Economic Analysis on Integrated Gasification Combined Cycle (IGCC) under Two Environmental Fiscal Policies in Korea

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Introduction

Current Issues in Korean Electricity Market
- Increasing risk of electricity shortage due to:
  - High demand
  - The lack of power generation facilities
- Environmental fiscal policy in Korea
  - The world’s second largest Emission Trading Scheme (ETS)
  - Tax on imported coal
  - Persistent dispute between the government and industries closed the emission trading market (current revenue from ETS = 0)

Objective
- Analyse the investment feasibility of IGCC under the current environmental policy in Korea.
- Analyse whether the current environmental fiscal policy provides the optimal tax benefit to the society

Methodology

- Monte Carlo simulation to compare investment returns on the conventional PC, thermal IGCC and lignite IGCC under two fiscal policies:
  - Coal Tax (along with ETS)
  - Carbon Tax
- Compare tax benefits under coal tax and carbon tax

Results

Investment Analysis
- Under the current coal tax scheme
  - The conventional PC yields the highest investment return
  - The lignite IGCC yields the lowest marginal cost (LCOE)

<table>
<thead>
<tr>
<th>Coal Tax</th>
<th>Conventional PC</th>
<th>Thermal IGCC</th>
<th>Lignite IGCC</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pre-Tax NPV</td>
<td>US$ 1,653 million</td>
<td>US$ 1,572 million</td>
<td>US$ 1,700 million</td>
</tr>
<tr>
<td>Post-Tax NPV</td>
<td>US$ 980 million</td>
<td>US$ 920 million</td>
<td>US$ 850 million</td>
</tr>
<tr>
<td>LCOE</td>
<td>US$ 51.60</td>
<td>US$ 52.90</td>
<td>US$ 48.71</td>
</tr>
</tbody>
</table>

- Under the carbon tax scheme
  - The lignite IGCC yields the highest investment return and the lowest marginal cost (LCOE)

<table>
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<th>Carbon Tax</th>
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</tr>
</thead>
<tbody>
<tr>
<td>Pre-Tax NPV</td>
<td>US$ 1,672 million</td>
<td>US$ 1,553 million</td>
<td>US$ 1,680 million</td>
</tr>
<tr>
<td>Post-Tax NPV</td>
<td>US$ 609 million</td>
<td>US$ 572 million</td>
<td>US$ 637 million</td>
</tr>
<tr>
<td>LCOE</td>
<td>US$ 60.20</td>
<td>US$ 65.07</td>
<td>US$ 56.00</td>
</tr>
</tbody>
</table>

Fiscal Policy Analysis
- Social benefits from the carbon tax is greater than the coal tax
- Both ETS and carbon tax decreases the supply curve, but:
  - ETS: perfectly inelastic supply curve → worsens the power shortage problem due to limited emission level
  - Carbon Tax: decrease in supply curve → higher electricity price yet still can produce more electricity

Conclusion
- Under the current fiscal policy (ETS+Coal Tax)
  - IGCC is not an attractive investment opportunity
  - Conventional PC still yields sufficient investment return due to less capital expenditure
    - But, conventional PC → higher greenhouse gas (GHG) emission
- Under the fixed carbon tax scheme
  - Higher tax benefit
  - Government can utilize the increased tax benefit to directly subsidise industries to develop more efficient, low-GHG technologies
  - The government’s direct subsidisation → can reduce burdens of IGCC’s excessive capital expenditure

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