

Analysis of introduction of Natural Gas in North Korea – Focusing impact of Climate Change mitigation –

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Overviews

Russia is promoting the supply of pipeline natural gas (PNG) to east Asia for natural gas in Siberia. PNG supply in Korea to eliminate the political situation, the most economical route is to go through this in the North. North Korea's energy mix is Coal 66.1%, 21.4% hydro, 4.5% oil in 2011, energy domestic production rate is more than 90%, Natural Gas is not included in. Therefore, North Korea can be a route point network PNG, not be a consumer. But considering the increase in the energy of the future, North Korea can be one of the PNG.

According to the National Report which is submitted to UNFCCC(2000), North Korea, and it plans to increase until the year 100TWh 70TWh, 2020 in the amount of power generation by 2015. However, when running full power generation facilities in North Korea now, but may produce up to 60TWh, and it is considered smaller the amount of that can be actually generated, because aging of power generation equipment, in the absence of little change in the amount of power generation capacity and amount of power generation in recent decades.

Therefore, the future, in order to improve national welfare and economic development of North Korea, but requires base facilities and possible expansion of the energy supply, the supply through alternative improvement of aging equipment and sophistication of existing facilities, and new power generation for that must be increased. .

However, the energy industry is necessary for large-scale investment, payback period is long, private business is difficult to participated in energy industry in developing countries. And UNFCCC, but acknowledged efforts to reduce greenhouse gas emissions to promote in countries without the burden reduction target, is recognized as a business CDM projects reduce GHGs emissions through the facility of carbon zero emission or low-carbon energy resource, through this project, in developing countries, funding can be smooth through cooperation with developed country or international fund. In North Korea six CDM projects registered in UNFCCC, these businesses are all hydropower projects, investing countries are the Czech Republic, the amount of reduction from these projects is expected 193,475 tCO₂ per year.

I performed to analysis on effect of climate change mitigation and feasibility as a CDM projects when Natural Gas power plant adopted in North Korea. Existing research has approached macroscopically for CDM project potential amount of research and possible reduction of greenhouse gas emissions in North Korea. But for more information, including the validity of the content and business-related expenses, but they did not explain about the size of the business and the technology applied to concrete.

Methods and Result

It is assumed that the construction of a natural gas power plant which is useless in a large-scale option for the present study. In order to use natural gas commercial and household area, so requires infrastructure based network for supply natural gas, in business reason, power plants large to be easily accessible from it's because it has determined.

A gas turbine power plant with natural gas is even higher efficient generation system among in fossil fuel power plant, I performed analysis on economic and environmental aspects when that power plant installed in North Korea. Using the methodology CDM of UNFCCC, calculation of greenhouse gas emissions, row data related this study is obtained from registered fuel transition to natural gas project hosted in China, data associated with North Korea is taken from in "Hamhung Hydropower plant project".

The capacity of this plant is equal to 7% of the total generation capacity, 17% among in the fossil fuel power generation capacity in North Korea(2011). If this plant will be operate 5,000hr per year, the amount generation of it is 2,500GWh, correspond to 11.8% of the amount of power generated in North Korea in 2011.

The most important problem is decision of baseline scenario when emission reduction is calculated. When large scale of energy demand is existed in North Korea, to solve this problem, renewable energy have financial and capacity aspects, the coal fired power plant is the most economical solution and it is domestic resource so abundant reserves of anthracite. In addition, and the power is supplied by a very low price 1.98UScent/kWh according to the CDM project in North Korea, and it is difficult to invest to increasing energy capacity and more expensive imported fuel power generation. Consequently, baseline scenario of large new power generation in North Korea is high efficiency coal power plant, and existing hydroelectric power also is considered in baseline emission in North Korea.

The amount of GHGs reduction of CDM projects is determined as the difference amount of between expected GHG emissions and baseline emission in the project

$$E_{\text{Emission Reduction}} = E_{\text{baselineemission}} - E_{\text{projectedemissions}}$$

$$E_{\text{baselineemission}} = \phi_{\text{baselineemission.factor}} * P_{\text{powergeneration}}$$

$$E_{\text{Projectedemission}} = \phi_{\text{projected emission.factor}} * P_{\text{powergeneration}}$$

	Coal power plant	Baseline*	NG Power Plant
CO₂ emission factor (tCO₂ /MWh)	1.109	0.8833	0.44
Efficiency	0.3191	-	0.4591
The amount of CO₂ Emission per year(tCO₂)	2,775,000	2,208,250	1,100,000

*Hamhung Hydropower Plant No1. PDD"(CDM No 5887)

**Power capacity 500MW, operation hour is assumed as 5,000hr/year

Reference data of Natural Gas Power Plant in CDM projects

Total Investment(US\$/kw)	275.1~597.9
Annual O&M cost(exclusive fuel cost) relative to total cost	2.2~7.6%
PLF	0.26~3.09%
Power consumption rate	2~5%

To construct of a natural gas combined cycle power plant of 500MW class in North Korea, the amount of emission reduction can be about 1.6million tCO₂ compared to new coal-fired power plants and about 1.1M tCO₂. International emissions price is 10US\$/tCO₂ if and if, the value carbon credit from this project is a scale sales revenue of approximately US\$ 11 million is possible. Considering of average investment of China's natural gas power plant in 437.6US \$ per kw, investment of 500MW power plant about one million of \$ 218.8 is expected when you apply it. Income of this natural gas power plant which can be calculated as the sum of the selling GHGs credit and electricity might be deficit finance status because of very low price of electricity in North Korea, that of the price is much lower than of row material of natural gas(China 0.37US \$ / Nm³, South Korea 0.75US \$ / Nm³).

Implications

The economics of Natural Gas power plant is depend on the carbon credit price and natural gas price, therefore, it is desirable to design the CDM project with North Korea these elements would take account in. The amount of GHG reduction take into account of primarily data being used in a real project, for the reduction of GHGs, in the case of power generation efficiency, taking into account the loss of dispatch of recent higher the efficiency of the power plant in South Korea. Data of investment per capacity is refer to similar CDM project hosted China, who have the largest number of natural gas power generation CDM project and smaller investment than other country of it to access conservative approach. Thereof, consider of economic situation and financial condition in North Korea, a large-scale new power plant is difficult to implement in without high stable prices of CERs.

With the introduction of natural gas power in North Korea, in addition to the reduction of greenhouse gases, less environmental impact among the natural gas, the most convenient adjustment of the power generation load, it is useful with this variety. Looking at the energy mix if electricity of the North Korea, it is composed of load growth adjustment in response to changes in demand little difficult. The lowest operation unit cost hydropower should be as base load power generation, coal and oil is a source of some of the remaining energy. Coal power has high shut down cost, along with time-consuming to turn-off, so respond in real time to changes in the economic power demand is difficult. Crude oil, usage is a little limiting, the highest in the price among of fossil fuels, it is difficult to expand the usage of it. Thus, the power usage in accordance with as being supplied pattern that is not fit for the user, he can be difficult to use the

structure, especially household sector. Natural gas power generation may be the most efficient alternative to the load variation. To adopt natural gas power generation, electricity use in response to demand can be, with can be supplied as heat in the vicinity of residential areas due to little environmental emitter, as natural gas, changes in usage patterns in the case of household intense, the welfare of the inhabitants of the North Korea, it would help to improve. In addition, if the power generation electric power supply in North Korea has exceeded the demand, it is an option that they can also consider the power supply to Korea and China, and it will improve to connect energy system within east Asia.

For the more study, continue to analyze the sensitivity of the price fluctuations of natural gas and CERs prices, based on this, in North Korea is expected to consider the methodology and create an environment that allows you to promote greenhouse gas reduction projects. In PNG network in East Asia, when North Korea become as a new natural gas consumer not a simple path pointer, the effect on the degree of stability of the PNG supply in South Korea and elsewhere, there is a need for academic analysis.

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