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Assessment of U.S. restrictions on public financing for new coal-fired power plants overseas and proposed regulation

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This document is partially modified and added on the basis of the presentation slide titled ‘Climate policy considering restrictions on public financing for new coal-fired power plants’ by Nagashima, M., Homma, T., Sano, F., Akimoto, K., Oda, J., Wada, K. and Tomoda, T. at the 19th annual meeting of the Society for Environmental Economics and Policy Studies (SEEPS) in Japan on September 13, 2014.

U.S. restrictions on public financing for new coal-fired power plants overseas

- June, 2013

U.S. President Obama presented his Climate Action Plan, and called for an end to U.S. government support of public financing for new coal plants overseas, except for

  - The most efficient coal technology available in the least developed countries with no other economically feasible alternatives
  - Facilities deploying CCS technologies

- October, 2013

The U.S. Department of the Treasury announced the guidance for U.S. positions on Multilateral Development Banks (MDBs) engaging with developing countries on coal-fired power plants. The conditions for financing are as follows;

  - In IBRD and IDA-blend equivalent counties, the plants should deploy CCS to reduce the carbon intensity to a level of 500gCO_2eq./kWh.
  - In IDA-only countries, the plants should employ the best available technology that is practically feasible.

- **Under these conditions, new highly-efficient coal-fired power plants in IBRD and IDA-blend equivalent countries will not be financed.**
- **From the climate control perspective, the MDBs such as World Bank, and some western countries followed the President Obama's policy.**

U.S. regulations on coal-fired power plants

- September, 2013
  - Under President Obama's Climate Action Plan, the EPA issued a new proposal for carbon pollution standard for new power plants which is based on the Clean Air Act.
  - The emission standard is 1,100 lbCO2/MWh (about 500gCO_2/kWh) which requires CCS technologies. (This implies the prohibition of new construction for coal-fired power plants.)

- June, 2014
  - The EPA proposed the Clean Power Plan to cut carbon emissions from existing power plants which is based on the Clean Air Act.
  - It proposes state-specific emission rate-based goals for CO_2 emissions. This would achieve CO_2 emission reductions from the power sector of about 30% in 2030 relative to the 2005 level**.**

In addition to climate policy, there is a weak need to construct new coal-fired power plants as inexpensive gas became available in the U.S.

Problem definitions and research questions

Problem definitions

- Loophole in the restriction on public financing:

  There is a possibility that some developing countries construct inexpensive low- or middle-efficiency coal plants with own fund or financed by other financial institutions.

- It requires time for practical use and deployment of CCS technologies. Why not allow public financing for high-efficiency coal plants to realize stable supply of electricity as well?

Research questions

- How much GHGs emissions and average reduction costs will be

  when a) only new coal plants with CCS are allowed, or b) new highly-efficient coal plants are also allowed ?

- To minimize the loophole, what kinds of financing conditions can be considered?

Objectives and Method

Objectives

- This study explores the impact of the restrictions of new coal plants on 'Environment (emissions)' and 'Economy (reductions costs)'.
- Specifically, we estimate GHG emissions and average reduction costs when
  i) only new coal plants with CCS are allowed, and
  ii) new highly-efficient coal plants (ultra supercritical (USC), advanced USC (A-USC), integrated coal gasification combined cycle (IGCC), integrated coal gasification fuel cell combined cycle (IGFC)) are also allowed.
- Moreover, we estimate GHG emissions and average reduction costs in the case in which loophole appears even though considering the case in which only new coal plants with CCS are allowed.

Method

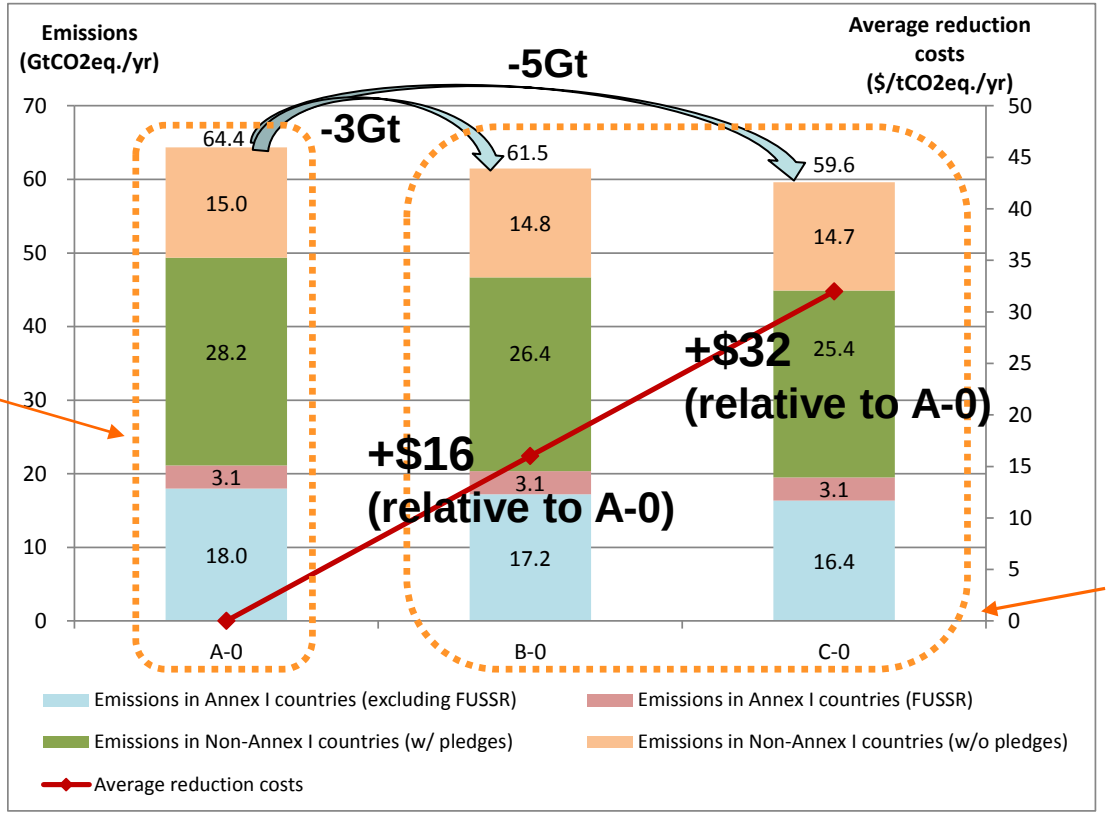
- Energy System Model DNE21+ is used (see Appendix).
  - Time period: 2000 – 2050
  - 54 regions, and about 300 technologies are considered.
  - Especially, the model considers three types of coal plants: i) low efficiency, ii) middle efficiency iii) highly efficiency, and CCS technology
  - Regional-specific payback periods are incorporated.

Scenarios

	Assumption on new construction of coal plants	Cancun pledges or MAC in 2020 Strengthened targets in 2030 are in parentheses		
		Annex I countries	**Non-Annex I countries w/ pledges**	**Non-Annex I countries w/o pledges**
A-0	All types allowed	No additional climate policy: MAC\$0/tCO_2 (MAC\$0/tCO_2)		
A-1	All types allowed	Cancun low pledges jointly achieved: MAC\$39/tCO_2 (MAC\$51/tCO_2)	Cancun pledge (Extension of improvement rate in CO_2 intensity from 2010 to 2020)	\$0/tCO_2 (\$0/tCO_2)
B-0	Only highly-efficient ones and CCS allowed	No additional climate policy: MAC\$0/tCO_2 (MAC\$0/tCO_2)		
B-1	Only highly-efficient ones and CCS allowed	Cancun low pledges jointly achieved: MAC\$39/tCO_2 (MAC\$51/tCO_2)	Cancun pledge (Extension of improvement rate in CO_2 intensity from 2010 to 2020)	\$0/tCO_2 (\$0/tCO_2)
C-0	Only ones with CCS allowed	No additional climate policy: MAC\$0/tCO_2 (MAC\$0/tCO_2)		
C-1	Only ones with CCS allowed	Cancun low pledges jointly achieved: MAC\$39/tCO_2 (MAC\$51/tCO_2)	Cancun pledge (Extension of improvement rate in CO_2 intensity from 2010 to 2020)	\$0/tCO_2 (\$0/tCO_2)

Global GHG emissions and average reduction costs in 2030 (No additional climate policy)

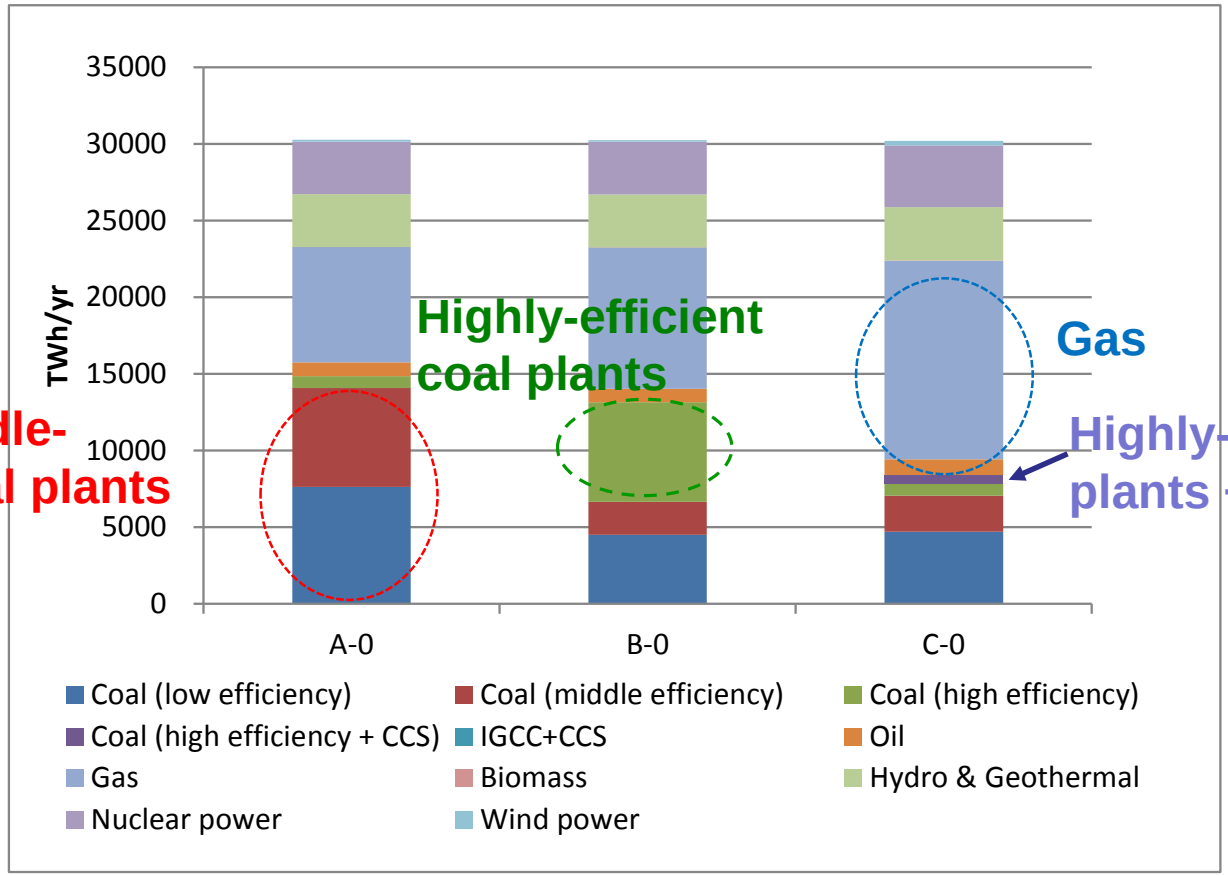
No regulation on new coal plants



With regulation on new coal plants

- **If the regulation on new coal plants functions well (C-0 scenario), the emissions will be reduced by 5Gt relative to A-0 scenario, and its average reduction costs will be +$32.**
- **Even when new highly-efficient coal plants are also allowed, the substantial amount of reductions (3Gt) will be achieved, which is equivalent of 2.3 times of GHG emissions in Japan in 2012. The average reduction costs will be +$16.**
- **In the case of the same amount of regional reductions (global reductions of 3Gt or 5Gt) are achieved without regulation on new coal plants (Optimal solution), average reduction costs will be +$6 and +$22, respectively. This implies that the costs under the regulation will be higher than optimal ones.**

World energy mix in 2030 (No additional climate policy)



Low-and middle-efficiency coal plants

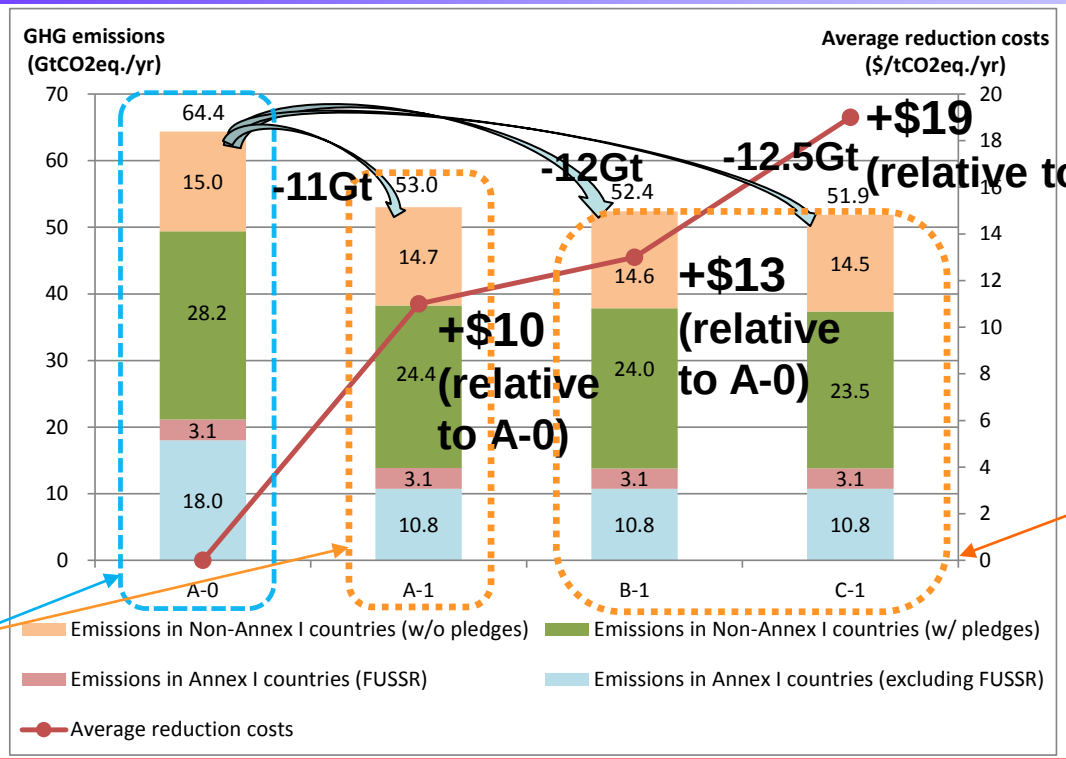
Highly-efficient coal plants

Gas

Highly-efficient coal plants + CCS

- Under the regulation on new coal plants (B-0, C-0), power generations by low- and middle-efficiency coal plants will be halved relative to those under no regulation (A-0).
- Instead, to meet power demand, power generation by highly-efficient coal plants (B-0) and gas plants (C-0) will increase substantially. The power generation by highly-efficient coal plants with CCS is slightly introduced (C-0).

Global GHGs emissions and average reduction costs in 2030 (With Cancun Pledges in 2020 and strengthened targets in 2030)

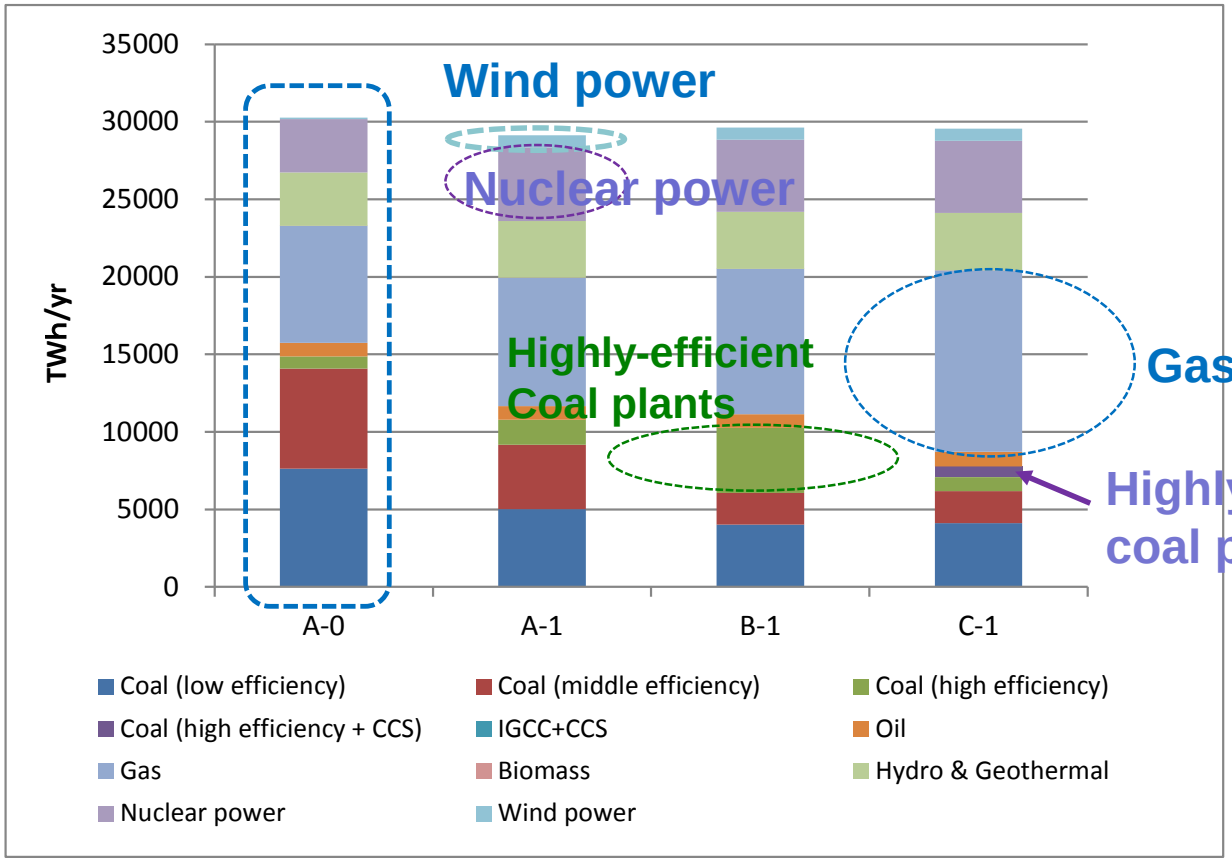


No regulation on coal plants

With regulation on coal plants

- **In this study, regulation on emissions enables more effective reductions than regulation on new coal plants.**
- **If the regulation on new coal plants functions well（C-1）, the reduction will be 12.5Gt relative to A-0 scenario. Average reduction costs will be +$19. Deviation from the costs in A-0 scenario under regulation on emissions will be smaller than that under no additional climate policy.**
- **In the case of the same amount of regional reductions (global reductions of 11Gt-12.5Gt) are achieved without regulation on new coal plants (Optimal solution), average reduction costs will be +$10, and the deviation from the optimal costs will be $3-$9 under regulation on coal plants.**

World energy mix in 2030
(With Cancun Pledges in 2020 and strengthened targets in 2030)



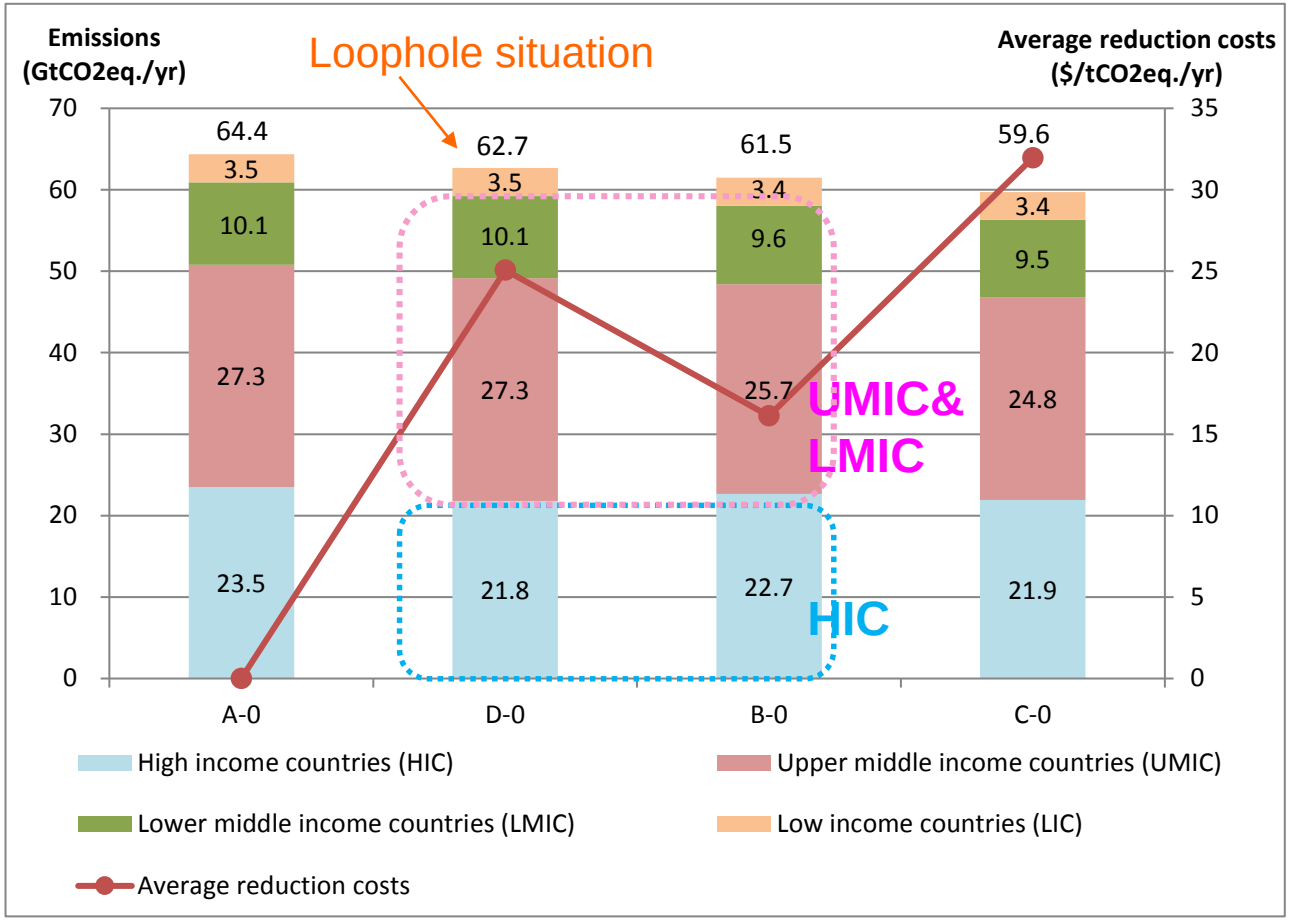
- With reduction targets, power generation by nuclear and wind powers will increase relative to those under no reduction targets (A-0).
- In substitution for low-and middle-efficiency coal plants, power generations by highly-efficient coal plants (B-1) and gas plants (C-1) will increase. Power generation by highly-efficient coal plants with CCS will be slightly introduced (C-1).

Loophole Scenario

- Currently, 1,199 construction of new coal plants have been planned in the world. About 76% of them will be constructed in China and India (Yang and Cui 2012). As these countries can construct the plants with its own fund or financed by other financial institutions, the restrictions on public financing for coal plants will not function if inexpensive low-and middle-efficiency plants are constructed.
- According to Indian government officials, the restriction on financing will not lead to the termination of coal project as support by the World Bank for the project around the world is originally very small. (From interview in 'Down to Earth')
- In July, 2014, the leaders of BRICS countries (India, China, Brazil, South Africa and Russia) signed the agreement of establishment of New Development Bank (BRICS Bank) . Financing for new coal plants in developing countries will increase (Pedersen 2014).
- To express the loophole, we develop the following scenario (D-0 scenario). It shows the situation in which the world is prone to the D-0 scenario in reality, even though C-0 scenario is expected after the restrictions on financing.

Regions	Assumption on new construction of coal-fired power plants
High income countries (HIC)	Only plants with CCS allowed
Upper middle income countries (UMIC) and Lower middle income countries (LMIC)	All types allowed (with own fund or financed by other financial institutions)
Low income countries (LIC)	All types allowed (exemption of financing restrictions for poor countries)

Global GHGs emissions and average reduction costs in 2030 (No additional climate policy)



- **The D-0 scenario represents loophole situation. In D-0, emissions in High income countries (HIC) will decrease, however, those in Upper middle income countries (UMIC) and Lower middle income countries (LMIC) will increase when compared with those in B-0 in which highly-efficient coal plants are allowed.**
- **Allowing new highly-efficient coal plants (B-0) is desirable in the context of GHG emissions and average reduction costs when compared with the loophole situation (D-0).**

Discussions

- When assuming stringent condition of emission reductions by all regions including developing countries, there are low incentives to construct low- and middle-efficiency coal plants. In this case, a certain amount of emission reductions will be achieved even without regulation on new coal plants. ← Small loophole

  Our results show that when Cancun pledges are realized in 2020 and reduction targets are strengthened in 2030, low-and middle-efficiency coal plants will be less likely to be selected even without regulation on new coal plants.

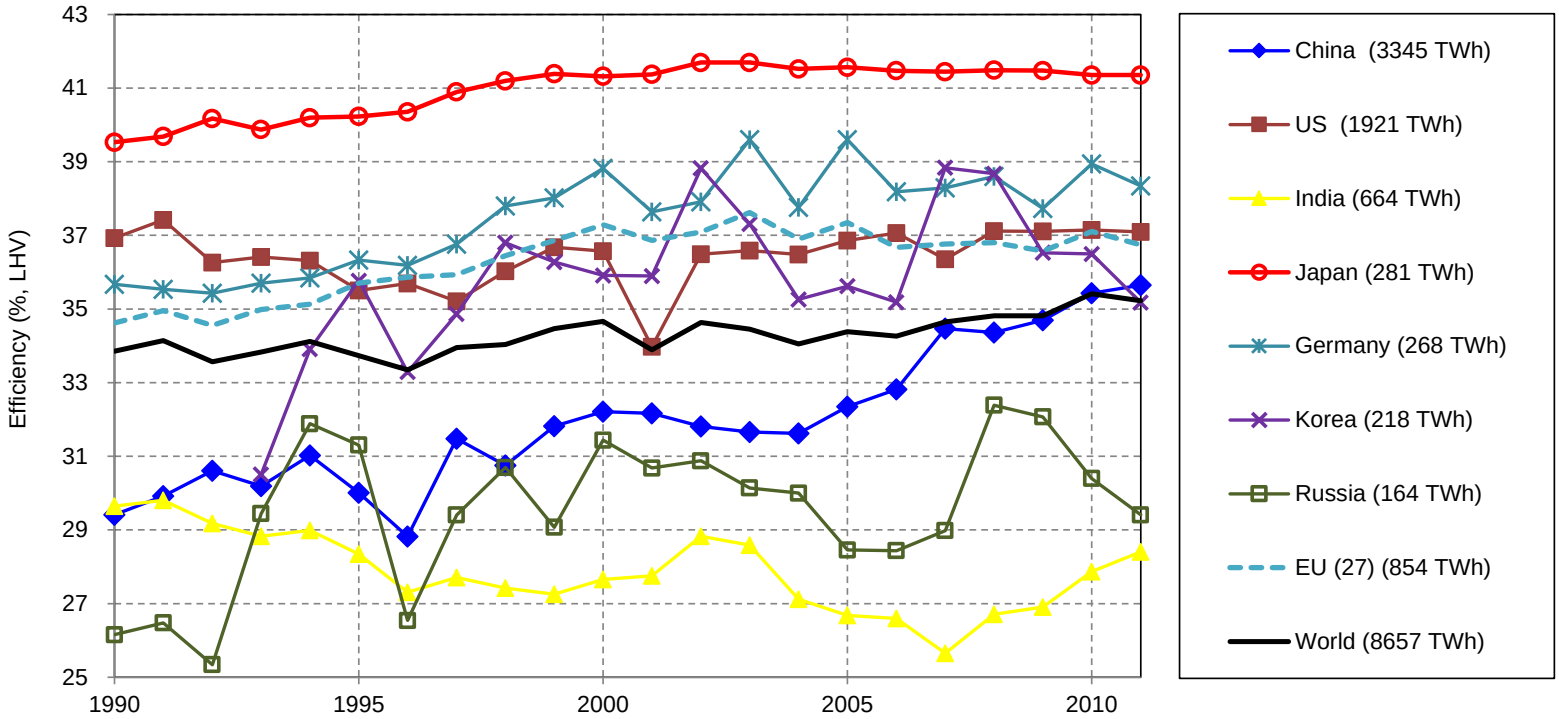
  When only coal plants with CCS are allowed, average reduction costs will be +$19 relative to base case, therefore, the loophole will not be large.

- In reality, however, it is challenging to set stringent reduction targets for all countries. Coal will remain a major source of energy in the future, and if other than coal plants with CCS cannot be financed, low-and middle-efficiency coal plants will continue to be used under loose restriction on emissions. ← Large loophole

  Our results show that when there is no additional climate policy, strict regulation which requires CCS will result in the loophole. If so, minimizing the loophole by allowing new highly-efficient coal plants will be important. Allowing public financing for highly-efficient coal plants will lead to effective reductions and low reduction costs when compared with the loophole situation.

Appendix

Comparison of energy efficiency of coal-fired power plants (LHV, gross thermal efficiency)



Source：RITE (2014) http://www.rite.or.jp/Japanese/labo/sysken/about-global-warming/ouyou/energyefficiency.html; Oda et al. (2012). Numbers in parentheses represent average power generation by coal plants from 2009 to 2011.

- **Regional differences are driven by differences in such as steam conditions, fuel types used, and operation & maintenance.**
- **Not only in developing countries but also in some developed countries (Russia and Australia etc.), low- and middle-efficient coal plants are used.**

There are large potentials of improvement in energy efficiency through transfer of highly-efficient coal technologies.

Global Energy and CO_2 Assessment Model DNE21+ (Dynamic New Earth 21+)

- The model can make a cost assessment of global energy system and CO_2 reduction technologies.
- Linear programming model (minimizing world energy system cost)
- Evaluation time period: 2000-2050
- World divided into 54 regions: U.S. and China are further divided, and the world is divided into 77 regional categories.
- Interregional trade: coal, crude oil, natural gas, electricity, ethanol, hydrogen, CO_2 (CO_2 trade is not allowed in base case), and CO_2 credit
- Bottom-up modeling for technologies in energy supply (power sector etc.) and CCS technologies
- Bottom-up modeling for technologies in demand sides, such as iron & steel, cement, paper & pulp, chemicals, aluminum, transport and residential & commercial sectors
- 300 specific technologies are modeled.
- Top-down modeling for other sectors (energy saving impacts are assessed with long-term price elasticity)

- **We provided many long-term scenario analyses in IPCC AR5.**
- **Analyses and assessments with this model are utilized in many policy review processes by the Japanese government (such as in the mid-term target committee and new low carbon technology plan).**

【Example of the peer-reviewed papers】

- K. Akimoto et al., Assessment of the emission reduction target of halving CO_2 emissions by 2050: macro-factors analysis and model analysis under newly developed socio-economic scenarios, Energy Strategy Reviews, 2, 3-4 (2014);
- F. Sano et al., Assessment of GHG emission reduction scenarios of different levels and different short-term pledges through macro and sectoral decomposition analyses, Technological Forecasting & Social Change (2014)