Feasibility of reducing greenhouse gas (GHG) emissions in Korea

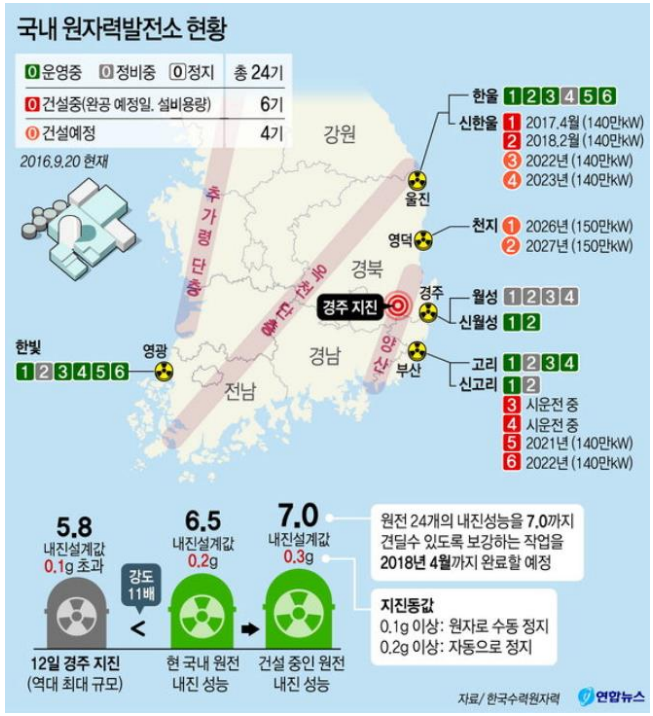
2017.11.28

Chan Park, Tae Yong Jung, Dong Kun Lee

University of Seoul, Yonsei University, Seoul National University

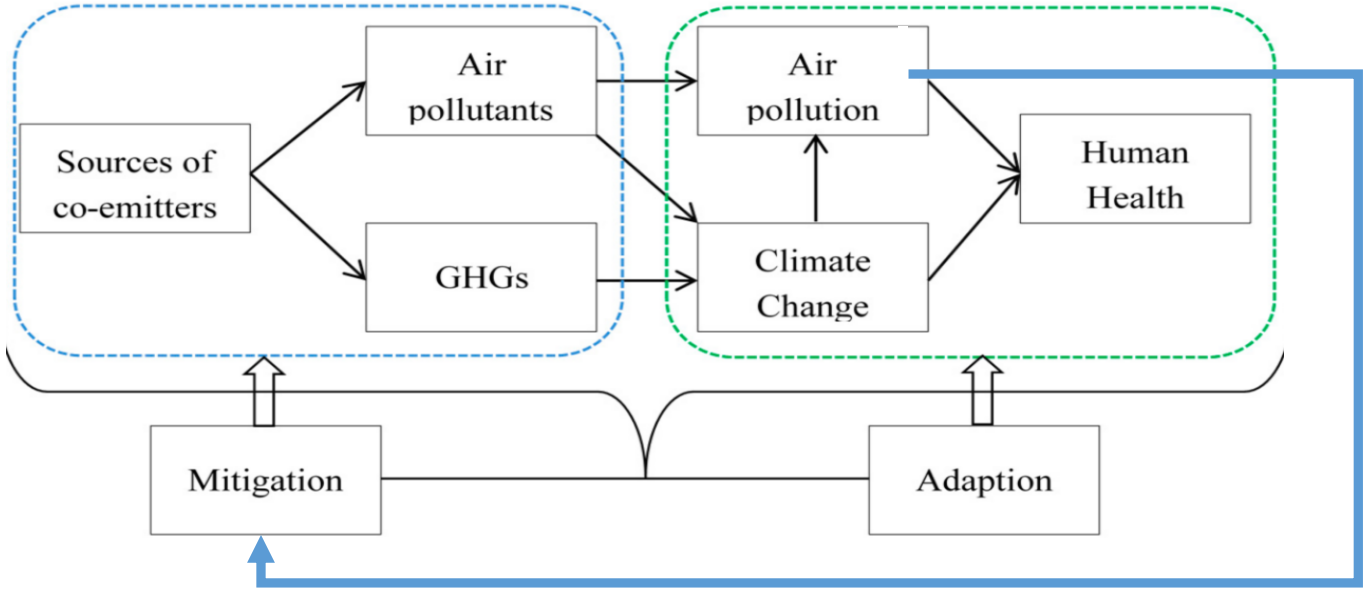
1. Background

- Environmental issue in 2017
  - Tackling South Korea's deteriorating air pollution is an urgent issue for the new administration (Renewable, fade-out of nuclear)
  - Security issue from earthquake



1. Background

- Co-benefits of Reducing GHGs
  - Energy production and use is the most important source of air pollution in Korea
  - Korea's NDC and zero emission as a long term global target will effect on energy use and air-pollutants emission of many sectors in Korea
  - Analyzing emissions of air-pollutants under climate mitigation pledge leads to helps shape air-pollution policy with feedback process



2. Objective

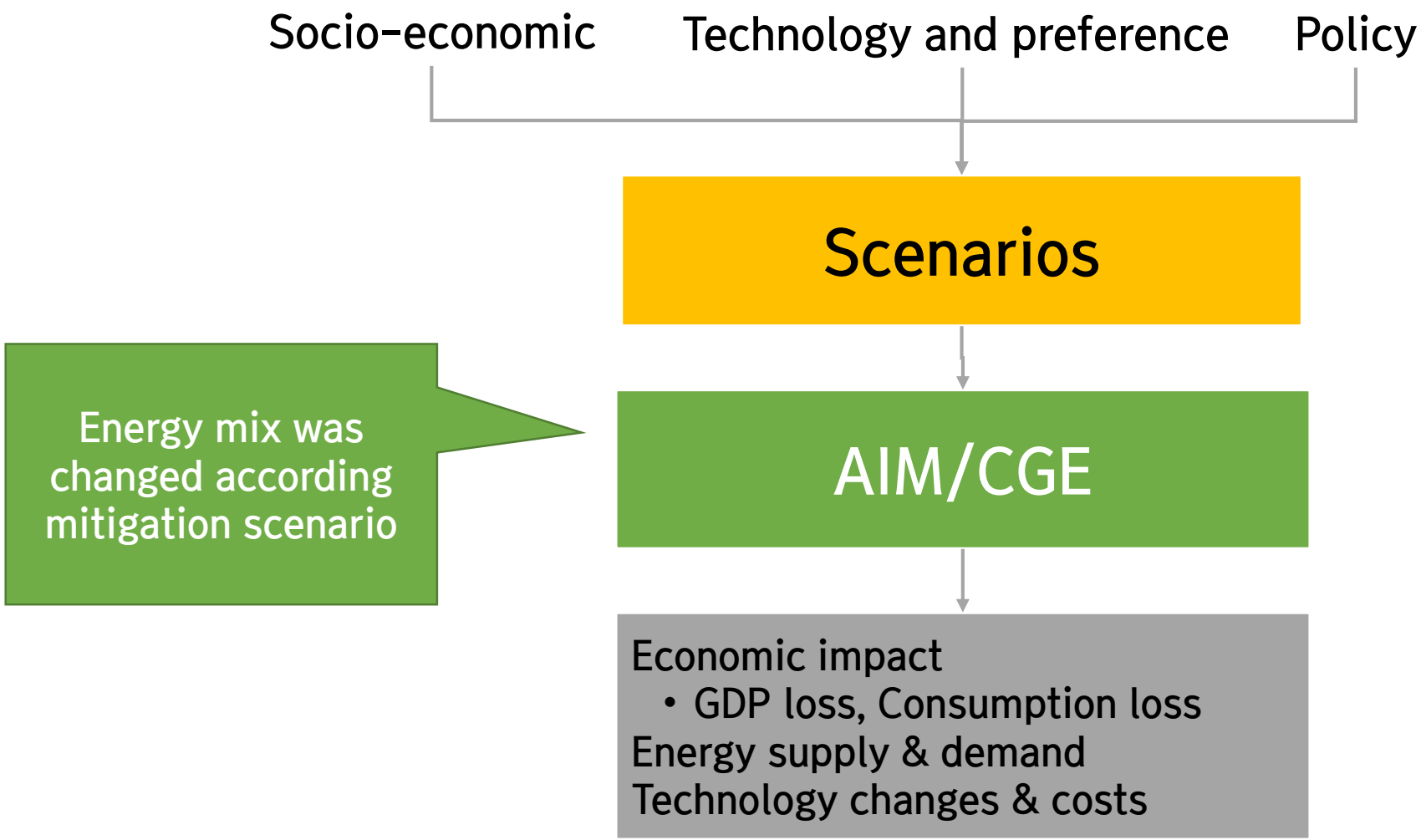
- Feasibility of reducing greenhouse gas under various conditions

  - The feasibility of reducing greenhouse gas (GHG) emissions in Korea to help limit the global temperature increase to 1.5 ˚C above pre-industrial levels, as agreed in Paris (Including sensitivity analysis)
  - Exploring co-benefits of air-pollutant while reducing GHGs
  - Cost and benefit

※ We didn't explore air-pollutant and SLCP emission by air-pollutants reduction measures

3. AIM/CGE

- Structure



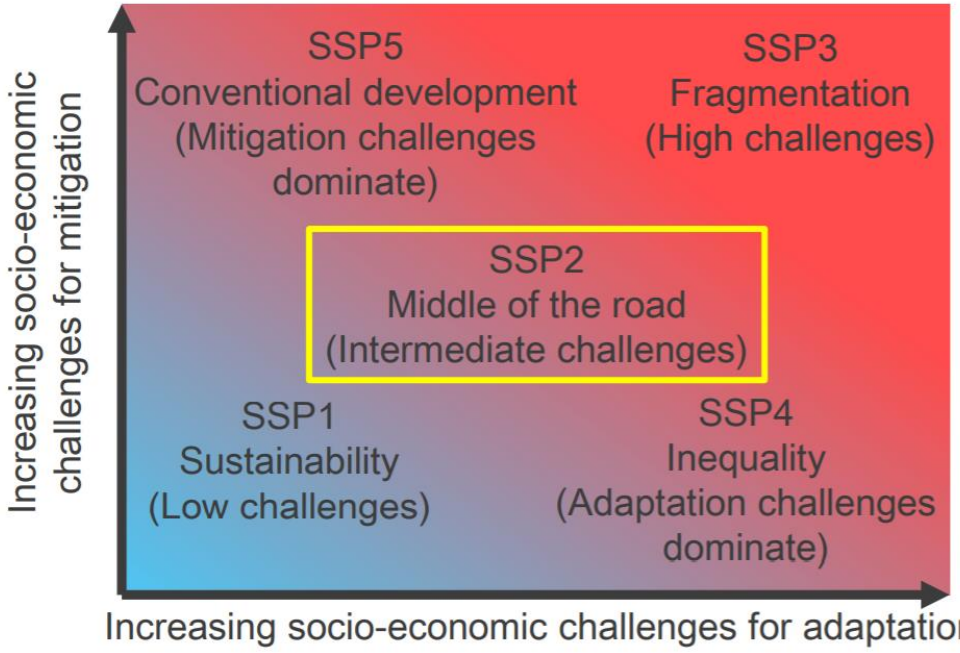
3. AIM/CGE

- Characteristics

Emissions	CO2, CH4, N2O, NH3, SOx, NOx, BC, OC, …
Institution	Household, government, Enterprise
Dynamics	Recursive dynamic (1 year step)
Base year	2005
Base data	Original energy balance and SAM
Program	GAMS / MCP

4. Scenario and Assumptions

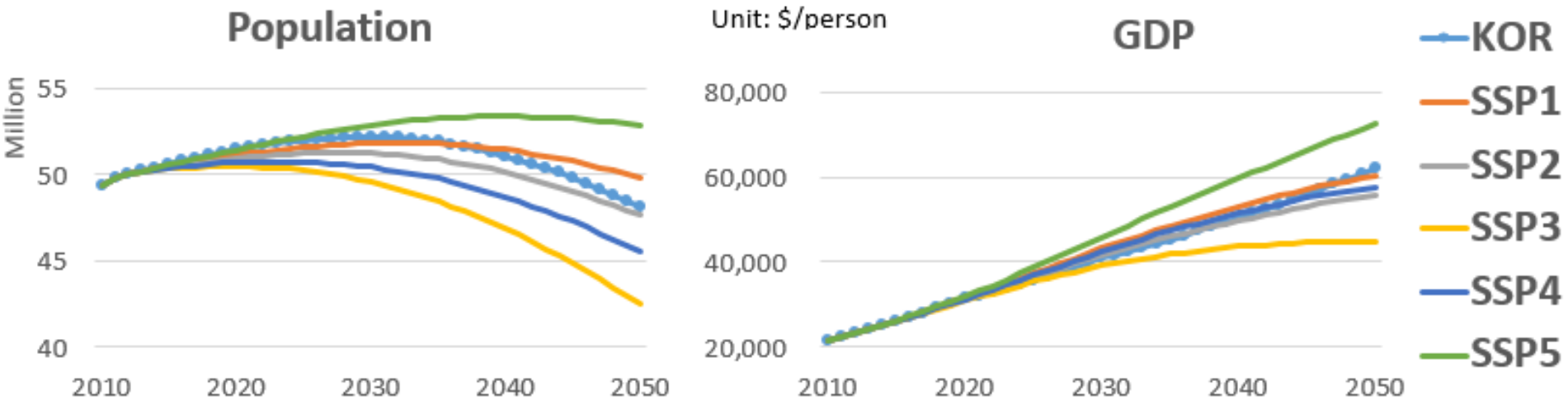
- Basic Assumptions
  - Population data for Korea are projections taken from Statistics Korea to provide basic data for mid-to-long-term national economic and social development plans
  - Future changes of GDP, technology and preference followed SSP “middle of the road”



Source: Brian O’Neill et al. (2012)

4. Scenario and Assumptions

- Basic Assumptions



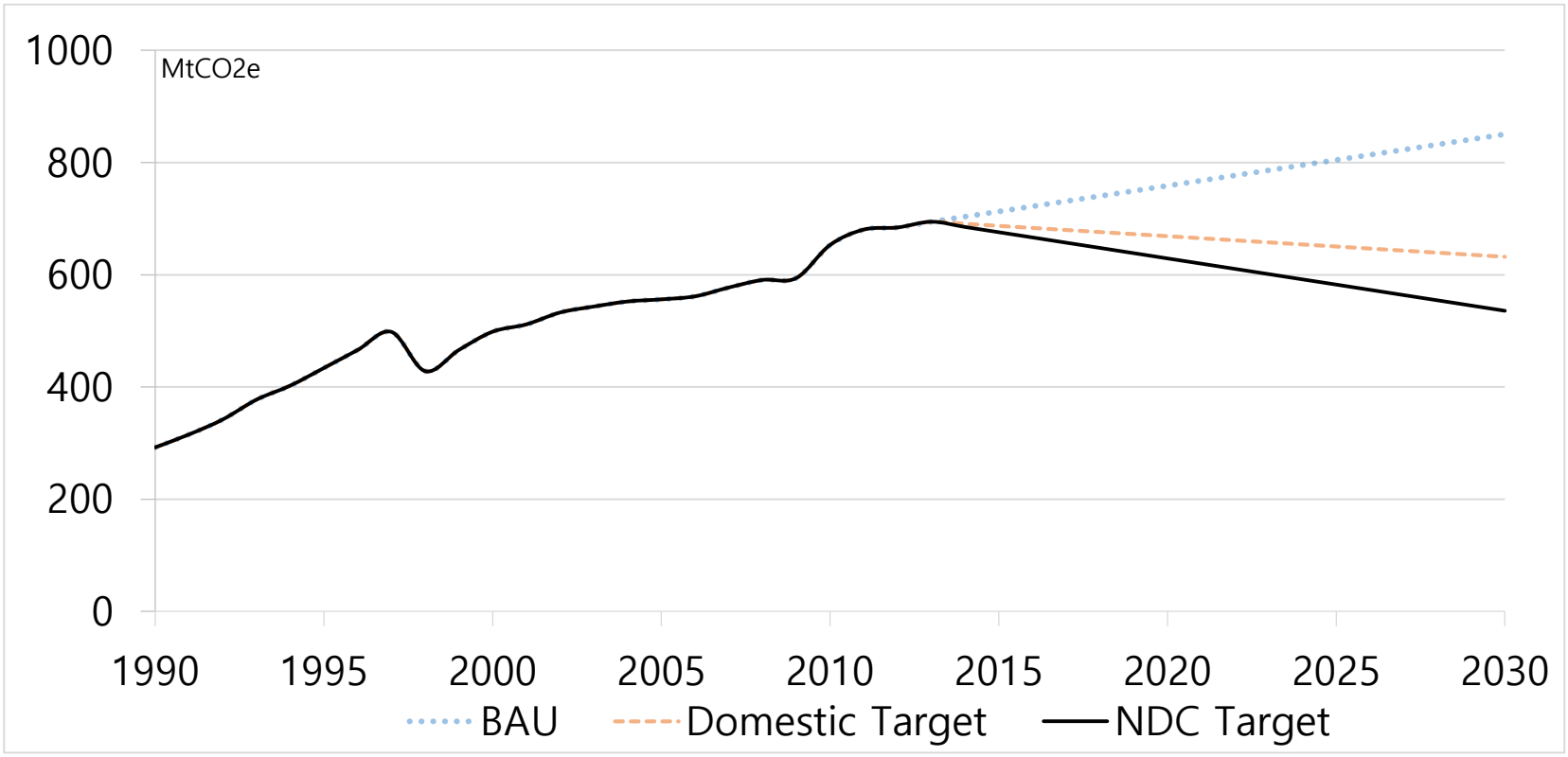
4. Scenario and Assumptions

Korea's NDC mitigation scenarios and related policies

Scenario	Reduction from BAU	Climate Policies
SC 1	14.7 %	● Implementation of cost-effective abatement technologies in industry, power generation, transportation, and buildings sectors
SC 2	19.2%	● Extra financing support for fuel efficiency improvement, energy management system for buildings and factories
SC 3	25.7%	● Additional large-scale financial support for expansion of nuclear power, introduction of CCS and commercialization
SC 4	31.3%	● Further expansion of nuclear, CCS and fuel switching from coal to LNG
International	11.3%	● Additional reduction from International Market Mechanism (IMM)
NDC	SC 3 + International (37.0%)	● Reduction from both domestic and international sources

4. Scenario and Assumptions

- Korea's NDC is an economy-wide target to reduce its greenhouse gas emissions by 37% below business-as-usual (BAU) emissions of 850.6 MtCO2e by 2030



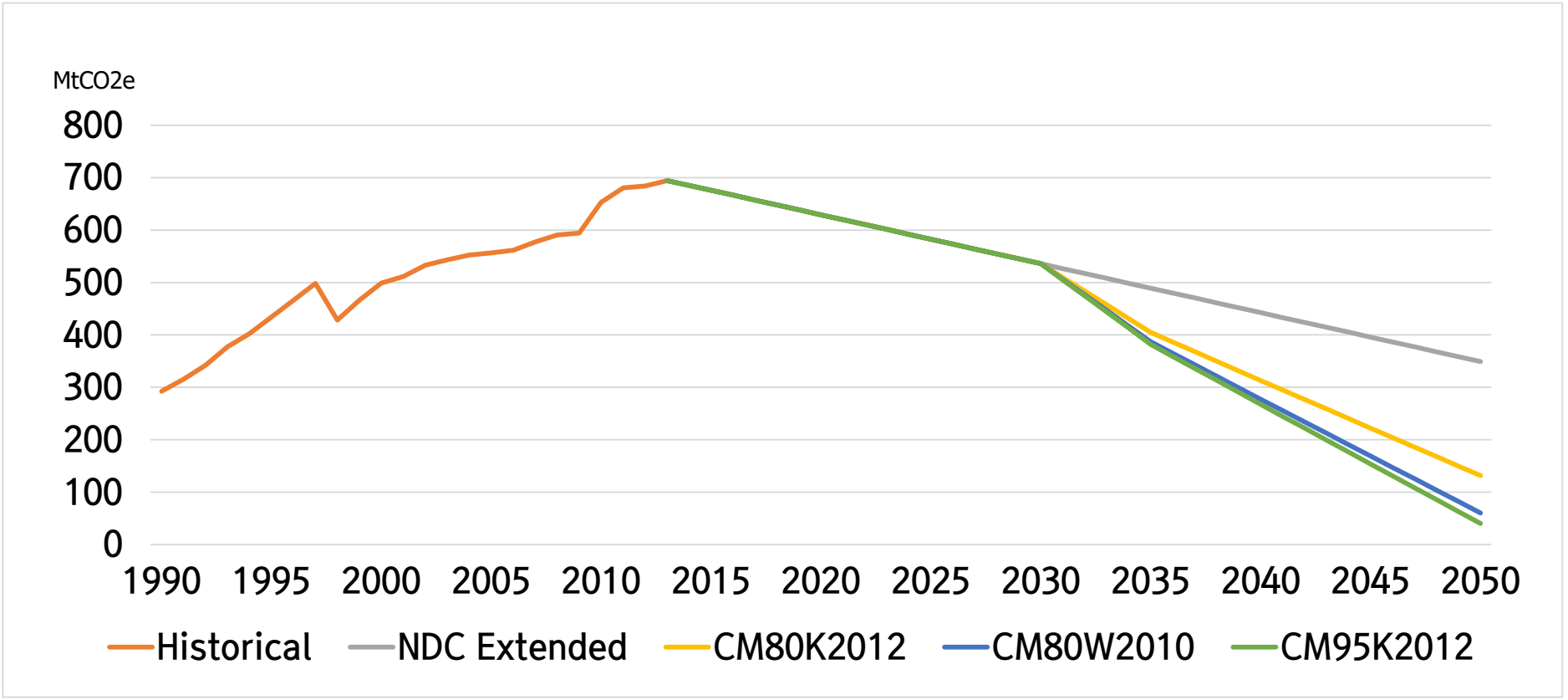
4. Scenario and Assumptions

- Mitigation Scenario

Scenario	Reduction in 2050 (Comparison)	Description
NDC extended	0%	Extension of NDC trend to 2050 (BaU)
CM80K2012	80% (Korea's emission in 2012)	Global GHG emissions in 2050 are 80% below those of 2010 (Allocated by Korea's 2012 emission amount)
CM80W2010	80% (World emission in 2010)	Global GHG emissions in 2050 are 80% below those of 2010 (Allocated by per capita emission cap)
CM95K2012	95% (Korea's emission in 2012)	Global GHG emissions in 2050 are 95% below those of 2012 (Allocated by Korea's 2012 emission amount)

4. Scenario and Assumptions

- GHG emission pathways by scenario

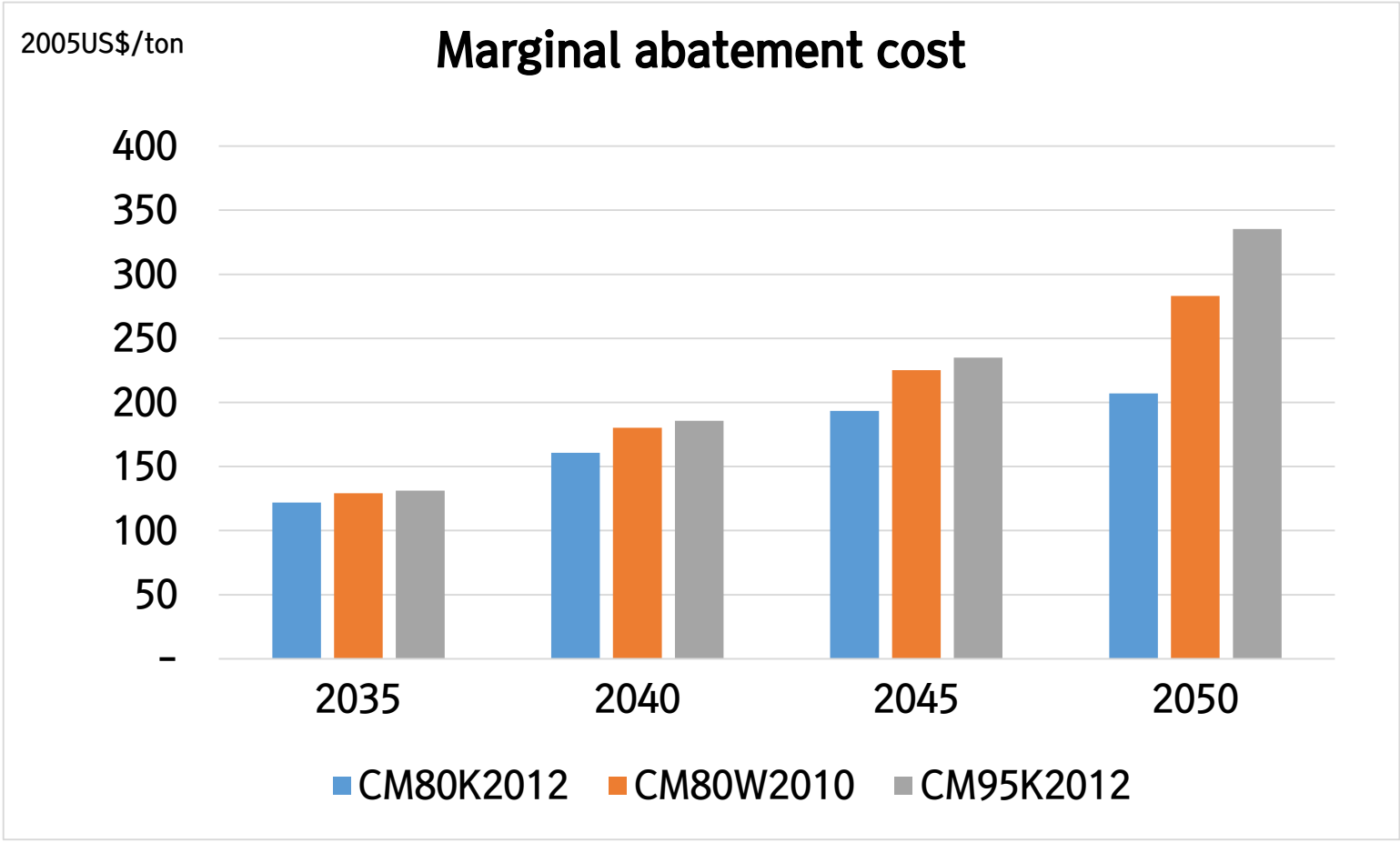


4. Scenario and Assumptions

- Sensitivity analysis
  - Various national mitigation strategy to meet 1.5 target
  - Various SSP assumption (SSP1, SSP2, SSP3)
  - Renewable energy scenario, fade-out of nuclear

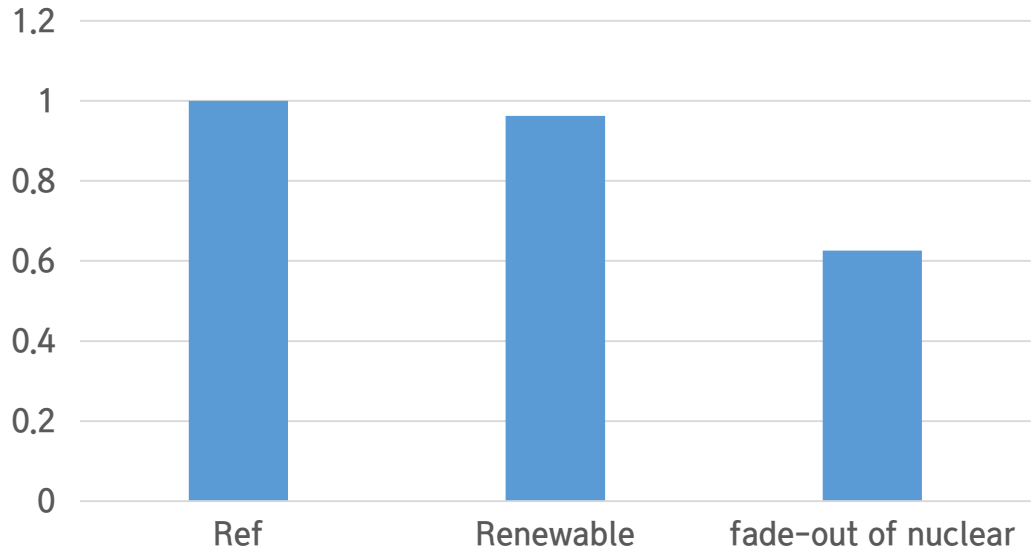
5. Results

- Marginal abatement cost



5. Results

- Ratio of Energy Requirements

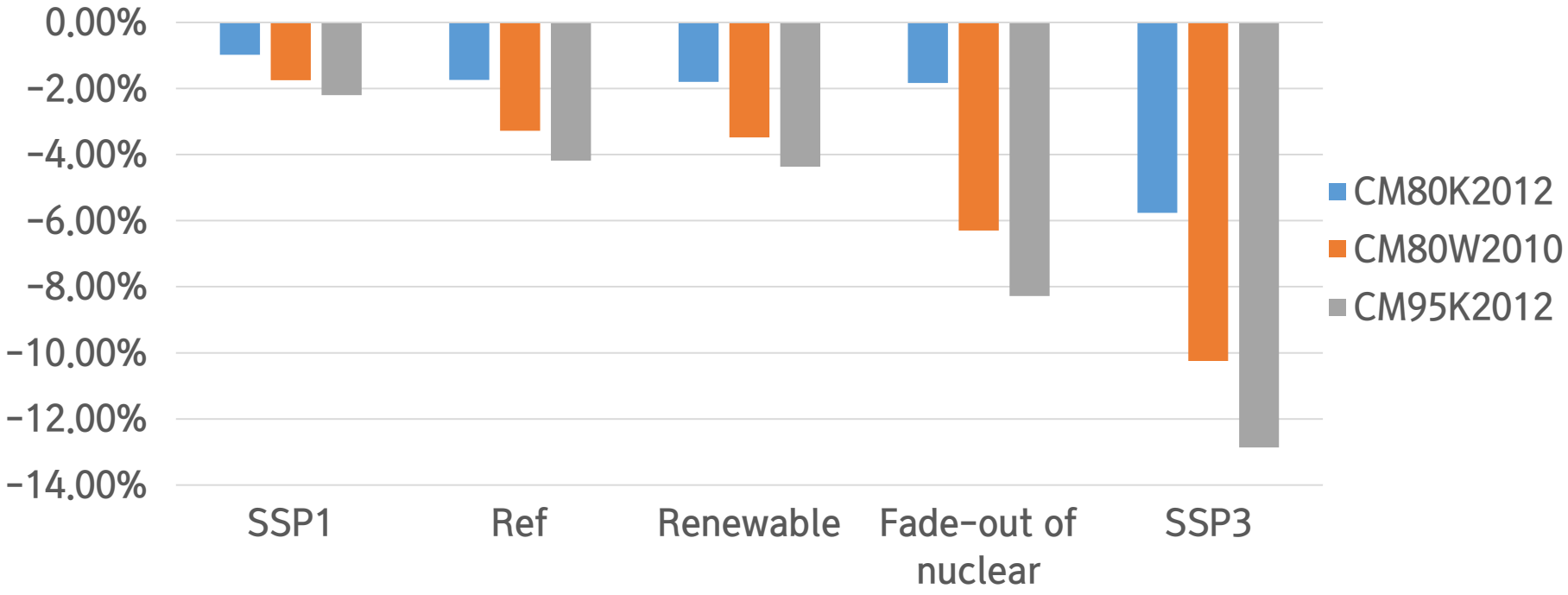


※ Note: Ref is SSP2 NDC extended scenario

5. Results

- GDP loss

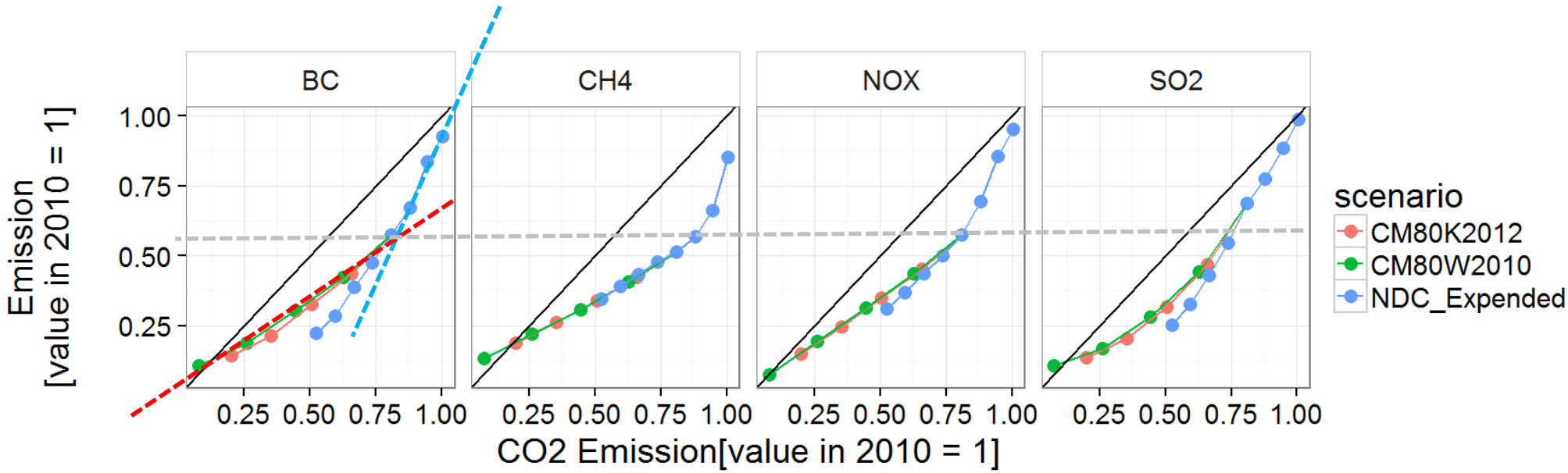
	SSP1	Ref	Renewable	Fade-out of nuclear	SSP3
CM80K2012	-0.98%	-1.74%	-1.80%	-1.83%	-5.76%
CM80W2010	-1.75%	-3.28%	-3.48%	-6.30%	-10.25%
CM95K2012	-2.20%	-4.18%	-4.37%	-8.28%	-12.87%



※ Note: Ref is SSP2 NDC extended scenario

5. Results

- Diagnosis of Air-pollutant and SLCP emission pathway



5. Results

▪ Benefits

Ambient Air Quality Standards for Particulate Matter

PM2.5	24 avg: 25㎍/㎥	WHO
	yearly avg: 10㎍/㎥	
PM2.5	24 avg: 50㎍/㎥	Korea
	yearly avg: 25㎍/㎥	

Value of statistical life VSL, Benefit

Mil$	Low estimate	Mean estimate	High estimate	Note
VSL	1.6	8.9	16.3	EPA 2016
	1.7	4.5	7.9	Korea
Benefit	3,200	17,800	32,600	EPA 2016
	3,400	9,000	15,800	Korea

*Reduce PM2.5 to the WHO standards

6. Discussion

- The cost of GHG emission reductions will be enormous while archiving zero emission near 2060
  - It is critical that we combine climate policy and measures with other key policies, such as air-pollutant reduction measures, technology, industry, energy, and other social policies, from the viewpoint of sustainable development

- Due to low carbon measures, there are large co-benefits of reducing air pollutants and SLCP
  - After achieve NDC extended, slope(effect of climate mitigation on air-pollutions and SLCP reductions) of co-benefits is reduced

Q&A