The Economic impact of NDC target and the role of electricity sector in Korea

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The Korean government has announced its revised emission reduction roadmap, which set higher efforts of emission reduction domestically until 2030. Considering its high emission portion and linkage with other industries, the role of electricity sector is important in achieving NDC target. In this study, we assess the economy-wide impact of Korea's NDC target using CGE model. By implementing electricity sector detailed model, we also analyze the impact of electricity sector transition policy. Reduction effort of electricity demand side should be accompanied by the supply side transition to meet the NDC target.

Background

① 2030 Emission reduction roadmap

- Korea pledge to reduce 37% (32.5% domestic) of carbon emission from BAU level in 2030
- Korea's electricity sector is carbon intensive, emitting more than 1/3 of national emission
- Electricity sector transition policy will be key enabler to achieve 2030 emission reduction target

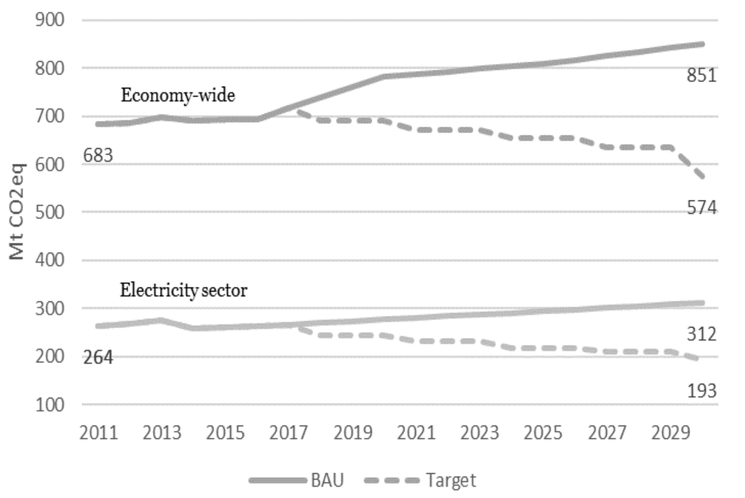

Fig 1. Emission reduction path of Korea's whole economy and electricity sector (Republic of Korea, 2018)

② Electricity sector transition policy (8th BPE)

- Replacing planned coal power with NGCCs
- No new nuclear after 2022
- Increasing renewables to 20% by 2030
- Managing demand side of electricity (2030 BAU: 667TWh, Target: 576.7TWh)

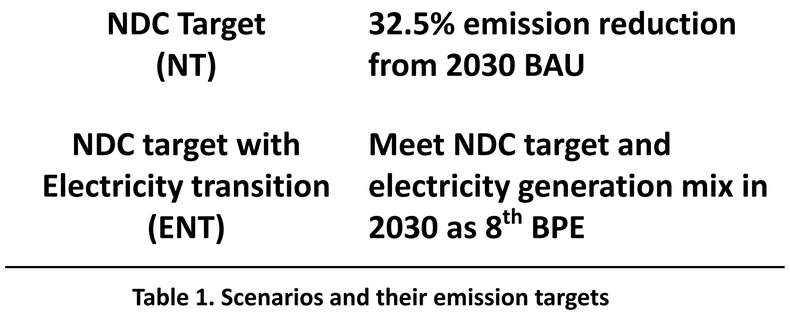

Fig 2. Electricity generation mix change (MOTIE, 2017)

Research Question

- What is the economy-wide impact of meeting 2030 NDC target in Korea?
- What is the role of electricity sector in achieving 2030 emission reduction target?
- What is the implication of pursuing electricity sector transition policy?

Scenario

Scenario	Explanation
BAU	2030 BAU CO_2 emission level announced by government
NDC Target (NT)	32.5% emission reduction from 2030 BAU
NDC target with Electricity transition (ENT)	Meet NDC target and electricity generation mix in 2030 as 8th BPE

Table 1. Scenarios and their emission targets

Model

① Data

- Electricity sector detailed GTAP (Global Trade Analysis Project) POWER DB, which provide 9 power generation technologies
- Emission data only cover CO_2 emission (Non-CO_2 emission is not included)

② Recursive dynamic CGE model

- MPSGE described by Rutherford(1995), GAMS with the MCP Solver
- Single country, Small Open Economy
- 21 Sectors (Industries & Commodities)
- Period : 2011 ~ 2030
- Emission trading without sector specific allocation (only exclude household)
- Major nest structures are referred from Winchester & Reilly (2018)
- Distinguish electricity generation technologies into continuous and intermittent (Kat et al., 2018)
- Continuous generation technologies are less substitutable (σ=0.5)
- Continuous – intermittent electricity are highly substitutable (σ=2)

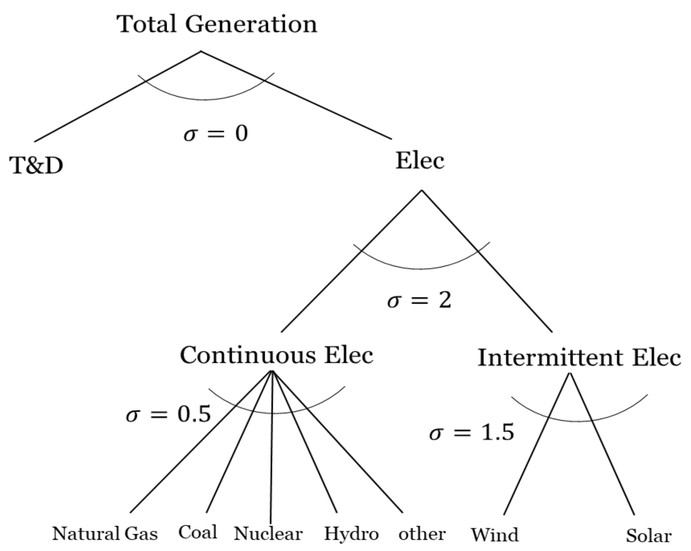

Fig 3. Electricity generation nest structure (Kat et al., 2018)

Result*

*All comparison among scenarios are relative to 2030 BAU level

① Economy-wide impact

- GDP loss was -0.40% for NT and -0.82% for ENT
- Both NT & ENT reduce -33.5% of CO_2 Emission
- The price of emission permit to is \$195/tCO_2 in NT while \$170/tCO2 in ENT
- Carbon intensity (tCO_2/\$1000) decreased from 0.40 in 2030 BAU to 0.27 in both policy scenarios
- Final energy use decrease -9.86% in NT and -9.46% in ENT

② Sectoral impact

- Output decrease in all sectors other than service (low carbon intensity) and equipment (high investment expenditure)
- Transportation, Metal, Textile sectors' output loss were large

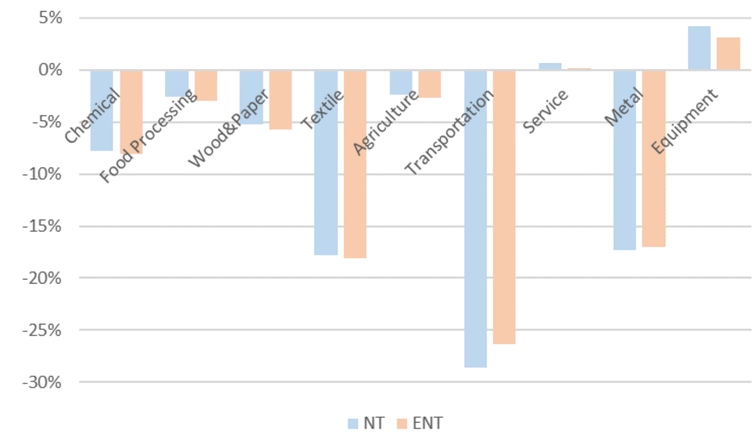

Fig 4. Sectoral output change relative to 2030 BAU level.

- Emission from electricity sector decrease more than half in both NT and ENT
- Even if NT and ENT have different electricity supply mix, their sectoral emission was similar

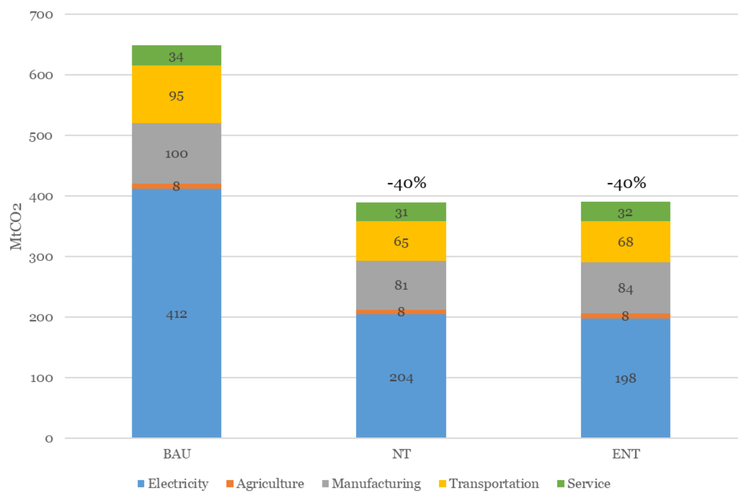

Fig 5. Emission of major sectors in each scenario 2030

③ Electricity sector

- Electricity sector in NT scenario highly depends on the nuclear power (41.7%)
- Electricity price of 2030 BAU was 1.10, NT 2.02, and ENT 2.16 (2011 electricity price is 1)
- Total supply of both policy scenarios were smaller than the target electricity demand in 2030.

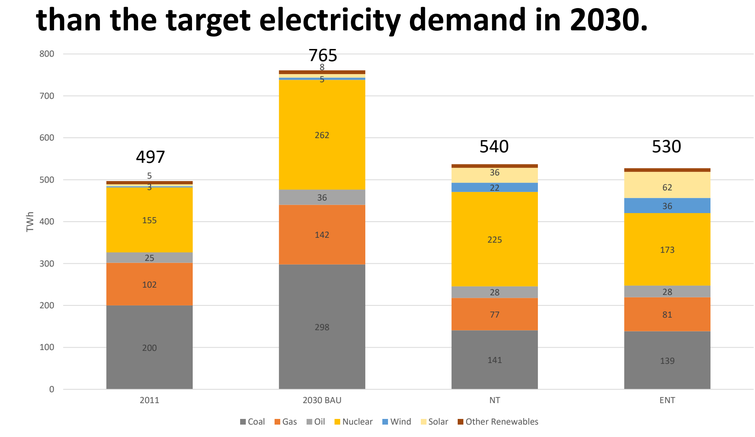

Fig 6. Electricity supply and portfolio

Policy Implications

① Economy wide : Electricity sector transition requires additional cost in achieving NDC target
② Sectoral : NDC incur high production loss in Transportation, and most of the manufacturing sectors
Regardless of electricity sector transition, electricity sector have large responsibility in meeting NDC target
③ Electricity sector : High electricity price and corresponding demand reduction is inevitable to meet NDC target
Meeting NDC target without electricity sector transition will make electricity sector highly dependent on nuclear, which can incur problems in other aspects (i.e. social acceptance, energy security, safety issue)

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