Fine Particulate Matter ($PM_{2.5}$)

Department of Air Quality Protection & Noise Control

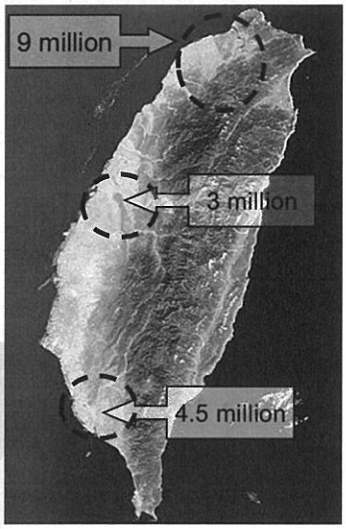
OCT. 2015

Outline

- Background
- Current Challenges
- Clean Air Efforts in Taiwan
- Discussion and Exchange

Environmental Load

- **Taiwan's Environmental Load compared to other countries:**
  Taiwan has a much higher population and vehicle density.



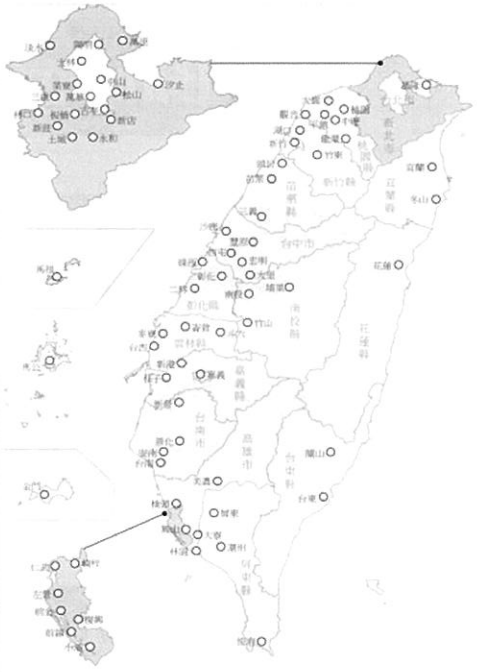
Total Population 23 million

Area 36,000km²

Environmental Load				
Density (per km²)	Taiwan	US	Japan	Germany
		multiples		
Population	644	20.2	1.9	2.8
Vehicles	588	22.8	2.5	4.0

Pollutant Standards Index, PSI

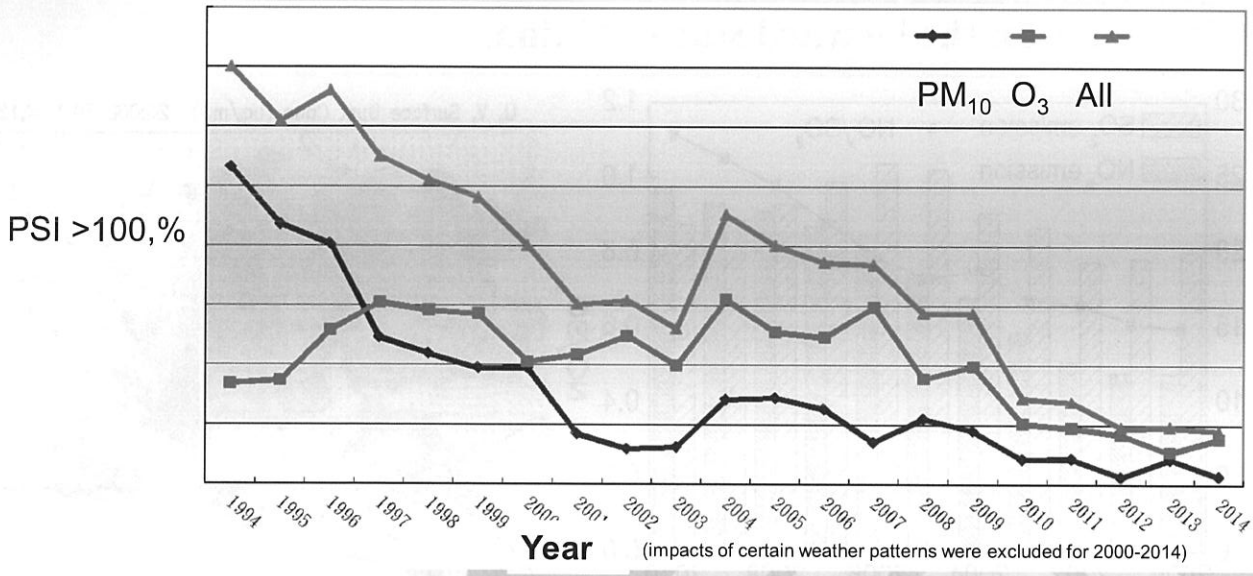
- **Website of air quality monitoring Real time (taqm.epa.gov.tw)**
- **PSI indicators：**
  O_3 、CO 、NO_2 、 SO_2、PM_{10}



空氣污染指標 (PSI)	0～50	51～100	101～199	200～299	>=300
對健康的影響	良好	普通	不良	非常不良	有害
	Good	Moderate	Unhealthful	Very Unhealthful	Hazardous
狀態色塊					

Air Quality Trend

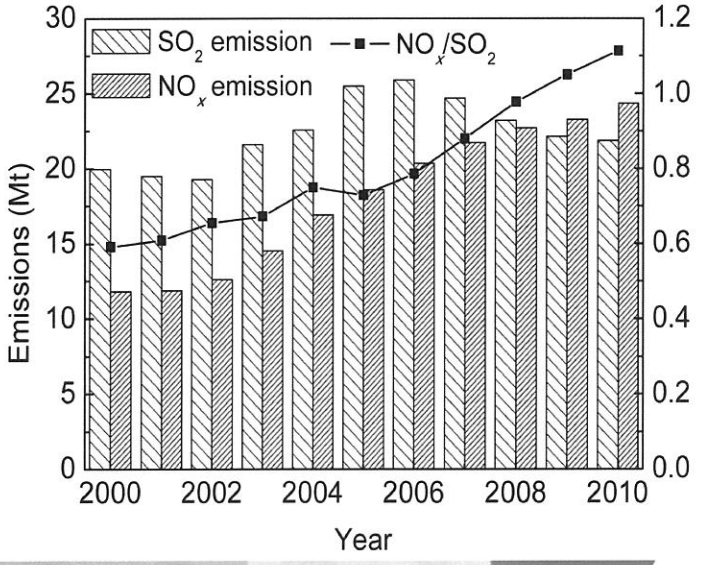
- **Percentage of days with poor air quality continues to decrease, dropping to 0.9% in 2014.**

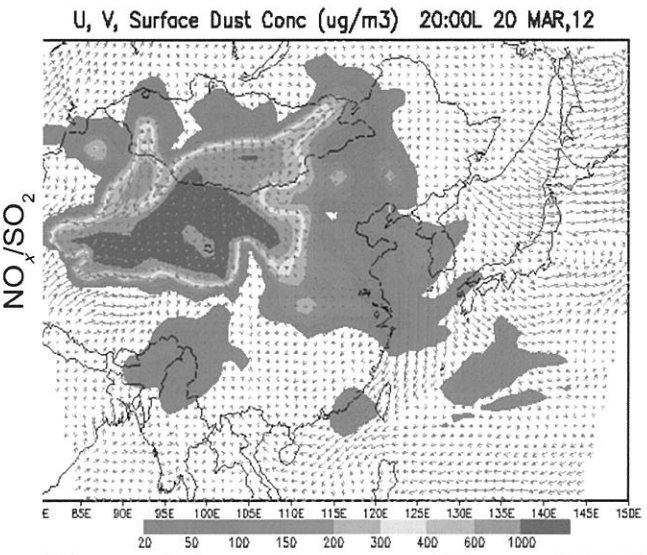


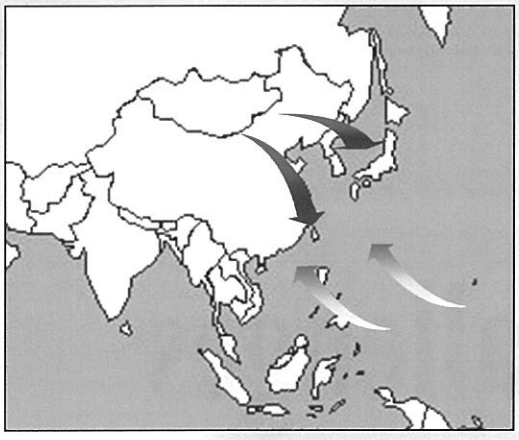
Current Challenges

Long-distance transport from China affects our air quality

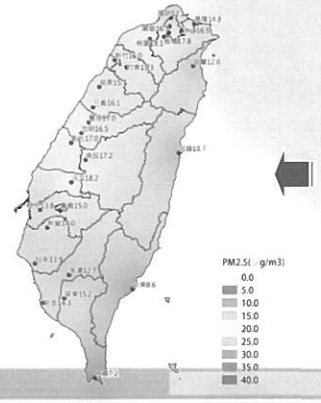
- The $PM_{2.5}$ precursor (SO_2,NO_x) emissions from China have sharply increased over the last decade.
- Taiwan is on the leeward side of China.





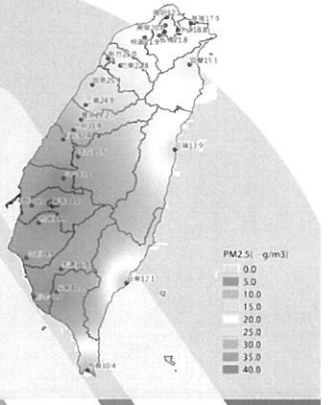


- $PM_{2.5}$：30% comes from China ($10\mu g/m^3$)
- Air quality shows significant seasonal differences



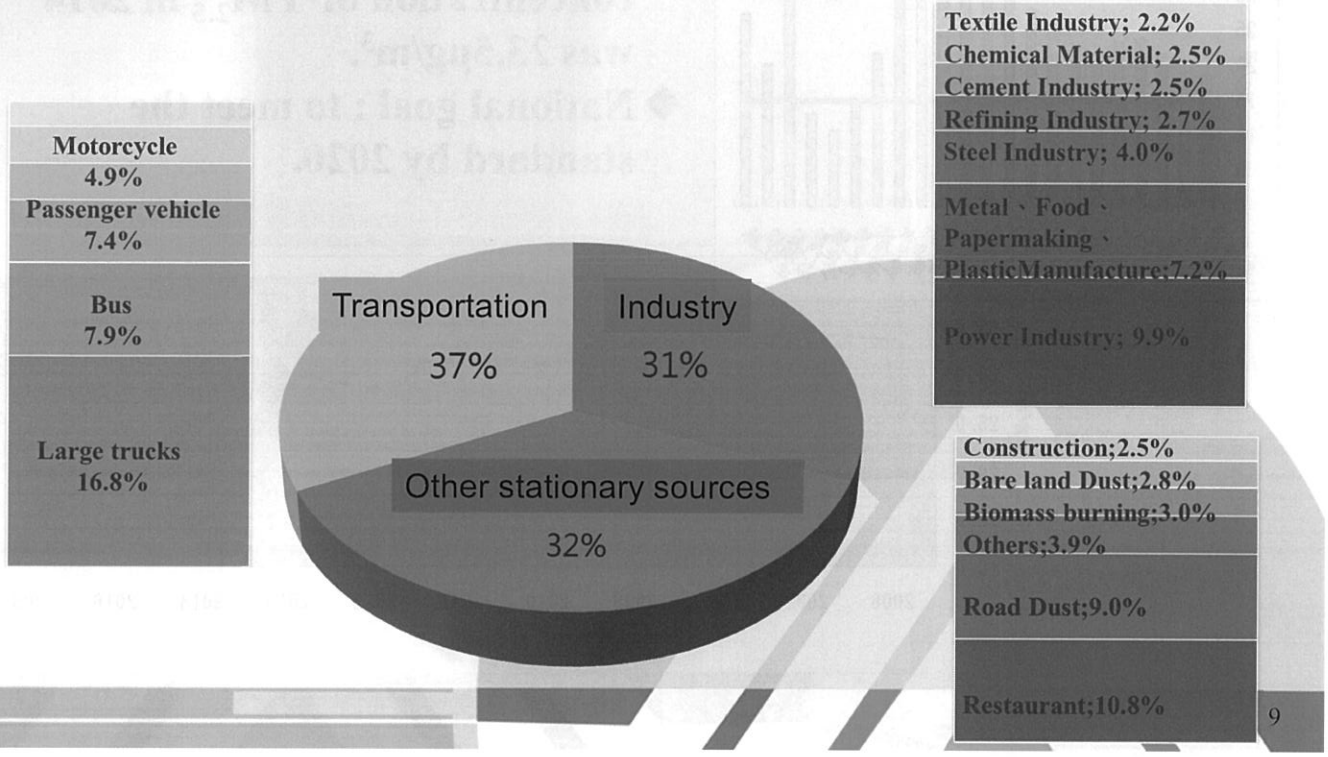
Summer south-west monsoon period Avg. conc. ($\mu g/m^3$)	
North	15.9
Mid	16.9
Mid south	15.0
South	12.4

Winter north-east monsoon period Avg. conc. ($\mu g/m^3$)	
North	18.8
Mid	31.7
Mid south	40.2
South	39.4



Local pollutant sources of total $PM_{2.5}$

- Transportation 37 % ; Industry 31 % ; Other stationary 32 %



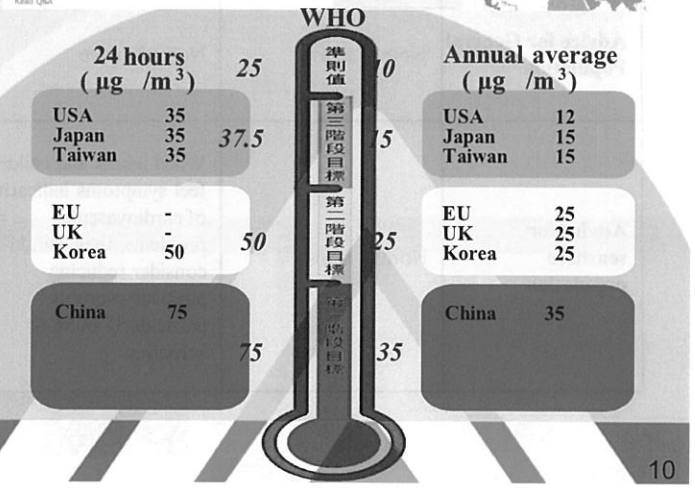
$PM_{2.5}$ Standards

- To help control $PM_{2.5}$ air pollution, Taiwan announced $PM_{2.5}$ air quality standards in 2012.

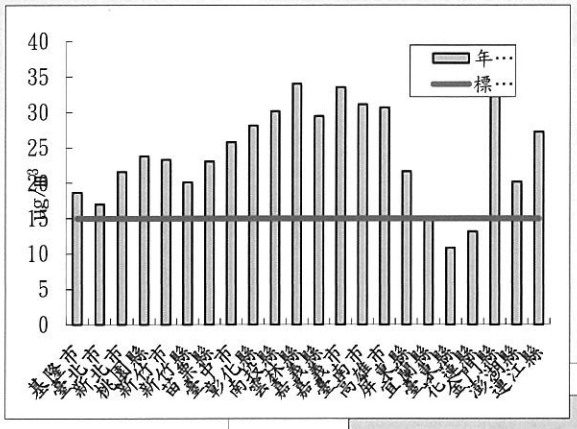
- $PM_{2.5}$ Standards：

  24-Hour : 35μg/m³

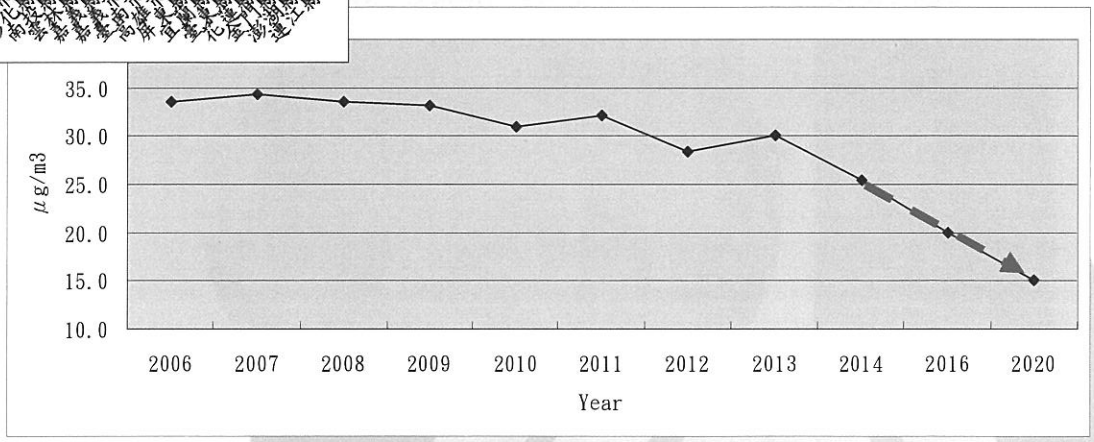
  Annual : 15μg/m³



$PM_{2.5}$ exposure trend



- **National annual average concentration of $PM_{2.5}$ in 2014 was 23.5μg/m³.**
- **National goal : to meet the standard by 2020.**



$PM_{2.5}$ Index

- **To protect public health, a "$PM_{2.5}$ Index" was implemented on October 1, 2014.**

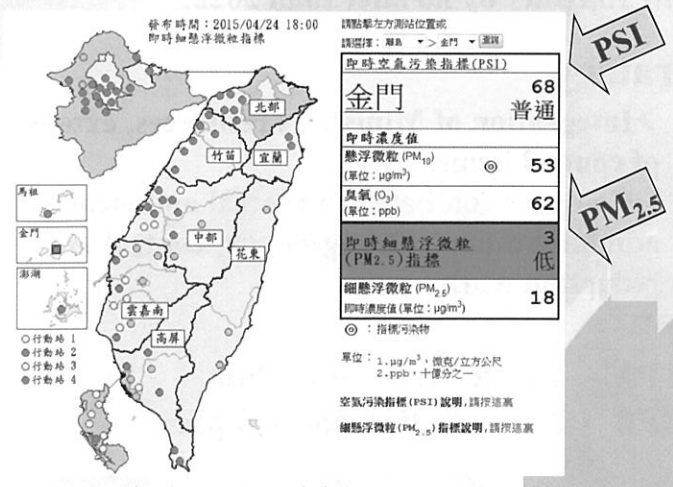
Index	1	2	3	4	5	6	7	8	9	10
Class	low	low	low	Moderate	Moderate	Moderate	high	high	high	Very high
24 hour concentration (μg/m³)	0-11	12-23	24-35	36-41	42-47	48-53	54-58	59-64	65-70	≧71
Advice for General Population	Normal active			Normal active			People who do not feel well, including eye pain, cough, or sore throat, should consider reducing outdoor activities.			People who do not feel well, including eye pain, cough or sore throat, should consider reducing outdoor activities.
Advice for sensitive population	Normal active			When adults and children feel symptoms indicative of cardiovascular problems, they should consider reducing physical exertion, particularly outdoor activities.			1. Those who have heart, respiratory or cardiovascular disease should reduce physical exertion, particularly outdoor activities. 2. The elderly should reduce physical exertion. 3. People with asthma may need to increase the frequency of the use of inhalants.			1. People with cardiac, respiratory or cardiovascular disease should avoid physical exertion, particularly outdoor activities. 2.People with asthma may need to increase the frequency of the use of inhalants.

Efforts for Cleaner Air in Taiwan

Air quality monitoring and forecast

◆ **Availability of monitoring and forecast data**

The government's open data platform



Real time and historical air quality data available

Real time air quality broadcasting

Data available to the public

Warning of poor air quality and response SOP

Clean Air Action Plan

Goal

- National annual average concentration of $PM_{2.5}$ will fall below 15μg/m³ by no later than 2020.

Vision

Clean Air

Blue Sky

Strategy

- Integration of Ministry's resources, extension of control items.
- Co-operation between central and local administrations. Strengthening control and reduction work.

Plan

EPA - Clean Air Action Plan

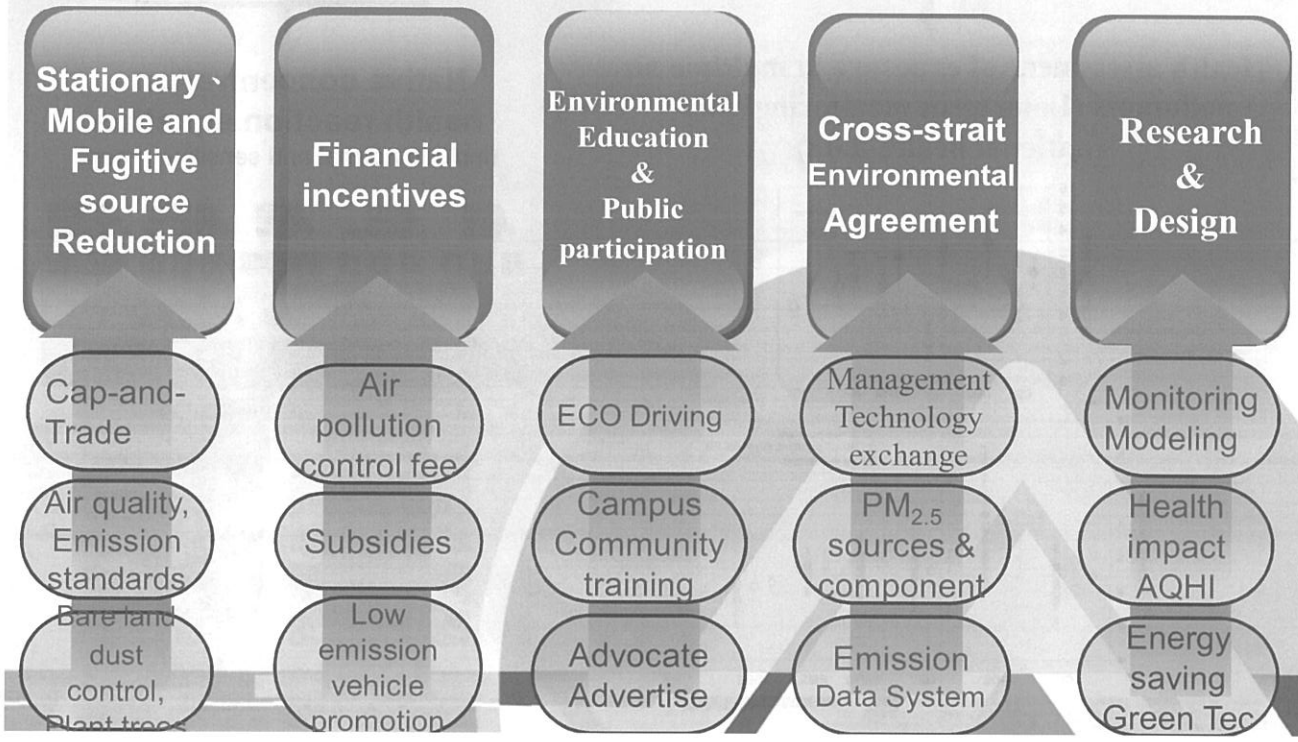
EPB - Air pollution control plan

Examine

Rolling tests and tracking.

Strengthen internal controls and permit review, and administer in-depth testing.

Air Pollution Management Strategy

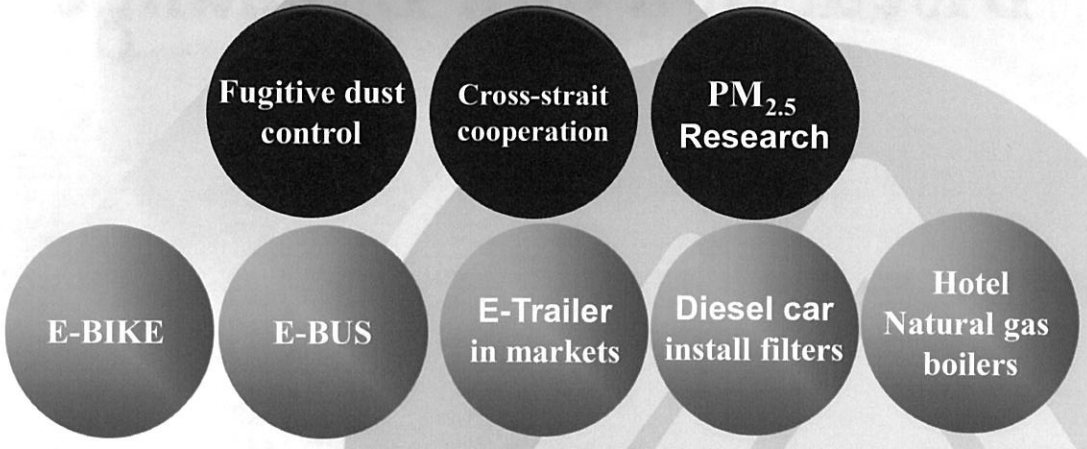


Short-term strengthen measures

2020
$PM_{2.5}$
$\leqq 15\mu g/m^3$

Goal

8 Short-term Strengthening measures



Reducing air pollution

Support green industries

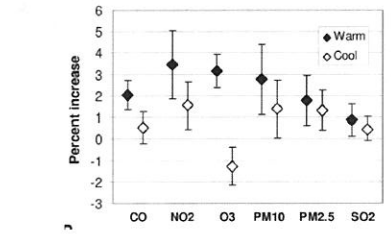
Create new Air Quality Health Index

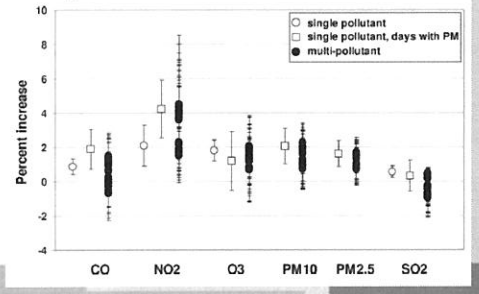
AQHI
(Air Quality Health Index)

CANADA AQHI | HONG KONG AQHI

Health assessment of exposure to multiple air pollutants (Long term monitoring data + national health data)

Native concentration – health reaction equation
(include normal and sensitive group)





低 LOW | 中 MODERATE | 高 HIGH | 甚高 VERY HIGH | 嚴重 SERIOUS

1 2 3 | 4 5 6 | 7 | 8 9 10 | 10+

Taiwan AQHI

Discussion and Exchange

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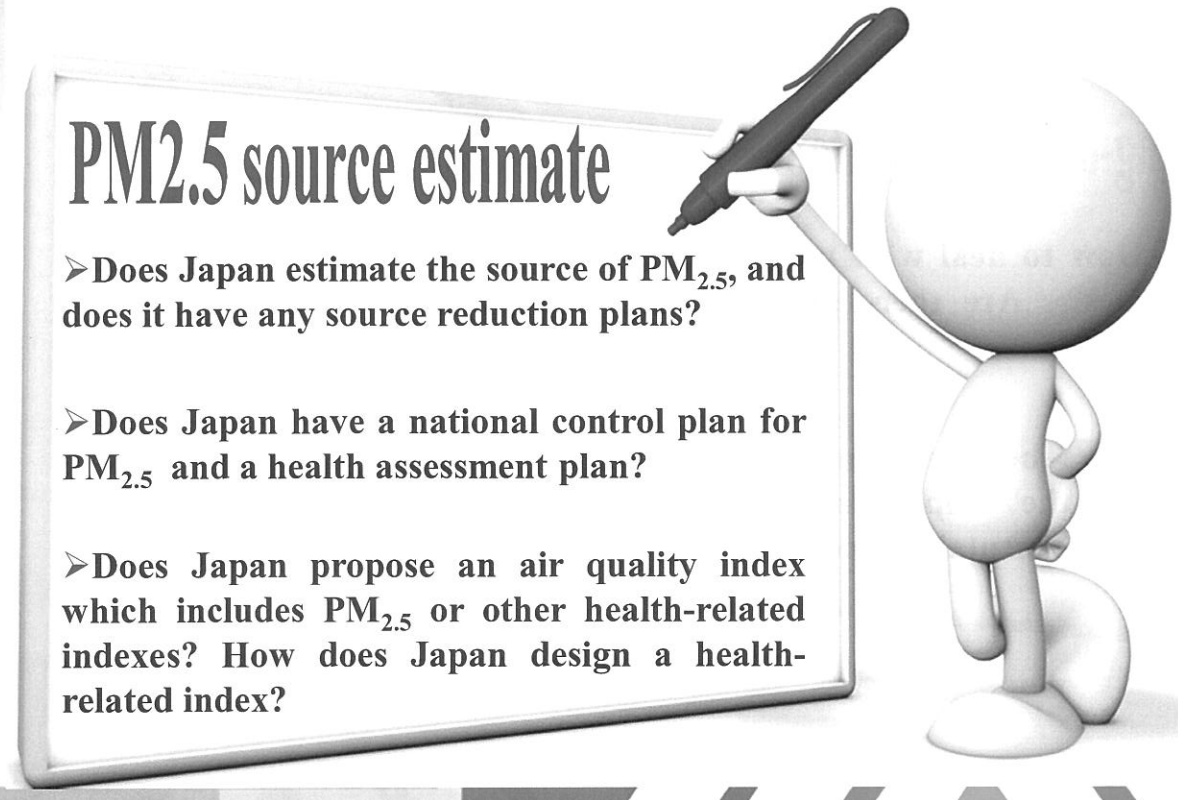
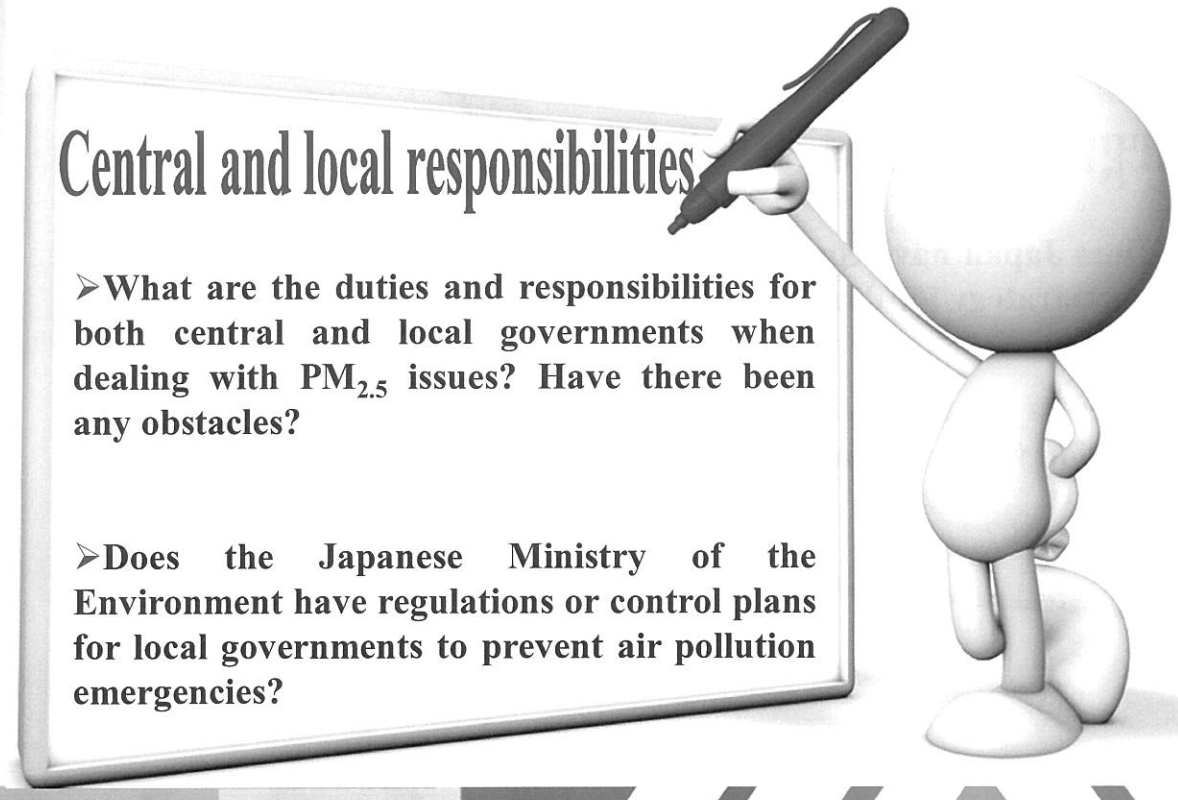


PM2.5 source estimate

- Does Japan estimate the source of $PM_{2.5}$, and does it have any source reduction plans?
- Does Japan have a national control plan for $PM_{2.5}$ and a health assessment plan?
- Does Japan propose an air quality index which includes $PM_{2.5}$ or other health-related indexes? How does Japan design a health-related index?

Discussion and Exchange



Central and local responsibilities

- What are the duties and responsibilities for both central and local governments when dealing with $PM_{2.5}$ issues? Have there been any obstacles?
- Does the Japanese Ministry of the Environment have regulations or control plans for local governments to prevent air pollution emergencies?

Current policy for controlling PM2.5 in Japan

Tatsuya Yanase

History of the Aerial Environment Administration (1)

■ Air Pollution Before the Second World War

Air pollution due to dirty smoke from factories and mines has become an issue since the early Meiji period when industrial development policy has been promoted.

■ High Economic Growth and Intensification of Air Pollution (1)

Air pollution has intensified in conjunction with the increased scale and sophistication of industry in the period of high economic growth after the war. Devastating industrial pollution begining from the Yokkaichi asthma has occured.

* Residents complaining of the symptoms of asthma have emerged in Yokkaichi (Mie Prefecture) in 1961.

From the web page of Yokkaichi

History of the Aerial Environment Administration (2)

■ High Economic Growth and Intensification of Air Pollution (2)

To cope with air pollution, etc. which in such a way occurred in various places,

- 1949~ Tokyo Metropolis, Osaka Prefecture, Kanagawa Prefecture, etc. have enacted their regulations concerning the prevention of air pollution.

Further, at the nation level,

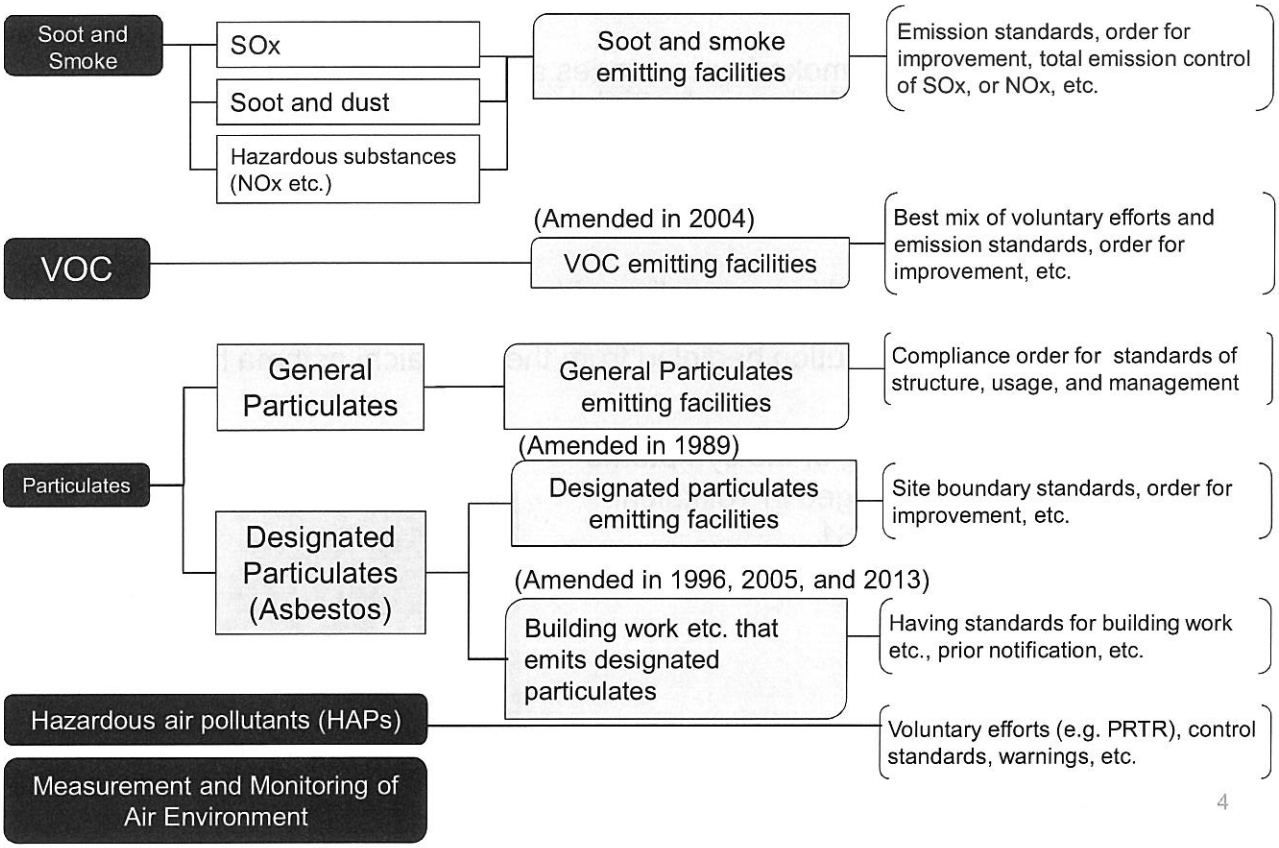
- 1962 The Smoke and Soot Regulation Law was enacted.

* Amended as the Air Pollution Control Law in 1968.

Moreover, as the opinion that basic principles which would serve as the premise for the promotion of measures should be clarified, such as the clarification of the responsibility of persons emitting pollutants and the duty of the admistration, has risen,

- 1967 The Environmental Pollution Prevention Act was formed.

Air Pollution Control Act of 1968



Air Quality Standards

Air Pollutants	Environmental Quality Standards (EQS)	
SO_2 (Sulfur Dioxide)	Daily average values shall be 0.04 ppm or less	Hourly average values shall be 0.1 ppm or less
CO (Carbon Monoxide)	Daily average values shall be 10 ppm or less	Average of hourly values for any consecutive eight hour period shall be 20ppm or less
SPM (Suspended particulate matter)	Daily average for hourly values shall be 0.10mg/m3 or less	Hourly average values shall be 0.20mg/m3 or less
Ox (Photochemical Oxidants)	-	Hourly average values shall be 0.06ppm or less
NO_2 (Nitrogen Dioxide)	Daily average for hourly values shall be within the 0.04-0.06 ppm zone or below that zone	-
PM2.5 (Particulate Matter 2.5)	Daily average values shall be 35 μg/m3	Annual average values shall be 15 μg/m3

5

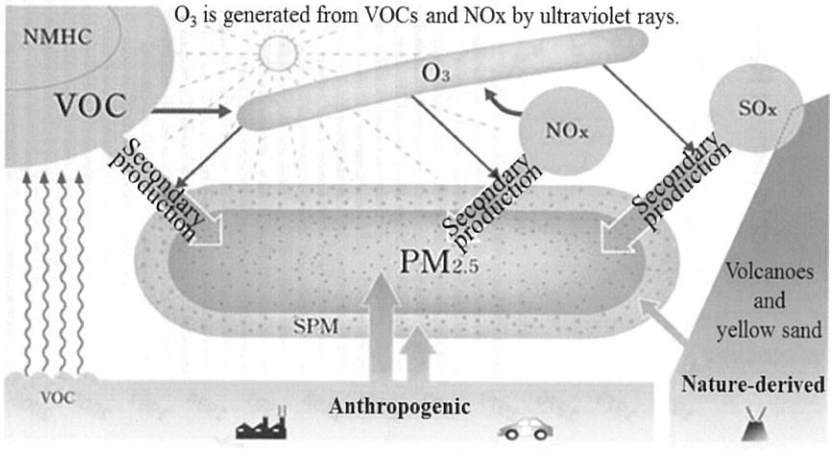
Current Status of Air Environment in Japan

SO_2 **NO_2**

- With regulations such as the Air Pollution Control Law and the Automobile NOx/PM Law, significant improvements have been achieved.

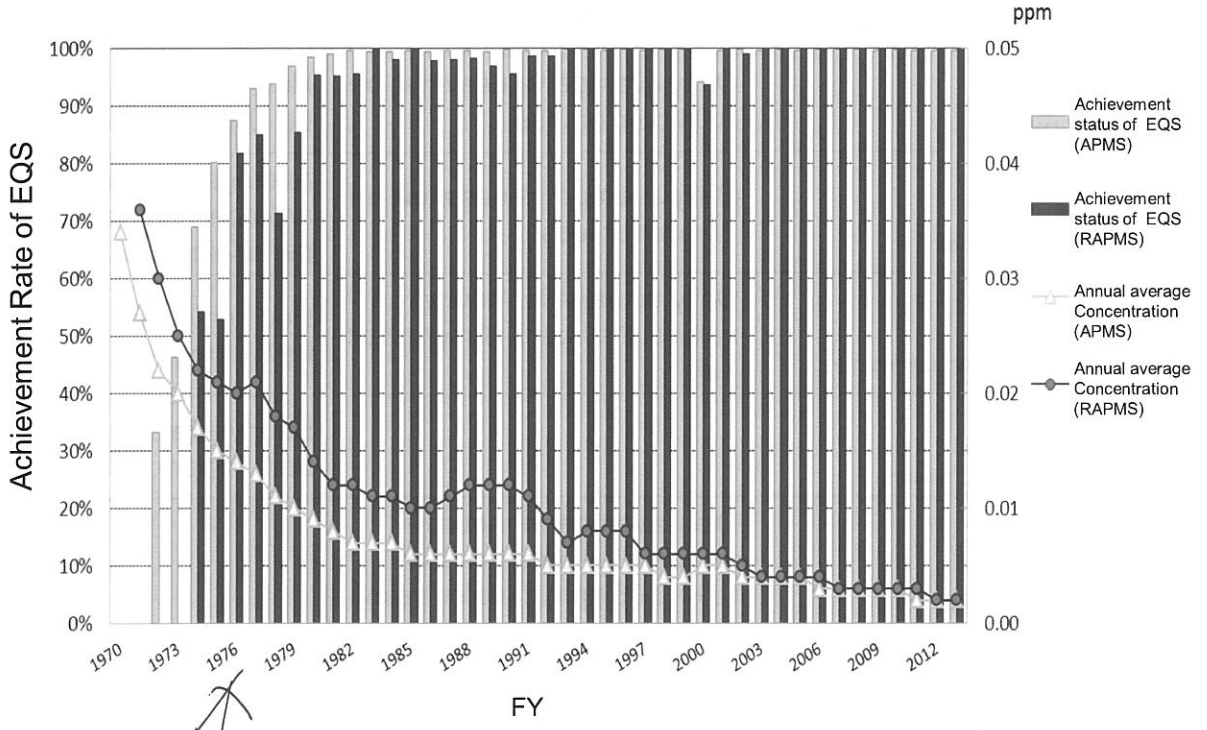
PM2.5 **O3**

- The rate of achievement for environmental quality standard is low.
- The causative substances and source of emission vary widely.
- The emission mechanisms are complicated and inadequately elucidated.



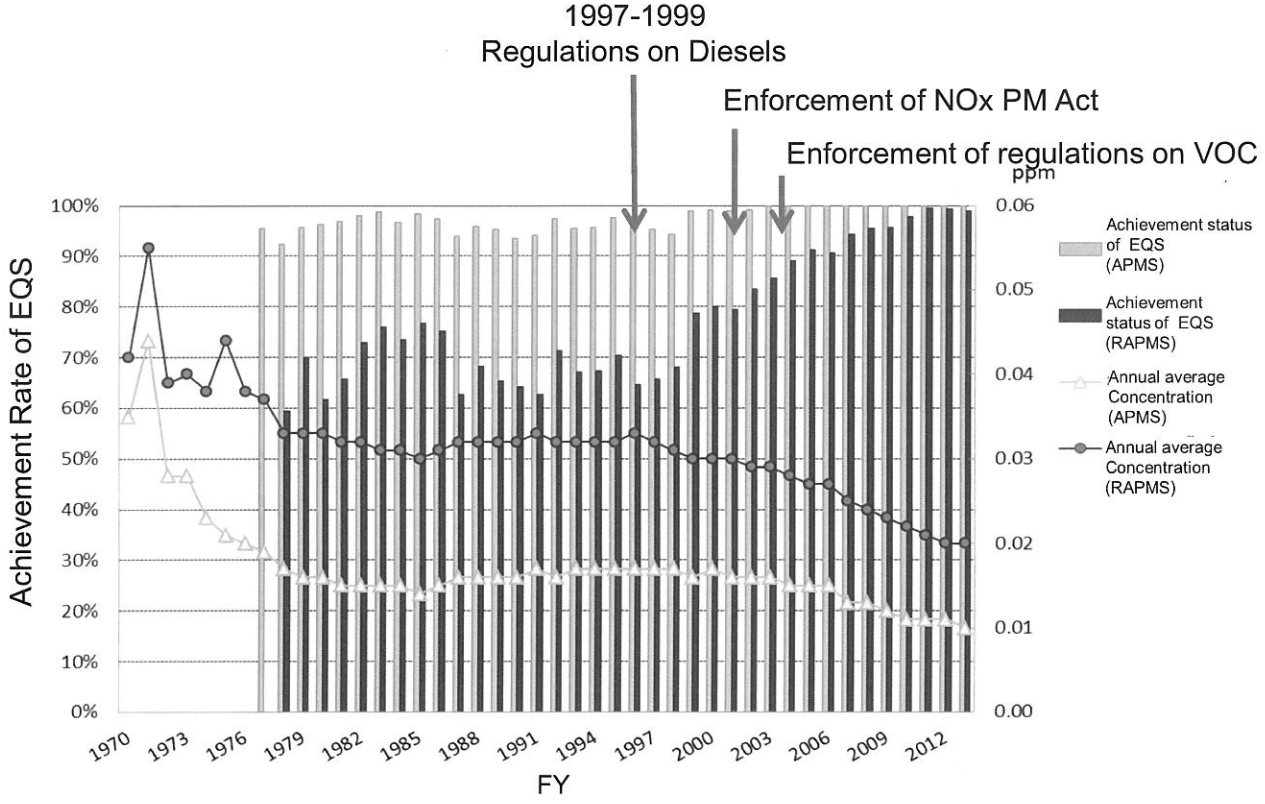
Excerpts from materials of the National Institute for Environmental Studies

Changes in Annual Average Concentrations of SO_2

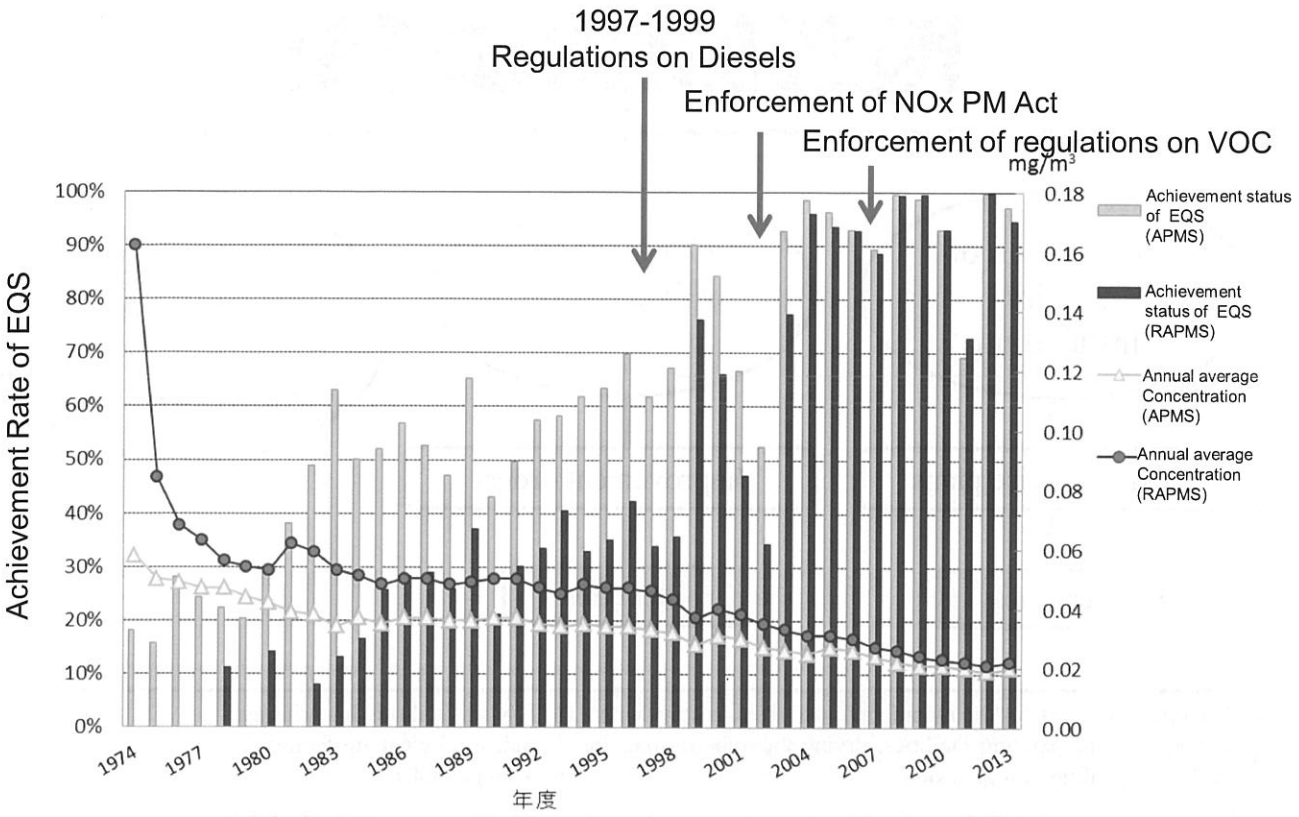


cause for the dramatic drop

Changes in Annual Average Concentrations of NO_2



Changes in Annual Average Concentrations of SPM



Control of Volatile Organic Compounds (VOC)

Statutory regulation

Regulation based on the idea of controlling total VOC emissions

Voluntary corporate efforts

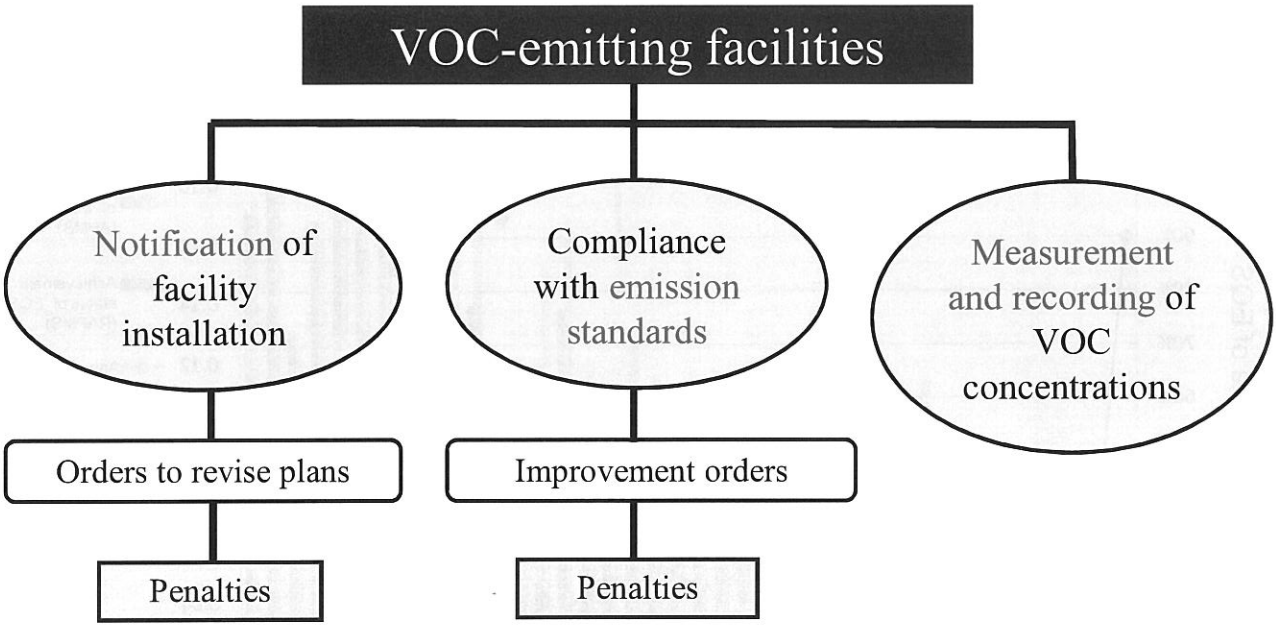
Adopting a broad range of emission control technologies which are actually applicable in reference to such technologies actually adopted

Emission control through by best mix

Progress of efforts

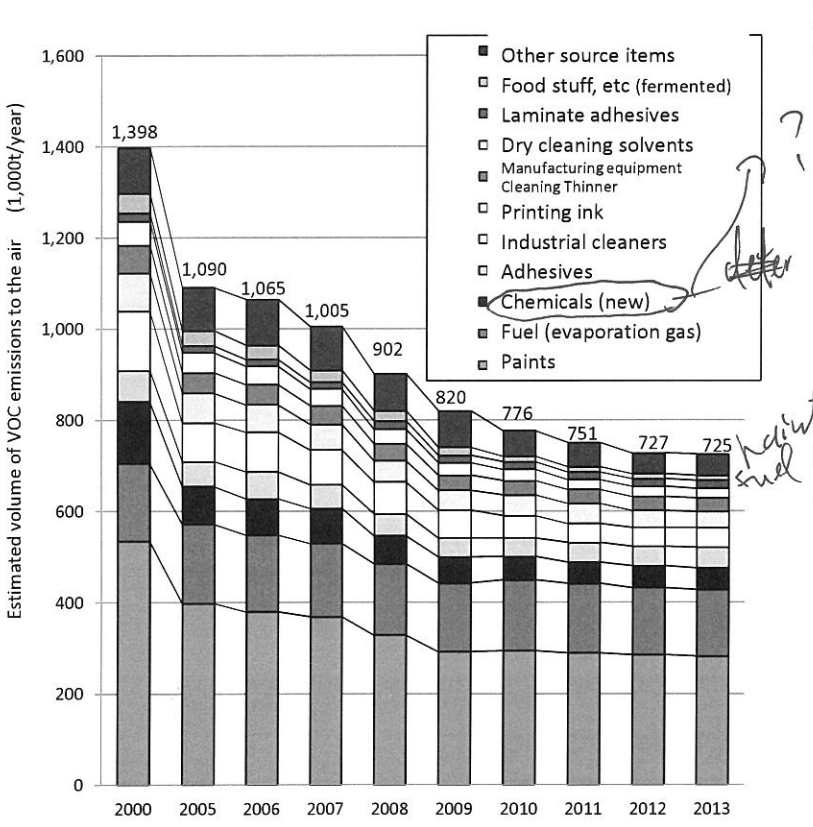
- **The emission control system started in 2005 with a goal of reducing the total VOC emissions in 2000 by 30% by 2010.**
- **The total VOC emissions in 2010 dropped by 44% from the 2000 level.**
- **Efforts to control VOC emissions will be continued.**

Control of VOC Emissions



(1) Drying facilities for the manufacture of chemical products
(2) Spraying and painting facilities, drying facilities for painting
(3) Drying facilities for adhesion
(4) Drying facilities for printing
(5) Industrial cleaning facilities
(6) Storage tanks

Changes in VOC Emissions



Emissions from stationary sources in Japan

1.40 million tons in FY2000

1.09 million tons in FY2005

725,000 tons in FY2013

(48% reduction compared to the 2000 level)

(33% reduction compared to the 2005 level)

[Reference]

Emissions from mobile sources in Japan

490,000 tons in FY2005

350,000 tons in FY2009

VOC emissions have been reduced steadily.

Environmental Standards for PM2.5

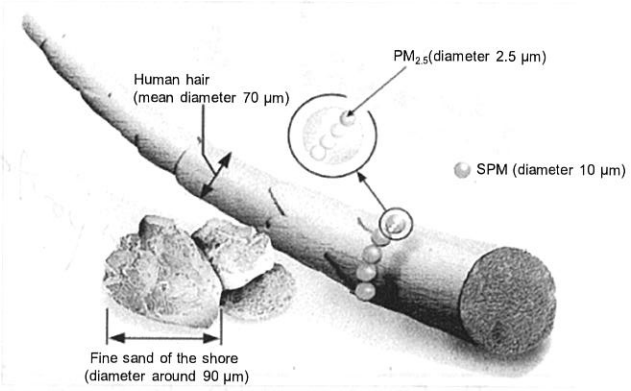
Establishment of the Environmental Standards of Air Pollution Relating to PM2.5

The environmental standards of air pollution relating to PM2.5 was established as follow in September
2009.

One year average 15 μg/m3 or below and one day average is 35 μg/m3 or below

Currently, consideration is carried with the aim of developing the monitoring system of PM2.5 and the
implementation of countermeasures.

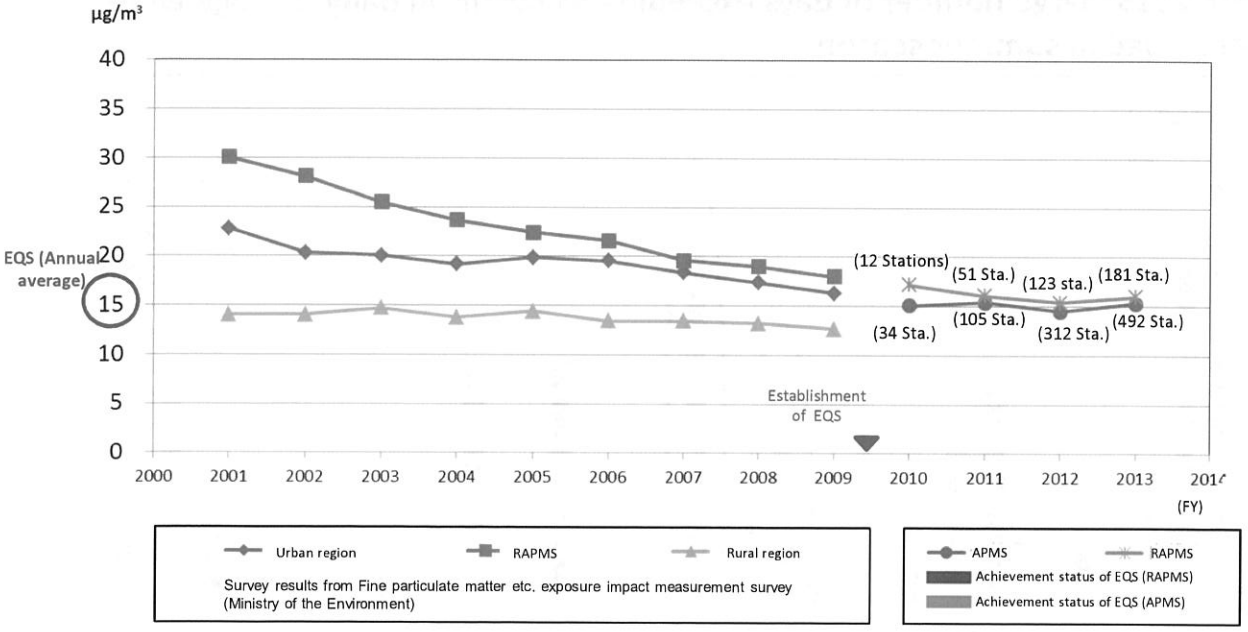
PM2.5 : Particulate matters (PM) drifting in the atmosphere whose particle diameter is 2.5 μg or below. Due to the smallness of their particle diameter, they easily enter into the inner part of the lungs and are raising concern not only for the lung cancer and effects on the respiratory system but also for effects on the circulatory system.



Comparison with the size of PM (human hair and seashore fine sand) (conceptual diagram)

Trends of PM2.5 Concentration in Japan

Annual average PM2.5 concentration is on a decreasing trend. However, the Environmental Quality Standards achievement rates are low – approximately 30-40 %



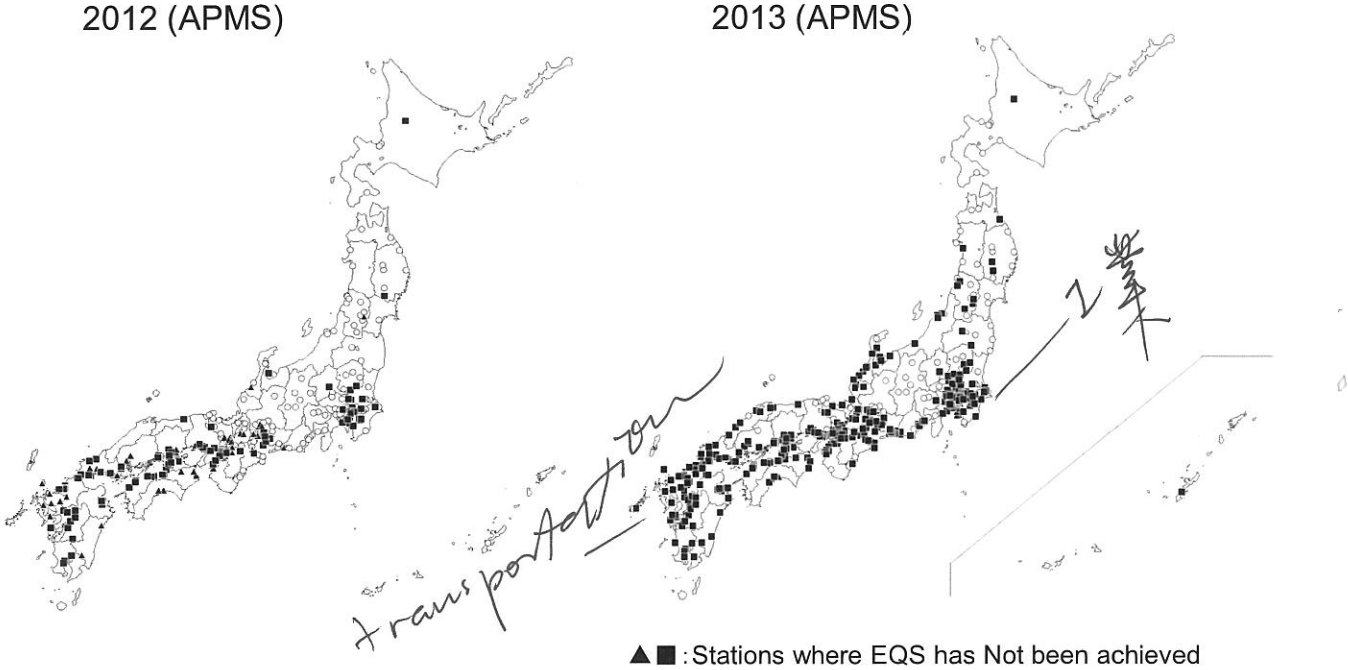
[**APMS** (Ambient air pollution monitoring station)] A monitoring station which monitors the state of ambient air pollution in residential areas
[**RAPMS**(Roadside air pollution monitoring station)] A monitoring station which monitors the state of pollution from automobile exhaust by the roadside

* The monitoring results from FY2001 to FY2009 are by the pilot monitoring project conducted by the Ministry of the Environment, Japan. Since FY2010, nationwide monitoring has been started by local governments through standard monitoring methods.
* Regulations of soot and dust or dioxin emissions for waste incinerators, diesel vehicle emissions, etc. are appreciated as they contributed to the reduction of PM2.5 in the air environment

Achievement Status of PM2.5 Environmental Quality Standards

2012 (APMS)

2013 (APMS)

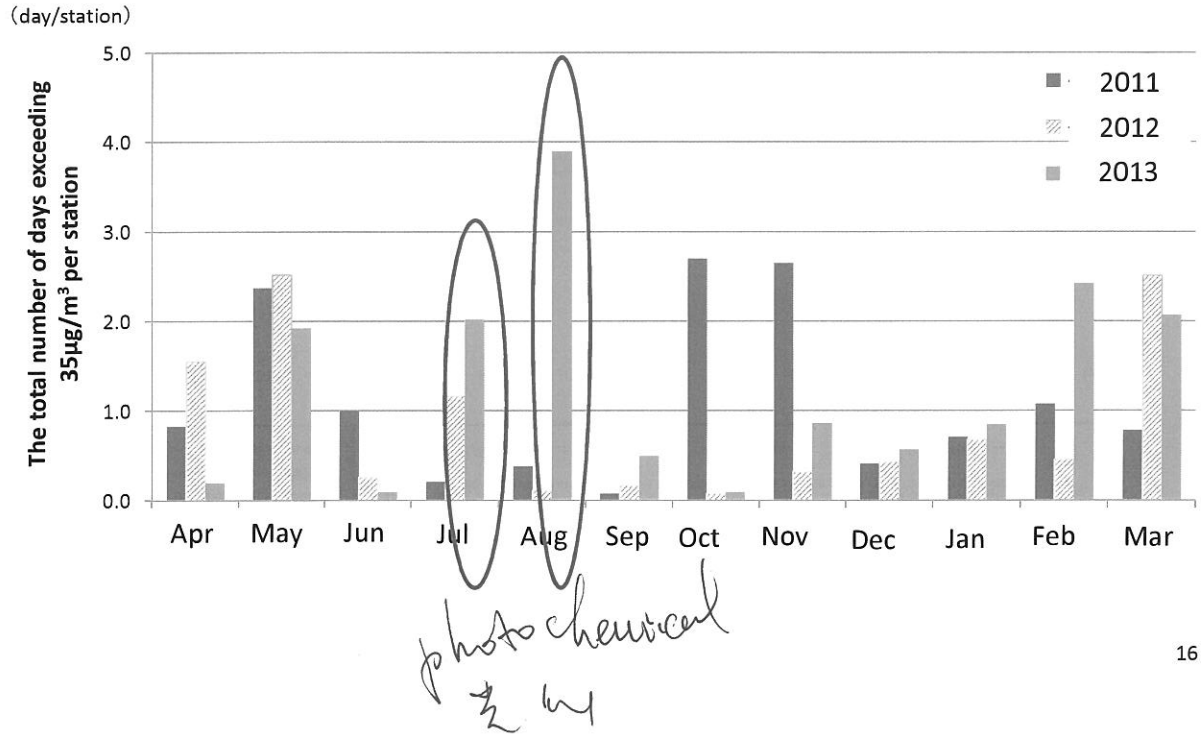


▲■ : Stations where EQS has Not been achieved
○ : Stations where EQS has been achieved

- The Environmental Quality Standards have not been achieved in the large urban regions and in Western Japan

Total number of days exceeding 35μg/m^3

・In 2013, large number of days exceeding 35 μg/m^3 in daily average were observed in summer season

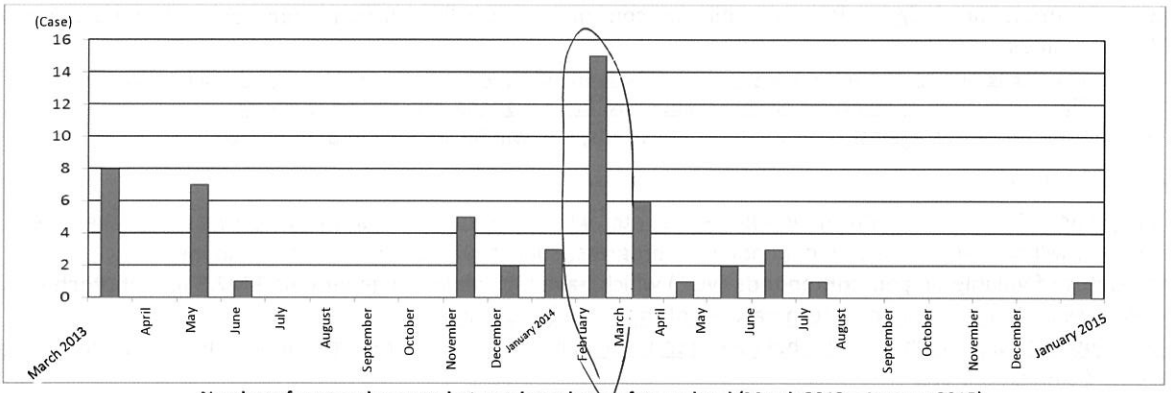


Issuance of Alerts for PM2.5

In February 2013, the "Provisional Guidelines for Alerts" was set, to warn the public to refrain from non-essential outings, or long hours of outdoor strenuous exercise as much as possible, on days when high PM2.5 concentrations are predicted. (Residents are notified through their local government's HP or e-mail)

[Provisional Guidelines for Alerts: Daily average exceeding 70 μg/m³]

- ○ Values used for judging alert issuance (Hourly value)
  - Judgment in early time period, in mornings (5:00 – 7:00) : Excess of **85** μg/m³
  - Judgment prepared for afternoon activities (5:00 – 12:00) : Excess of **80** μg/m³



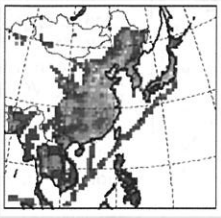
Number of cases where an alert was issued at prefecture level (March 2013 – January 2015)

Comprehensive Efforts on PM2.5 (December 2013)

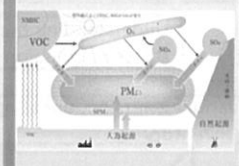
Goal 1 **To secure the safety and reassurance of our nation**	**Goal 2** **To achieve Environmental Quality Standards**	**Goal 3** **To share clean air among the whole Asian region**
Efforts ✓ Improvement of forecast/prediction accuracy ✓ Issuance of alerts	Efforts ✓ Phenomenon clarification of PM 2.5 and Examination of reduction measures	Efforts ✓ Promotion of regional activities

Projects serving as a foundation for these efforts

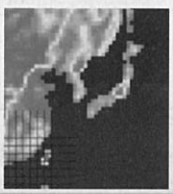
✓ Maintenance of Source Information



✓ Clarification of Secondary Generation Mechanism



✓ Building of Simulation model



✓ Enhancement of environmental air quality monitoring

✓ Accumulation of knowledge on Health effects

The Intermediate Summary Proposal for the National Interim Emission Control Measures for Fine Particulate Matter

of the Central Environment Council Air/Noise and Vibration Committee , Expert Committee on Fine Particulate Matters

On the background of low achievement rate of the environmental quality standards for PM2.5 and growing public attentions for transboundary air pollution, national immediate measures for reducing emissions of PM2.5 is summarized in March, 2015.

【Summary】 **Based upon the fact that there have been issues to be scientifically clarified with regard to the PM2.5 generation mechanism or attributable proportion of individual source, the short, mid- and long-term agendas should be sorted out and the step-by-step measures should be promoted.**

[Short-term Agenda]

Based on current knowledge, existing air pollution control policies will be further promoted, with the perspective of PM2.5 measures.

- The strengthening of emission regulations of soot and dust, and nitrogen oxides (NOx) will be reviewed.
- The introduction of measures against evaporative fuel emissions, etc., will be reviewed.

In addition, measures against motor vehicle emissions, etc. will be steadily implemented.

[Mid- and Long-term Agendas]

Phenomenon clarifications, information gathering, etc., which are fundamental to addressing comprehensive measures, will be worked on, and, depending on progress, additional measures will be examined.

•The status of Volatile organic **compounds** (VOC) which **have** high ability of generating PM2.5 and photochemical oxidant will be clarified, and countermeasures of them will be examined

•Air pollution sources with high attributable proportion will be estimated through source information gathering and advanced simulation, etc.

Provisional Plan