Improvement on allocation method of air pollutants Cap-and-Trade system in South Korea

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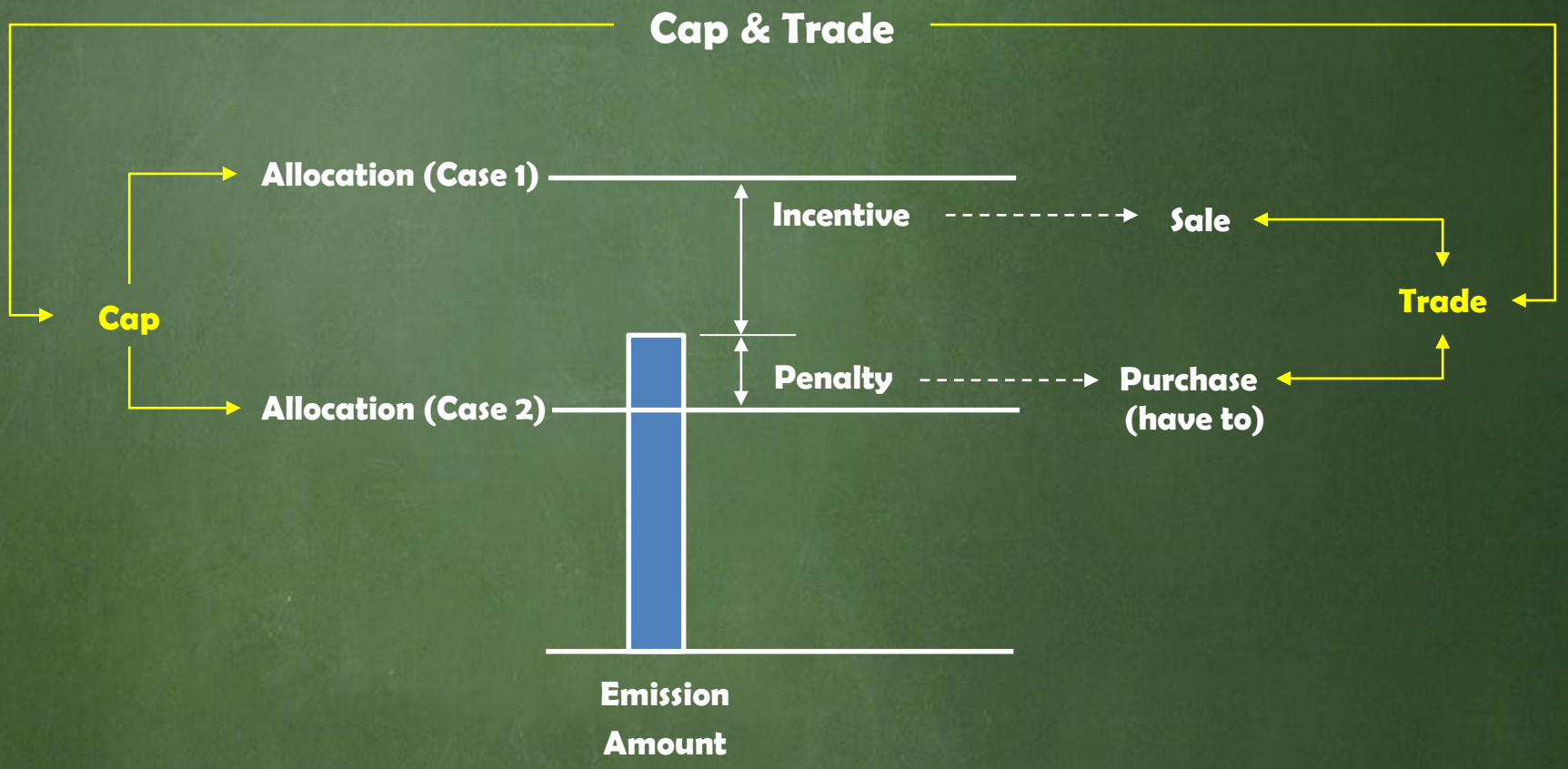
Overview on Cap and trade



Cap and trade of South Korea

Rule		1 Master plan		2 Master plan
Period		2005-2014		2015-2024
Criteria (and)	Pollutants	NO_X, SO_X,		
	Area	Seoul, Incheon[1], Gyeonggi[2]		
	Annual emissions after preventive facilities (above)	2008.1-2009.6	2009.7-2015	2016-2024
		NO_X: 30t, SO_X : 20t	NO_X: 4t, SO_X : 4t	NO_X: 4t, SO_X : 4t
	Annual emissions[3] before preventive facilities (or above)	80t	20t	10t
Number of company		2008-2009	2010-2015	-
		121-126	270-321	270-
Total emission		NO_X: 26-28Kt/yr, SO_X : 10-14Kt/yr	NO_X: 22-33Kt/yr, SO_X : 9-14Kt/yr	NO_X: 23-?Kt/yr, SO_X : 10-?Kt/yr
Allocation methods		2008.1.1-2012.11.6		After 2012.11.6.
		Allocation factors (group)		Emission rate (each)

[1]except Ongjin-gun (include only Yeongheung-myeon)
[2]except Gwangju-city (1MP), Anseong-city (1MP), Yeoju-city (1MP), Pocheon-city (1MP/2MP), Yeoncheon-gun (1MP/2MP), Gapyeong-gun (1MP/2MP), Yangpyeong-gun (1MP/2MP),
[3]sum of NO_X and SO_X and TSP

Allocation	year	Seoul	Incheon	Gyeonggi
NO_X (t)	2015	1,891	17,594	27,117
	2016	1,802	17,443	28,948
	2017	1,713	17,264	28,979
	2018	1,590	16,588	27,827
	2019	1,465	16,059	26,146
	2020	1,340	15,506	24,588
	2021	1,214	14,837	22,898
	2022	1,090	14,165	21,204
	2023	975	12,960	18,793
	2024	861	11,754	16,379
SO_X (t)	2015	35	11,452	6,136
	2016	35	11,434	6,049
	2017	35	11,416	5,962
	2018	35	11,120	5,908
	2019	35	10,827	5,853
	2020	35	10,535	5,800
	2021	36	10,250	5,748
	2022	36	9,183	5,693
	2023	36	8,679	5,419
	2024	36	8,172	5,146

Regulatory assistance in South Korea

(For a business operator under Cap and trade system)

1. **Reduction or exemption of the emission dues (SO_X)**
2. **Exception of sulfur contents level limitations**
3. **Mitigation of permission concentration level (SO_X, NO_X)**

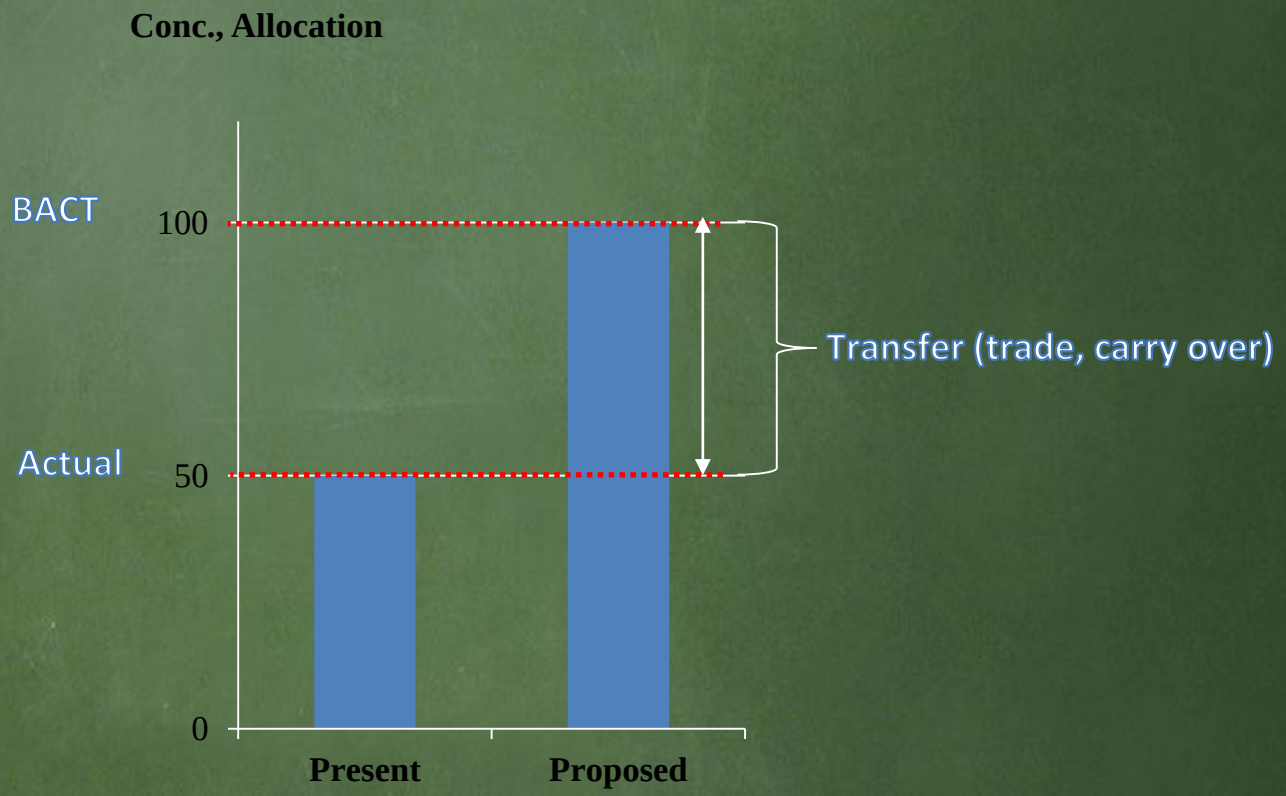
Challenges

1. **Economic growth**
2. **Accuracy of emission estimation**
3. **Equity of allocation**
4. **Over-allocation**

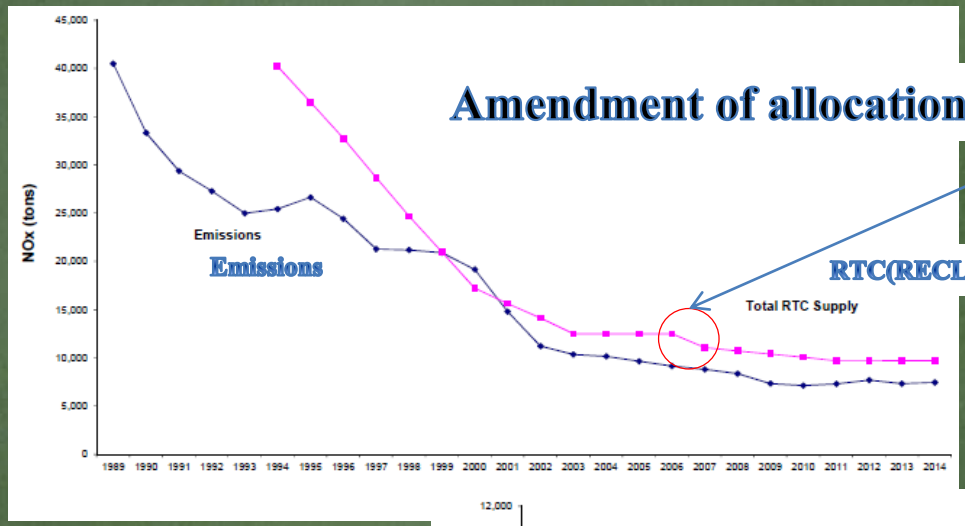
Points of improvement

1. **Advantage on facilities to be satisfied with BACT requirement**
2. **Over-allocation**
3. **Applicability in case of using several fuels**
4. **Accomplishment of emission targets; management of total allocation amounts**

1. Advantage


Conc., Allocation
BACT
100
Actual
50
0
Transfer (trade, carry over)
Present
Proposed

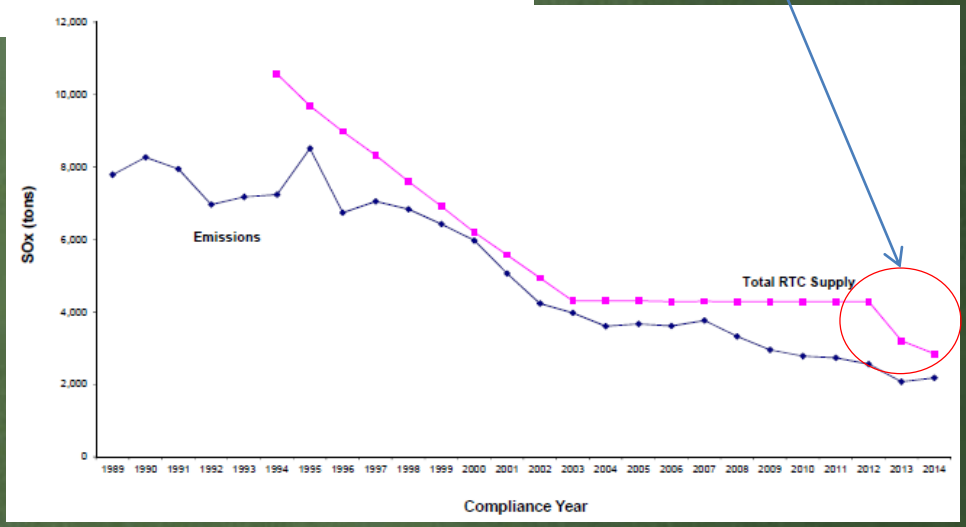
2. Over-allocation



Amendment of allocation method to manage over-allocation

RTC(RECLAIM Trading Credit)

Total RTC Supply



SOURCE: Annual RECLAIM Audit Report for 2014 Compliance Year, 2016, SCAQMD

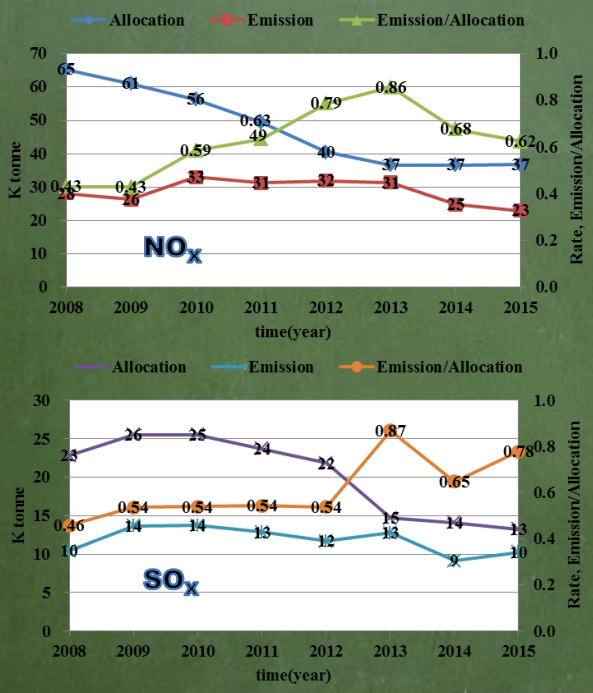
2. Over-allocation

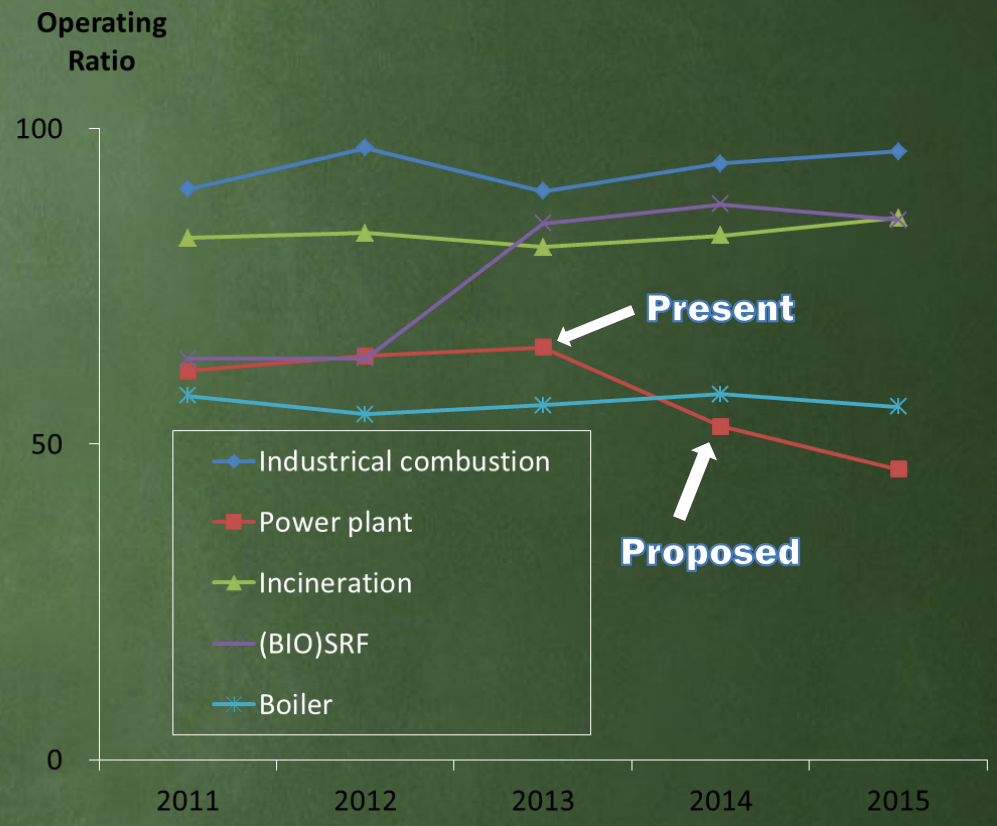
Allocation $_{year}$ = Allocation factors x Activities $_{max(year)}$

*** Activities Period (for 2018 allocation)**

Present: max(past 6yr, ’11-’16)

Proposed: max(past 3yr, ’14-’16)





3. Applicability

$$Allocation\ factors = \left(\frac{E_{year}}{A_{year}}\right)_{last\ year} \times \frac{BACT_{fuel,facily}}{C_{last\ year}}$$

Case 1: Several fuel combustion
Case 2: Several facilities

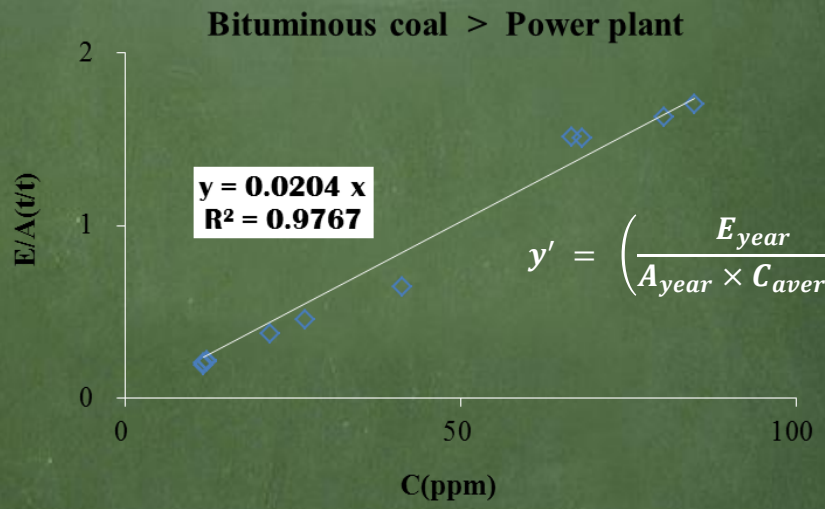
→ **flue gas → one stack → inapplicable (E, C, BACT)**

3. Applicability

Assumption: steady flow rate

$$\left(\frac{E_{year}}{A_{year} \times C_{average}}\right)_{last\ year} = \left(\frac{Q_{year}}{A_{year}}\right)_{last\ year}$$

$$Allocation\ factors = \left(\frac{Q_{year}}{A_{year}}\right)_{fuel,facility} \times BACT_{fuel,facily}$$



$$y' = \left(\frac{E_{year}}{A_{year} \times C_{average}}\right)_{fuel,facility} = \left(\frac{Q_{year}}{A_{year}}\right)_{fuel,facility}$$

4. Accomplishment

Case 1: Total allocation $_{S, I, G}$ ($=\sum a_{facility}$) < Emission target $_{S, I, G}$ → go ahead

Case 2: Total allocation $_{S, I, G}$ ($=\sum a_{facility}$) > Emission target $_{S, I, G}$ → reduce allocation

* **Reduce amount $_{facility}$ = b $_{facility}$ x r**

  r = (total allocation $_{S, I, G}$ – emission target $_{S, I, G}$) / $\sum b_{facility}$

* **Allocation $_{reduced}$ = a + b(1-r)**

	Year	Seoul	Incheon	Gyeonggi
NO_X	2015	1,891	17,594	27,117
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5. Result & Conclusion

1. Advantage (Additional transfer of possible)

* 2018-2022: NO_X 8,200t(4.8%), SO_X 2,552t(4.2%)

2. Over-allocation (Reduce amount of allocation)

* 2018-2022: NO_X 9,439t(5.6%), SO_X: 1,523t(2.5%)

Application 1 & 2 methods simultaneously → NO_X: +1,489t(2.5%), SO_X: -22t(0.04%)

3. Applicability

NO_X(fuel, facility)			y'	R^2
B-C			0.0275	0.6650
Bituminous	Power plant		0.0204	0.9767
LNG	Power plant	non-ICE	0.0283	0.8236
		ICE	0.0505	0.7758
	Boiler		0.0288	0.6712
Municipal waste			0.0145	0.9020
Industrial waste			0.0260	*0.3346*

SO_X(fuel)	y'	R^2
B-C	0.0050	*-0.2263*
Bituminous	0.0263	0.9549
Industrial waste	0.0375	0.8889
Municipal waste	0.0139	0.6957

4. Accomplishment: " ∑a < Emission target " → go ahead

* 2018-2022: NO_X 169,792t/188,368t , SO_X: 61,695t/81,095t

Recommendations

For Cap and trade system

1. **Low cost, high efficiency method**
2. **Infrastructure needs (CEMS)**
3. **Alternatives to concentration regulation**
4. **Key point of operation: over-allocation, trade**

End

Thanks. ^^

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