



Modeling Issues and Challenges

Facing Korea's Emission Trading System

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I. Overview of the KETS

▷ Launched on January 1, 2015

- Cap = 573 Mt CO₂e in 2015, 2/3 of the country's total emissions
- 23 Sub-sectors in the 5 sectors (525 companies)
- Second largest after the EU ETS
- 1st Nationwide ETS in operation in Asia

II. Challenges and Opportunities ①

▷ A Voluntary Reduction Target, as a Non-Annex 1 Party Country

A Former President, Lee (2010)

- A Pledge at the Copenhagen meeting:
- A national emission reduction target of 30 percent by 2020 under the BAU scenario.

Welcomed by the international society

Not based on national consensus → Weak base

+ Opposition from the business sector & Weak MOE

Make up
for the
weak
base

Strong legal bases

- Defining important steps and timelines by laws

Governance

- PCGG reflecting the president's will
- Multiple governance (MOE+PCGG, MOSF)

II. Challenges and Opportunities ②

▷ Institutional Preparations

- Energy Management System & Target Management System
 - A step-stone to the ETS
 - Provides Energy consumption and Emission data and MRV experiences
- Registry → GIR
- KRX (January 2014) → a single market for permit-trading
- KECO (the Korea Environment Corporation) & KEMCO (the Korea Energy Management Corporation) → MRV

III. Timelines for KETS

Procedures (Lead authority)	Legal Timeline	Nationwide (B2009 =B2013)		ETS		
		BAU 2009	BAU 2013	Total	Sub-sectors	Entity level
				Cap	Designation /Allocation	Designation /Allocation
Pledge at the Copenhagen meeting (2010), <i>President</i>	-	○				
Framework Act (2010), <i>PCGG</i>	-	○				
Emission Trading Act & its Enforcement Decree (2012), <i>PCGG</i>	-	○				
Roadmap (January 2014), <i>Multiple (MOE)</i>	2013		○			
Master Plan (January 2014), <i>MOSF</i>	By Jan 1, 2014		○			
Allocation Plan (September 2014), <i>MOE</i>	By Jul 1, 2014		○	○	○/○	
Allocation Committee (September 2014), <i>MOSF</i>	July 2014		○	○	○/○	
Allocation Approval Committee (November 2014), <i>MOE</i>	Sep., 2014		○	○	○/○	○/○

IV. Cap Setting ①

▷ Challenges

- 1) Korea's GHG reduction target is based on BAU (in 2020 & 2030 BAU is used for INDC) → *Uncertain* [*National Target and Sector Targets & Cap*]
- 2) Sectoral reduction targets exist (considering differences in growth rates and mitigation capacities across sectors) → *Uncertain* [*National Target and Sector Targets but NOT for Cap and Sector Caps*]
- 3) Inclusion of both direct and indirect emissions (sector i 's indirect emission = $E_{i,t} \times CI_{power,t}$) → *Complicated* [*Sector Targets, Cap and Sector Caps but NOT for National Target*] * *Elc and CI are predicted using EI and the Nation's Energy Plan*

IV. Cap Setting ②

▷ BAU in 2020 (BAU_{2020}^*)

- In 2009, predicted values for macro variables (i.e., GDP growth rates, population size), energy-related consumption behavior, nation-wide energy consumption levels* and IPCC emission factors by fuels were used. ~ seems to be “*Bottom-up*”
 - * estimated by a nation-wide Energy consumption model
- Quality of BAU in 2020?
 - * Questionable: Due to data quality and generic uncertainty factors computing BAU estimates
- Re-estimated in 2013
 - * Little difference but still questionable

IV. Cap Setting ③

▷ KETS Cap

- Nation-wide
 - (Estimated) BAUs: BAU_{2020}° , BAU_{2015}°
 - (Computed) Target Emissions in 2020: $E_{2020}^{\circ} = (1 - \Delta) \times BAU_{2020}$, where $\Delta = 0.3$
 - (Computed) Annual Reduction rate: $\delta = \sqrt{(2020 - 2015) \frac{BAU_{2015}^{\circ}}{BAU_{2020}^{\circ}}} - 1$ & adjustment
 - (Computed) Target Emissions in year t : $E_t^* = (1 - \delta)^{t-2015} \times BAU_{2015}^{\circ}$
 - (Observed) Historical Base-year (2011-13) Emissions: $E_{2011 \sim 13}$
 - (Observed) Historical Base-year (2011-13) Emissions of a Sector j : $E_{2011 \sim 13}^J$

IV. Cap Setting ④

- KETS Cap

- (Observed) Historical Base-year Emissions of All Entities covered by KETS: $E_{2011 \sim 13}^{KETS}$
- (Computed) Proportion of KETS Emissions: $r = E_{2011 \sim 13}^{KETS} / E_{2011 \sim 13}$
- (Computed) Entire Cap for year t : $Cap_t = r \times E_t^* = r \times (1 - \delta)^{t-2015} \times BAU_{2015}^\circ$

Due to claims from the business society $\rightarrow Cap_t \cong r \times (1 - 0.9\delta)^{t-2015} \times BAU_{2015}^\circ$

- (Computed) Sector J 's Cap for year t : $Cap_t^J = Cap_t \times \frac{E_{2011 \sim 2013}^J}{E_{2011 \sim 13}^{KETS}}$

➔ Different from the Original Plan in 2011

1) Consider different growth rate across sectors

2) Consider different mitigation potentials across sectors

➔ **Gains**: Reduce the level of uncertainty, **Losses**: Cannot reflect different conditions

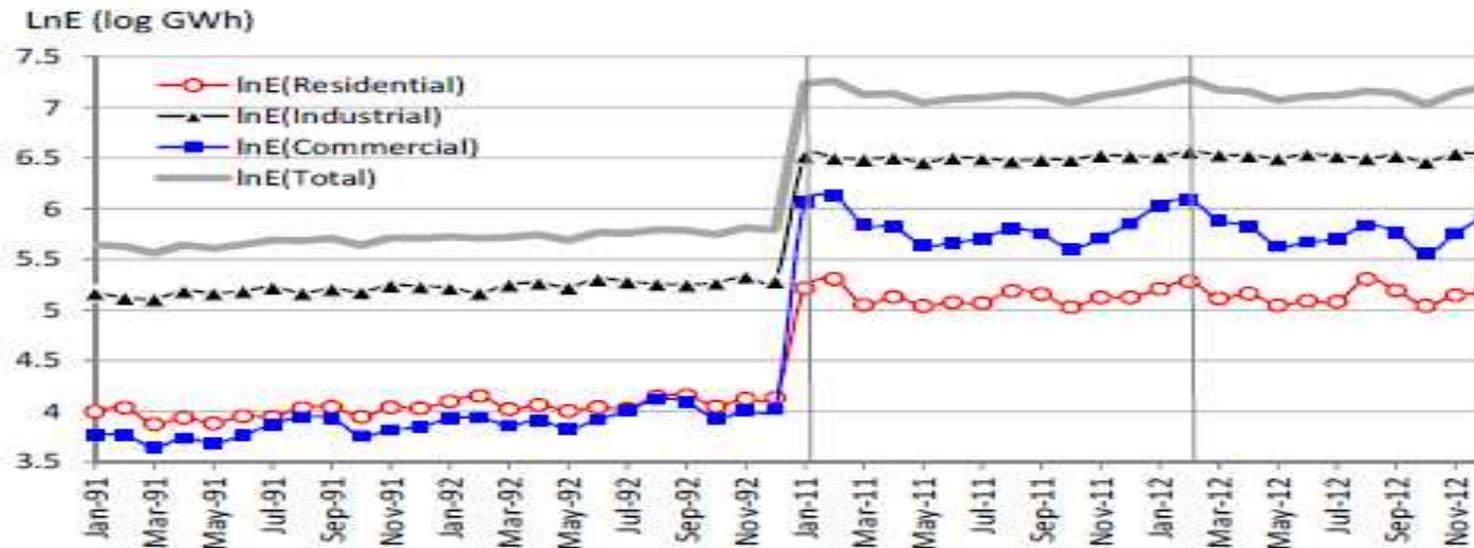
IV. Cap Setting ⑤

▷ Inclusion of Indirect Emissions

● Rational

- Electricity consumption for 2 periods (1991-92 and 2011-12)

→ The industrial sector's share is still the largest.



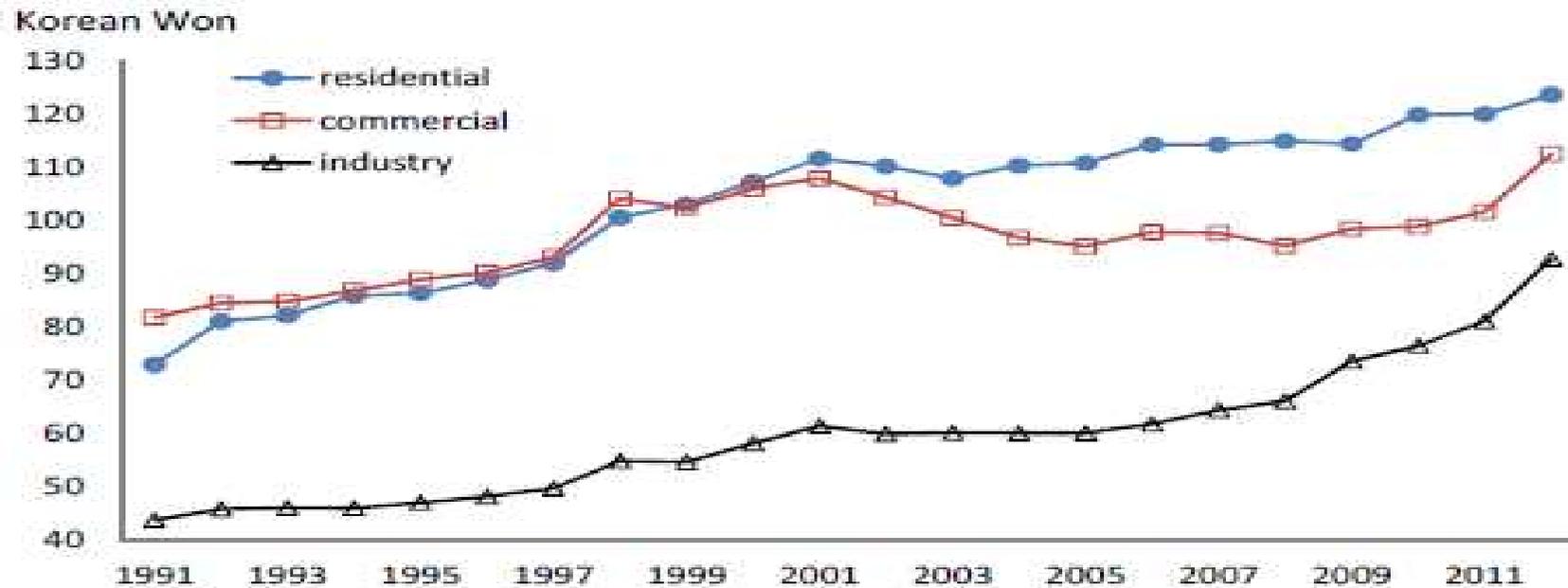
Source: Kim, Choi and Oh (2016)

IV. Cap Setting ⑥

- Electricity price in Korea (Residential price \cong Costs).

→ Provide end-users (covered entities) incentives to reduce electricity consumption.

< Electricity Prices: Nominal Values (L) and Real Values (R) >



Source: Kim, Choi and Oh (2016); Oh (2015)

IV. Cap Setting ⑦

Category (unit) / year	2014	2015	2016	2017	2020
National BAU (1 million tonnes of CO ₂ e)	694.5	709.0	720.8	733.4	776.1
National reduction rate (% to BAU)	5.1	10.0	13.8	16.2	30.0
National emissions target (1 million tonnes of CO ₂ e)	659.1	637.8	621.2	614.3	569.0
Yearly reduction rate (%)	-	3.2	2.6	1.1	
Cap* (1 million tons of CO ₂ e)	-	573.5	562.2	550.9	-

Note: * The KETS cap includes the amount of indirect emissions.

Source: The Allocation Plan (2014).

V. Challenges During & After the Launching ①

▷ During the Launching: Market Stabilization Measures

- A Reference price (10,000K-won, approximately \$9)
 - This reference price was proposed by the Allocation Plan, as a reference price for the government to consider the use of market stabilization measures.
 - Limiting a) carbon price-finding & b) investment decision

▷ Little Trade so far (0.8% of Allowances were traded in 2015)

- Expected
- But, may be persistent (∴ Thin market ~ limited participants, no-international offsets, less developed financial markets for derivatives)

V. Challenges During & After the Launching ②

▷ After the Launching

- Covered Entities' Distrust toward the Government in Setting Cap and Sector Caps
 - ➔ Industrial entities sued the government
- Concerns on Price Competitiveness (carbon leakage) → Sharing burdens with Non-ETS Sectors (non-Industrial Sectors)

▷ Harmonizing KETS with Korea's INDC

- INDC: 37% below BAU by 2030 (Domestic reduction: 26% + International Offset 11%) + Reduction rate for the industrial sector would not exceed 12%.
- How to harmonize this with KETS Cap and sector caps?

V. Challenges During & After the Launching ③

▷ Modifying KETS

- **Re-checking**: Cap and Sector Caps, Limits on market participants
- **Enhancing cooperation among authorities and public consultation** (GIR is relocated under the Prime Minister's Office)
- **Providing Hedging tools**: Introducing derivative markets
- **Scientific Approach to Optimize Mitigation Actions**: Kim's Simulation Model, a CGE model to Optimize Mitigation Actions with Consideration of Available Mitigation Technologies (contact: Young-Gun Kim at ygkim@kei.re.kr) ~ under development

Thanks

Thank you!!!

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Appendix: Comparison Between KETS and the EU ETS

	KETS	EU ETS
National reduction target	<ul style="list-style-type: none"> - Voluntary - As of 2020: 30% reduction relative to BAU (4% reduction relative to 2005) 	<ul style="list-style-type: none"> - Mandatory under the Kyoto Protocol (8% reduction by 2012 relative to the 1990 level) - As of 2020: 20% reduction relative to 1990 (13% reduction relative to 2005)
Starting year (and month)	<ul style="list-style-type: none"> - January 2015 	<ul style="list-style-type: none"> - January 2005
Phases	<ul style="list-style-type: none"> - 1st commitment period: 2015-17 - 2nd commitment period: 2018-20 - 3rd commitment period: 2021-25 	<ul style="list-style-type: none"> - Phase I: 2005-2007 - Phase II: 2008-2012 - Phase III: 2013-2020
ETS Coverage	<ul style="list-style-type: none"> - Not lower than 55% of all GHGs (1st commitment period) 	<ul style="list-style-type: none"> - 50% as of CO₂ - 40% as of all GHGs (43% in Phase III)
Scope	<ul style="list-style-type: none"> - 23 sub-sectors in 5 sectors (Power generation/Energy, Mining, Food and beverages, Wood and Wood products, Paper, Oil refining, Petrochemical, Glass and Ceramics, Cement, Iron and Steel, Non-ferrous metals, Machinery, Semi-conductor, Display, Electronics, Motor vehicles, Ship building, Building, Telecommunication, Aviation, Water service, Waste management) - Controlled GHGs: CO₂, CH₄, N₂O, HFCs, PFCs, SF₆ - Direct emissions + Indirect emissions 	<ul style="list-style-type: none"> - Power sector, industrial sector: power combustion, oil refining, coke and steel, cement and lime, glass, bricks and ceramics, pulp and paper, others - Aviation: Inside the EU from 2012, outside the EU from 2014 (negotiations underway through ICAO) 2) - Controlled GHGs: CO₂ (industrial gasses, such as aluminum PFCs and N₂O included from Phase II) - Direct emissions
Covered entities	<ul style="list-style-type: none"> - A facility that has emitted 25,000 tons or more of CO₂e or a firm that has emitted 125,000 tons or more of CO₂e per year during the preceding three years - New entrants with the same criteria - Voluntarily participants 	<ul style="list-style-type: none"> - A facility that has emitted 25,000 tons or more of CO₂e per year during the preceding three years - New entrants with the same criteria - Voluntary participants
Number of eligible entities	<ul style="list-style-type: none"> - 525 entities (243 firm entities and 282 facility entities) 	<ul style="list-style-type: none"> - 5,000 business entities across 30 countries (11,500 installations)
Target reduction rates under the ETS	<ul style="list-style-type: none"> - 30% reduction relative to BAU in 2020 - Reduction rate for the 1st commitment period = 2% linear reduction on an annual basis 	<ul style="list-style-type: none"> - Reduction of 21% relative to 2005 by 2020 - Phase III reduction rate = 1.74% linear reduction on an annual basis (equivalent to annual 5% reduction relative to 2010)

How to determine a Cap	- Estimated emissions and reduction potential by sectors are reflected in a bottom-up manner	- Bottom-up reflection of NAPs of each country by the end of Phase II - Reflection of a harmonized single EU-wide Cap starting in Phase III
Cap	- 1 st commitment period (1 billion tons of CO ₂ e): 16.867 for 3 years (annual=5.62)	Phase III of the EU ETS (2013-20). Cap in 2013 = 2,084,301,856. This cap decreases each year by 1.74%.
Allocation Method	- Free allocation * 1 st commitment period: Grandfathering (basic), benchmark (for oil refining, gray cement clinker and aviation) * 2 nd commitment period and afterwards: extended application of benchmark cases - non-free allocation: auction	- Free allocation * Phase I, II: Grandfathering (basic), benchmark (partly) * Phase III: benchmark (basic), Grandfathering (auxiliary) - non-free allocation: auction
Ratio of allowances distributed free of charge	- 1 st commitment period: 100% - 2 nd commitment period: 97% or lower - 3 rd commitment period: 90% or lower - Sensitive sectors will receive 100% of their allowances for free. ① Trade intensity > 30% ② Production cost > 30% ③ Trade intensity > 10% + Production cost > 5%	- Phase I: 95% - Phase II: 90% - Phase III (excluding power sector): 80% in 2013 → about 30% in 2020 → 0% in 2027 * 0% for power sector from 2013 - Up to 100% free allocation for EITE sectors(based on trade intensity) 3)
BM calculation	- GHG/activity level average	-Average of top 10 percent of GHG/activity level
Compliance period	-One year	-One year
Allocation unit	- Firm & facility	- Installation
Emission permits	- Permit of 1t CO ₂ e emission per 1 KAU	- Permit of 1t CO ₂ e emission per 1 EAU
Borrowing	- 10% - Allocation is made one-year beforehand, hence higher borrowing limit than upper limit	- Not allowed - Allowance is made a year earlier, meaning borrowing within a year is actually possible within the pertinent phase
Banking	-Allowed without any restriction.	-Unlimited banking in Phase II and beyond
Offsets	- 1 st and 2 nd commitment periods: Domestic offset alone is recognized (upper limit: 10%)	- CERs (offshore) and ERUs (onshore) recognized (upper limit for Phase III:11%) - Recognition of CERs alone that have been produced in poorest countries since 2012
Market-stabilizing measures	- Implementation of market-stabilizing measures through the Allocation Committee when abnormal price or excess demand occurs.	- Price containment reserve: adjustment of emission permits in reserve to respond to abnormal prices
Auction market	- Korea Exchange (single market) - Limitations on market participants (covered entities + 4 public financial institutions)	- Multiple markets - No limitations on market participants

Linking	- Not allowed in 1 st and 2 nd commitment periods	- International CDM market, Norwegian ETS, Swiss ETS (one-sided link), link to Australian ETS (full link)
Use of auction revenue	- Similar to that of the EU ETS - Little emphasis on climate finance for developing countries	- Support for climate-related projects in developing countries - Investment in onshore renewable energy, EU targets, adaptation, assistance for low-income households in difficulties brought by the increase in electricity rates, afforestation projects, support for carbon storage projects
Failure to comply with the obligation	- A failed entity shall return emission permits that are leftover, or pay penalty surcharges (three-times the market price within the scope of 100,00 won per t CO ₂ e)	- A failed entity shall pay penalty surcharges of 100 euros per t CO ₂ e and be obliged to surrender emission permits additionally (list of failed entities to be disclosed)
Upper and lower limits for permit prices	- Lower limit: none - Upper limit: none (actually 100,00 won per t CO ₂ e)	- Upper and lower limits: none

Note: 1) Subjects of the Target Management System are 'road' and 'railway' besides 23 subjects eligible for ETS. 2) ICAO = International Civil Aviation Organization, 3) Emissions-intensive trade exposed (EITE), 4) Penalty surcharge in Phase I=40 euros/t CO₂e. Source: Constructed by authors, using data such as the Allocation Plan (Sep. 2014), EDF/IETA (May 2013).

Source: Oh and Hyun (2016), Korea's Emission Trading System: An Attempt of a Non-Annex I Country to Reduce GHG Emissions Voluntarily

Original Source: Act on the Allocation and Trading of Greenhouse-Gas Emission Permits and its Enforcement Decree (<http://www.law.go.kr>); Hood (2010); EU ETS documentations (http://ec.europa.eu/clima/policies/ets/documentation_en.htm).