Integrated Analysis of Energy - Air quality - Climate Change policies in South Korea, Japan, and China







Yeora Chae

Complex problems

POLICY RESPONSE: Air quality Management, adaptation, Mitigation Sea Level Rise Agriculture Human health Ecosystem Water resource **Air Pollution Climate Change** Policy NO_{x.} PM, VOC, SO₂, O₃, CO₂, N₂O, NO_{x.} PM, VOC, SO₂, O₃, CO₂, N₂O, **Technical** SF₆, NH₃, BC, CH, HFCs, PFCs SF₆, NH₃, BC, CH, HFCs, PFCs **Measures** Analysis Land use Change **Fossil fuel combustion** Forestry **Non-Technical** Socioeconomic Change: GDP, population, and etc. **Measures**

SYSTEM RESPONSE

Integrated analysis on Energy, Air Quality and Climate Change policies

 Air Quality and climate change policies will be mutually influenced by the goals and directions of each policies



• Information sharing on best practices are important

Towards multifunctional policies

► Integrated Assessment Model for Synergistic Air quality and Climate change policies



Importance of Co-benefit

- Concept and framework of co-benefit
 - Co-benefit
 - The positive effects that a policy or measure aimed at one objective might have on other objectives, irrespective of the net effect on overall social welfare. (IPCC AR5)
 - AQ-Climate policy of a country shares various social goals with neighboring countries





The results of social optimal mitigation level can be changed with consideration of co-benefits or co-costs ($Q_{PB} \rightarrow Q_{PB+CB}$)

Primary benefits and other co-benefits will be changed



• Marginal cost is same

<Change of optimal policy level and policy mix by estimation of co-benefits>

• Co-benefits of policy combination a is 0

Without constraints, the social optimal mitigation level is Q^{b}_{PB+CB} Policy combination b is better than combination **a**, although we consider Policy goal (Q*).

The Importance of Policy Decision

Determining Policy Directions considering co-benefit effects



PM2.5 and CO2 in NEA



Source: World Development Indicator

Questions for better policy decision



Research Objective

Integrated Analysis on Energy-Air quality-Climate Change policies in South Korea, China, and Japan

- 1. To analyze the Interconnection of Energy, Climate Change and Air Quality policy
- 2. To review current policies
 - Listing climate change, air quality and energy policy in South Korea, China, and Japan
 - energy, economic activity, population, energy use, etc.
- 3. To develop of an Integrated Analysis framework
 - Sharing research idea and methodologies
 - To build collaborative research framework

Current Korea: Air quality, GHG, energy policy status

• The needs...



3rd Energy Basic Plan: Supply safe energy with reducing climate change risk and improving air quality

- Changes From basic plans aim to energy supply and demand To comprehensive plans related to climate and air quality policies
- Efforts to improve consistency with Special Act on Fine Dust, 2020 road map for GHG
- Expanding the air quality management policy centered on the metropolitan area to the national level
- Expansion of emission trading system and strengthening of market function.

Energy Policy Analysis: Korea

- Policy Decision with Co-Benefits
 - Optimizing multi-policy objectives



Sector	Objective		Policy	Reduction e	Total Cost		
5600	Objective		Folicy	PM _{2.5}	CO ₂ eq	(M won/yr)	
Power Generation	PM reduction	Old c	oal plant early retirement(7 plants)	40.7	2,109,323	31,005 (Total cost)	
		Coal plant re-planning	Installation of Environmental protection equipment (7 plants)	335.4	179,243	15,200 (Total cost)	
		scheme	Coal →LNG (2 plants)	46.1	4,728,847	240,815 (Total cost)	
		Environmental	controlling for running coal plant(39 plants)	1,104	2,466,179	1,400,000 (for 9yr)	
	CO ₂ reduction	Photovol	taic Power Generation in city(140MW)	1.01	76,323	140,541 (for 20yr)	
		Photovoltaic	Power Generation in farming area(10GW)	86.25	6,059,397	485,670 (for 20yr)	

Source: Chae et al(2018)

Current Japan: Air quality, GHG, energy policy status

• The needs...



- In the 5th Strategic Energy Plan, it emphasized the "the enhanced 3E+S (Safety, Energy security, Environment, Economic efficiency)"
 - Safety + reform of technology and governance
 - Energy security + technology self-sufficiency rate improvement / diversification of options
 - Environment + decarbonization
 - Economic efficiency + Strengthen competitiveness of domestic industries

Policy Analysis: Japan

• Renewable Energy Targets

- Overall goal: increasing power generated by renewables up to 22-24% by 2030
- "make renewables primary generation source"



Source: Yamazaki, 2018

Reductions in CO2 and PM2.5 from shifting to solar power (2020-2030)



中央层面污染物与温室气体协同控制政策框架

China: Policy Framework for Co-control of Air Pollutants and GHGs at Central Level

立法效力级别 Legislative L evel	发布主体 Issue Unit	名称 Name					
国家法律 National Laws	全国人民代表大会 The National People's Congress of the P. R. China	《中华人民共和国大气污染防治法》(2015修订) <i>Atmospheric Pollution Prevention and Control Law of the People's Republic of China</i> (2015 Revision)					
国务院规范性 文件 Normative do cuments of T he State Cou ncil	国务院 The State Council	《大气污染防治行动计划》(2013) <i>Air Pollution Prevention and Control Action Plan</i> (2013) 《"十三五"控制温室气体排放工作方案》(2016) <i>The 13th Five-Year Work Plan for Control of Greenhouse Gas Emissions</i> (2016) 《打赢蓝天保卫战三年行动计划》(2018) <i>Three-Year Action Plan for Winning the Battle for Blue Sky</i> (2018)					
	环境保护部 Ministry of Environmental Prote ction (MEP)	《工业企业污染治理设施污染物去除协同控制温室气体核算技术指南(试行)》(2017) Technical Guideline of Pollutants Reduction and Relevant Greenhouse Gas Emissions Accounting for Pollution Control Measures of Industrial Enterprises (Trial) (2017)					
部门规范性文 件 Departmental	生态环境部 Ministry of Ecology and Environment (MEE)	《重点行业挥发性有机物综合治理方案》(2019) <i>Comprehensive Control Plan for Volatile Organic Compounds in Key Industries</i> (2019					
Regulatory d ocuments	生态环境部、发展改革委、工业 和信息化部、财政部 MEE, NDRC, Ministry of Industry and Information Technology (MIIT), Ministry of Finance (MOF)	《工业炉窑大气污染综合治理方案》(2019) <i>Comprehensive Control Plan for Air Pollution in industrial Furnaces</i> (2019)					

地方层面污染物与温室气体协同控制政策框架

China: Policy Framework for Co-control of Air Pollutants and GHGs at Local Level

立法效力级别 Legislative Level	发布主体 Issue Unit	名称 Name					
地方性法规 Local Regulations	海南省人大常委会 The Standing Committee of the People's Congress of Hainan Province	《海南省环境保护条例》(2017第二次修正) <i>Environmental Protection Regulation of Hainan Province</i> (2017)					
地方政府规章 Rules of Local Gover nments	德州市人民政府 The People's Government of De zhou City	《德州市大气污染防治管理规定》(2016) <i>Regulation on the Air Pollution Prevention and Control of Dez hou City</i> (2016)					
	北京市人民政府 The People's Government of Bei jing Municipality	《北京市打赢蓝天保卫战三年行动计划》(2018) <i>Three-Year Action Plan for Winning the Battle for Blue Sky of Beijing</i> (2018)					
其他规范性文件	山西省人民政府 The People's Government of Sh anxi Province	《山西省打赢蓝天保卫战三年行动计划》(2018) <i>Three-Year Action Plan for Winning the Battle for Blue Sky of Shanxi Province</i> (2018)					
Other Normative do cuments of Local Go vernments	四川省人民政府 The People's Government of Sichuan Province	《四川省控制温室气体排放工作方案》(2017) Work Plan for Control of Greenhouse Gas Emissions of Sichua n Province (2017)					
	哈尔滨市人民政府 The People's Government of Harbin	《哈尔滨市打赢蓝天保卫战三年行动计划实施方案》(2019) <i>Implementation Programme for the Three-Year Action Plan for</i> <i>Winning the Battle for Blue Sky of Harbin</i> (2018)					

中国协同效应政策发展概述 Review of Policy Developments on Co-benefits in China

大气污染物和温室气体协同控制的概念已 纳入国家法律

The concept of co-control of air polluta nts and GHGs has been incorporated in to national law

出台协同控制核算技术指南,在特定行 业或特定污染物的治理方案中要求开展 协同控制

Technical guidelines of co-benefits ac counting has been published, and co -control has been required in industr y-specific or pollutant-specific control plans



国务院发布的指导文件将污染物与温室气体 协同减排作为指导思想或基本目标 The guidance documents issued by the Sta te Council take co-control of air pollutants and GHGs as the guiding ideology or basic goal

> 地方层面开始探索污染物和温室气体协 同控制政策制定实践 Local levels begin to explore policy-m aking practice for co-control of air pol lutants and GHGs

Research strategy

Current Integrated Assessment Models

	Socioeconomic scenarios				Air Pollutants						GHGs						Health	GHGs	Cost	Optimi	Temporal	Spatial	
	Popula tion	Econ	Land- use	Energy	NO _x	NH₃	РМ	SO ₂	O ₃	BC	VO C	CO2	CH ₄	N ₂ O	HFC s	PFC s	SF ₆	benefits	benefits	Cost	zation	range	range
GAINS	\checkmark		\checkmark	V	V	\checkmark	V	V	\checkmark		\checkmark	\checkmark	\checkmark	V	V	V	V		\checkmark	V	\checkmark	1990- 2020 (every 10 yrs)	39 countries
GAINS -Korea	\checkmark	\checkmark		V	V	\checkmark	V	V			\checkmark	\checkmark	\checkmark	V				\checkmark		V		2010- 2030 (every 5 yrs)	17 cities
MERGE	\checkmark	\checkmark		V			V					\checkmark	\checkmark	V					\checkmark	V	\checkmark	2000- 2200 (every 25 yrs)	OECD, non- OECD
EPPA5			\checkmark	V	\checkmark	\checkmark		\checkmark		V		\checkmark	\checkmark	V	V	V	V					1990- 2100 (every 10 yrs)	World

Conceptual Model(Plan): Structure of decision-making model for integrated management



