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

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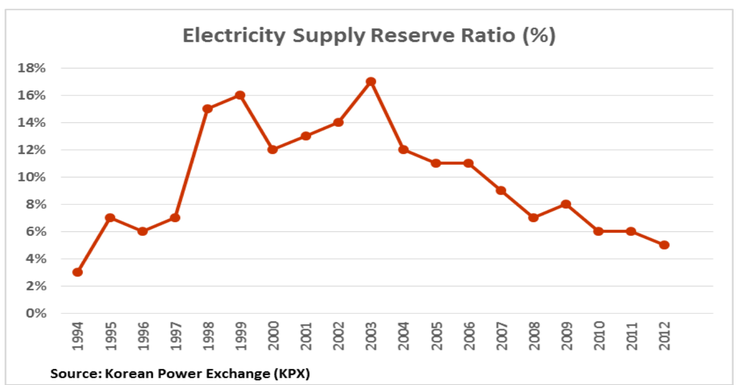
Introduction

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

IGCC

PROS	CONS
Lower Operating Costs (Various Inputs and High efficiency)	**High capital expenditures (CAPEX)** (High CAPEX → low investment return)
Low greenhouse gas emission	**Early stage of commercialisation** (recent commercialisation → high risk)

Methodology

- Monte Carlo simultion 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

Investment Analysis	• NPV • IRR • Levelized Cost of Electricity (LCOE)
Fiscal Policy Analysis	• Coal Tax Benefit • Carbon Tax Benefit

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)

Coal Tax	Conventional PC	Thermal IGCC	Lignite IGCC
Pre-Tax NPV	US$ 1,653 million	US$ 1,572 million	US$ 1,700 million
Post-Tax NPV	US$ 980 million	US$ 920 million	US$ 850 million
LCOE	US$ 51.60	US$ 52.90	US$ 48.71

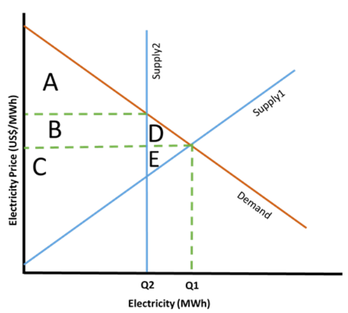
- Under the carbon tax scheme
  - ✓ The lignite IGCC yields the highest investment return and the lowest marginal cost (LCOE)

Carbon Tax	Conventional PC	Thermal IGCC	Lignite IGCC
Pre-Tax NPV	US$ 1,672 million	US$ 1,553 million	US$ 1680 million
Post-Tax NPV	US$ 609 mllion	US$ 572 million	US$ 637 million
LCOE	US$ 60.20	US$ 65.07	US$ 56.00

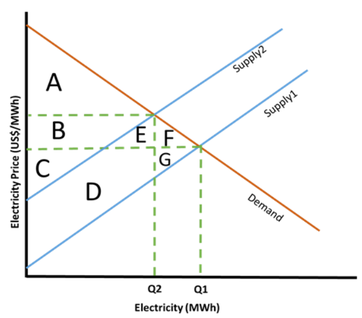
Fiscal Policy Analysis

- Social benefits from the carbon tax is greater than the coal tax

	Conventional PC	Thermal IGCC	Lignite IGCC
Coal Tax Benefits	US$ 258 million	US$ 222 million	US$ 434 million
Carbon Tax Benefits	US$ 740 million	US$ 608 million	US$ 630 million



Supply and Demand under ETS



Supply and Demand under Carbon 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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