Chapter 4

Macroeconomic Impact of Coal-fired Power Plants

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CHAPTER 4

Macroeconomic Impact of Coal-fired Power Plants

Focusing on India and Indonesia, this chapter quantitatively analyses how the economies of both countries are affected by discontinued financing for coal-fired power generation by multilateral development banks (MDBs) and export credit agencies (ECAs).

4.1. Recent Trends of Financing Policy for CPPs

In June 2013, President Obama announced the Climate Action Plan which, as part of addressing the climate change issue, includes a policy introducing advanced CCS technology as a precondition for financial support for overseas coal-fired power generation.

In response to this, the Export-Import Bank of the United States (US Eximbank) announced in December 2013 major regulations on financing coal-fired power plants (CPPs) and technology export. Thereafter, Denmark, Finland, Iceland, Holland, Norway, Sweden, and Great Britain, among the advanced countries,[16]and the World Bank, European Investment Bank, and European Bank for Reconstruction and Development, among MDBs, one after another announced similar regulations.

In contrast, ADB, ECAs in Japan, and China continue to finance coal-fired power generation.

4.2. Scenario Setting and Methodology

If MDBs and ECAs stop financing the development of coal-fired power generation in developing countries, what influence will be seen? Will it reduce the number of CPPs to be constructed? This study assumes two paths of influence.

The scope of influence of this prediction is up to 2035. For supply–demand prospect, the values in ERIA's *Analysis on Energy Saving Potential in East Asia,* June 2013, were used, unless specified otherwise.

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[16] Ueno et al. (2014), *Quantifying Chinese Public Financing for Foreign Coal Power Plants,* November.

Table 4.1: Description of Scenarios

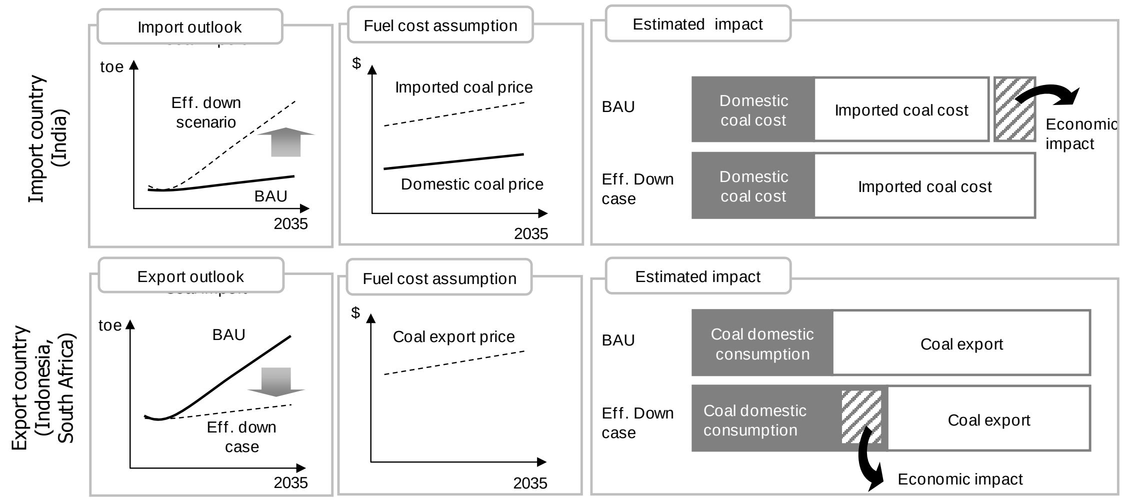
Efficiency Downgrade Scenario	Despite discontinued financing by MDBs and ECAs, construction of coal-fired power plants is continued by using alternative funds. Because no efficiency standards and environmental protection regulations are imposed by MDBs and ECAs, improvement of coal-fired power generation efficiency is delayed.
Gas Conversion Scenario	A project, assuming financing from MDBs and ECAs, is partly deadlocked. Needs for new electric power development are satisfied by a gas-fired power generation project entitled to financing.

A. Efficiency Downgrade Scenario

Coal consumption for power generation becomes higher than in the business-as-usual (BAU) scenario because of reduced power-generation efficiency. If the target of analysis is a net coal-importing country (e.g. India), an increment of coal consumption for power generation directly results in an increase in import volume. Since increased import leads to increased payment, an increment of payment serves as a factor to compound macroeconomic indicators such as gross domestic product (GDP).

If the target of analysis is a coal-exporting country (e.g. Indonesia), an increment of coal consumption for power generation results in a decrease in coal export volume. Since decreased export leads to decreased export income, this decrement badly affects macroeconomic indicators.

Figure 4.1: Path of Influence of the Efficiency Downgrade Scenario



BAU = business as usual, Eff. = Efficiency.
Source: Authors.

Based on objective foundation, it is difficult to quantitatively indicate the influence of discontinued financing by MDBs and ECAs on lower coal-fired power-generation efficiency. There is not enough information to measure the degree of financing by MDBs and ECAs, as described in Chapter 1. For this reason, this study observes the width of influence by assuming a five-percent across-the-board drop based on future expectation of average power-generation efficiency in the target countries.

Table 4.2: Assumption of Average Efficiency of Coal-fired Power Plants

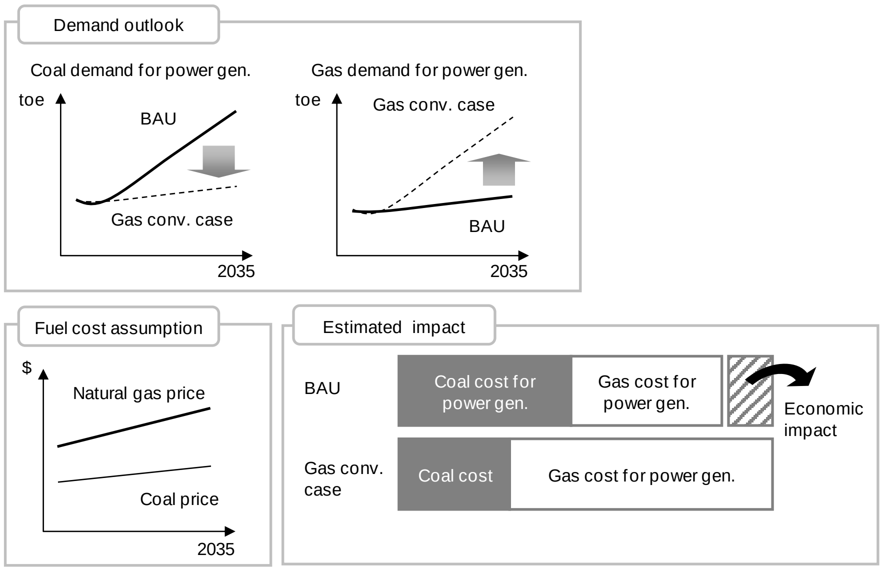
Average efficiency in:	India	Indonesia
BAU scenario	37.6% *	38.7% **
Efficiency down scenario	32.6% (BAU -5%)	33.7% (BAU -5%)

BAU = business as usual, CPP = coal-fired power plant.
* Economic Research Institute for ASEAN and East Asia, *Analysis on Energy Saving Potential in East Asia,* June 2013, BAU scenario.
** Institute of Economic Energy, Japan, *Asia/World Energy Outlook 2013,* Reference scenario.
Source: Authors.

B. Gas-conversion Scenario

Coal consumption becomes lower than in the BAU scenario by a conversion of construction plan from coal-fired to gas-fired power generation, and natural-gas consumption increases to the contrary. A shift to gas-fired power generation means higher fuel cost because natural gas is more expensive than coal. It was assumed that target country would make up for an increment of natural gas demand by import. Increased consumption of natural gas results in higher import of natural gas, creating bad effects on the macro economy.

Figure 4.2: Path of Influence of the Gas Conversion Scenario



BAU = business as usual, conv. = conversion, gen = generation.
Source: Authors.

Based on objective foundation, it is difficult to quantitatively indicate how a shift from coal-fired to gas-fired power generation is affected by discontinued financing from MDBs and ECAs. The degree of financing by MDBs and ECAs, as described in Chapter 1, cannot be measured as there is not enough information. For this reason, this study observes the width of influence by assuming that 15 percent and 30 percent will be converted into gas-fired power generation across the board according to the future prospect of generated energy by coal-fired power generation in the target countries.

Table 4.3: Assumption of Fuel Share in Power Generation

		India	Indonesia
BAU scenario	Coal	67.7% *	42.0% *
	Gas	15.3% *	28.4% *
15%	Coal	-10.1%	-6.3%
Gas conversion		(-15% of 67.7%)	(-15% of 42.0%)
scenario	Gas	+10.1%	+6.3%
30%	Coal	-20.3%	-12.6%
Gas conversion		(-30% of 67.7%)	(-30% of 42.0%)
scenario	Gas	+20.3%	+12.6%

BAU = business as usual.
*ERIA, *Analysis on Energy Saving Potential in East Asia,* June 2013, BAU scenario.
Source: Authors.

C. Combined Scenario

As described, efficiency downgrade and gas conversion scenarios are assumed here. Are these contradictory events occurring independent of each other? Is the occurrence probability of each scenario much the same?

First, regarding the contradictoriness of the scenarios, these events occur at the same time and not independently of each other. Effects of discontinued financing differ depending on the target project. Accordingly, it is only natural to presume that reactions also differ, i.e. one project decides to employ low-efficiency but also inexpensive power-generation technology as an alternative and another decides a shift to gas-fired power generation. A combination of the two scenarios is likely to occur in reality.

Next, for occurrence probability, the efficiency downgrade scenario has higher probability because it conforms to the behavioural principle of profit-seeking corporations, whereas a shift to gas-fired power generation, which compounds economic efficiency, runs counter to that. Of course, economic efficiency is not the only element in deciding investment. For instance, a changing financing environment for coal-fired power generation and expected future enhancement of environmental regulations are risk factors in a coal-fired power plant construction project. If these are considered big risks, a shift to gas-fired power generation can be an appropriate option.

Based on these considerations, this study analyses the following three cases.

Table 4.4: Case Setting

	Eff. downgrade	Gas conversion
Efficiency downgrade case	-5% than BAU	-
Combination scenario 1	-5% than BAU	15% of CPPs will be converted
Combination scenario 2	-5% than BAU	30% of CPPs will be converted

BAU = business as usual, CPP = coal-fired power plant, Eff. = Efficiency.
Source: Authors.

D. Assumption of Fuel Costs

In the analysis, the change of coal or natural gas export/import volume brought about by each scenario is converted into monetary value which requires an assumption of fuel prices.

The domestic fuel prices in the target country were first calculated based on statistical data published by a typical electric company, etc. in the relevant country, and with the assumption that those prices would not change in the future.

Next, the international prices related to export/import used the 2035 nominal prices in the *IEA World Energy Outlook 2013*.

Table 4.5: Assumption of Fuel Costs for Power Generation

		India	Indonesia
Coal price	domestic	n.a.	$80/tonne *
	import	$110/tonne **	n.a.
	export	n.a.	$110/tonne **
Gas price	domestic	n.a.	$14.9/MMBtu **
	import	$14.9/MMBtu **	n.a.

MMBtu = million British thermal units, n.a. = not applicable.
* MEMR, *Handbook of Energy & Economic Statistics of Indonesia.*
** International Energy Agency, *World Energy Outlook 2013,* New Policy Scenario.
Source: Authors.

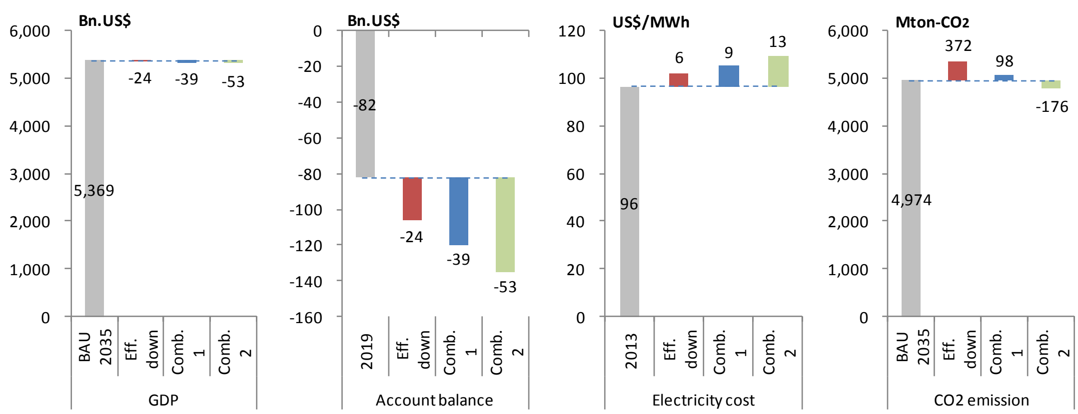
4.3. Calculation Results

A. India

The calculation result indicates that the Indian macroeconomy is influenced by delayed efficiency improvement of coal-fired power generation and a shift to gas-fired power generation. The degree of influence increases in the order of efficiency downgrade, combination 1, and combination 2, corresponding to approximately 1 percent increase of GDP (2035), 28 percent increase of current account balance (2019), and 13 percent increase of electricity charge at maximum.

On the other hand, CO_2 emissions are reduced more as shift volume to gas-fired power generation becomes larger. In the case of combination 2, CO_2 emissions are expected to be four percent lower than in the case of BAU. However, in the case of combination 1, for instance, CO_2 emissions become higher than in the case of BAU because increased CO_2 emissions due to lower efficiency cannot be offset by a reduction effect brought about by a shift to gas-fired power generation.

Figure 4.3: Calculated Result (India)



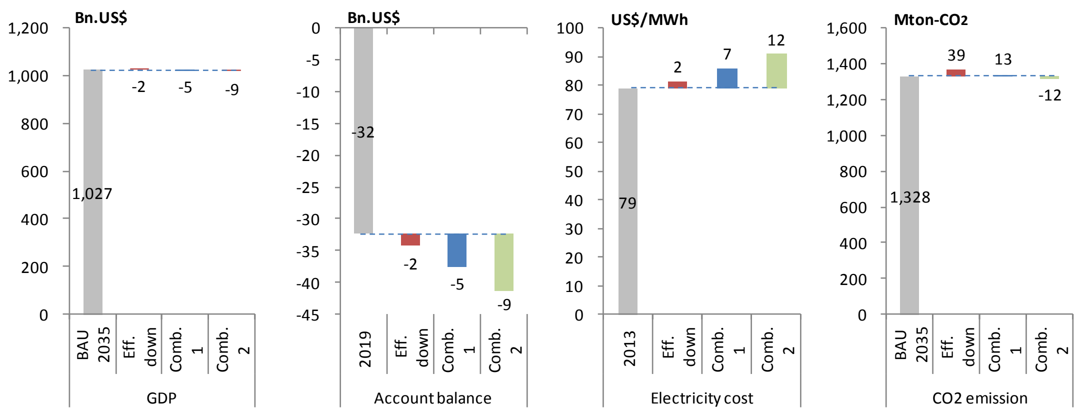
BAU = business as usual, Bn = billion, CO_2 = carbon dioxide, Comb. = Combination, Eff. = Efficiency, GDP = gross domestic product, Mton = megaton, MWh = megawatt-hour.
Electricity price in 2013: Simple average of sector-wise tariff effective during FY2013.
Sources: Economic Research Institute for ASEAN and East Asia, *Analysis on Energy Saving Potential in East Asia,* June 2013, BAU scenario; International Monetary Fund, *World Economic Outlook April 2014*; CEA.

B. Indonesia

The calculation result indicates that the Indonesian macroeconomy is influenced by delayed efficiency improvement of coal-fired power generation and a shift to gas-fired power generation. The degree of influence increases in the order of efficiency downgrade, combination 1, and combination 2, corresponding to 0.9 percent increase of GDP (2035), 28 percent increase of current account balance (2019), and 16 percent increase of electric charge (2013) at maximum.

On the other hand, CO_2 emissions are reduced more as shift volume to gas-fired power generation becomes larger. In the case of combination 2, CO_2 emissions are expected to be one percent lower than in the case of BAU. However, in the case of combination 1, for instance, CO_2 emissions become higher than in the case of BAU because increased CO_2 emissions due to lower efficiency cannot be offset by a reduction effect brought about by a shift to gas-fired power generation.

Figure 4.4: Calculated Result (Indonesia)



BAU = business as usual, Bn. = billion, CO_2 = carbon dioxide, Comb. = Combination, Eff. = Efficiency, GDP = gross domestic product, Mton = megaton, MWh = megawatt-hour.
Electricity price in 2013: Simple average of sector-wise tariff effective during FY2013.
Sources: Economic Research Institute for ASEAN and East Asia, *Analysis on Energy Saving Potential in East Asia,* June 2013, BAU scenario; International Monetary Fund, *World Economic Outlook,* April 2014; PLN.

4.4. Conclusion

Discontinuation of financing for coal-fired power generation by MDBs or ECAs may influence electric power development in the developing countries. The most likely scenario is that although use of alternative funds will continue to help construction of CPPs, improvement of coal-fired power generation efficiency will be delayed by the abolition of efficiency standards and environmental protection regulations imposed by MDBs and ECAs. It is also predicted that projects to develop new CPPs will be partly deadlocked based on the premise of financing by MDBs and ECAs, and electric power development needs will be provided by gas-fired power generation.

This study chose India and Indonesia, which greatly depend on coal for power generation, and analysed the influence of potential scenarios on their macroeconomies. As a result, it was found that these scenarios were likely to have negative effects. In a scenario where improvement of coal-fired power generation efficiency is delayed, the country's GDP, current account balance, and electric charge are adversely influenced by increased coal import volume and decreased coal export volume. In case a shift to gas-fired power generation advances, those factors are adversely influenced through an increased natural gas import volume. A shift to gas-fired power generation contributes to reduced CO_2 emissions, but cannot offset increased CO_2 emissions due to concurrent delayed improvement of coal-fired power generation efficiency, possibly allowing higher emissions than in a BAU scenario.