#### BABCOCK & BROWN WIND PARTNERS



Babcock & Brown Wind Partners Limited · ABN 39 105 051 616 Babcock & Brown Wind Partners Trust · ARSN 116 244 118 Babcock & Brown Wind Partners (Bermuda) Limited  $\cdot$  ARBN 116 360 715 Level 23 The Chifley Tower · 2 Chifley Square · Sydney NSW 2000 Australia T +61 2 9229 1800 · F +61 2 9231 5619 · www.bbwindpartners.com

#### **ASX** Release

#### 17 January 2007

#### WIND RESOURCE & ENERGY YIELD ASSESSMENT PRESENTATION

Babcock & Brown Wind Partners (ASX: BBW) has today released to the market a wind resource and energy yield assessment presentation (refer attached). The purpose of this presentation is to provide the market with educational material in relation to the process behind wind energy assessment and how this relates to BBW's business.

Following the release of this presentation, BBW will be presenting it to institutional investors and stock broking analysts at 9.30am today. There is a telephone conference facility available for other investors who also wish to participate (contact +61 2 9229 1800 for conference line details).

#### **ENDS**

#### Further Information:

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#### About Babcock & Brown Wind Partners

Babcock & Brown Wind Partners (ASX: BBW) is a specialist investment fund focused on the wind energy sector. BBW listed on the Australian Stock Exchange on 28 October 2005 and has a market capitalisation of approximately A\$950 million.

It is a stapled entity comprising Babcock & Brown Wind Partners Limited (ABN 39 105 051 616), Babcock & Brown Wind Partners Trust (ARSN 116 244 118) and Babcock & Brown Wind Partners (Bermuda) Limited (ARBN 116 360 715).

BBW's portfolio comprises an interest in 25 wind farms on three continents that have a total installed capacity of approximately 1,200 MW and are diversified by geography, currency, equipment supplier, customer and regulatory regime.

## BABCOCK & BROWN WIND PARTNERS

BBW is managed by Babcock & Brown Infrastructure Management Pty Limited, a wholly owned subsidiary of Babcock & Brown Limited (ASX: BNB), a global investment and advisory firm with longstanding capabilities in structured finance and the creation, syndication and management of asset and cash flow-based investments. Babcock & Brown has a long history of experience in the renewable energy field and extensive experience in the wind energy sector, having arranged financing for over 3000 MW of wind energy projects and companies for nearly 20 years, with an estimated value over US\$3 billion. Babcock & Brown's roles have included acting as an adviser/arranger of limited recourse project financing, arranging equity placements, lease adviser, project developer, principal equity investor and fund manager for wind energy projects situated in Europe, North America and Australia. Babcock & Brown has developed specialist local expertise and experience in the wind energy sector in each of these regions which it brings to its management and financial advisory roles of BBW.

BBW's investment strategy is to grow security holder wealth through management of the initial portfolio and the acquisition of additional wind energy generation assets.

For further information please visit our website : <a href="https://www.bbwindpartners.com">www.bbwindpartners.com</a>



# Wind Resource & Energy Yield Assessment January 2007

## Introduction

- Demonstrate that wind energy is predictable over the long term
- Define the process behind forecasting wind energy generation
  - Industry standard
  - Independent source
- Discuss interpretation of wind assessments
  - Actual BBW experience
  - Seasonality of generation
  - Portfolio benefits



## Overview

## Predictable Resource

- Aim of assessment is to forecast the long-term mean energy generation of a wind farm
- Actual annual generation will vary around the forecast long-term mean

## Robust & Independent

- ▲ Accurate measurement and prediction of the wind resource
- ▲ Correlation with long-term reference data informs the assessment
- ▲ Accurate modelling of wind, topographic effects, turbine characteristics, etc

#### Seasonality

- ▲ Generation varies by season within each year
- ▲ Influences BBW's interim and full year results

# Variability & Portfolio Advantages

- ▲ Uncertainty of portfolio forecast reduces with diversification & scale
- Analysis addresses uncertainty and produces a **probability distribution of energy generation** incorporating all known quantifiable variables



## Agenda

- 1. Introduction & Overview
- 2. Wind & Energy Yield Assessment Methodology
- 3. Defining Uncertainty
- 4. BBW Experience Wind Farm Performance
- 5. BBW Current Portfolio Seasonality
- 6. Portfolio Effect
- 7. Conclusion

**Presenters:** Miles George Acting Chief Executive Officer

Geoff Dutaillis Chief Operating Officer

#### For further information please contact:

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2. Wind & Energy Yield Assessment Methodology

## Wind Resource & Energy Yield Assessment

#### **FOCUS** is to determine:

- Average long-term wind speed
- Variability in wind speed
- Direction influences layout of wind farm
- Diurnal profile
- Seasonal profile

..... Energy yield of the wind farm

## STEPS in the process:

- I. Wind Monitoring on-site
- II. Wind Resource Assessment long term wind prediction
- III. Wind flow modelling & Energy yield forecast
- IV. Identification and quantification of sources of uncertainty

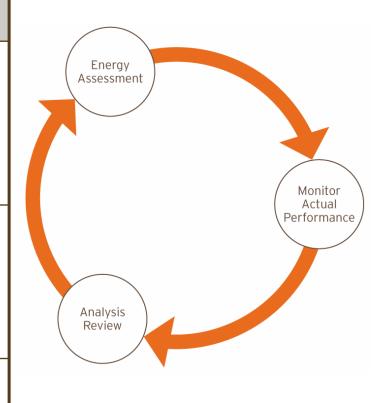
Wind **Monitoring Wind Resource Assessment Energy Yield Prediction Uncertainty Analysis** 

Aim is to produce a probability distribution of energy and revenue



## Wind Monitoring

When undertaken	How undertaken	Why undertaken
Development stage - prior to construction	<ul> <li>Short-medium term data from met tower on site</li> <li>Long term data source</li> <li>Cross correlation analysis</li> </ul>	Project/acquisition feasibility analysis
At completion of construction	On site met towers	Determine turbine compliance with performance guarantees (i.e. energy output is adequate given the actual wind experienced)
On-going monitoring of operating wind farms	<ul><li>On site met towers</li><li>Long term data source</li><li>Cross correlation analysis</li></ul>	<ul> <li>Revenue forecasting and trend analysis</li> <li>Determine WTG compliance with operator guarantees</li> </ul>



Critical for initial energy forecast and ongoing performance monitoring



## Wind Monitoring

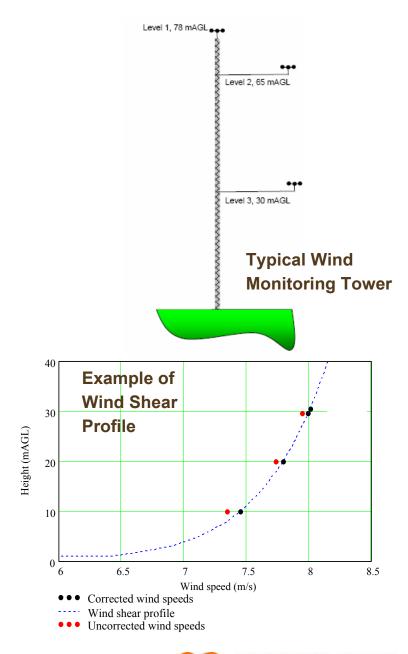
#### **Towers & Instruments**

- Get the best data possible
- Accuracy & duration important to improve estimate
- Site coverage

#### **International Standards**

#### **Wind Shear**

 Hub height measurement - extrapolation adds uncertainty





## Wind Monitoring

#### **Wind Speed Distribution**

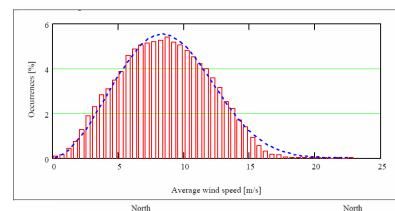
- Weibull distribution can provide a good approximation
- Provides concise description

#### Wind Direction

- Provides directional distribution of energy
- Important for wake effects and design optimisation

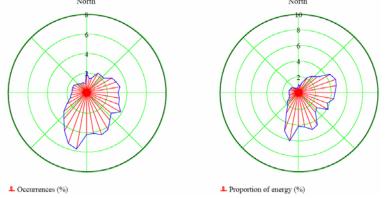
## Seasonal & Diurnal pattern

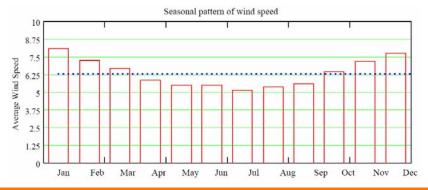
- Opportunity to match generation with demand
- Provides basis for planning operational activities



Actual Average	8.53			
Weibull Parameters				
c (m/s)	9.87			
k	2.76			

The Weibull curve is the best fit to give similar energy





Provides wind speed distribution and direction profile for site



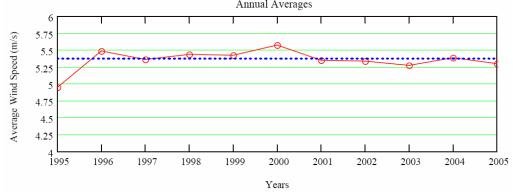
#### Wind Resource Assessment

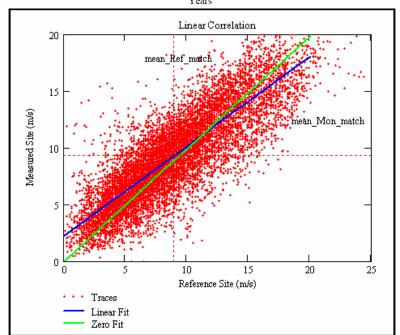
#### **Reference Station**

- ▲ Long-term data source
- ▲ Duration varies by country, region and site
- Consistency of measurement is vital
- ▲ Typically provides 10min or hourly data over periods of 5-10 years or more

## Measure – Correlate – Predict (MCP)

- ▲ Site data typically correlated with reference site for each of 12, 30<sup>0</sup> direction sectors
- ▲ Wind speed ratios determined
- ▲ Used to convert the reference data into the expected long-term wind speed at the site





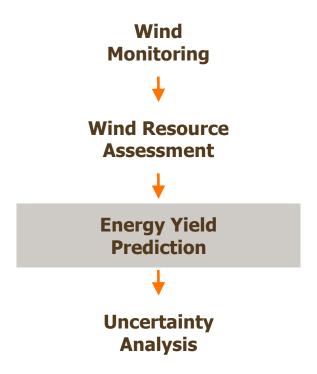
Long-term reference station data correlated with on-site data – informs the long term on-site wind resource prediction



## **Energy Yield Prediction**

#### In order to Predict Energy:

- Model the variation in wind speed across the site at the hub height – 'wind flow modelling'
- II. Convert wind resource to energy and optimise
- III. Estimate losses e.g. wake, electrical, etc



Computer programs developed to accurately model dynamics of wind moving across a site



## **Energy Yield Prediction**

#### 1. Wind Flow Modelling

- ♣ Predict the long-term wind speed & direction across the site
- ▲ Industry commonly uses the WAsP modelling tool Riso National Lab, Denmark
- ▲ Takes into account topography & surface roughness

#### 2. Wind Resource to ENERGY

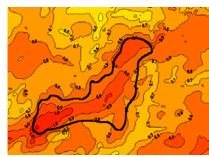
- ▲ Turbine Characteristics Power Curve
- Optimise turbine layout, accounting for:
  - Site specific wind variations
  - Turbine wake interactions
  - Land constraints
- ▲ Iterative process to optimise

## 3. Estimate Energy Loss Factors

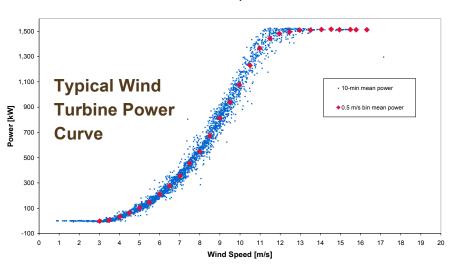
▲ Mainly to consider topographic effect, wake effects, electrical transmission efficiency and turbine availability



# Terrain Map > Wind Speed Map

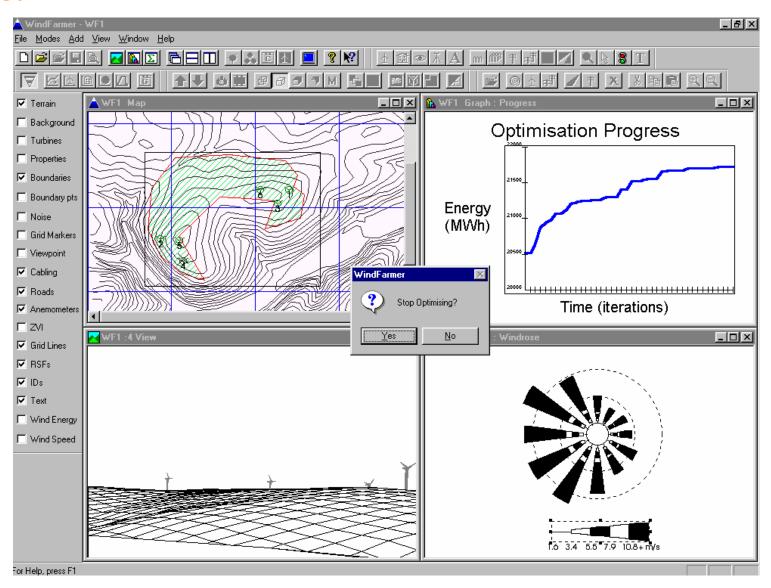


WTG measured power curve





## **Energy Yield Prediction**





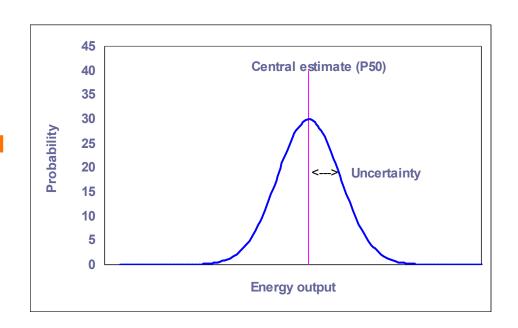


3. Defining Uncertainty

## **Defining Uncertainty**

- ▲ Recognises that the methodology introduces a number of sources of uncertainty into the predicted energy yield:
  - Wind Data and Measurement
  - 2. Analysis and Modelling
  - 3. Future Wind Variability
- ▲ ALL are quantifiable
- ♣ Provides ability to forecast probability of performance at, or above, a specified level

Commonly quoted as "Probability of Exceedence" or P50 / 75 / 90 values



All sources of uncertainty can be quantified



## **Definition of Uncertainty**

▲ An example - "Probability of Exceedence" or P50/75/90 values

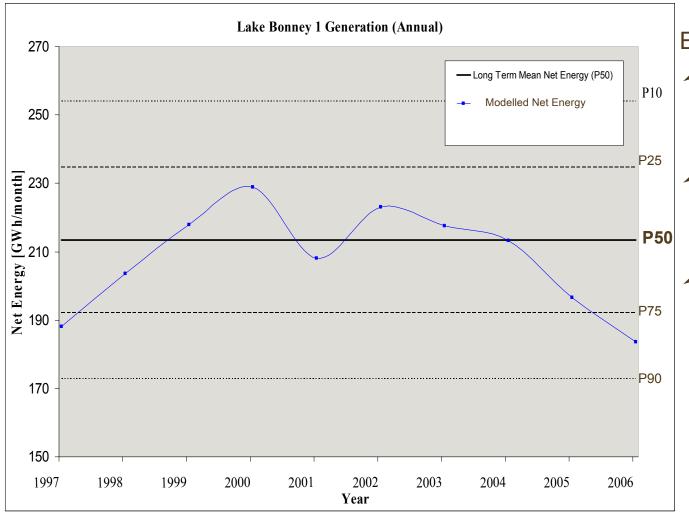
Probability of	Net energy output		
Exceedance	1 year average	10 year average	
[%]	[GWh/annum]	[GWh/annum]	
90	387.5	415.6	
75	430.3	445.1	
50	477.9	477.9	

E.g. 'P90' means that there is a 90% probability that this level of energy output will be exceeded

Uncertainty in data measurement, analysis and modelling can be reduced over time by analysis of operating history



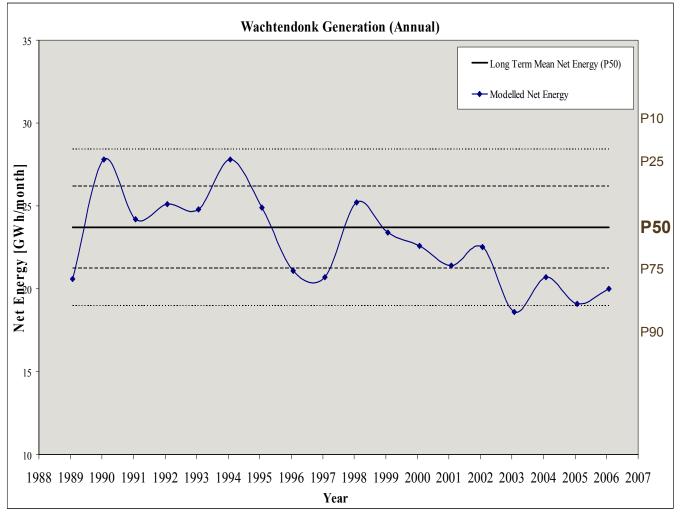




#### EXAMPLE ... Australia

- ▲ Demonstration of variability around the long term mean
- ♣ Pre-operation modeling based on recorded wind speeds
- ★ Forecasts will be continually reviewed with the benefit of operational performance
  - 2-3 yr rolling program
  - Communicate to Investors with regular Portfolio Summary updates

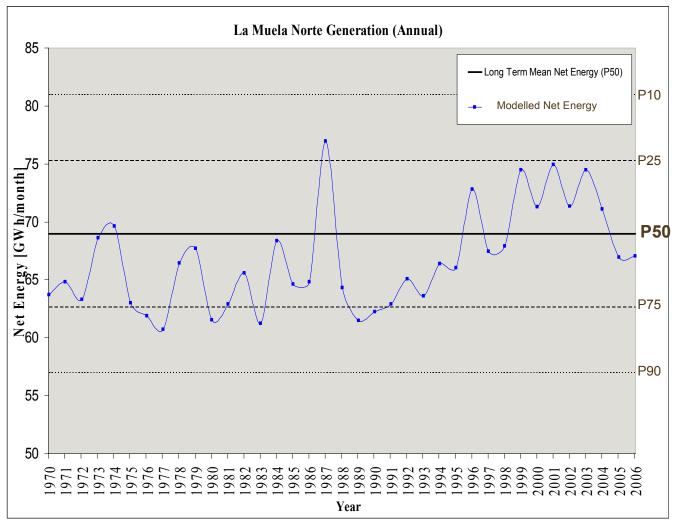




## EXAMPLE ... Germany

- ▲ Demonstration of variability around the long term mean
- Pre-operation modeling based on recorded wind speeds
- ▲ Forecasts will be continually reviewed with the benefit of operational performance
  - 2-3 yr rolling program
  - Communicate to Investors with regular Portfolio Summary updates

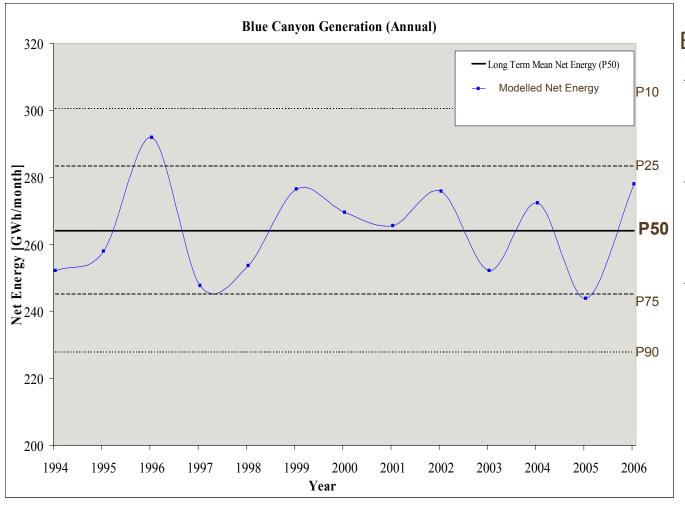




## EXAMPLE ... Spain

- ▲ Demonstration of variability around the long term mean
- ♣ Pre-operation modeling based on recorded wind speeds
- ★ Forecasts will be continually reviewed with the benefit of operational performance
  - 2-3 yr rolling program
  - Communicate to Investors with regular Portfolio Summary updates



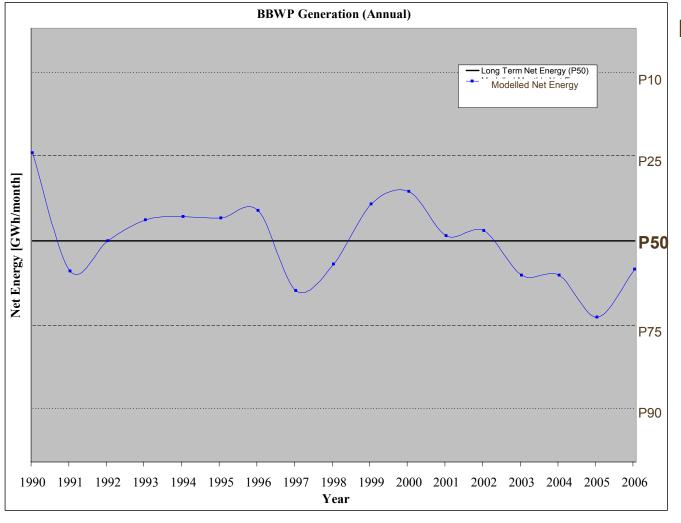


#### EXAMPLE ... USA

- ▲ Demonstration of variability around the long term mean
- ♣ Pre-operation modeling based on recorded wind speeds
- ▲ Forecasts will be continually reviewed with the benefit of operational performance
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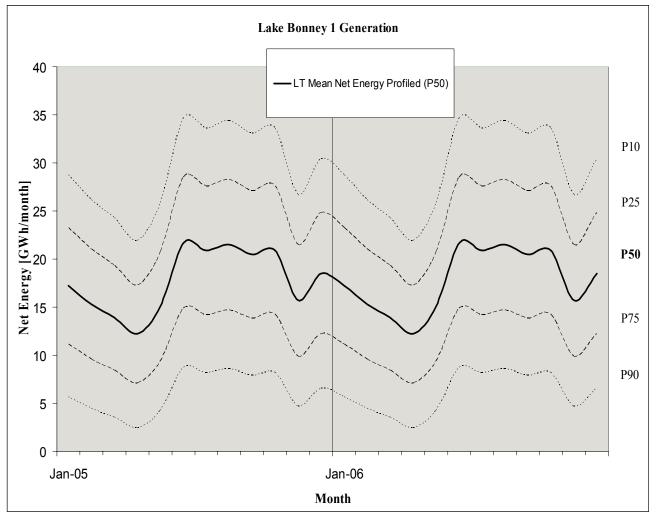
## BBW Experience – Portfolio Performance



#### **PORTFOLIO**

- ▲ Constructed BBW portfolio based on modelled performance pre-operation
- ▲ Demonstrates similar performance to individual wind farms variability around the long term mean
- ♣ Portfolio benefit will narrow variability over long-term



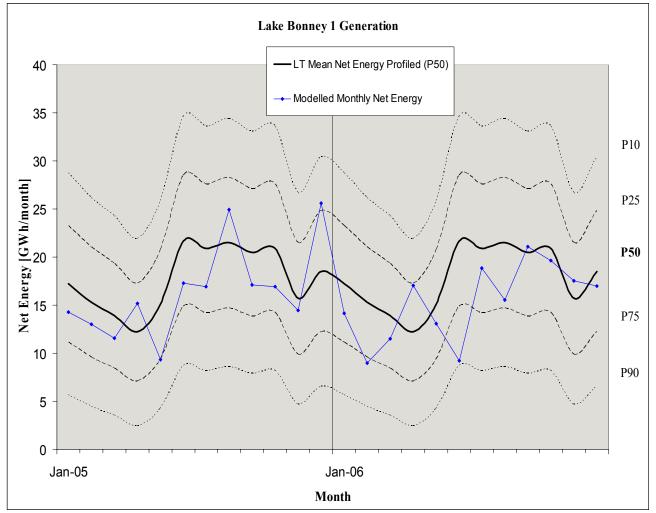


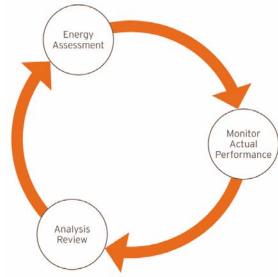


- ▲ More detailed analysis and review of the operational period for each wind farm
- ▲ Provides ability to review accuracy of energy assessments and identify the need for review and/or update

Actual performance fits comfortably within probability limits



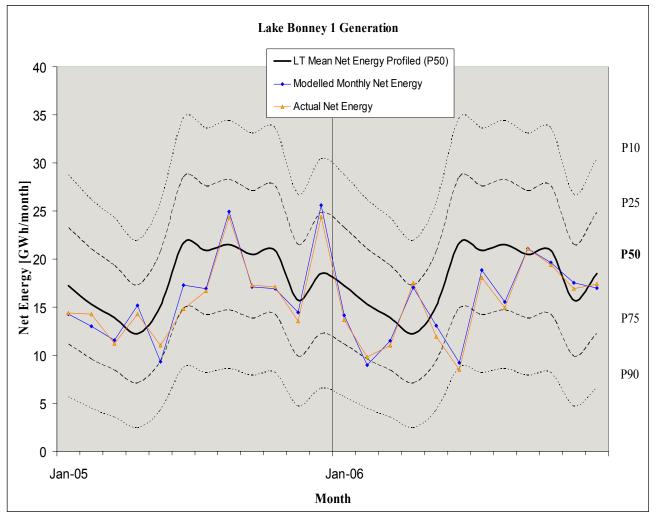




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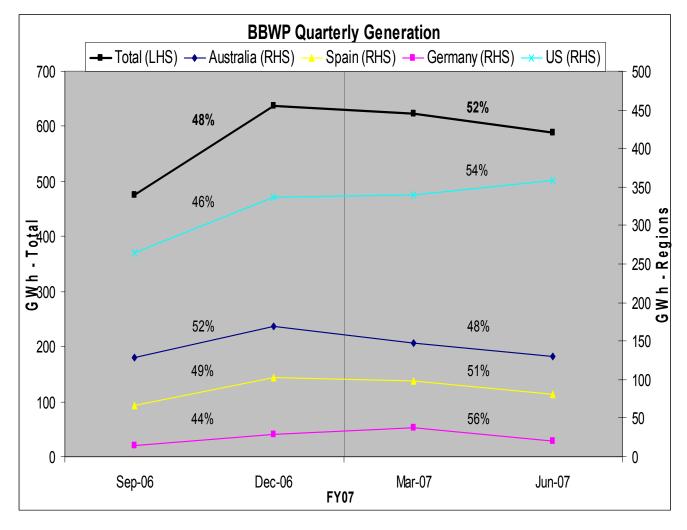
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5. BBW Current Portfolio Seasonality

## **BBW Current Portfolio Seasonality**



- Wind energy generation reflects seasonal weather patterns for the specific region
  - Europe peak production is through winter months
  - US <u>generally</u>, peak production is late winter and spring months
  - Australia is summer months
- Overall BBW's current portfolio generation is skewed to the second half of the FY in the ratio of 48:
   52%

Generation profile skews generation to the second half of the FY





6. Portfolio Effect

## Portfolio Effect

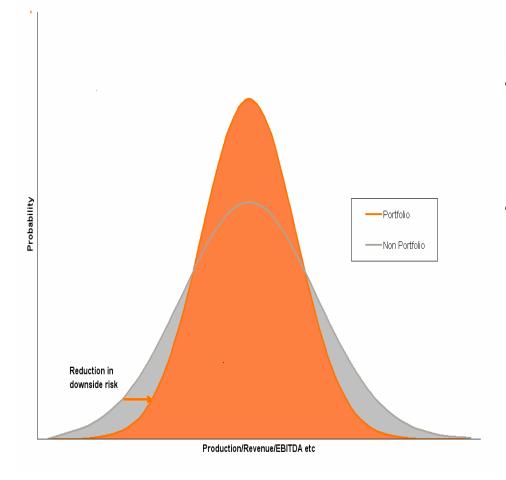


- Geographical
   diversification provides
   benefit of reduced
   variability around the
   forecast energy
   generation the 'Portfolio
   Effect'
- Results from limited correlation of:
  - Wind regions; and
  - Other sources of uncertainty

Strategy of diversification & scale to mitigate natural variability of wind and reduce impact of uncertainties from individual wind farms



## Portfolio Effect – a definition



## In summary

- The standard deviation of a portfolio of independent (or partially dependent) variables will be less than the sum of the standard deviations of the individual variables.
- By the addition of wind farms with uncorrelated or partially correlated sources of energy prediction error, the overall certainty of BBW's earnings is improved.

The Portfolio Effect reduces the portfolio uncertainty resulting in a narrower probability distribution



## Portfolio Effect

• The 'Portfolio Effect' benefit at P90 level for the current BBW portfolio is shown below

	Non Portfolio GWh/Annum		Improvement
1 year	3,190.3	3,406.6	6.8 %

- Portfolio Effect benefits to BBW include:
  - Increased certainty of achieving generation
  - Increases earnings certainty
  - Portfolio financing benefits optimises cost of capital

The Portfolio Effect increases earnings certainty





## 7. Conclusion

## Conclusions

- Wind energy is a predictable energy source
- The process for wind & energy assessments is well established and independently verified
- BBW continually monitors and reviews ongoing performance of wind generation
- Energy generation of BBW's portfolio is seasonal and generation profile is currently skewed to the second half
- BBW's strategy for dealing with wind variability and the impact of other uncertainties is diversification and scale

As BBW acquires more assets, the portfolio benefits will enhance long term generation and earnings certainty







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