

Modelling the power sectors of East Asia in 2050 using E3ME-FTT: Power-economic impacts by choice of power source under regulations on nuclear and coal power generation

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Objective

In this paper, we apply the power mix obtained from the simulation results under the policy scenarios of regulations on nuclear and coal power generation through 2050 to estimate and confirm the impact on the economy (GDP, employment, etc.) and environment (CO₂ emissions) by using the E3ME (Energy-Economy-Environment Macro-Econometric Model). E3ME was developed by Cambridge Econometrics and Cambridge University and has been widely used to evaluate EU energy and climate policies.

To ascertain what power mix is desirable from a social perspective, it is necessary to scientifically assess the effects of various power mixes on the economy and environment, via quantitative analysis and evaluation using a reliable estimation model.

Restricting nuclear and coal-fired thermal power in East Asia would increase power generation costs and exert a negative influence on the economy (particularly the GDP), but we show that the effect of investment demand into alternative power sources—that is, the construction of renewable energy power plants—and a reduction in imports of fossil energy would ameliorate the negative impacts over time. Regarding CO₂ emissions, the study highlighted considerable reductions, although the amounts will differ between countries.

Methods adopted

This paper will describe the scenarios that will be developed to assess the future power generation targets and ways in which they could be met (through the power sector). The policies already announced in each country will be considered as the baseline. The baseline scenario of this paper adopts the reference scenario of Asia/World Energy Outlook 2016 issued by IEEJ (The Institute of Energy Economic, Japan) by 2040 and extends straightly from 2030 to 2040 trend of above reference scenario to 2050.

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The policy scenarios are: i. constraint not to build new nuclear power plants and keep to 40-year strictly in each country, and ii. phase out coal-fired power by 2050 from 2030 (use remains constant from 2017-2030) in each country. The policies analyzed will be: Scenario 1–baseline; Scenario 2–baseline + i; Scenario 3–baseline + ii; and Scenario 4–baseline +i+ii. As well as presenting the key findings and comparing the results from the scenarios, this paper will explain the main mechanisms through which the results are derived.

The economic impacts of following these scenarios will be presented as well. The outcomes will include impacts on:

- GDP growth, employment;
- Sectoral output, trade and competitiveness; and
- GHG emissions.

Each of the four East Asian countries and region will be assessed ~~over a time period~~ up to 2050.

Major findings

In this paper, we conducted simulations through 2050 to predict power mixes under the above four policy scenarios and see the effect on the economy and environment in East Asia. Restrictions on nuclear power alone (Scenario 2) have a negative short-term impact on the economy due to higher power costs and a shift to coal-fired power. In addition, carbon dioxide emissions increase. Under restrictions on coal-fired power alone (Scenario 3), power costs increase and there is a modest burden on the economy, but there is a further shift to renewable energy and liquefied natural gas, so there is a significant decrease in carbon dioxide emissions. Under simultaneous restrictions on nuclear and coal-fired power output (Scenario 4), there is a larger initial burden on the economy than in Scenario 2 and 3, but this turns positive over the medium- and long-term due to reduced capital costs for renewable energy and the impact of investment in renewables, as well as a reduction in fossil-fuel energy imports. Carbon dioxide emissions differ somewhat by country, but large reductions are forecast.

Our research shows that despite severe restrictions on nuclear and coal power, the negative impact on the economy is limited, and it is possible to shift to a sustainable low-carbon power mix. Further, if the restriction on coal-fired power plants is implemented in all four regions simultaneously, the negative effect on the GDP becomes lower in Japan and Korea, who face severe international trade competition with the price of electricity becoming a determinant of comparative competitiveness.

References

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