PAPER 2

THE COST OF WIND/ GAS GENERATION AT A TIME OF RISING GAS PRICE

Abstract

Under the Renewable Energy Target (RET) scheme wind and solar power generation are set to provide an increase in the supply of electricity over the next decade. The target is for 20% of electricity consumed to be from renewable energy by 2020 but this seems likely to be exceeded. Because wind and solar are extremely variable in output, practical use of these technologies relies on the grid being supplied by gas-turbine generators as back-up. Because over 20% of the generating capacity is set to come from this system it is important to analyse where this expenditure in new base-load capacity is taking us in terms of cost of generation which will ultimately be paid by the consumer. It is likely that gas price is set to rise dramatically in the near future. This will have a major impact on generating cost which is set to significantly increase the cost of base-load power generation which will flow through to the consumer. It is feasible that sufficient gas may not be available in which case the security of supply of power on the eastern seaboard may be compromised.

Background

A previous papers discussed wind-farm generation in the context that each farm is in effect aligned with an open-cycle gas turbine operation which is able to ensure a constant power supply when as the output from the wind-farm fluctuates due to change in wind strength. The first paper showed that when wind farm efficiencies (load factor) falls below about 32%, carbon saving would result if the wind-farm is decommissioned and the associated turbine facility up-graded to a combined cycle operation.

The combination of wind-farm and gas turbine (WFGT) generator effectively supplies base-load power to the grid[1]. A similar situation occurs with solar generation with gas turbines providing power in times of cloud cover and darkness. The development of these combination generators for base-load power is driven by the Renewable Energy Target (RET) scheme. This scheme aims to deliver 20% of base-load power from renewable sources by 2020 and on present trends is likely to exceed 25% by 2020. Because of this combination, generating costs are dependent on the availability and price of gas for the turbine (the major portion) of the generator. This issue is addressed in this second paper which indicates that the cost of generation from WFGT systems could lead to significant increases in generating costs as the cost of gas rises.

Generating costs

Because of the importance in relative generating costs and carbon emissions to planning and policy formulation, the US Energy Information Administration (EIA) has developed and published capital

[1] G. King (Origin Energy), Interview with Alan Kohler ABC “Inside Business” 21 July 2013.

and operating costs for a wide range of generating technologies[2]. This publication appears to build on earlier work performed by Black and Veatch and published by the National Renewable Energy Laboratory (NREL)[3]. This data has been used as the basis for the economic analysis presented in this paper.

Feedstock usage has been translated from heating rate (BTU/kWh) to estimated annual usage for the gas plants (PJ/y). The capital and operating costs have been maintained at 2012 values without inflation. Non feedstock operating costs have been calculated on an annual basis using the EIA data. The high capital costs in Australia relative to the US are the subject of much current debate. To reflect the widely held view of high costs in Australia, all costs have been translated from US basis to Australian basis using a 30% uplift factor.

The econometric statistics for the facilities are given in Table 1. The return on capital (ROC) seeks to account for interest payments over the construction period following by 100% of operational capability from day 1 of the project to the final day of operation. There is no net value at the end of the period: decommissioning cost is equal to the scrap value.

The economic analysis follows the methodology previously published[4]. Using this method, the production cost for the hypothetical wind-farm is estimated at 15.3c/kWh ($153/MWh). Wind-farm generating costs *per se* are independent of the gas price but is central to generating cost for gas-turbine and combined cycle generators.

Table 1: Statistics for generating facilities

		GAS TURBINE	COMBINED CYCLE	WIND FARM
NOMINAL CAPACITY	MW	500	500	100
LOAD FACTOR	%	80%	80%	33%
PRODUCTION	MW	400.00	400.00	33.00
CAPEX	$Million	298.03	596.05	287.69
CONSTRUCTION PERIOD	years	2	3	2
PLANT LIFE	years	20	20	20
RETURN ON CAPITAL	%/a	13.57%	14.32%	13.57%
NON FEED OPERATING COSTS	$Million/year	12.38	24.96	5.14
FUEL USAGE (HHV)	PJ/year	42.24	29.04	0.00
THERMAL EFFICIENCY	%	33%	48%	

Gas Costs

At the time of writing, the future cost of gas on the eastern seaboard of Australia is subject to much speculation. In the near future, when the large export LNG projects come on-stream in Gladstone, there is a strong possibility that gas will become priced by the value to the export LNG operations

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[2], "Updated Capital Cost Estimates for Utility Scale Electricity Generating Plants,", April 2013, US Energy Information Administration, Washington DC 20585

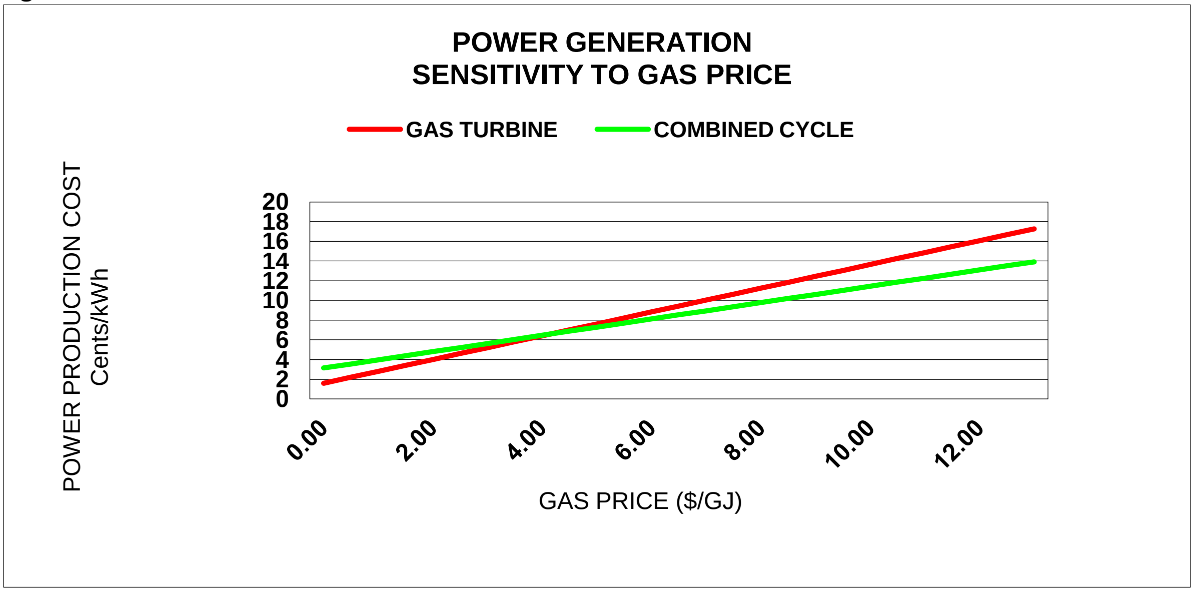
[3] Black & Veatch, "Cost and Performance Data for Power Generation Technologies", National Renewable Energy Laboratory, February 2012

[4] D. Seddon, "Gas Usage and Value – Technology and Economics of Natural Gas Use in the Process Industries," PennWell, 2006 building on work by Stratton et alia, IEA Coal Research, EAS Report E5, November 1983.

which are in effect set by the delivered CIF price of LNG to Japan and South Korea. Currently this price is about $16/GJ. Allowing for shipping (about $1/GJ) and liquefaction costs (2/GJ say), the gas value at the gate price of LNG facilities at Gladstone could be as high as $13/GJ. This compares with large scale gas contracts to date being in the vicinity of $3.5/GJ in Victoria and $4 to $5/GJ in NSW and SE Queensland. In this scenario gas suppliers and gas developers appear reluctant to settle for future gas prices below $8/GJ.

The sensitivity of power generation using gas by gas turbine only and combined cycle are illustrated in Figure 1 for gas price to $13/GJ.

Figure 1



The generating cost curves cross at about $4/GJ at a generating cost of about $65/MWh. Below this gas cost, it is cheaper to generate power using simple gas turbines. For higher gas costs combined cycle generation is cheaper. At this gas price generation cost is close to typical wholesale power price, which is typically in the range $40 to $60/MWh.

Discussion

At the very high gas prices canvassed above, the gas-turbine portion of a Wind-Farm – Gas-Turbine generator is higher than the wind-farm generator which is estimated at $153/MWh. Combined cycle operations lower generation cost but not by very much; $140/MWh with gas at $13/GJ. At $8/GJ for gas, a possible future equilibrium price, the generating cost from gas turbines is $112/MWh. At this value the generating cost of the Wind-Farm – Gas-Turbine combination is $140/MWh assuming the wind-farm has a 33% load factor.

These generation costs are well above current wholesale power prices. Clearly with possibly 25 to 30% of the base-load in the network being made up of generators of the WFGT type, rising gas cost will have a major impact on wholesale prices pushing it well above current values. Clearly this result has profound political and social implications but it is not the worse-case scenario.

The worse case occurs when not only are long term gas contracts fixed by the export parity value of gas as LNG but also the LNG operations, being short of gas, vacuum up all available gas so as to satisfy their export contracts. This situation is possible because of the very large scale of operations being planned: Table 2.

Table 2: Gladstone LNG operations (bold are under construction)

Company	OWNERSHIP	INITIAL LNG OUTPUT (Mt/year)
QCLNG	BG Group	8.5
Gladstone LNG	Santos/Petronas/Total/Kogas	3.9
Australia Pacific LNG	Origin/ConocoPhillips/Sinopec	4.5
Arrow LNG	Shell (Arrow) and Petrochina	8.0
Fishermans Landing	LNG Ltd./HQCEC(CNPC)	1.5
Sun LNG	Sojitz Corporation	0.5
Southern Cross LNG	Impel	1.3

The estimated 2015 demand for 16.9 million tonnes of LNG will require 1,071PJ of gas per annum, this should be compared with the current 780PJ demand for all of the eastern states. The future (2020) demand is expected to be 2,536PJ/year (more than three times the current eastern states demand). Given that industry and government claim over 31,000PJ of CSG (coal seam gas) reserves (2P) in theory, there should be no problem with the gas supply.

However, much of the potential CSG supply may not be available because of high production costs, the exclusion of national parks and towns, resistance by land owners and opposition from environment action groups. The alternative is for the LNG companies to purchase their gas needs from the open gas market potentially denying supply to both generators and industry at large.

Can these risks be mitigated?

I have described above possible situations which present a serious risk to the energy generating sector from the standpoint of gas availability and price. It has to be recognised that the scenarios described do not result from market failure, rather they occur from the normal operation of an open and transparent market where one consumer has the financial strength to purchase all available gas.

The 2012 Energy White Paper[5] states:

"*The Australian Government does not support calls for market interventions such as a reservation policy. Such measures should be a matter of last resort, undertaken only where there is clear evidence of market failure. Currently, there is no compelling evidence to support this.*"

This statement indicates that there appears no political will to address what could become a serious issue in electricity generation and price and it will take a serious revision of policy directives to ameliorate the risks.

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[5] Energy White Paper 2012, Commonwealth of Australia 2012