

ASSESSMENT OF THE ECONOMIC AND ENVIRONMENTAL IMPACTS FOR KOREAN GREEN GROWTH POLICIES

Won-Sik Hwang

Inha Oh

Jeong-Dong Lee

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Introduction



□ Research motivation

- Korean government established the greenhouse gas (GHG) reduction target by sector and by industrial classification up to 2020
- Comprehensive analysis on the recent Korean government's mid-term target, released in 2011, has not been carried out yet.

□ Research purposes

- One is to evaluate the economic responses quantitatively when government's GHGs emission targets are achieved. Reduction of GHGs emissions needs the abatement costs.
- The other is to verify the impacts by GHGs abatement measures. Korean government selected major green technologies to meet the mid-term target and at the same time, determined detailed plans to increase R&D investments for these technologies.

Korea's green growth polices

Greenhouse gas reduction target

Large classification	Small classification	2007 emissions	2020 BAU	Reduction target	
				quantity	rate (%)
	Refined petroleum products	12.8	17.1	1.28	(7.5)
	Mining	1.0	0.68	0.027	(3.9)
	Iron and Steel	86.0	121.35	7.88	(6.5)
	Cement	42.2	41.48	3.53	(8.5)
	Petrochemistry	50.7	63.47	4.77	(7.5)
	Paper and wood products	8.7	7.73	0.55	(7.1)
	Textiles and leather products	11.9	9.81	0.61	(6.3)
	Non-metallic minerals	4.5	5.50	0.22	(4.0)
	Non-ferrous metals	5.4	5.02	0.21	(4.1)
	Machinery equipment	10.2	13.10	0.99	(7.6)
	Electron equipment	9.7	12.09	0.96	(7.9)
Industry	(Energy) (Non-energy)	18.0	29.25	24.55	(83.9)
	Electronic display equipment	6.3	71.65	28.32	(39.5)
	Semiconductor	8.4	14.53	4.03	(27.7)
	Motor vehicles	6.7	8.72	0.68	(7.8)
	(Energy) (Non-energy)	2.9	3.62	3.25	(90.0)
	Ship building and repairing	1.8	3.79	0.25	(6.7)
	Other manufactured products	17.6	16.91	0.29	(1.7)
	Food products and beverages	6.8	6.16	0.31	(5.0)
	Construction	2.5	3.22	0.23	(7.1)
	Subtotal	314.1	455.18	82.937	(18.2)
Transport	Transport, private vehicles	87.7	107.25	36.82	(34.3)
	House	70.5	87.44	23.62	(27.0)
Building	Commercial buildings	67.6	91.52	24.44	(26.7)
	Subtotal	138.1	178.96	48.06	(26.9)
Public services and others		16.2	18.85	4.70	(25.0)
Agriculture and fishery		30.0	29.10	1.52	(5.2)
Waste		17.1	13.83	1.71	(12.3)
Six large sector				175.7	(21.6)
Transformation		610	813¹⁾	68.2 ²⁾	
Total				243.9	(30.0)

Korea's green growth polices

□ Renewable energy policies

- In 2008, the Korean government finally determined ***the Third Basic Plan for New and Renewable Energy Development, Utilization and Deployment*** (MKE, 2008)
- While the previous goal on the deployment of renewable energy was to supply 20480GWh, 3.6% of total power generation, by 2030, the current plan extended it to 39517GWh, 7.7% of total power generation.
- After the plan, the government announced ***the Development Strategy for New and Renewable Energy Industry*** (MKE, 2010)

□ Carbon Capture and Storage (CCS)

- Korea established ***the Comprehensive National Plan for CCS Deployment*** (PCGG, 2010) to develop and commercialize the CCS technology by 2020
- According to this plan, the CO₂ emissions to capture and sequesterate would amount to about 3 mmt CO₂ per annum by 2020, and increase to 32 mmt CO₂ per annum by 2030

□ Other green energy technologies

- Korea Institute of Energy Technology Evaluation and Planning (KETEP) selected 15 green-energy technologies for the “Low Carbon, Green Growth” vision and released ***Green Energy Strategy Road Map 2011*** (KETEP, 2011) as research and development (R&D) action plans for the “Low Carbon, Green Growth” vision

Data and model

□ Model

- Standard MIT EPPA model is modified into EPPA-KOREA
- This approach enables us to apply various Korea's features into the model such as economic growth rate, energy mix, population, CO₂ emissions projection, and industrial structure.
- To examine the economic and environmental effects of Korean policies, all the regions are aggregated into two regions: Korea and the rest of the world

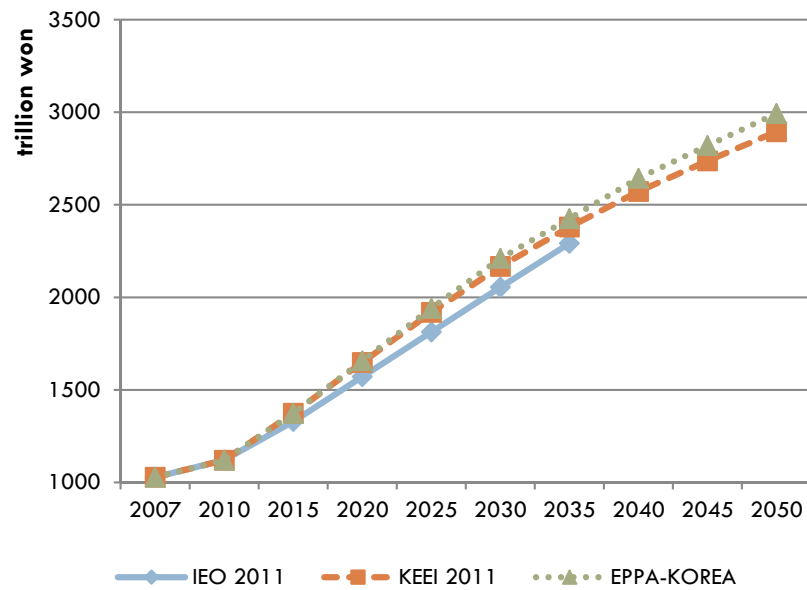
□ Data

- The Global Trade Analysis Project (GTAP) 8 database was used as the main data in this study
- We used the prediction of major variables in national economy from *the Long-Term Energy Prospect 2011* released by Korea Energy Economic Institute (hereafter KEEI 2011)

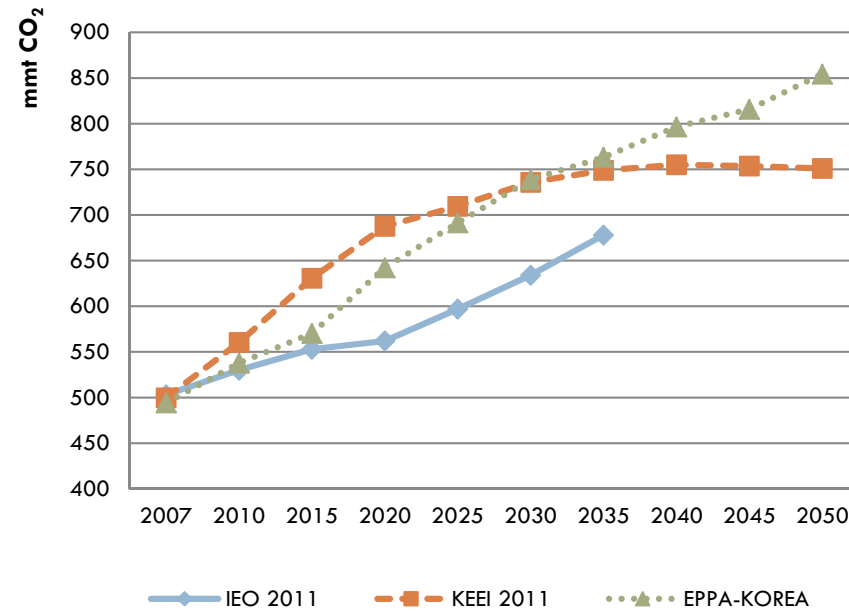
Scenarios

□ Baseline Scenario

- GDP



- CO₂ emissions



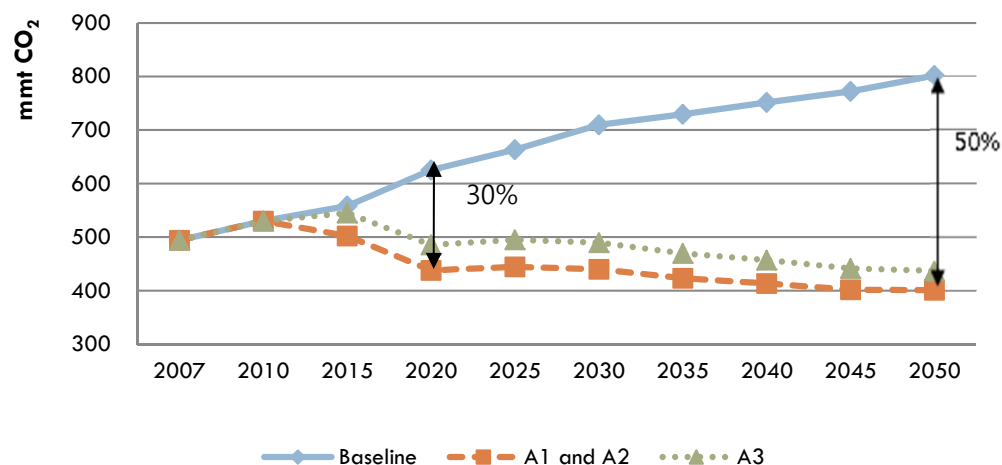
Scenarios

Categories	Scenario number	Scenario description
Baseline		National economy proceeds without government's green growth policies. Some variables like GDP growth rate, international oil price and population are adjusted to follow exogenously projected data.
Scenario A	A1	Total carbon emission cap is imposed as the government's reduction target from 2015
	A2	A1 and the situation that sectoral emission caps are enforced in each sector from 2015
	A3	A1 and the situation that international emissions trading is allowed from 2015
Scenario B	B1	The Korea government enforces RPS on generation companies with three levels from 2015
	B2	The Korea government expands CCS plants based on the national plan from 2020
	B3	Three different green technologies (smart grid, green car and green home) are implemented and increase energy efficiencies in each sector contributing emissions reduction from 2015

Simulation results

Scenario A(A1, A2, A3)

Projection of CO₂ emissions, 2007-2050



GDP loss relative to the baseline scenario (unit: trillion won)

Scenario	2020	2030	2040	2050
A1	29.50 (-1.88)	48.02 (-2.29)	63.42 (-2.53)	73.09 (-2.58)
A2	49.92 (-3.18)	82.36 (-3.93)	107.96 (-4.31)	109.33 (-3.87)
A3	16.99 (-1.08)	32.66 (-1.56)	45.88 (-1.83)	57.05 (-2.01)

Note: Numbers in the blanket mean differences in percentage from the baseline scenario,

Simulation results

□ Scenario B1

- The government goal for RPS ratio as a reference level and two additional cases below and above the level are simulated
- RPS ratios over time in scenario B1 (unit: %)

LEVEL	2015	2020	2025	2030	2035	2040	2045	2050
LOW	2.0	2.5	3.0	3.6	4.0	5.0	6.0	7.0
REF	2.9	4.7	6.3	7.7	8.5	9.2	9.7	10.0
HIGH	4.0	8.0	10.0	11.0	12.0	13.0	14.0	15.0

□ Change of GDP and CO₂ emission in scenario B1

	LEVEL	2015	2020	2025	2030	2035	2040	2045	2050
GDP loss (trillion won)	LOW	1.60	3.89	6.51	9.68	12.46	14.30	20.73	30.56
	REF	(-0.12)	(-0.25)	(-0.35)	(-0.46)	(-0.54)	(-0.57)	(-0.78)	(-1.08)
	HIGH	3.14	9.20	16.95	25.53	32.80	37.42	45.86	57.06
CO ₂ Reduction (mmt CO ₂)	LOW	(-0.24)	(-0.59)	(-0.92)	(-1.22)	(-1.43)	(-1.50)	(-1.72)	(-2.01)
	REF	5.02	16.81	29.39	40.65	50.46	58.16	70.74	89.21
	HIGH	(-0.39)	(-1.07)	(-1.60)	(-1.94)	(-2.20)	(-2.32)	(-2.65)	(-3.15)
CO ₂ Reduction (mmt CO ₂)	LOW	4.91	10.13	16.80	24.55	31.27	46.13	60.80	97.00
	REF	(-0.86)	(-1.58)	(-2.43)	(-3.32)	(-4.10)	(-5.79)	(-7.45)	(-11.35)
	HIGH	8.84	22.75	39.50	57.77	73.27	75.53	102.72	143.36
		(-1.55)	(-3.54)	(-5.71)	(-7.82)	(-9.60)	(-9.48)	(-12.59)	(-16.78)
		13.47	39.69	63.13	84.02	101.87	100.61	147.23	202.79
		(-2.36)	(-6.18)	(-9.13)	(-11.37)	(-13.35)	(-12.63)	(-18.05)	(-23.73)

Simulation results

□ Scenario B2

- Scenario B2 is based on *the Comprehensive National Plan for CCS Deployment (PCGG, 2010)*
- In this study we assume that the government leads the investment for CCS consistently as the plan so that coal or gas power plant with CCS could capture and sequester around 32 mmt CO₂ per annum by 2030

□ Change of GDP and CO₂ emission in scenario B2

		2015	2020	2025	2030	2035	2040	2045	2050
CCS	GDP loss	0.00	1.00	5.82	13.97	20.23	26.13	32.09	40.56
	(trillion won)	(0.00)	(-0.06)	(-0.29)	(-0.62)	(-0.82)	(-0.97)	(-1.12)	(-1.33)
	CO ₂ reduction (mmt CO ₂)	0.00	10.13	48.10	109.32	140.19	177.64	216.92	268.36
	(mmt CO ₂)	(0.00)	(-1.58)	(-6.96)	(-14.80)	(-18.37)	(-22.30)	(-26.59)	(-31.41)
	Annual CO ₂ sequestration	0.00	3.06	14.65	31.61	37.77	45.48	55.24	65.40
	Accumulated sequestration	0.00	7.66	51.93	167.57	341.01	549.14	800.95	1102.56
CCS+ RPS(ref)	GDP loss	3.38	10.78	23.28	39.25	48.87	58.51	67.68	83.14
	(trillion won)	(-0.24)	(-0.64)	(-1.18)	(-1.74)	(-1.98)	(-2.17)	(-2.36)	(-2.73)
	CO ₂ reduction (mmt CO ₂)	8.84	31.96	80.06	142.55	181.72	217.81	252.54	298.51
	(mmt CO ₂)	(-1.55)	(-4.98)	(-11.58)	(-19.29)	(-23.81)	(-27.34)	(-30.95)	(-34.94)
	Annual CO ₂ sequestration	0.00	2.90	12.63	27.94	33.01	37.88	43.56	48.38
	Accumulated sequestration	0.00	7.25	46.06	147.48	299.87	477.09	680.69	910.54

Simulation results

□ Scenario B3

- In scenario B3, we examine green technologies that would improve energy efficiency in three sectors: transport, transformation (electricity) and final demand (households) sector
- Energy efficiency improvement in scenario B3 compared to the baseline

Sector	2015	2020	2025	2030
Transport	3%	6%	8%	10%
Electricity	1%	5%	10%	34%
Final Demand	0.8%	2%	4%	12%

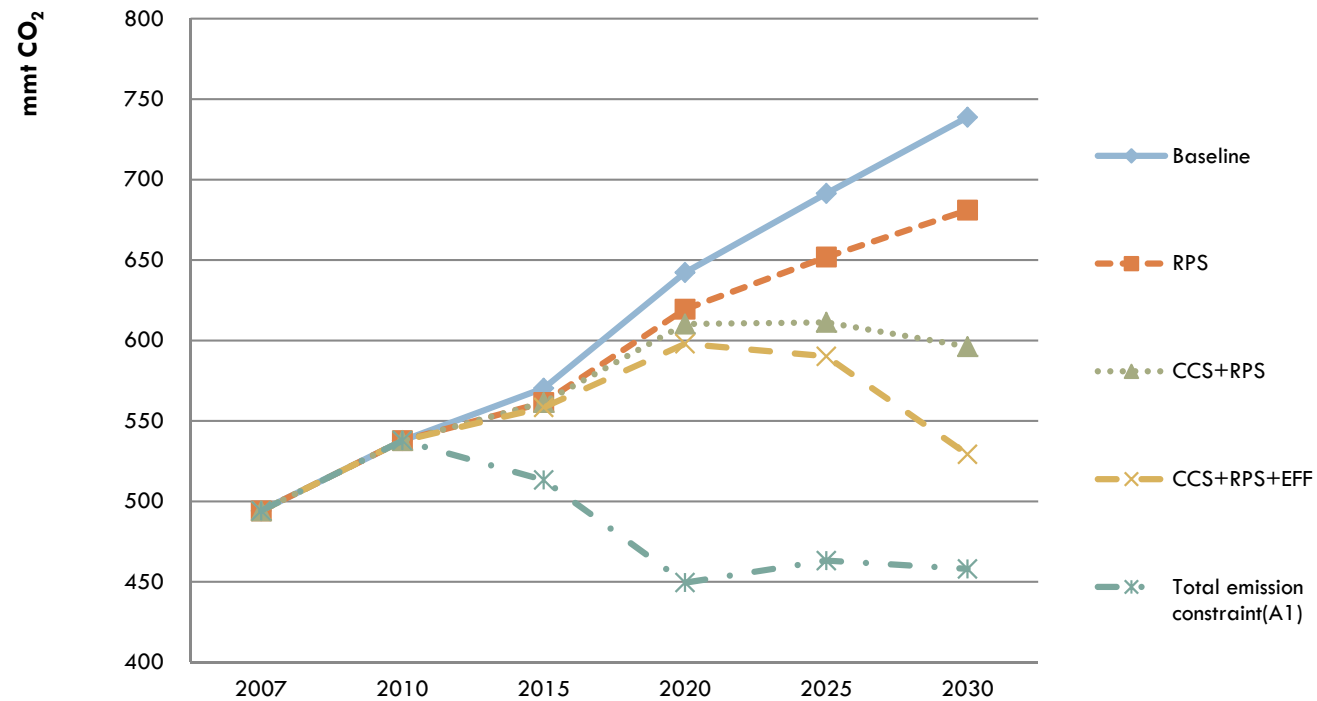
□ Change of CO₂ and GDP due to three green technologies

Technology	CO ₂ reduction (mmt CO ₂)				GDP differences from the baseline scenario (trillion won)			GDP differences under total emissions constraint. (trillion won)		
	Government's plan		Simulation							
	2015	2030	2015	2030	2015	2030	~2030	2015	2030	~2030
Smart Grid	-	44.28	3.05	40.32	0.24	10.29	52.83	0.26	18.08	96.92
Green Car	1.57	14.15	1.49	14.47	1.57	7.05	96.92	1.90	11.86	115.86
Energy-saving building	1.43	10.76	1.51	9.89	0.85	5.02	35.67	1.34	10.10	65.60
EFF ¹⁾	-	-	3.13	68.12	1.95	19.47	137.73	2.38	34.80	237.84

Note: 1) EFF represents simultaneous adoption of above three technologies.

Simulation results

- CO₂ emissions under different compositions of green technologies



Conclusion

□ Conclusion

- The simulation results show that the government's mid-term target could be a big challenge to Korea's national economy
 - In case of no technical change, cumulative economic loss by 2020 amounts to about 102 trillion won owing to total emissions limit and about 179 trillion won owing to emissions constraint by sector
 - From the results, we can know that the mid-term target should be moderated and some gradual steps for GHG emissions reduction are needed up to 2050

- On the other hand, if the detailed plans on the low-carbon and energy efficient technologies are achieved successfully as expected, Korea can reach the CO₂ reduction target very closely after 2030
 - Korea is expected to reduce the CO₂ emissions by 6.89% in 2020 and by 28.37% in 2030 relative to BAU due to major green technologies
 - Importantly, economic and environmental benefits from the high energy-efficiency technologies are much larger than investments regardless of compulsory abatement responsibility
 - Consequently, it is obvious that there is an urgent need to develop and implement low carbon-emitting technologies to prepare low-carbon society



Thank you.