

# Proposed Stockyard Hill Wind Farm and the Mortlake Open Cycle Gas Generation Power Station

This report compares the costs of the proposed Stockyard Hill wind farm and Mortlake open cycle gas generation power station and their greenhouse gas savings.

by

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## INTRODUCTION

Wind farms are proposed as a method of reducing Greenhouse Gas (GHG) however careful examination of the merit of this type of power generation seems to have eluded government departments and politicians alike. The wind industry has not been forthcoming in providing concrete evidence to justify mandating the additional cost of wind generated electricity to consumers.

The proposed Stockyard Hill wind farm and the Mortlake gas fired power station, are of similar stated capacity and are in the same region, Western Victoria. They present an ideal opportunity to examine and compare cost and purported benefits of wind power and gas generation.

## A BREIF DESCRIPTION OF THE PROJECTS

The following provides a brief outline of the respective projects.

### Stockyard Hill Wind Farm

- 484 MW made up of 242 turbines of 2MW “nameplate” capacity.
- Covers an estimated 215 square kilometers of land.
- Construction estimated to cost \$1.4 billion.
- Connection to the power grid estimated to cost \$100 million.
- Proponents claim power generation is 1,890,000 MWH/year.
- Claimed GHG savings are 1,890,000 tonnes/year.
- Environmental constraints governed by wind industry guidelines.
- A “Shadowing” gas generator is estimated to cost \$0.6 billion.

### Mortlake Gas Fired Power Station

- 550MW Open Cycle Gas Generator (OCGG).
- Site area is 20 hectares with generator confined to a building.
- Project estimated cost is \$0.640 billion.
- Proponents claim power generation is 4,700,000 MWH/year.
- GHG savings are 3,780,000 tonnes /year.
- Environmental constraints governed by EPA requirements.

## SUMMARY

The proposed Stockyard Hill wind farm is examined in Appendix 1. The Mortlake gas fired power station is compared with the Stockyard Hill wind farm in Appendix 2. The principal findings in these works are:

1. The Mortlake plant costs only 43% of the Stockyard Hill wind farm and yet produces 4.4 times as much power.
2. The GHG savings per Megawatt Hour for the gas plant are more than twice that of the wind farm.
3. The gas plant can replace 550 MW of coal fired generating plant whereas the highly variable output of the wind farm may only enable a very small percentage of its capacity, say 5%, of coal fired generation to be shut down.
4. To accommodate the highly variable output of the wind farm constant backup would need to be provided by a responsive gas fired generator and this would be at an additional cost to the wind farm cost.
5. The Mortlake plant could achieve further GHG savings in a cost effective way by upgrading the OCGG to a Closed Cycle Gas Generator (CCGG).
6. Wind industry claims of GHG savings are grossly exaggerated.

## CONCLUSION

Policies to adopt wind power as a generation method to reduce GHGs are misplaced. Gas fired generation of power using OCGG provides a greater reduction in GHG at a lower capital cost and lower cost per MWH. Future upgrades of an OCGG to a CCGG would increase output and further reduce GHG emissions.

**Note:** The cost, power output and other figure used in this analysis for the Mortlake gas fired power station were announced by Origin Energy and those for the Stockyard Hill wind farm were taken from the project website. Other information used is from published and other available literature including the report **"Cost and Quantity of Greenhouse Gas Emissions Avoided by Wind Generation"** by Peter Lang, an engineer and recognised authority on the power industry. Although the information has been prepared and checked it is provided without any guarantees or warranties as to its accuracy. It is published in good faith for discussion on a matter of public policy.

**APPENDIX 1  
PROPOSED STOCKYARD HILL WIND FARM**

		Claimed by WPPL		"Corrected"	Under/ Over	
<b>Turbine Details</b>		<b>Explicit</b>	<b>Implicit</b>	<b>Claim</b>	<b>Statement</b>	
Number of Turbines		<b>242</b>		242		
Turbine Name Plate Capacity	- MW		2.0	2.0		If operated with constant optimal wind speed
Total <b>Nameplate</b> Capacity	- MW	<b>484</b>	<b>484</b>	<b>484</b>		If operated with constant optimal wind speed
Capacity Factor	- %	<b>44.6%</b>		27%	65%	estimated power generated divided by nameplate capacity
Turbine Capacity	- MW		0.89	0.54	65%	predicted output per turbine
Project Capacity	- MW		216	131	65%	predicted output of wind farm
Project Output	- MWH/year	1,890,000		1,144,757	65%	predicted annual output of wind farm
Less Reactive Power say 5% of output	- MWH/year	0		<b>-57,238</b>		ignored by WPPL, 5% is best estimate; provided <b>free</b> to operator
<b>Net Project Output</b>	<b>- MWH/year</b>	<b>1,890,000</b>		<b>1,087,519</b>	74%	
Project Estimated Cost		\$1,400,000,000		\$1,400,000,000		
Power Line Estimated Costs 59 km @ \$2million/km				\$118,000,000		
Project Total Estimated Cost		<b>\$1,400,000,000</b>		<b>\$1,518,000,000</b>		
<b>Actual Capital Cost per Net MWH from Project</b>			<b>\$741</b>	<b>\$1,326</b>	<b>-44%</b>	
<b>Greenhouse Gas</b>						
Produced by Gas Fired Power	- kg GHG/kw			0.50		average of Open and Closed Cycle Gas Generators
Produced by Brown Coal Fired Power	- kg GHG/kw			1.40		
Savings Claimed by WPPPL	- kg GHG/kw		1.00			assumes saves half gas and half brown coal generated power
	- tonnes/year	<b>1,890,000</b>				
<b>Correction to Claims</b>						
Gross Savings Average for Life of Project	- kg/ GHGkw			0.50		over life of project would displace gas not coal (too unresponsive)
Less:						
Reactive Power Consumed				0.03		ignored by proponents, assume provided by a gas generator
Excess from Balance Generator (OCGG)	- kg GHG/kw			0.20		OCGG kept in hot spinning mode to shadow variation in wind power
<b>Corrected Net Saving</b>	<b>- kgGHG/kw</b>			<b>0.38</b>		
	<b>- tonnes/year</b>			<b>299,068</b>	<b>632%</b>	
<b>Capital Cost of GHG Savings</b>	<b>- \$/tonne</b>		<b>741</b>	<b>5,076</b>	<b>-585%</b>	

Notes: "WPPL" denotes Wind Power Pty. Ltd.

Numbers in the **Explicit** column have been announced by Wind Power Pty. Ltd. ("WPPL")

Numbers in **Implicit** column are calculated from those in the Explicit column

Numbers in the **Corrected** column are calculated with actual numbers or the best assumptions available

The embodied GHG in the siteworks, supplied, delivered and erected or constructed works is not included. The wind farm would need to operate for 6-12 to offset this amount.

The GHG produced in maintenance which includes the transport of cranes and equipment to the site and works at the site is not included. This would increase over the life of the wind farm.

**APPENDIX 2  
COMPARISON OF MORTLAKE GAS PLANT AND STOCKYARD HILL WIND FARM**

		<b>Open Cycle Gas Generator</b>	<b>Wind Turbines</b>	
Capacity	MW	550	484	
Number of 2.5 kw Tubines			242	
number of 500 MW Tubines		1		
Capital Cost		\$650,000,000	\$1,518,000,000	
Nameplate Capacity	MW	550	484	
Capacity Factor	%	98%	27%	world average for wind seems to be between 20% and 25%
Total Annual Production	MWH	4,721,640	1,144,757	
Less Reactive power	5% for wind	0	57,238	estimate only
<b>Net Annual Production</b>	<b>MWH</b>	<b>4,721,640</b>	<b>1,087,519</b>	<b>4.4 times the power output for 43% of the cost</b>
Capital Cost Per MWH	\$/MWH	\$138	\$1,396	10.1 times higher for wind
Annual Capital Charge Included in Power Cost	20%	\$28	\$279	Interest 7%,maintenance 3%,depreciation 5%, profit 5%
Greenhouse Gas Produced By Generator	tonnes/MWH	0.6	0	OCGG produces 50% more GHG than CCGG
Greenhouse Gas Savings - by Gas Generators	tonnes/MWH	1.4		would replace brown coal generation (permanently)
Greenhouse Gas Savings - by Wind Generators	tonnes/MWH		0.5	would only replace a gas generator not coal, but has to be "shadowed"
Excess Produced by Shadowing Gas Generator	Est. at 30%		-0.2	Estimated additional GHG production from shadowing OCGG
Net Greenhouse Gas Saved per unit of Power	tonnes/MWH	<b>0.8</b>	<b>0.3</b>	
<b>Net Greenhouse Gas Saved per Year</b>	<b>tonnes/year</b>	<b>3,777,312</b>	<b>326,256</b>	<b>Gas saves 11.6 times the CO2 of wind power for 43% of the cost</b>
<b>Annual Subsidies Paid by Consumers</b>	<b>\$40/MW</b>		<b>\$43,500,758</b>	

Notes: The wind farm's more highly dispersed larger quantity of steel, concrete, power connections and roading would mean high embodied GHG.

Maintenance of the wind farm would require transport and use of mobile cranes, imported parts would result in high GHG production.

The gas plant's less expansive nature with less concrete and steel would limit embodied GHG.

Maintenance of the gas plant's equipment would be carried out with installed equipment resulting in low GHG production.

The report "Cost and Quantity of Greenhouse Gas Emissions Avoided by Wind Generation" by Peter Lang 16/2/2009 was used for the review and verification.