Long-term historical trends in air pollutant emissions in South Korea (2000~2018)

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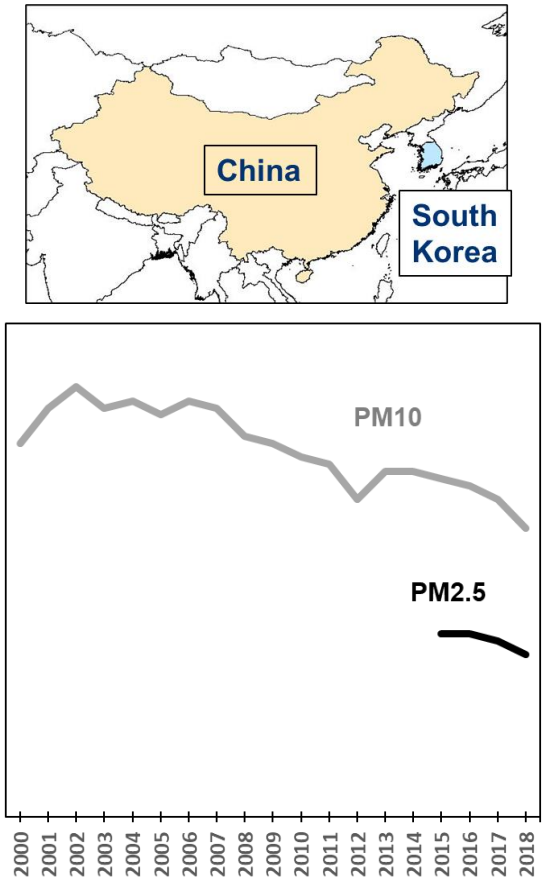
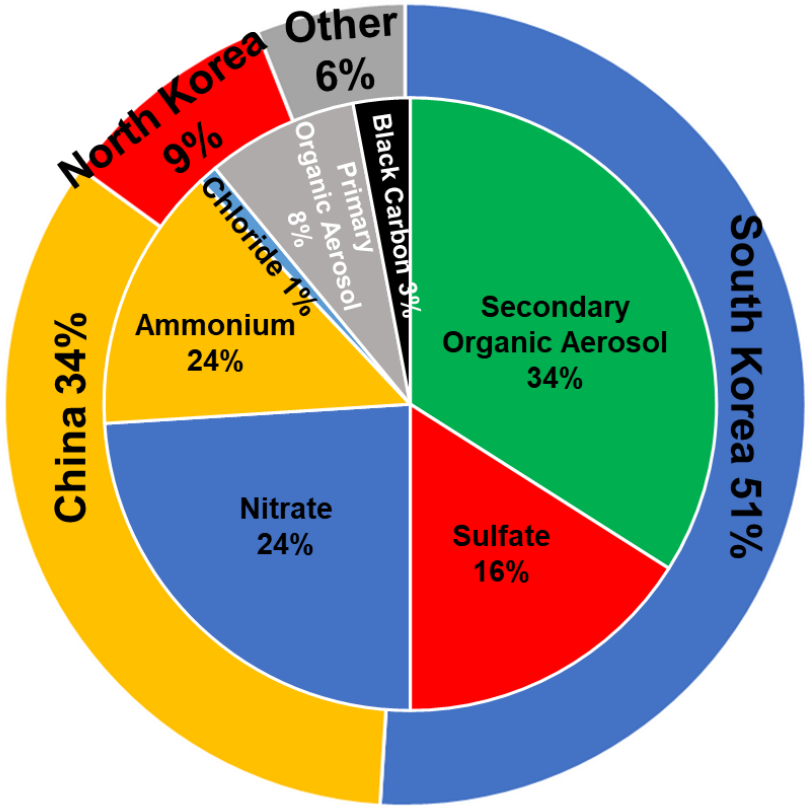
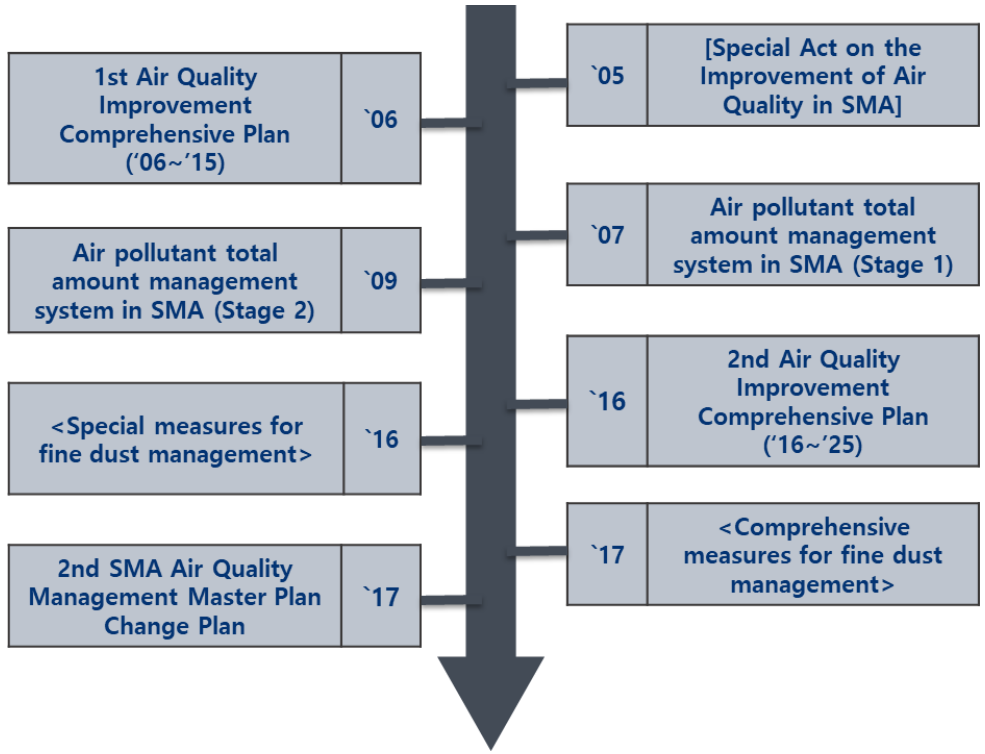
I . Background & Objective



Annual changes in Concentration trend for fine dust in South Korea (PM10, PM2.5)
(NIER, 2019)



Contribution to PM2.5 by countries and pollutants
NASA KORUS-AQ
(RSSR, 2017)



Major Air Quality Policy since 2000 in South Korea

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수정필요

Ⅰ. Background & Objective

1. In order to analyze the impact of air quality improvement policies, **it is necessary to estimated long-term emission trends**.
2. CAPSS, Korea's official emission inventory, has been estimated and published every year since 1999, **but it is difficult to compare and analyze long-term emissions** due to **differences in the method of calculating emissions by year**.

1. **Recalculate past emissions using the 2018 emissions calculation method of the CAPSS emissions inventory**
2. **Analysis of long-term air pollutant emission trends and confirmation of connectivity with air quality improvement policies**
3. **Unification of emissions source categories to participate in TF HTAP, an international long-term air pollutant emission analysis study**
4. **Emission trend analysis of three Northeast Asian countries using TF HTAP data**

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Ⅱ. Data & Methodology

3.1. Research Framework & Data

CAPSS emissions by year
(2000~2018)

↓

Unification of emissions source categories
(HTAP source category)

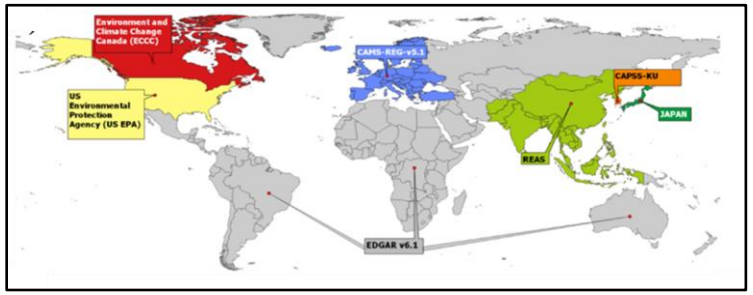
Changed	Added
Estimation Method	New Pollutants & Sources
Emission Factor	Missing Activities

↓

Recalculated emissions by year
"CAPSS-KU"
(2000~2018)

1. Emission Inventory : CAPSS (Clean Air Policy Support System)
2. Year : 1999~2019
3. Region : South Korea (250 county)
4. Pollutant : TSP, PM-2.5, PM-10, SOx, NOx, VOCs, NH3, CO, BC (9)
5. Emission source : Tier 1 (13), Tier 2 (63), Tier 3 (271)
6. Fuel : Tier 1 (47), Tier 2 (99)

LRTAP Task Force on Hemispheric Transport of Air Pollution



1. Emission Inventory: TF HTAP (Task Force Hemispheric Transport Air Pollution) version 3
2. Year : 2000~2018
3. Pollutant : PM-2.5, PM-10, SO2, NOx, VOCs, NH3, CO, BC, OC (9)
4. Emission source : Tier 1 (9), Tier 2 (17)

Source : Marilena et al., The HTAPv3 emission mosaic: a global effort to tackle air quality issues, AGU, 2022

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Ⅱ. Data & Methodology

3.2. Source Category

HTAP Source Category		CAPSS Source Category		
Sector Number	Sector Description	Level 1	Level 2	Level 3
Sector_2.1	Domestic Aviation	Non-road Transport	Aviation	Domestic airport traffic
Sector_3	Energy	Energy Production		
Sector_4.1	Industry	Manufacturing Industry Industrial Processes		
Sector_4.2	Fugitive	Energy Tansport and Storage Biomass Combustion	charcoal manufacturing	
Sector_4.3	Solvents	Solvent Use		
Sector_5.1	Road Transport	Road Transport		
Sector_5.2	Brake and Tyre wear	Fugitive Dust	paved road unpaved road tire wear	
Sector_5.3	Domestic shipping	Non-road Transport	Inland waterways Offshore	
Sector_5.4	Other ground transport	Non-road Transport	Railways	
Sector_6	Residential	Non-Industry Combustion Non-road Transport Biomass Combustion	Construction machinery Fireplace	
Sector_7	Waste	Waste Biomass Combustion	Waste disposal	
Sector_8.1	Agricultural waste burning	Biomass Combustion	Agricultural residue burning	
Sector_8.2	Agriculture livestock	Agriculture Fugitive Dust	Manure management Stockbreeding activity	
Sector_8.3	Agriculture crops	Agriculture Fugitive Dust	Cultures with fertilizers Agriculture activity	
Sector_9	Fires	Other Area source	Forest fire and Fire	Forest fire

Ⅱ. Data & Methodology

3.3. Summary of Changes to Emissions Inventory Calculation Methods

Changed	
2002	Update of CNG Bus E.F.
	Development of Two-wheeled Vehicle E.F.
	Deterioration Coefficient of Mobile source
2004	Energy Comb., Non-ind. Comb., Ind. Comb. E.F.
	Ind. Proc. Tier 2 E.F.
	Road Transport, Solvent use Activies
2005	Road Transport source E.F.
	Diesel Vehicle Estimation Method
	VKT for Passenger Car
2007	Solvent use, Energy Transport&Storage E.F.
2008	Construction Equipment Estimation Method
	Error of NH3 E.F. in the Waste Treatment Source

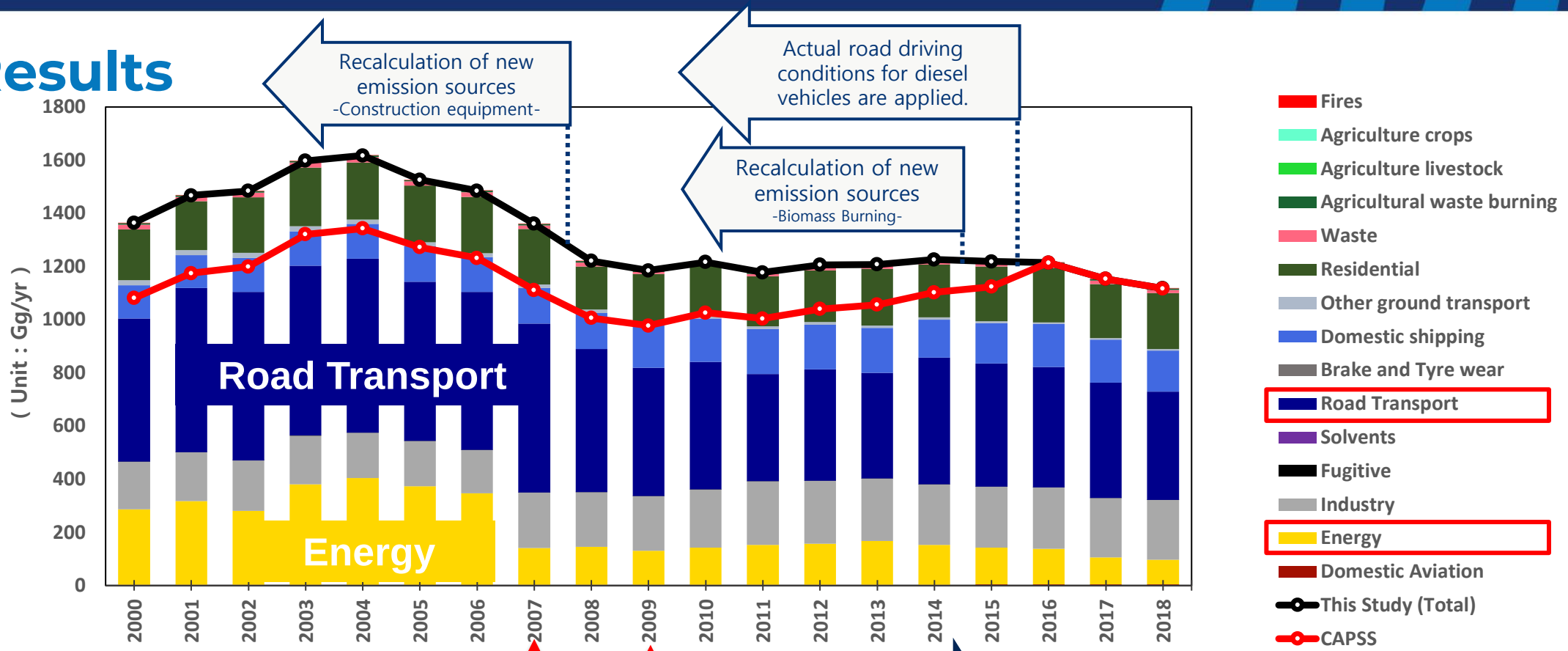
Added	
2001	Agricultural Sector
	Industrial Process - Ammonia Consumption
2007	Wastewater Treatment source - NH3 Emisison
	Imported Anthracite Activity
2011	New E.F. for Road transport
	agricultural manure management-"broiler"
	New Pollutant - PM2.5
2015	Official Emission source - Fugitive Dust
	Official Emission source - Biomass Burning
2016	Driving Conditions on Actual Roads for Diesel Vehicles

- A new emission source has been added.
- Emission factors have changed.
- Changes in Emissions Estimate Methods.

➢ Changes were applied to the previous year.

Ⅲ. Results

NOx



Special Act on the Improvement of Air Quality in SMA

1st Air Quality Improvement Comprehensive Plan (`06~`15)

2nd Air Quality Improvement Comprehensive Plan ('16~`25)

1st Master Plan for Air Quality Control in the SMA (`05~`14)

2nd Master Plan for Air Quality Control in the SMA (`15~`24)

Air pollutant total amount management system in SMA (Stage 1)

Air pollutant total amount management system in SMA (Stage 2)

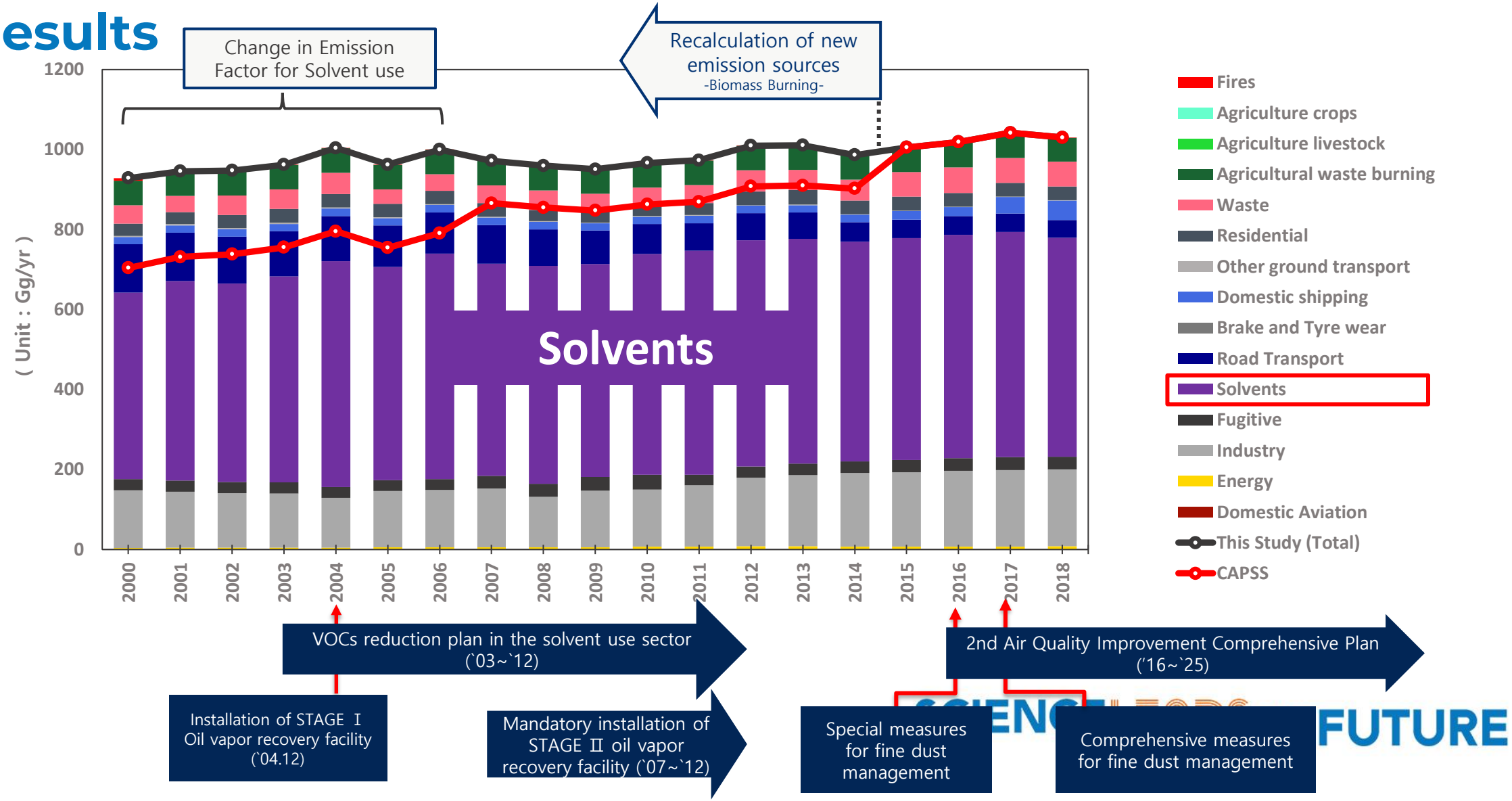
Special measures for fine dust management

Comprehensive measures for fine dust management

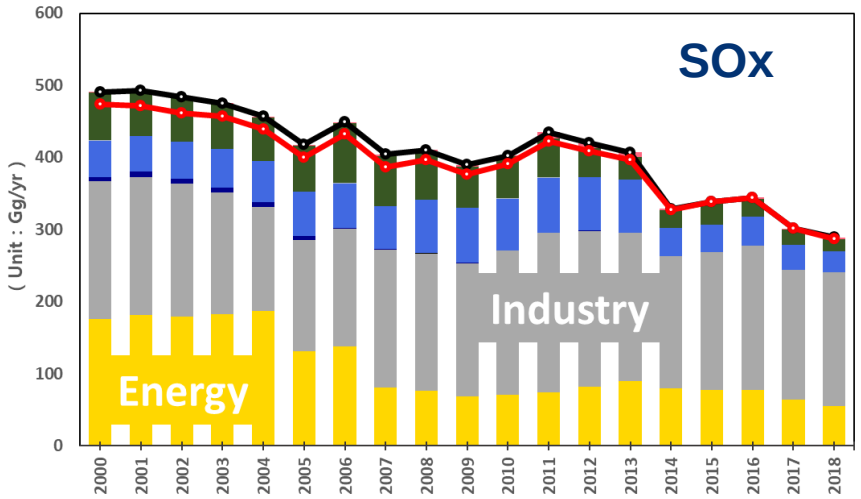
*SMA : Seoul Metropolitan Area

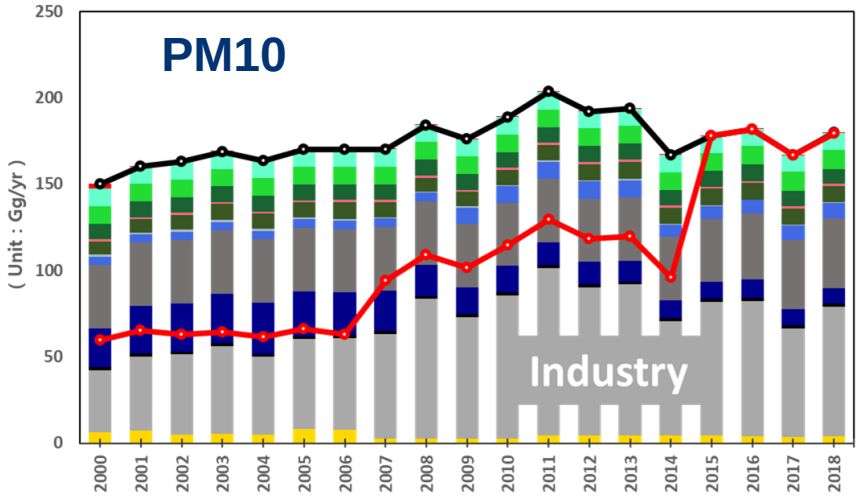
Ⅲ. Results

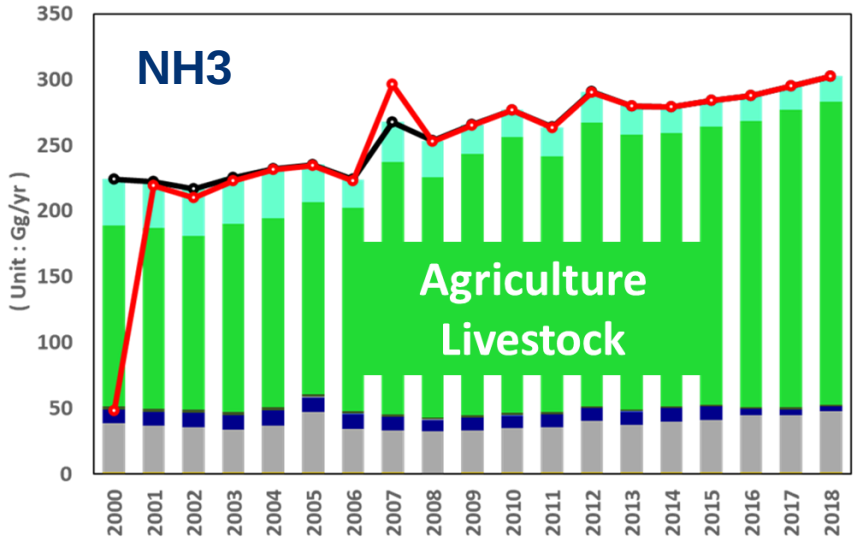
VOCs

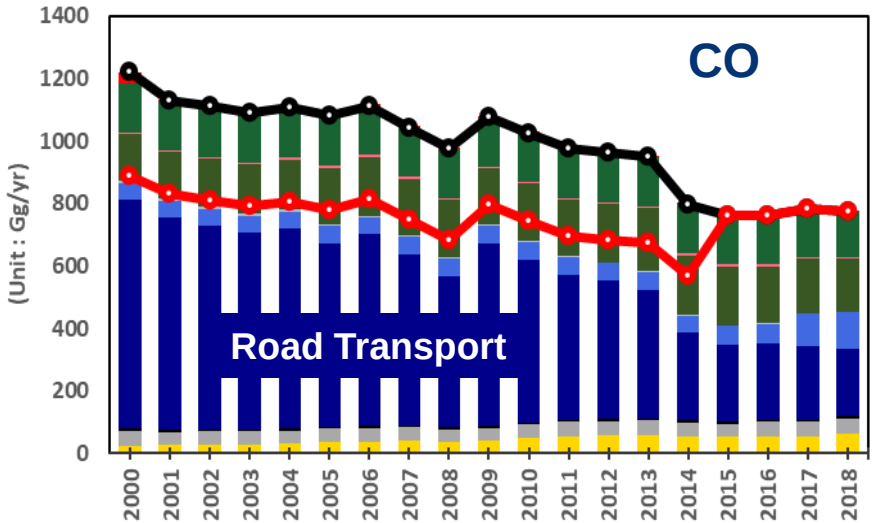


Ⅲ. Results


SOx
(Unit : Gg/yr)
Energy
Industry
0
100
200
300
400
500
600
2000
2001
2002
2003
2004
2005
2006
2007
2008
2009
2010
2011
2012
2013
2014
2015
2016
2017
2018


PM10
(Unit : Gg/yr)
Industry
0
50
100
150
200
250
2000
2001
2002
2003
2004
2005
2006
2007
2008
2009
2010
2011
2012
2013
2014
2015
2016
2017
2018

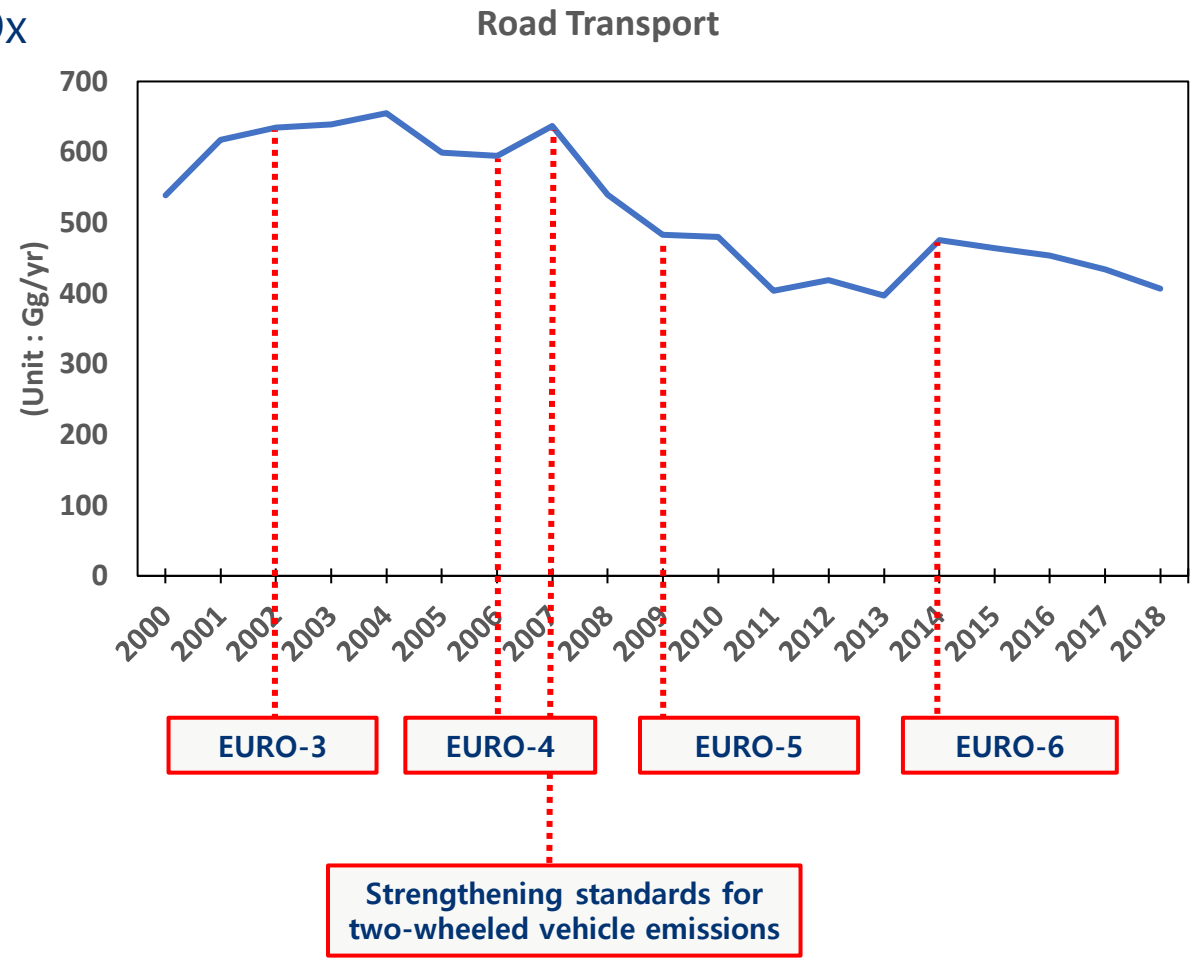

NH3
(Unit : Gg/yr)
Agriculture
Livestock
0
50
100
150
200
250
300
350
2000
2001
2002
2003
2004
2005
2006
2007
2008
2009
2010
2011
2012
2013
2014
2015
2016
2017
2018

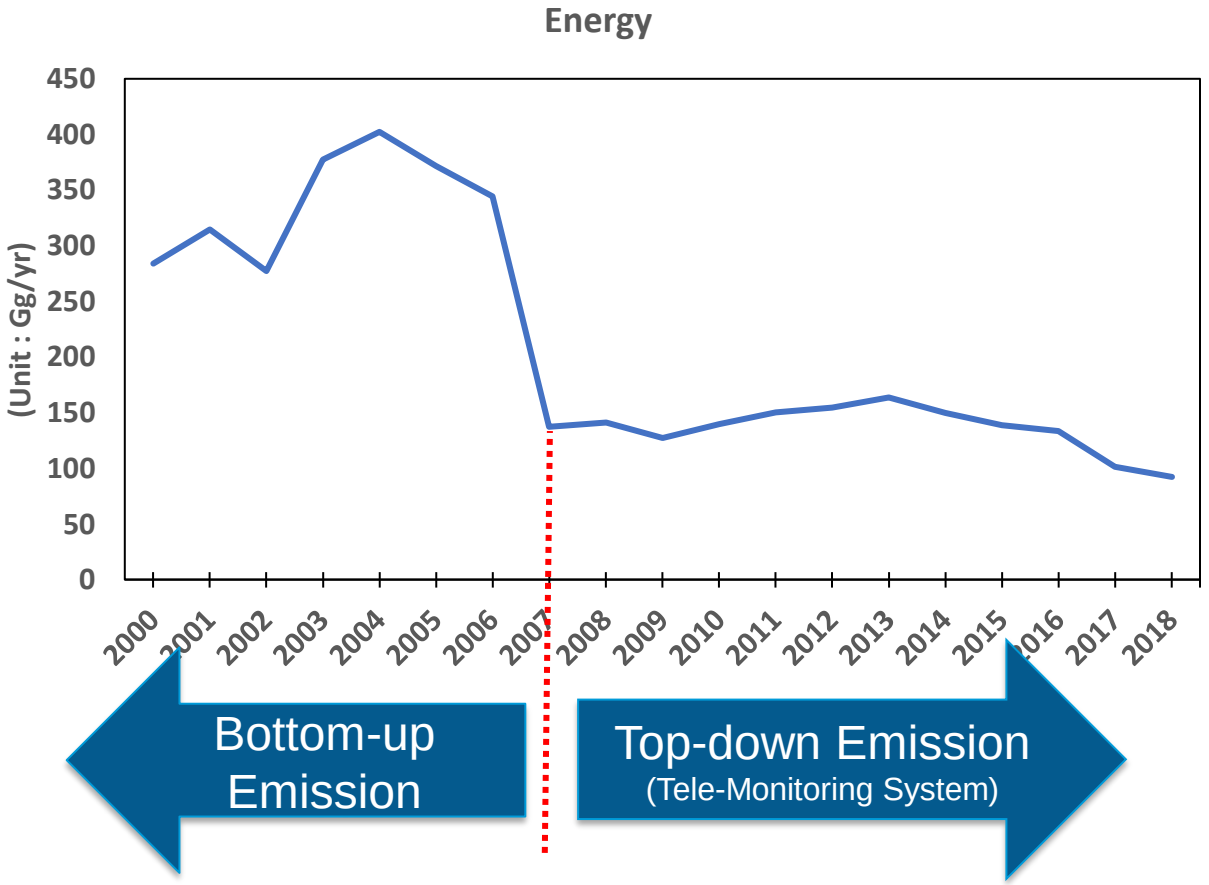

CO
(Unit : Gg/yr)
Road Transport
0
200
400
600
800
1000
1200
1400
2000
2001
2002
2003
2004
2005
2006
2007
2008
2009
2010
2011
2012
2013
2014
2015
2016
2017
2018


Fires
Agriculture crops
Agriculture livestock
Agricultural waste burning
Waste
Residential
Other ground transport
Domestic shipping
Brake and Tyre wear
Road Transport
Solvents
Fugitive
Industry
Energy
Domestic Aviation
This Study (Total)
CAPSS

Ⅲ. Results

NOx





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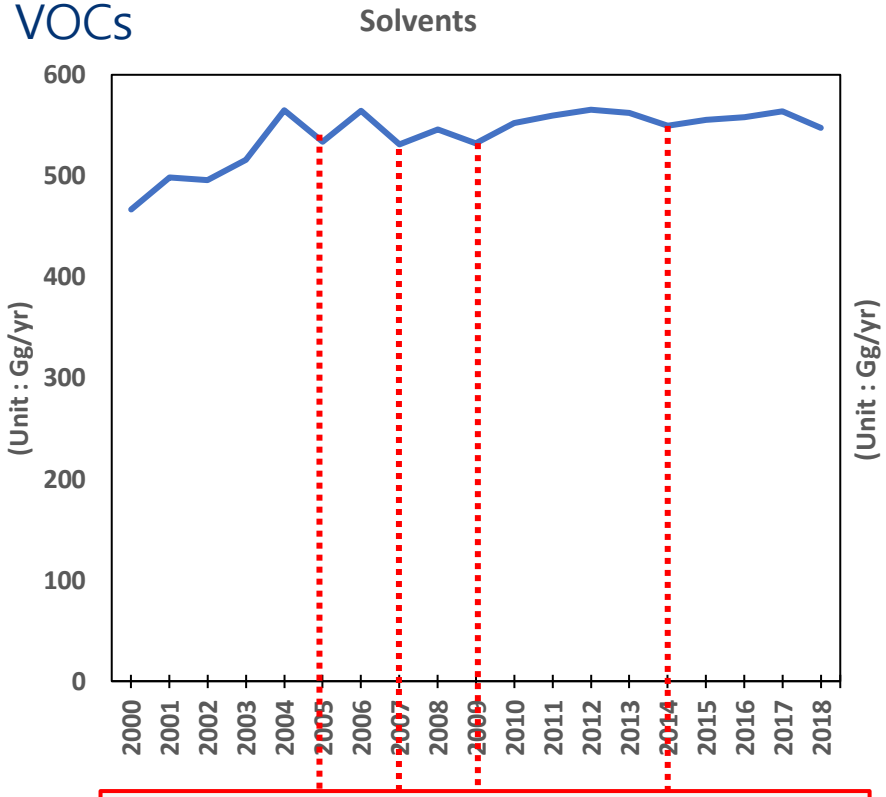
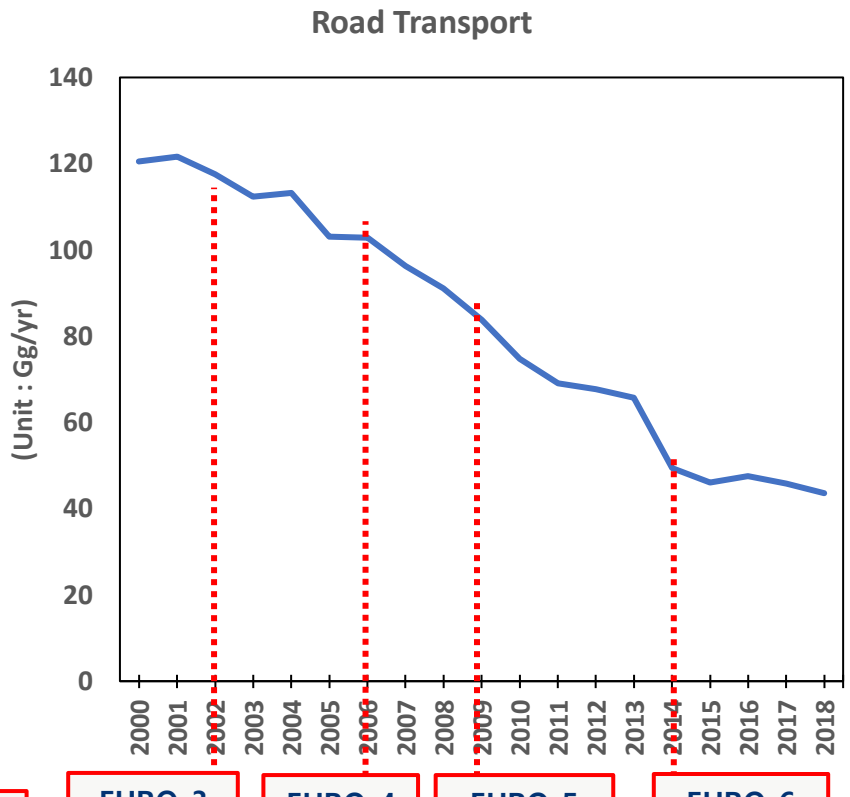
Ⅲ. Results

VOCs



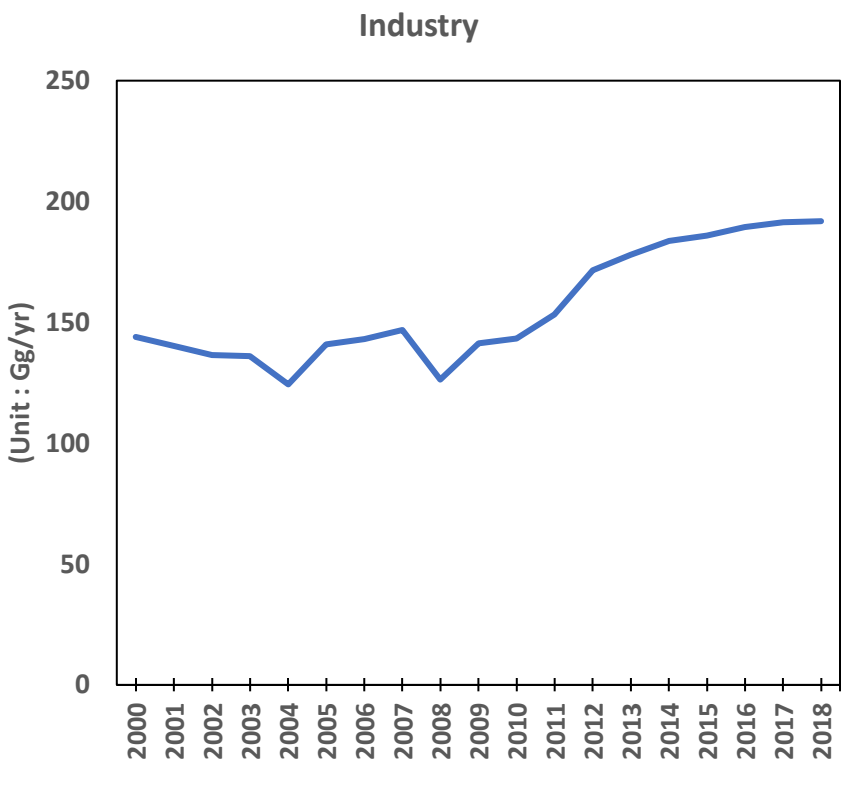
Strengthening VOC content standards in paints ('05, '07, '14)

Addition of VOCs species to content regulation in paints (37 species -> TVOCs)



EURO-3 EURO-4 EURO-5 EURO-6

Changed from diesel bus to natural gas bus('00~'07)



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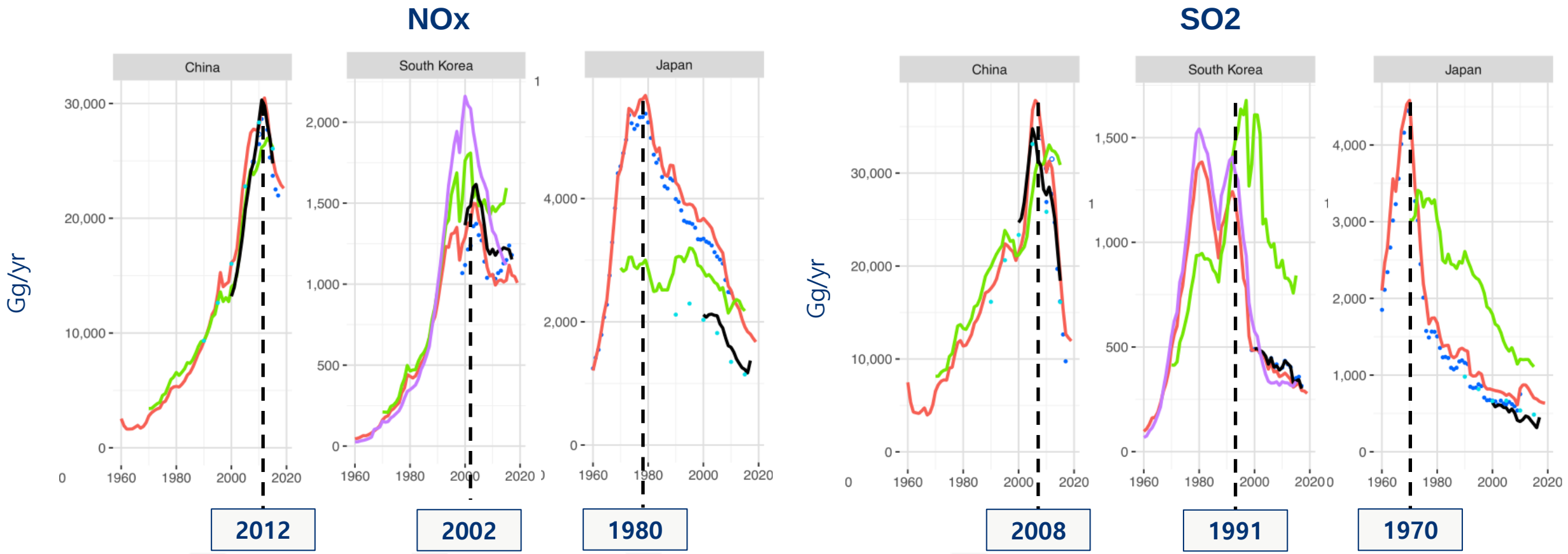
Ⅲ. Results



South Korea = CAPSS-KU

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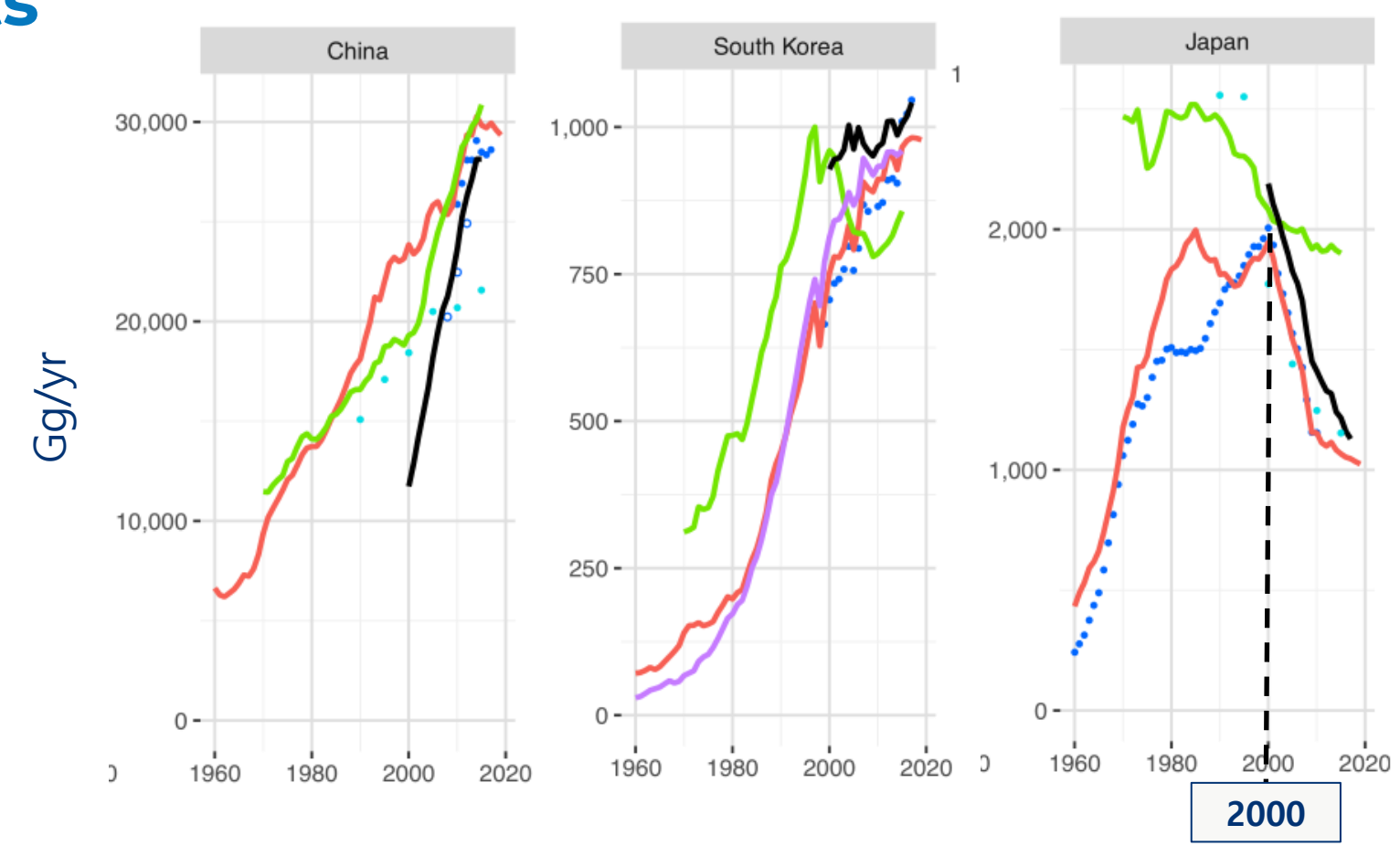
Source : Harrison Suchyta et al, EDGAR-HTAPv3 – CEDS – Other Comparison, 2021

Ⅲ. Results

VOCs



South Korea = CAPSS-KU

SCIENCE LEADS THE FUTURE

Source : Harrison Suchyta et al, EDGAR-HTAPv3 – CEDS – Other Comparison, 2021

IV. Summary and Conclusion

1. Through this study, CAPSS-KU, a recalculated emission inventory from 2000 to 2018, was prepared.
2. Emissions of pollutants mainly emitted through combustion, such as NOx, SOx, and PM10, are on the decline.
3. NH3 and VOC are steadily increasing
   - NH3 and VOC are the main precursors of secondary aerosol, so it is judged that additional policies should be implemented and the effectiveness of the policies should be increased.
4. If Korea's emissions are not recalculated, NOx and CO emissions stagnant and PM10 emissions increase by year.
   - Through the recalculation of emissions, it was confirmed that Korea's emissions showed a decreasing trend.
5. Unification of the emissions source categories for the participation of TF HTAP.
   - Comparison of emissions trends in Korea and other countries through participation in HTAP research.
6. Among the three Northeast Asian countries, VOCs show a trend of reduction only in Japan.
   - There is a need to refer to Japan's air quality improvement policy to reduce Korea's VOC emissions in the future.

Thank you for your Attention