

ECONOMICS OF THE NUCLEAR ENERGY CONSIDERED CO₂ EMISSION

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1. Introduction

The energy consumption in Korea has greatly increased along with its rapid economic growth and industrialization since the 1970s. Total energy consumption increased at an average annual growth rate. Due to the lack of domestic energy resources, however, the overseas dependence rate of energy consumption has continuously increased. Also Climate change, resulting from increases in greenhouse gas emissions (GHG), is considered one of the biggest environmental dangers facing the world today [1].

The objective and approach of this study are to compare the different types of scenarios in terms of the power plant type and CO₂ emission from each power plant. We estimated cost of electricity generation using fuel cost, O&M cost(Operation and Maintenance Cost) and CO₂ emission.

2. Electricity Generating Cost

Electricity production costs refer to fuel plus operation and maintenance (O&M) costs only, exclude capital cost since this varies greatly among utilities, states, the age of the plant and decommissioning cost of nuclear power plant because this is a small portion in live of it. Also policies to reduce greenhouse gas emissions have reached a level of maturity such that members of the Expert Group decided that a carbon price of 10 USD per ton of CO₂ was now the most realistic assumption for plants being commissioned in 2015 [2]. Finally we consider electricity generating cost applied two level of carbon tax estimated in US and Europe.

2.1 Fuel Cost

Fuel costs are important to the economics of coal, nuclear, and natural gas plants. Recent trends in the delivered cost of fuel to power plants are illustrated in Fig. 1 [3]. Cost of coal and natural gas to power plants has increased since the beginning of the decade, but the price escalation has been especially severe for natural gas. Fuel costs are high for fossil fuel and very low for nuclear and renewable. And the quantities of uranium needed are very much less than for coal or oil so a large fuel price escalation will have relatively little effect in electricity generating cost.

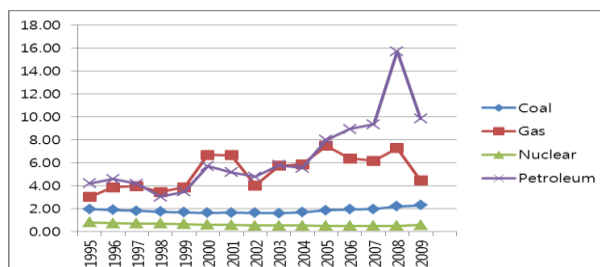


Fig. 1. Fuel Cost of the power plant type each.

2.2 Operations & Maintenance (O&M) Cost

Fig. 2 shows the annual cost associated with the operation, maintenance, administration, and support of a power plant. Included are costs related to labor, material & supplies, contractor services, licensing fees, and miscellaneous costs such as employee expenses and regulatory fees. O&M costs tend to be high for nuclear, petroleum, and low for coal and gas fired peaking units.

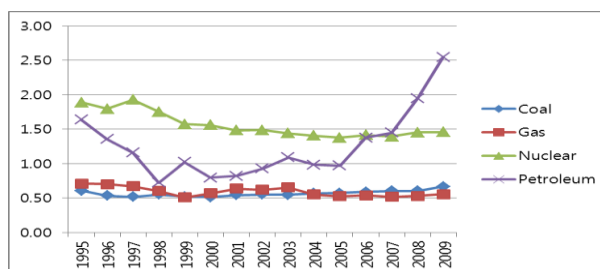


Fig. 2. O&M Cost of the power plant type each

2.3 CO₂ Emission from power plant

Energy demand in the world is expected to increase rapidly and the consumption of fossil fuels is anticipated to grow. Therefore, achieving reduced CO₂ emissions-while maintaining a stable energy supply-is a social challenge requiring a worldwide solution. There is international consensus that CO₂ emission levels need to be reduced by Kyoto Protocol [4]. That will require securing a stable energy supply while developing and innovating power generation methods technologies that greatly reduce CO₂ emissions. Fig.3 shows CO₂ emissions not only from power generating fuel combustion but from all the energy consumed in the electric power supply process from the mining of raw materials to the construction of power generation plants, fuel transportation, operation, repairs and maintenance. The nuclear power plant's figure includes domestic reprocessing of spent fuel currently being planned and

highly radioactive waste disposal. Considering CO₂ emission, nuclear power generation is expected to play a major role in reducing CO₂ emissions in the years ahead.

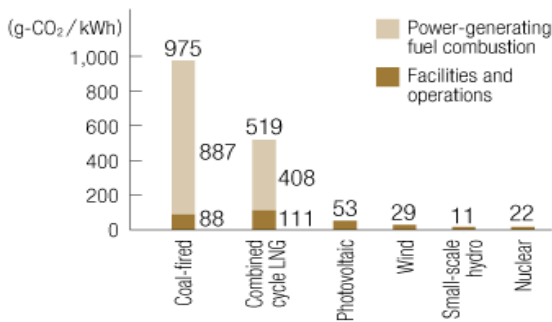


Fig. 3. CO₂ Emission from each power plant.

2.4 Decommissioning cost of nuclear power plant

An OECD survey published in 2003 reported US dollar costs by reactor type. For western PWRs, most were \$200-500/kWe, for VVERs costs were around \$330/kWe, for BWRs \$300-550/kWe, for CANDU \$270-430/kWe. So decommissioning costs are about 9-15% of the initial capital cost of a nuclear power plant. But when discounted, they contribute only a few percent to the investment cost and even less to the generation cost [5].

2.5 Results

Electricity production costs generally refer to fuel plus operation & maintenance, capital and decommissioning cost of power plants. However we exclude the costs of capital and decommissioning for substantive comparison. Costs are obtained using a sum of fuel and O&M cost. The cost of nuclear power plants is the lowest 1.96\$/kWh and 2.03\$/kWh in 2009 because of low and sustainable fuel cost even if it have a high O&M cost.

Cost of electricity generation [\$] = Fuel cost + O&M cost

Table.1. Cost of electricity in current situation

Year	Coal	Gas	Nuclear	Petroleum
2008	2.80	7.80	1.96	17.63
2009	2.97	5.00	2.03	12.37

And we apply a carbon tax 10.76\$/ CO₂ ton that is expected in US and 21\$/ CO₂ ton that is expected in Europe.

Carbon tax applied cost [\$] = Cost in current situation[\$] + CO₂ Emission from each power plant [g/kWh] x Carbon tax [\$/CO₂ ton]

Table.2,3. Cost of electricity applied carbon tax in U.S. (10.76 \$/ CO₂ ton) and Europe(21\$/ CO₂ ton).

Year	Coal	Gas	Nuclear	Petroleum
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2008	3.85	8.40	2.20	18.42
2009	4.01	5.59	2.27	13.16
Year	Coal	Gas	Nuclear	Petroleum
2008	4.88	9.00	2.01	19.22
2009	5.05	6.19	2.08	13.95

The highest increase is seemed in coal power plant 1.04\$, 2.08\$ when applied carbon tax expected in U.S. (10.76\$/CO₂ ton) and Europe (21\$/CO₂ ton) in 2009 while nuclear power plant hardly changed. Fuel consumption imposes a number of other external costs, besides carbon emissions, including environmental costs. Unless a portion of fossil fuel plant change to nuclear, it is hard achieving objective of Kyoto Protocol even if considered decommission cost of nuclear power plant.

3. Conclusion

Climate change, uncertain future energy prices, and other problems are caused by high fossil fuel consumption rates. It begins small and increases gradually, allowing consumers and industry to respond with many energy saving strategies. Without the option of new nuclear power stations, we would be more heavily reliant on carbon emitting fossil fuel electricity generation, with negative impacts on environment. However renewable plant is eco-friendly, but this had high cost of electricity generation and is supplied unstably. So nuclear power is likely to be one of the most cost effective fuel and low carbon emission plant.

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