

Economic Analysis of the Levelized Cost of Electricity Generation

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INTRODUCTION

Due to the high volatility of the gas prices and the concern for CO₂ emissions, the nuclear option seems to be an option that needs to consider in a electricity expansion portfolio. In this paper a levelized electricity cost analysis is performed to compared different scenarios of electricity generation using combined cycles by using gas and nuclear power stations.

LEVELIZED COST METHODOLOGY

Each technology used to produce electricity has specific characteristics among these are: construction time, electrical output, lifetime and different cost for investment, operation and maintenance. Due to these differences it is very difficult to perform a comparison between different technologies by only considering one of those characteristics.

One way to perform comparisons among different technologies is to use the levelized cost methodology [1], it allows to quantify the unitary cost of the electricity (the kWh) generated during the lifetime of the nuclear power plant; as it is a mean value, it allows the immediate comparison with the cost of other alternative technologies.

The Levelized Cost Methodology considers the total electrical energy that the power plant will produce in its lifetime and it is divided between the total cost generated by construction investment along with the interest rate and the cash flow during construction plus the operation and maintenance cost, everything in present money worth.

ASSUMPTIONS FOR THE ANALYSIS

Nuclear power is considered as base-load technology to produce electricity along with the combined cycle plants based on natural gas and the coal plants. Thereby a electricity generating cost-comparison can gives some guidance about the economical viability of the nuclear option.

One of the main concerns for the investors in Nuclear Power is the construction time and the delays due to the licensing process. The Nuclear Regulatory Commission has modified the licensing process to decrease the possibility to stop the construction of a Nuclear Power Plant due to licensing conditions.

Two scenarios for the discount rate will be considered 5 and 10%, three for the gas prices 4.44 (Gas 1), 5.20 (Gas 2) and 7 USD/mmBTU (Gas 3).

Currently, AREVA, AECL, General Electric and Westinghouse have claimed in public documents that the overnight-cost for kWe can be between 1200 and 1600 USD/kWe [3,4,5,6,7]. Thereby, in this study we will consider three scenarios 1200, 1400 and 1600 USD/kWe as nuclear low, medium and high scenarios, respectively. The output power for these reactor is between 1100 and 1600 MW, therefore we will use a medium value of 1350 MW.

For the maintenance and operation costs we will use the ones reported by the OECD [2]. Table I shows all the characteristics of the Electricity generating systems used along with their corresponding associated cost.

TABLE I. General characteristics of the Electricity-generating Plants.

Plant Type	Gas	Coal	Nuclear
Lifetime years	25	40	40
Capacity Factor %	80	80	90
Power Output MWe	560	700	1350
Construction Time years	2	4	5
Overnigh Cost USD/kWe	450	1000	1200 1400 1600
Fuel Cost *USD/mmBTU	4.44*		
+USD/MWh	5.20*	1.78*	6.80*
O&M cost USD/MWh	7.00*		
	2.77	4.75	7.83

RESULTS

The electricity generating cost for the three base-load technologies (combined cycle using natural gas, coal and nuclear) for three discount rates 5, 8 and 10% is reported in Table II. To perform these calculations we use the data given in Table I and we apply the levelized cost methodology.

TABLE II. Electricity-generating levelized cost
(USD/MWh)

Discount Rate	5%	8%	10%
Gas 1	38.45	40.21	41.51
Gas 2	43.69	45.45	46.75
Gas 3	56.09	57.84	59.15
Coal	35.07	40.43	44.41
Nuclear Low	25.38	30.82	35.01
Nuclear Medium	27.13	33.48	38.37
Nuclear High	28.89	36.14	41.73

CONCLUSIONS

Due to the investment for a nuclear project is high and it requires at least five year to be build, the levelized cost is very sensitive to the discount rate as can be seen in the results shown in the Table II, where the differences for a discount rate from 5 to 10% can be up to 45% higher.

On the other hand, the combined cycle does not show a big difference when different discount rates are used, the difference is lower than a 10% when it goes from a discount rate of 5% to 10%.

However the gas price is a key element in the electricity generating cost, it shows a high sensitivity to the gas price, if it goes from 4.44 to 7 USD/mmBTU the levelized cost varies more than 40% no matter what the discount rate is.

In all the cases analyzed the levelized cost of the electricity by using nuclear power is lower than the one given by using natural gas. Therefore the nuclear power is a competitive way to produce electricity and it needs to be taken into account in any electricity expansion program.

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