Current status and future potential of the multi-pollutant approach to air pollution control in Japan, China, and South Korea

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Rationale

Discussed at Tripartite Environment Ministers Meeting

Worsening Air Pollution in East Asia

- Transboundary
- Domestic

- Need to Link to Climate Change (Cobenefits & Cost Effectiveness)
- Increasing Complexity: Secondary Pollutants (PM2.5 & Ozone) composed of primary pollutants

How can international (regional) cooperation help?

Lessons from LRTAP in Europe? (Convention on Long Range Transboundary Air Pollution)

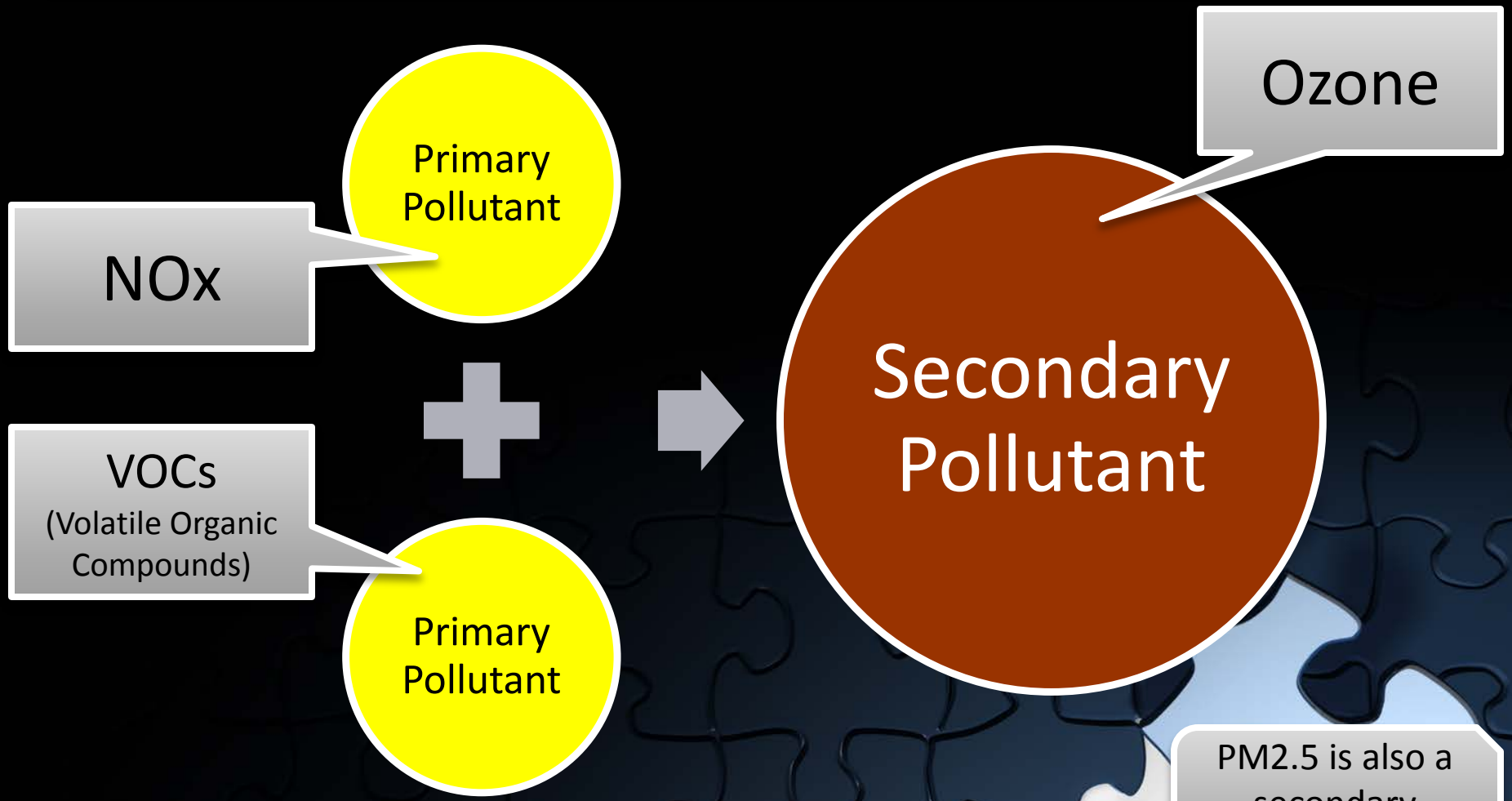
- Legally binding treaty
- Multi-pollutant Multi-effect approach (MPME)

This presentation focuses on MPME

Main functions of MPME:

- Address secondary pollutants like ozone (addresses multiple pollutants and complexity)
- Address multiple effects (environment & health)
- Improve cost effectiveness of reduction measures

Secondary Pollutants & Primary Pollutants



It is more effective to regulate secondary pollutants based on primary components (rather than simply regulate secondary pollutants)

Research Questions

1. What is the potential for using MPME in East Asia (with different conditions than Europe)?

2. What are the main components of MPME?

3. To what extent are China, Japan, Korea already implementing MPME?

4. What kinds of capacities, institutions, administrative mechanisms are necessary for implementation?

5. How can international (regional) cooperation assist?

Rationale:

- Concept is complex & confusing
- Typical interpretation based on LRTAP
- Hard to compare to other countries

Methodology:

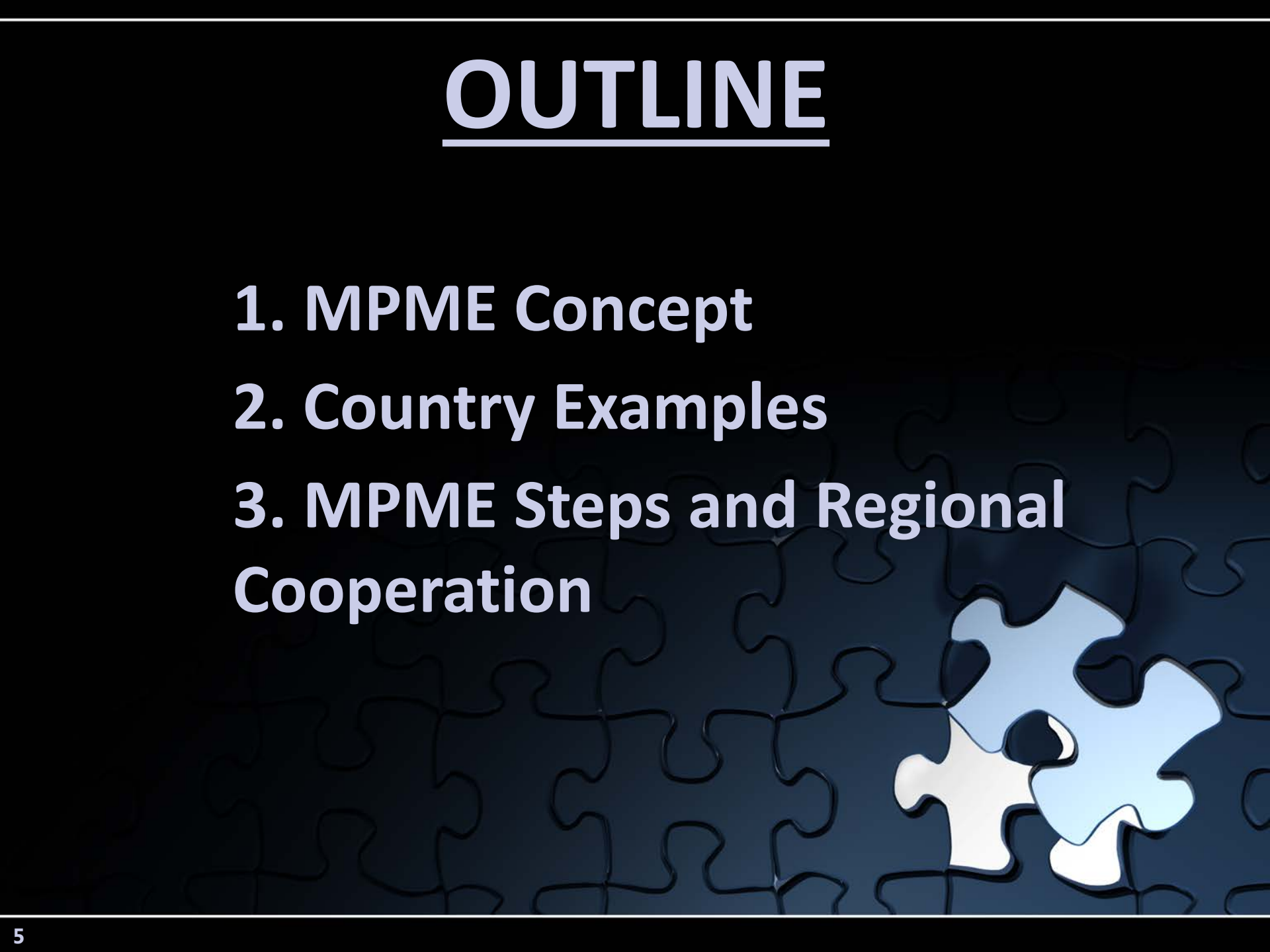
- Inductive approach
- Analyzed cases of LRTAP, US, China, Japan, Korea, Thailand

Methodology:

- Policy documents
- Interviews with experts and government officials

OUTLINE

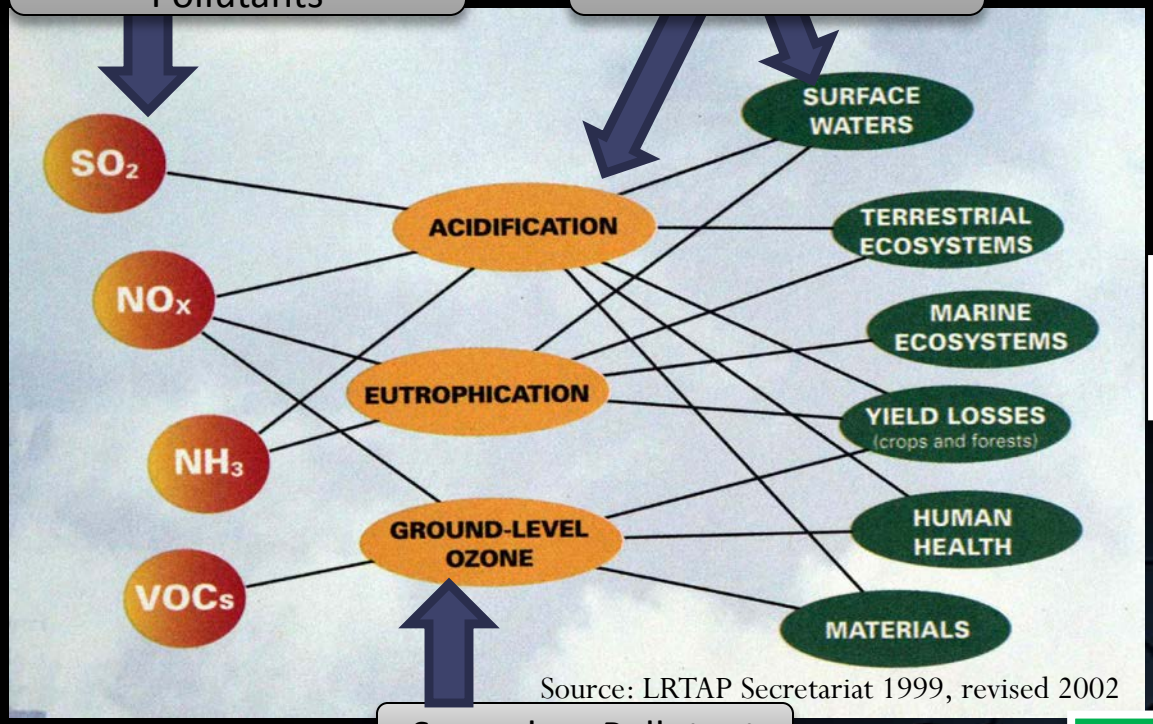
1. MPME Concept
2. Country Examples
3. MPME Steps and Regional Cooperation



Concept map of the Multi-pollutant Multi-effect (MPME) approach in the Gothenburg Protocol of LRTAP

Multiple (Primary) Pollutants

Multiple Effects



Secondary Pollutant

Integrated Modeling (RAINS => GAINS) / EMEP Monitoring

- Interactions among pollutants
- Effects of pollutants
- Reduction technologies
- Reduction costs
- Transboundary movement

MPME Elements

A. System of Scientific Analysis
B. Target Concept & Rationale
C. Recommendations for targets

MPME's Role in the LRTAP/Gothenburg Protocol

MPME as a system of scientific analysis

Can conduct analysis without linking to a treaty

MPME Role: Support Negotiations

- Informs target setting
- Cost-benefit optimization
- Target concept, principles
- Scientific justification

MPME as a science policy interface

GOTHENBURG PROTOCOL

- Legally binding treaty
- Reduction targets informed (recommended) by MPME
- But actual targets are decided politically
- Countries have different targets
- Targets are cost optimized

Note: Gothenburg/MPME is an integrated approach, but not comprehensive (still room for more)

Negotiations for Revision of Gothenburg Protocol

- How to incorporate new pollutants (e.g. PM2.5)
- How to incorporate climate change?

Example of adding new pollutants, new effects

Concept Development: Multi-Pollutant & Multi-Effects

Multi-Pollutant and Multi-Effect dimensions can be distinguished

Need to distinguish:
a) scientific aspects
b) policy aspects

MPME is a scientific decision tool to inform policy & target setting

Transition from a Single Pollutant to a Multi-Pollutant Approach

Scientific Aspect of MP Approach

- Focus on secondary pollutants (PM, ozone)
- Analyzing interactions among primary pollutants
- (Not just increasing quantity of pollutants addressed

Control Strategy		Description	Example
Single Pollutant Control	**Phase 1 (S1)**	Managing one or more primary pollutants individually	Direct toxicants (NO2, Sulfur, VOC, Heavy Metals), precursors for simple secondary pollutants (NOx and Sulfur for acid control)
	Phase 2 (S2)	Managing complex secondary pollutants through one primary pollutant	VOC or NOx for Ozone control
Multi Pollutant Control	**Phase 1 (M1)**	Managing a secondary pollutant through multiple primary pollutants	VOC and NOx for Ozone control, Sulfur for PM2.5 control
	Phase 2 (M2)	Managing multiple secondary pollutants and toxicants in an integrated way	Simultaneous Ozone and PM management

Policy focus:

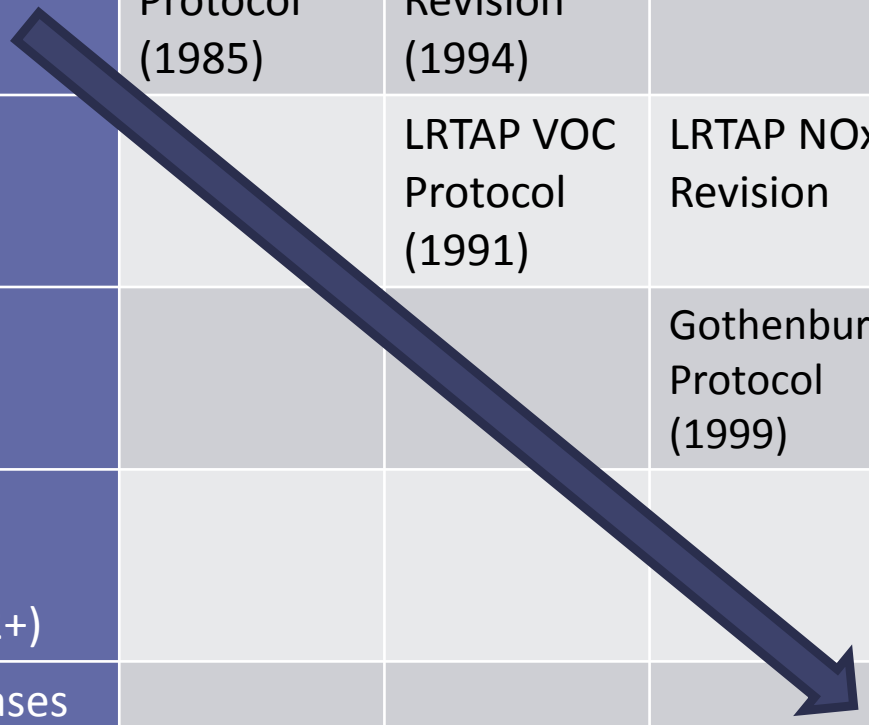
- Focus on secondary pollutants) by managing components
- MP is not a list of several pollutants regulated separately

Multi-Effects Concept

	Multi-Effects (ME)
Scientific Analysis	• Analysis of several effects • Complex integrated modeling • Needs considerable scientific capability
Link to Policy, Regulation	• Extent to which effects are considered in setting targets • Considering several effects
Comparison with "single" effects	• Even analysis of single effects is not easy • Single-effect analysis foundation needed to analyze multiple effects

Progression of MP & ME Implementation in LRTAP

	Multi-effects → Multi-pollutants ↓	Effects Supported	Effect-based	Multi-effects	Climate	Risk-based
S1	Direct toxicant or acid component (1)	LRTAP Sulfur Protocol (1985)	LRTAP Sulfur Revision (1994)			
S2	O3 or PM Component (1)		LRTAP VOC Protocol (1991)	LRTAP NOx Revision		
M1	O3 or PM Component (2)			Gothenburg Protocol (1999)		
M2	O3, PM, Acid, component, toxicant, etc. (2+)					
	Greenhouse Gases				Gothenburg Revision (2012)	



Multi-pollutant and multi-effect aspects progress in parallel in LRTAP

Main Arguments

Conventional Thinking

- MPME is an integrated approach.
- MPME is closely linked to a legally binding treaty (LRTAP).
- Therefore, MPME may not be feasible in East Asia

Main Results

- MPME consists of several components.
- MPME is a system of scientific analysis, not a treaty
- MPME assists decision making about targets (sci./policy link)
- MPME improves effectiveness, lowers costs
- Can set targets without MPME, but will be less effective
- Components can be separated and implemented in steps
- China, Japan, Korea, already moving towards MPME steps (can be used domestically, not just for international treaties)
- Less developed countries can also begin steps

MPME is a science policy interface

International cooperation can be helpful without a treaty

- Focus can be on information sharing & capacity building
- Can use MPME in E. Asia as a scientific system w/o a treaty
- Scientific epistemic community can promote MPME

2. COUNTRY EXAMPLES

US Case

US typically uses a single pollutant approach.

US legal & regulatory framework is not suited to MPME.

US has domestic transboundary air pollution issues (also international transboundary issues with Canada).

However, USEPA has been trying to develop & implement MPME in a stepwise approach since the 1990s.

US has been promoting MPME-type research on multiple effects

US calls it a “Multi-pollutant” approach, but its efforts include effects.

Some pilot projects and voluntary initiatives with states & companies (since MPME can reduce costs).

MPME as scientific analysis

EPA uses a different name

Legally binding approach may be helpful, but not necessary

Cost incentive is important for voluntary action

MPME can be implemented:

- In steps
- In a voluntary context (cost motivation)

China Case

POLICY ASPECTS

- China regulates multiple pollutants
- Secondary pollutants now regulated (PM2.5, O3)
- Concept: co-control (climate & air)
- Government promotes scientific analysis
- Analysis of interactions and effects not directly used in policy
- Targets, standards are based on technological feasibility, economic considerations, other countries
- Regional management plan for domestic transboundary air pollution (future domestic LRTAP?)

SCIENTIFIC ANALYSIS

- China (including a few major cities) has some capability to analyze effects and interactions, but not enough to implement nationwide
- Research on air-climate cobenefits
- Research on health impacts
- Increased monitoring (incl. PM2.5)

Implications

- **China is already moving towards a domestic MPME**
- **Development of MPME in China can be further encouraged**

China: Regional Air Pollution Management

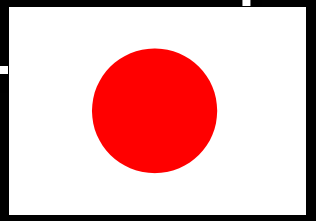
12th Five Year Plan On The Prevention And Control Of Air Pollution In Key Regions

- Address regional transboundary pollution (from Beijing Olympics, etc.)
- Designates key regions and city clusters
- Sets up coordination mechanisms
- Additional pollutants (PM2.5, Ozone, VOCs)
- Stronger targets & implementation measures
  - (e.g. stronger EIA, tech. requirements, industrial adjustment, key projects, etc.)

Analysis

- Good policies on paper / difficult to implement
- Sets up a coordination structure
- (But coordination may be difficult)
- Originates from Beijing Olympics w/modeling
- Modeling/MPME analysis could be incorporated
- Could become domestic LRTAP

Japan Case



Need for multi-pollutant approach not widely recognized until recently

Transition motivated by low attainment of EQS for photochemical oxidants

Single pollutant Phase 1	Single pollutant Phase 2	Multi pollutant Phase 1	Multi pollutant Phase 2
Japan used historically (1970s =>)	VOC emission reduction policy to address SPM & oxidants (2004)	NA	Follow-up scheme to the VOC policy (2012)

- Based on a policy mix of legal control &voluntary action plans.
- Policy target overachieved (44.1% reduction from 2000-2010 instead of 30%).
- Still attainment of photochemical oxidant's EQS remains extremely low.

- Panel recommended new committee to address not only VOC, but also photochemical oxidants & PM2.5.
- Consideration: the complex linkages among VOC, photochemical oxidants and PM2.5, need for data on VOC emissions & effectiveness in emission reduction, and need to reduce business costs.

Policy Implications

- Need for further research on chemical reaction
- Need more accurate modeling & integrated assessment systems to improve analysis of effectiveness of reduction policies of precursors

South Korea Case

- Risk based management concept introduced in 1980s
  - Research mainly on single pollutants & basic risk assessment
  - Research results not generally accepted by policymakers
  - Integrated MPME perspective is needed to incorporate results into policy
- MPME concept is not used in Korea, but similar efforts have been made or are underway
  - Secondary pollutants addressed in policies related to Seoul (2003, 2005) (NOX, SOX, VOC, PM10)
  - Korean policies are moving in the direction of risk based comprehensive systemic management, including toxicology
  - Discussions on integrated management which includes air environment, energy, climate (and considering state of the economy, possibility of employment creation) (E.g. Green growth policies linking air & climate)
  - Focus of PM is shifting from PM10 to PM 2.5
  - NIER & IIASA collaboration on integrated climate & air to develop GAINS Korea from 2013

Comparison of Single/Multi-Pollutant Transition Status in Case Study Countries

Phase	Japan	China	South Korea
Single Pollutant Phase 1	Initial policy	Initial policy (regulating several pollutant)	Initial policy
Single Pollutant Phase 2	VOC for ozone & PM10	Policy transition?	Capital region
Multi Pollutant Phase 1	NA	Policy transition?	PM 2015 Management Plan: NOx & VOC for PM2.5
Multi Pollutant Phase 2	Transition to integrated ozone, PM2.5 & VOC discussion	Research & policy trend (regional management)	Policy in transition to risk-based management

Note: This table was not included in the paper.

Capacity for MPME

Key Foundation: Scientific Capacity
(Many developing countries lack)

Scientific

- Analytical capability (human resources)
- Multidisciplinary cooperation
- Monitoring capability

Administrative

- Officials need some technical understanding
- Ability to coordinate between departments
- Legal framework that allows differentiated targets

International cooperation

- Means for international cooperation among scientists
- Mechanism for information sharing
- Means for scientists to communicate with policymakers

MPME Steps and Choices: Overall

Main Ideas
➢ MPME can be introduced in a stepwise manner
➢ Range of possible focuses for pollutants & effects
➢ Focus first on scientific analysis, then incorporate into policy (variable scientific support for an influence on targets)
➢ Targets: range of possible magnitudes, types, principles

Scientific Analysis

- Start with studies & models
- Focus on interactions & effects
- Less emphasis on transboundary aspects

Policy

- Start with domestic policy framework
- International cooperation can use various models
- International cooperation can be voluntary
- May recommend differentiated targets

3. MPME STEPS AND REGIONAL COOPERATION

MPME Steps and Choices: Countries with Underdeveloped Capacity

Start with basic capacity development (science and policy).

However, MPME is needed to increase effectiveness & reduce costs.

Reduction policies for 2ndary pollutants (PM2.5, ozone) may be needed before sufficient domestic MPME science & policy capacity exists

- Countries can adopt policy frameworks & targets developed by others (without conducting extensive domestic analysis)
- Targets can be based on technological or economic feasibility (rather than analysis of effects or interactions among pollutants).

International cooperation

- Can emphasize capacity building initially
- Transboundary aspects need not be emphasized initially

MPME and Regional Cooperation

MPME may be a good focus for the international cooperation framework and science policy interface.

Focus on scientific aspects & capacity building at first, but also start on a path to reach agreement on reductions later.

EANET already covers monitoring

Not necessary to link with a legally binding agreement/treaty.

This will help countries implement unilateral domestic policies (countries are already moving in this direction).

Emphasize cost savings and co-benefit aspects.

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