



Power Production Analysis for 990 MW of Wind Power in the Gaspésie

2004 Data Simulation

May 24, 2005

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Final Report

Acknowledgements

The Pembina Institute would like to acknowledge the support of Philip Raphals of the Helios Centre for his guidance in this work.

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Cover Photo: Tim Weis, The Pembina Institute.



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1 Introduction

1.1 Context of Simulation

990 MW of wind energy have been approved by Hydro-Québec to be installed in the Gaspésiesie between 2006 and 2012 across an area of approximately 350 km. The successful bids are listed in Table 1, and the region where this development is to take place can be seen in the Environment Canada Wind Atlas¹ shown in Figure 1.

Table 1: Successful bids for Gaspésie wind development

2006	100.5 MW	Anse-à-Valleau
2006	109.5 MW	Baie-des-Sables
2007	150.0 MW	St-Ulric/St-Léandre
2008	109.5 MW	Carleton
2009	150.0 MW	Les Méchins
2010	100.5 MW	Mont-Louis
2011	58.5 MW	Montagne-Sèche
2011	100.5 MW	Gros-Morne phase 1
2012	111.0 MW	Gros-Morne phase 2

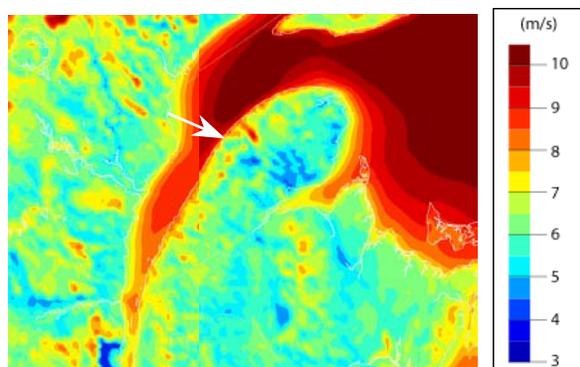


Figure 1: Wind map of Gaspésie and surrounding region at 80 m

The current study was completed in order to estimate the variability of the of power production from the proposed development. The study is based on 2004 data from the Environment Canada station in Cap Chat (location indicated by the arrow in Figure 1).

The anticipated mean annual power output from these wind farms is to be 3.2 TWh collectively delivered to Hydro-Québec². This study therefore assumes 3.2 TWh as a given annual output from all of the wind farms developed under the current bid.

¹ www.windatlas.ca

² Hydro-Québec, October 4/04 Press Release, *Call for tenders for electricity from wind power Hydro-Québec selects eight bids for a total of 990 MW*, http://www.hydroquebec.com/4d_includes/headlines/PcAn2004-161.htm

2 Methodology

2.1 Wind Resource

There are several Environment Canada anemometers in the Gaspésie. For simplicity, the data set was taken from a single tower at Cap Chat. This tower is approximately at the centre of the proposed wind energy development in the region. One full year of data was used from this tower beginning midnight January 1, 2004³. The collected wind data at a 10 m tower height is shown in Figure 2.

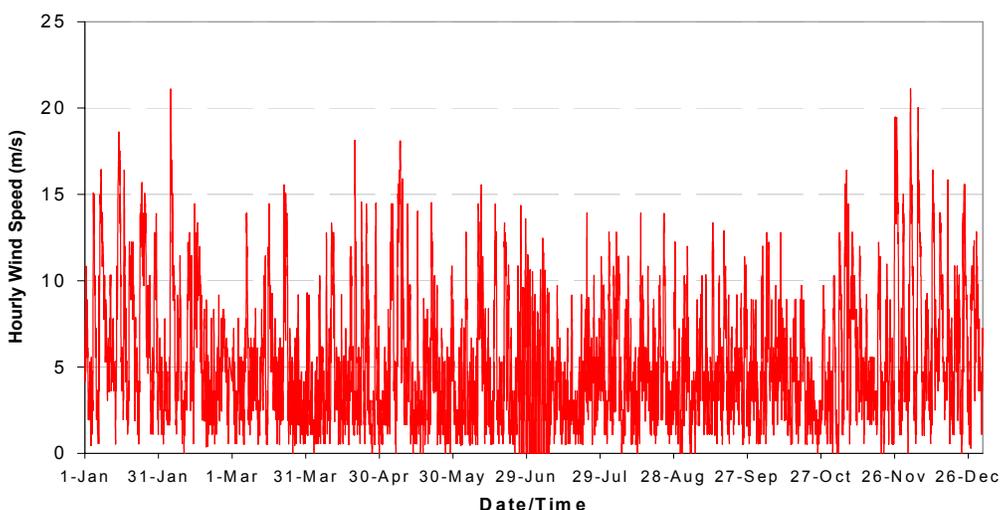


Figure 2: 2004 Cap Chat wind speeds at 10 m

General Electric sl/e and s/se turbines whose power curves are shown in Figure 3 will be used exclusively in the wind farms. The Cap Chat wind data was projected to a height of 80 m and annual power production was estimated using a linear average of the two GE wind turbines. In order to attain the desired 3.2 TWh of production, including 15% estimated losses, the wind speed was recalibrated multiplicatively to reach the average annual production.

³ A data gap exists in the Environment Canada data from June 25/04 at 11:00pm to July 8th at 9am. Data was used from the Environment Canada Gaspé station for this gap, scaled based on the difference in annual wind speeds from the two sites. Several other data gaps ranging from 1-4 hours were filled by linear interpolation.

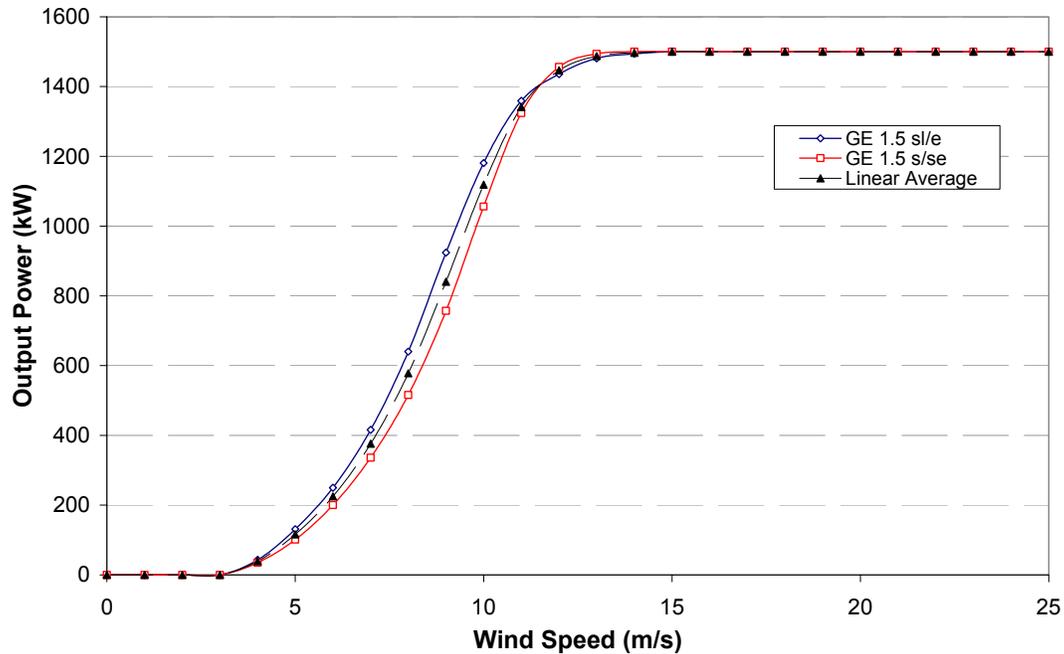


Figure 3: GE sl/e and s/se Power Curves

2.2 Data Smoothing

Because of the large area over which the wind turbines will be constructed it is unreasonable to assume that they will all experience the same wind speeds at the same time as weather systems move through the region. Using an average wind speed of 8.3 m/s (30 km/h), it can be assumed that it takes almost 11 hours for weather systems to move through the 350 kilometers where the wind farms are to be developed. In order to account for the varying wind speeds that turbines would experience simultaneously across this distance, the wind data was smoothed using an 11-hour average. The average was centred on the hour in question to account for the fact that the weather systems could be approaching from any given direction.

A more accurate simulation would include data from various other towers in the region weighted to reflect geographic location of the developments, as well as considering power smoothing within a wind farm caused by local variations in wind speeds, turbulence and turbine wakes. Such an approach would further smooth the data fluctuations. The current method was used as it can be considered a “worst-case scenario” in terms of the variability of the output power. While the simulation used a rolling average to represent some of the inherent reductions in output variability it is clear, based on the aforementioned reasons that the actual power output will be smoother than the data presented in the following section.

3 Simulation Results

3.1 Power Data

The processed wind speed data was then applied to the averaged power curve of the two GE turbines. The resulting data set is shown below in Figure 4 and Figure 5.

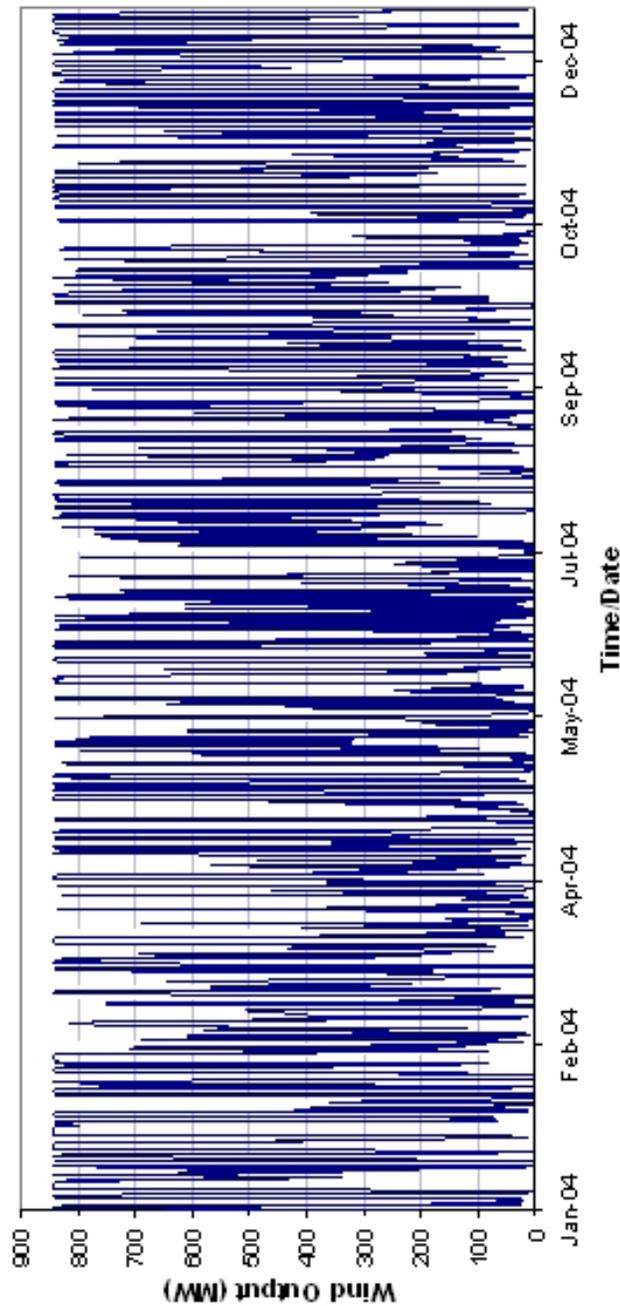


Figure 4: Simulated annual power production of the proposed 990 MW of wind power in the Gaspésie

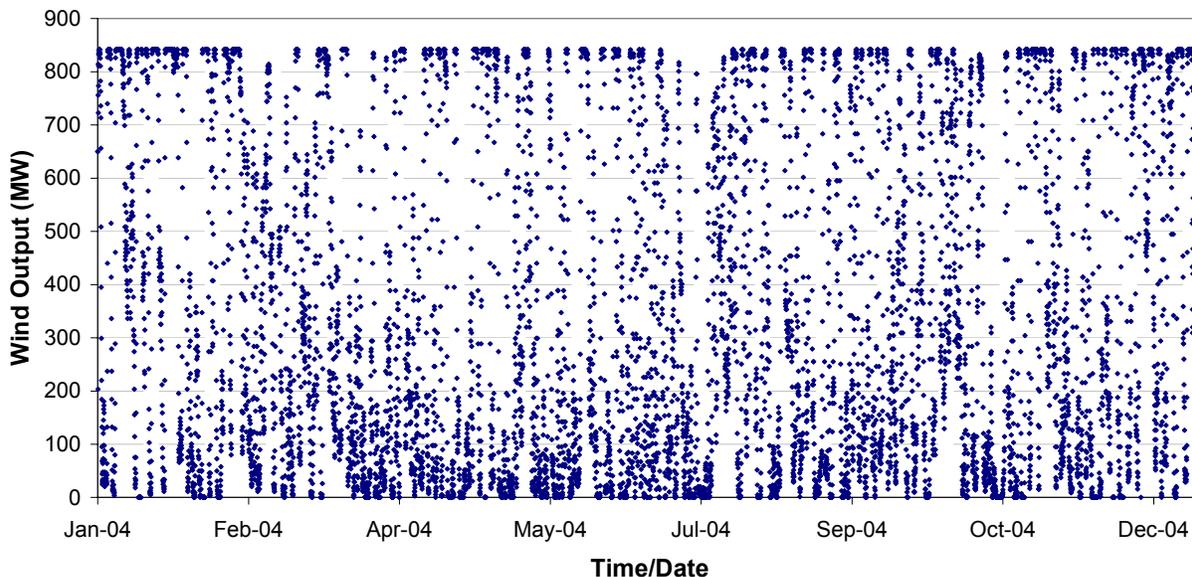


Figure 5: Power simulation data points

Because of the assumed 15% losses the maximum power output is 842 MW. The simulation shows an average output of 362 MW (a capacity factor of 36%), with the machines producing full power 15% of the year (1,275 hours) and no output for 7% (624 hours) as can be seen in Figure 6.

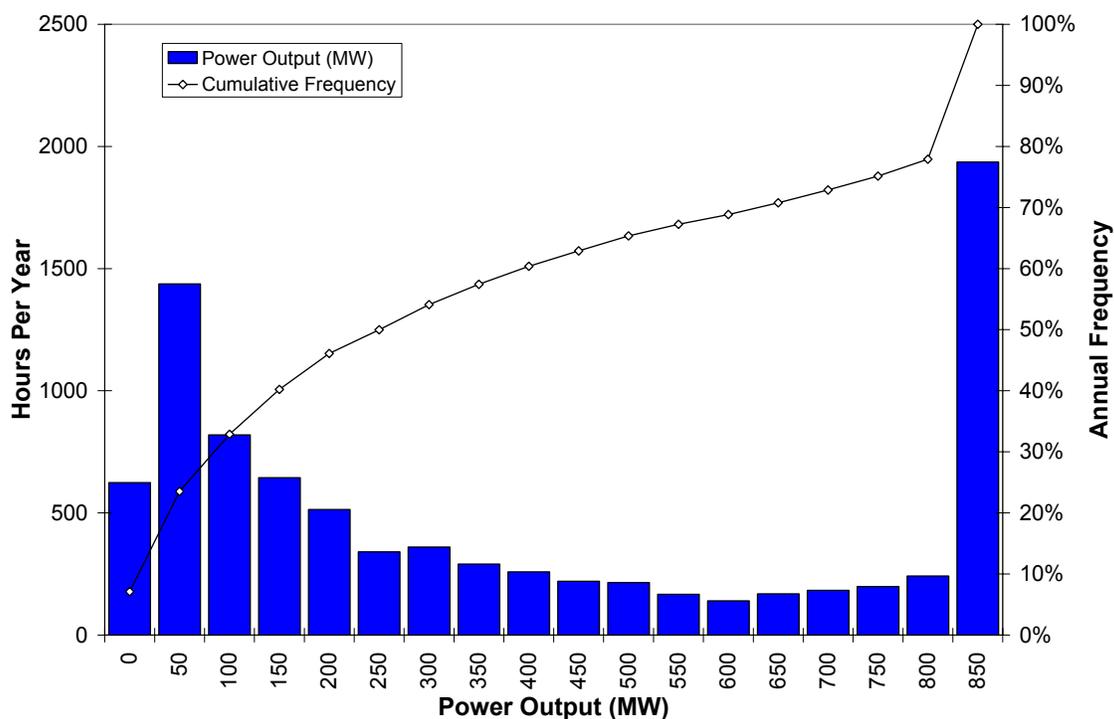


Figure 6: Simulated power output histogram

Figure 7 illustrates the seasonal power variations. January and December have average power outputs of over 500 MW, and the stretch between March and October is relatively flat with average outputs close to 300 MW.

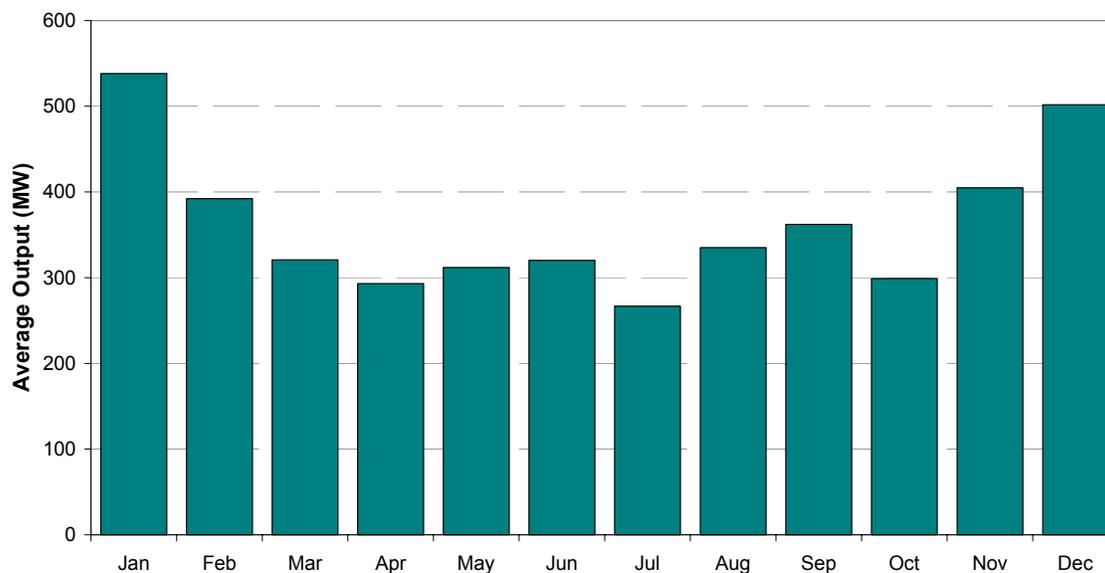


Figure 7: Seasonal variations in power production

The data presented within this report is based on actual 2004 weather data and is a realistic representation of the variability that can be anticipated from the proposed wind energy developments in the Gaspésie. While the wind resource will clearly vary from year to year, because the data smoothing was done as a *worst-case scenario*, the collective power output from the 990 MW of wind energy is unlikely to show larger hour-to-hour variability than the simulated power data presented in this report.