

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.