2-1-1 天然ガス生産増加と CO2地中貯留を考慮した
アジア地域の長期エネルギー予測

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Long-term Energy Situation Forecast in Asia-Pacific Region
Considering Natural Gas Production Increase and Geological CO2 Storage
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SYNOPSIS
DNE21 was used for the simulation of long-term energy situation forecast for 2050 in Asia-Pacific region. Six simulation case scenarios were proposed. Simulation results were summarized for BAU, CCS, GAS(Gas advanced scenario) cases in comparison with NIS(Nuclear intensive scenario), NRS(Nuclear restrictive scenario) and ETS(Emission trading scenario) cases.

1. Research Background
Asia-Pacific, the main regional focus for this study comprises of Central Asia, South Asia, Southeast Asia, North Asia and Oceania regions. Fast economic growth and increasing CO2 emission have made the study towards Asia-Pacific important, especially towards energy supply and demand, which is directly related to the emission of CO2.
Recent major important events and scenarios that related to energy given close attention by major international organization are the prospect of more discoverable shale gas reserves in North America and Fukushima-Daiichi nuclear power plant tragedy in Japan. Both events create the uncertain prospect for future energy landscape: a world that would increase it dependence towards natural gas, and intensive or restrictive usage of nuclear energy in electricity generation.
At the same time, the implementation of carbon capture and storage (CCS) technology and emission trading has been seen as the solution to regulate the hiking CO2 emission level in Asia. The main barrier for large-scale CCS project deployment in Asia is the high capital and operational project expenditure, thus cost transfer option via emission trading mechanism could be good option to spark CCS deployment in Asia-Pacific region. By considering all these uncertainties, the study of long-term energy outlook for Asia-Pacific region by implementation of CCS is crucial.

2. Research Objectives
This study aims at studying three main research objectives:

a) To predict and compare the energy supply and demand outlook in Asia-Pacific region with or without implementation of carbon capture and storage (CCS) under current energy landscape (business as usual), and also under advanced gas scenario in comparison with uncertain future energy landscapes and enforcement of emission trading scheme.
b) To investigate the CO2 emission of Asia-Pacific region with or without implementation of carbon capture and storage (CCS).
c) To evaluate CO2 storage potential in Asia-Pacific region

3. Simulation Model
This study utilizes DNE21 (Dynamic New Earth 21), a dynamic non-linear optimization energy model that combines energy system model, climate change model and macro-economic model. In DNE21, CCS system is included in energy supply side of the system.
Original DNE21 model covers the time range up to the end of 21st century, and disaggregates the world into ten main regions. For the purpose of reliability and to meet the objective of this study, the DNE21 has been further reformulated to simulate in the range of 50 years period from 2010 to 2050 and segregate the world to sixteen regions (ten in Asia-Pacific region).

4. Case Scenarios for Simulation
In order to fully understand the energy supply and demand, CO2 emission and CO2 storage potential in Asia-Pacific region, four different energy scenarios have been considered for this analysis:

a) Reference Scenario (BAU and CCS)
   i) Business-as-usual without CO2 geological storage (BAU)
   ii) Business-as-usual with CO2 geological
storage (CCS)
b) Gas Advanced Scenario (GAS)
higher estimates of natural gas and shale
gas reserves, both conventional and unconventional
c) Uncertain Future Nuclear Scenario (NRS
and NIS)
i) Nuclear Intensive Scenario (NIS)
ii) Nuclear Restrictive Scenario (NRS)
d) Emission Trading Scenario (ETS)
- implementation of carbon trading and
emission market by setting up
emission regulation based on latest
UNFCCC data in COP17.

5. Simulation Results
Figure 1 and Figure 2 show the energy
supply balance and CO2 emission for
Asia-Pacific region for all scenarios.

Figure 1: Energy supply balance of
Asia-Pacific region by case comparison

Figure 2: CO2 Emission of Asia-Pacific region
by case comparison

Figure 3 shows the CO2 storage potential as
CO2 reduction contribution in Asia-Pacific
under ETS case.

6. Conclusion
Based on the simulation results, the
following general conclusions could be drawn:
6.1 Energy supply and CO2 emission:
a) Coal is continuously used as the main
energy resources for Asia-Pacific.

b) The implementation of CCS and CGS in
Asia-Pacific countries will increase the fossil
fuel energy supply and fossil fuel based
electricity generation to the region.

c) In GAS case, higher prospect of recoverable
shale gas reserves would increase the natural
gas supply, and also other type of fossil fuel.
Highest CO2 emission level has been observed
in GAS case compared to all cases.

d) In ETS case, the emission trading will allow
carbon to be traded and thus will increase the
variety in energy mix in most Asia-Pacific
countries, and also increase the share of
renewables and other type of cleaner fuel in
long term perspective. CO2 emission level is
expected to be reduced gradually by
implementation of carbon trading.

6.2 CO2 storage capacity
e) In CGS case, CO2 storage potential is
significant in North America, Asia-Pacific and
Russia and East Europe.
f) In GAS case, higher prospect of shale does
not increase the CO2 storage amount but will
spark the CCS deployment to Asia Pacific.
g) Highest CO2 storage potential would be in
ETS case where the cost of CO2 storage has
potential to be compensated by traded carbon
cost.

7. Reference
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