

# The First Australian Installation of the Wind Power Prediction Tool

Nicholas Cutler<sup>1</sup>, Kieran Jacka<sup>2</sup>, Torben Skov Nielsen<sup>3</sup>, Merlinde Kay<sup>1</sup>

<sup>1</sup>University of New South Wales, Sydney, 2052, Australia.

Corresponding author email: n.cutler@unsw.edu.au

<sup>2</sup>Hydro Tasmania Consulting, GPO Box 355, Hobart 7001, Australia

<sup>3</sup>Informatics and Mathematical Modelling, Technical University of Denmark, DK-2800 Lyngby, Denmark

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## Abstract

The leading Danish statistical wind power forecasting system, the Wind Power Prediction Tool (Zephyr – WPPT) has been installed in Australia for the first time at Hydro Tasmania. The system was commissioned in March 2006.

Currently WPPT is forecasting the power output from the 64.75 MW Woolnorth Bluff Point wind farm and the forecasts will soon be used by Hydro Tasmania's electricity traders in the NEMMCO spot market. WPPT is running operationally and predicting the wind power output in hourly steps for a prediction horizon of up to 42 hours. It combines historical wind farm power output data back to October 2004 with current wind speed and direction forecasts for the region obtained twice a day from the Australian Bureau of Meteorology.

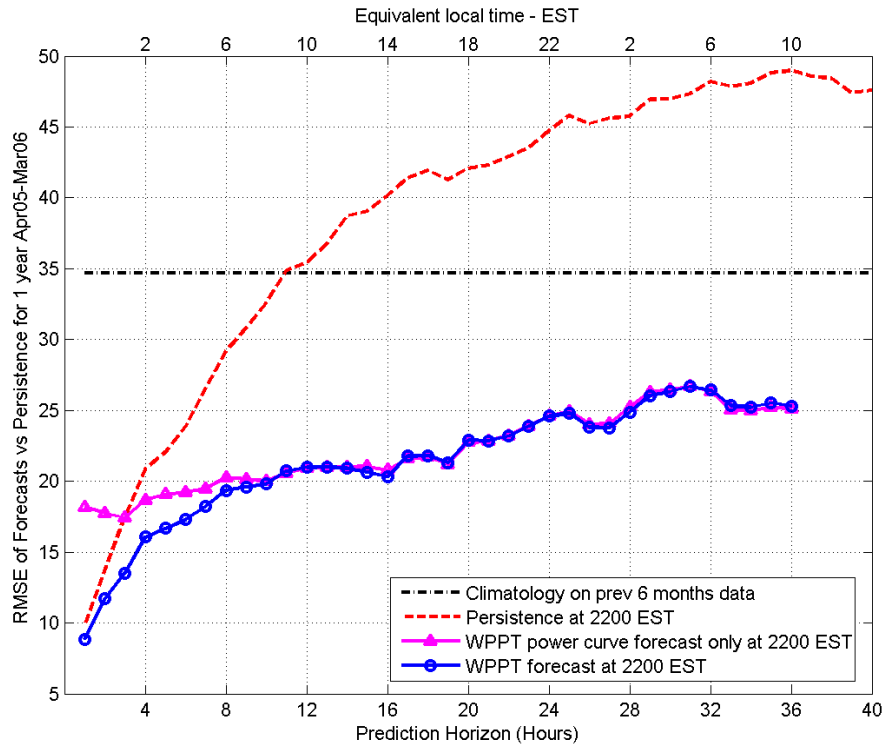
The results for one full year of WPPT operation are presented. This includes an assessment of the general performance of WPPT in predicting the wind farm output, as well as its performance during large-swings in wind power output. The potential benefits of the forecasts to the electricity market management and the scheduling of the hydro power plants are discussed.

## Discussion and Conclusions

The Roaring40s Woolnorth wind farm site has a very high, variable wind resource. The farm's rated power, 64.75 MW, represents 6.5% of a typical overnight demand minimum for Tasmania. Hydro Tasmania installed WPPT in March 2006. WPPT makes a statistical combination of recent wind power measurements and future wind speed and direction predictions to make a wind power prediction. WPPT is described in more detail in (Madsen, Nielsen et al. 2005; Nielsen, Madsen et al. 2006). The wind speed and direction prediction are obtained from the Bureau of Meteorology (BoM) Meso-LAPS 12.5 km resolution model. For more information on Meso-LAPS, see (Australian Bureau of Meteorology (BoM) 2006).

The general performance of the 12 UTC (22 EST) WPPT forecast is shown in Figure 1 for one full year of data (April 2005 to March 2006). The overall RMSE of the WPPT forecast is plotted along with the RMSE of the power curve component of WPPT only. The RMSE of the standard persistence and climatology forecasts are shown for comparison.

Both the persistence and climatology curves show higher errors than for less variable sites in the ANEMOS project, confirming that the wind resource at the Woolnorth site is highly variable. The WPPT forecast RMSE shows a significant improvement over these reference forecasts showing that it is on average a better forecast to assist Hydro Tasmania energy trading. However, as with the reference forecasts, the RMSE is higher than for the results obtained for less variable sites in Europe. In ANEMOS, WPPT has been demonstrated to give an RMSE between 12 and 20% after 36 hours. However these ANEMOS results included one very difficult site where WPPT had a similar RMSE to Woolnorth of around 25% after 36 hours.



**Figure 1: The RMSE of the WPPT power curve, the full WPPT algorithm forecast with persistence and climatology forecasts for comparison. All forecasts are made at 12 UTC (22 EST) and the equivalent local time is shown on the upper x-axis.**

Hydro Tasmania energy traders indicated that it would be most useful to predict large swings in the wind power output. Hence, a study was made on the performance of WPPT during large swings. Forty large swings were detected in the same one year of data. Eight of these swings are identified as turbine shut-down due to high wind speeds, 4 could be explained as a yaw-misalignment due to a swing in the wind directions and 27 of them are due to the variation in the wind resource. It is found that of all swings, there was more reliable information in the NWP change in wind direction, rather than the change in wind speed. The publicly available mean sea level pressure (MSLP) analyses from the BoM, revealed that for 24 (60%) of the swings a frontal system was moving nearby the Woolnorth wind farm. Other systems detected of note were troughs (5) and low pressure systems (3).

The NWP and WPPT predictions do not forecast large swings very well. Many swings occurred on a time scale too quick for the hourly forecasts to resolve. Fourteen of the 27 resource varying swings were chosen where the power change occurs on an hourly scale, making it possible to predict with hourly forecasts. The RMSE was calculated for WPPT just for the hours within the noted periods of these swings. This gave 41% whereas a climatology forecast during these periods gave an RMSE of just 32%. This indicates that an improvement for WPPT could be made by switching to a climatology forecast if a high probability of a large swing could be predicted.

These conclusions are only based on one year of data, and thus can only be considered tentative. A future paper is planned to include a further year of data, including some initial aggregated power data and forecasts for the 140MW wind farm (with stage 3 completed). It is also planned to include some results on the HT energy traders experience with using WPPT.

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