Power Generation Costs and Economic Efficiency of Nuclear Power Generation

Editorial Staffs

[SUMMARY] We made a quick review of electricity generating costs by major power sources and nuclear power economics. A balance of fixed costs and variable costs makes economic assessment more complex. Building new nuclear power plants is getting more difficult in advanced countries because of higher initial costs and higher risks, therefore, small modular reactors (SMRs) are the focus of feasible nuclear reactors in the future.

Units of generating costs

Power plant generating costs are often described by “yen per kWh” or “cents per kWh”. But we should be careful of the fact that this unit highly depends on the balance of fixed costs and variable costs. One typical example is a hydro power plant, which has no variable costs. Therefore, when the fixed costs are dominant, generating costs represented as cents/kWh depend on the plant’s availability.

Cost comparison for taking what kind of action?

When we evaluate and compare generating costs among power sources, we have to be sure what kind of action we are taking. For example, if we compare generating costs for building a new power plant in Japan, it is meaningless to include hydro power because there is no place where large hydro power plants can be built. Stopping operation of the existing nuclear power plant will hardly reduce costs. Rather, the fuel cost of substituting thermal power generation will substantially increase.

There are two ideas to evaluate costs.

1. Life cycle generating costs (by OECD/NEA)

A power plant has lifecycle of construction, operation and decommissioning. Cash-out flow occurs in each stage, while cash-in flow only occurs in an operation stage. The “life cycle cost” is defined as electricity rate that equals total discounted cash-in flow to total discounted cash-out flow. Thus, it depends on “discount rate”.

OECD Nuclear Energy Agency (NEA) has issued reports of electricity generating costs by power sources, using the above mentioned way. Most recent report was issued in 2010([1]).
The main purpose of this report is intended for new construction. Therefore, a hydro power is excluded from comparison for some developed countries.

Here are cost estimates (A) according to [1]. We will also show generating cost estimates (B) made by Japanese government’s committee after the Fukushima accident, although it is not appropriate to compare each pair of values directly, since precondition differs.

Nuclear (A) 4.3 yen/kWh （Operation: 60years Availability:85% Discount rate: 5%） (B) 8.9 yen /kWh
Coal-fired(A) 7.6 yen /kWh （Operation: 40years Availability:85% Discount rate 5%） (B) 9.5 yen /kWh
LNG-fired(A) 9.0 yen /kWh（Operation: 30years Availability:85% Discount rate 5%） (B) 10.6 yen /kWh

Especially a cost gap of nuclear power is large. It's probably because of a difference in availability and assumptions about serious accidents such as Fukushima.

2. Cost evaluation using financial statements

Private electric utility companies issue annual financial statements. Japanese electric companies release their annual costs by major accounts, such as operation, maintenance, administration and depreciation. Some cost estimating studies have been done using these statements prior to the Fukushima accident, one such being the research by Oshima ([2] ,[3]).

The following is a list of cost estimates (A), direct cost of power generation, average of 41 years from 1970 to 2010, according to [3], and cost estimates including "Policy Cost", such as government grants during same period(B).

Nuclear (A) 8.53 yen/kWh(B) 10.25 yen/kWh
Thermal (A) 9.87 yen/kWh (B) 9.91 yen/kWh
Hydro (A) 7.09 yen/kWh (B) 7.19 yen/kWh

However, further discussion will be needed to take these results as a basis of nuclear fade-out policy.

International research on economic efficiency of nuclear power

Academic studies on economic efficiency of nuclear power generation prior to the Fukushima accident had not been active, perhaps due to limited access to an accurate public data. In the United States, new nuclear construction had not been done for over twenty years after the Three Mile Island accident. However, since the Energy Policy Act was enforced in 2005, electric utilities have had a chance to get the Federal government's loan guarantee programs and in some States initial construction costs are able to be recovered by consumer electricity bill.

Stanford University professor Geoffrey Rothwell, who wrote what is considered a textbook of electricity economics ([4]), recently wrote "The Role of Nuclear Power in Climate Change Mitigation" in [5]. He also wrote [6] with Professor Masahiko Aoki and made a recommendation of Japanese electric industry unbundling.

Mark Cooper, who is a senior fellow of Vermont Law School, wrote "US new nuclear construction costs will be much higher than estimated in the beginning of 'Nuclear Renaissance', so the government subsidy to nuclear plant construction forces unfair burden to tax and electricity bill payers." ([7]) After the Fukushima accident, he is criticizing the Price-Anderson Law, which allows utilities' limited liabilities.

Stephen Thomas, a professor of University of Greenwich in the UK, wrote "New nuclear construction will be impossible without government's large amount of guarantee or subsidies" ([9]). After the Fukushima accident, he was a co-author of a report [10].

Energy Policy Institute at the University of Chicago issued two reports in December 2011 ([11], [12]). One is an update of its 2004 report of nuclear power economics ([11]) and another is about business feasibility of small modular reactors (SMRs) in the US. ([12])

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