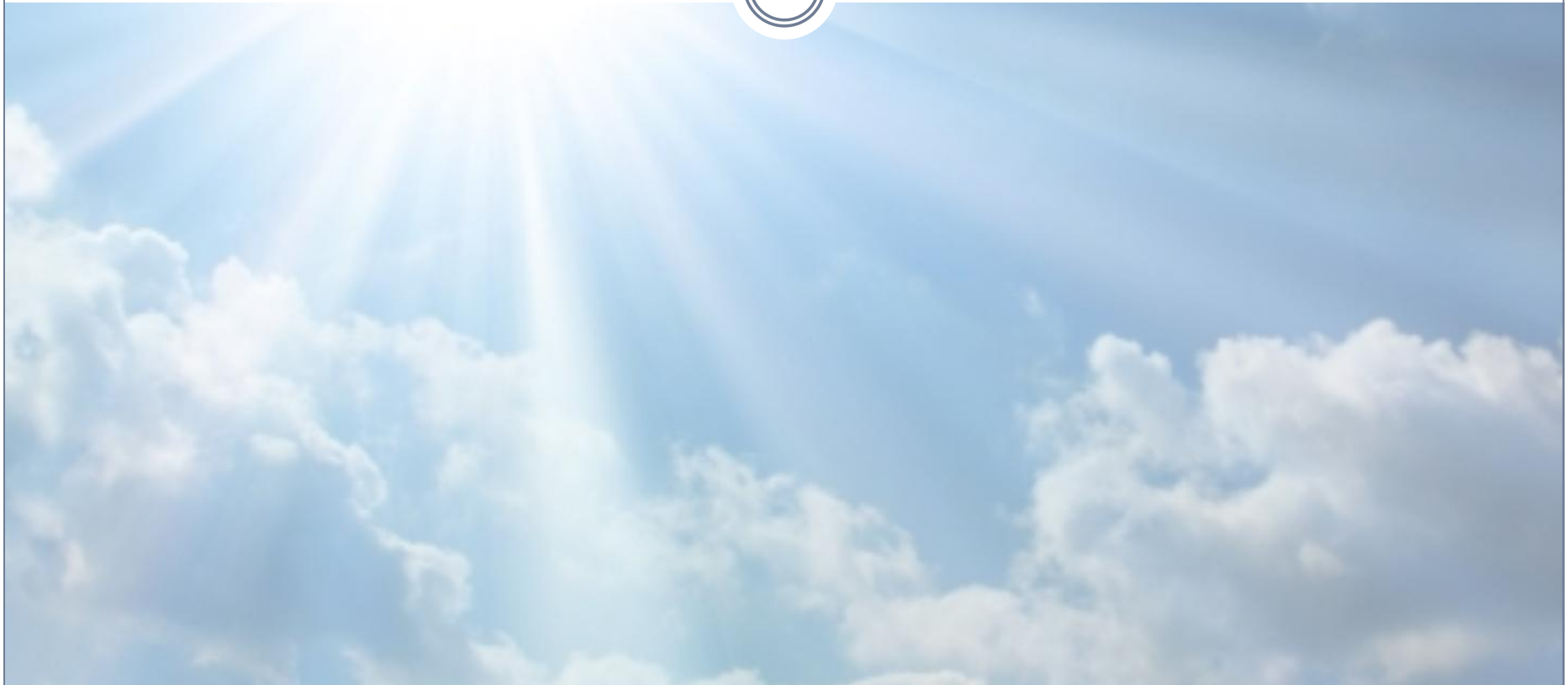


# **Air Quality Monitoring and Control in the Pearl River Delta Region**

## **CASE STUDY**



# Contents

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- Background
- Air quality monitoring system
- Progress and problems
- Scope of changes
- Option
- Timetable
- Implementation
- Top-down and bottom-up elements

# What is Air Pollution?

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## **Major pollutants:**

- NO<sub>2</sub> - nitrogen dioxide ,
- SO<sub>2</sub> - sulphur dioxide,
- O<sub>3</sub> - ozone,
- CO - carbon monoxide
- RSP - respirable suspended particulates (with a nominal aerodynamic diameter of 10 micrometers or smaller)

## **Direct consequences:**

- Poor visibility,
- Smell,
- Respiratory and cardiovascular illnesses.

# Air Pollution Sources in HK

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Local	Regional
<p>Street-level diesel vehicles: road vehicles and marine source.</p> <p>About 53% of the time (per year)</p>	<p>Smog motor vehicles, industry and power plants.</p> <p>About 36% of the time (per year)</p>

## Strategies

<p>Implementing measures locally.</p>	<p>Cooperation with Guangdong Provincial Authorities to implement a joint plan to solve the regional air pollution problem.</p>
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# Air quality monitoring in PRD

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## Separate Monitoring Systems



HK

Guangdong Province

## Pearl River Delta Regional Air Quality Monitoring Network



16 automatic air quality monitoring stations in HK and Guangdong

# Air Quality Monitoring Network of HK

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**14 fixed monitoring stations.**  
The Air Pollution Index (API)

The network is certified by the Hong Kong Laboratory Accreditation Scheme (HOKLAS).



# The Pearl River Delta (PRD) Regional Air Quality Monitoring Network

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Established in  
2003-2005

the Guangdong Provincial Environmental Monitoring Centre (**GDEMC**) and the Environmental Protection Department of Hong Kong (**HKEPD**)

the Guangdong - Hong Kong Quality Management Committee (**the QMC**)

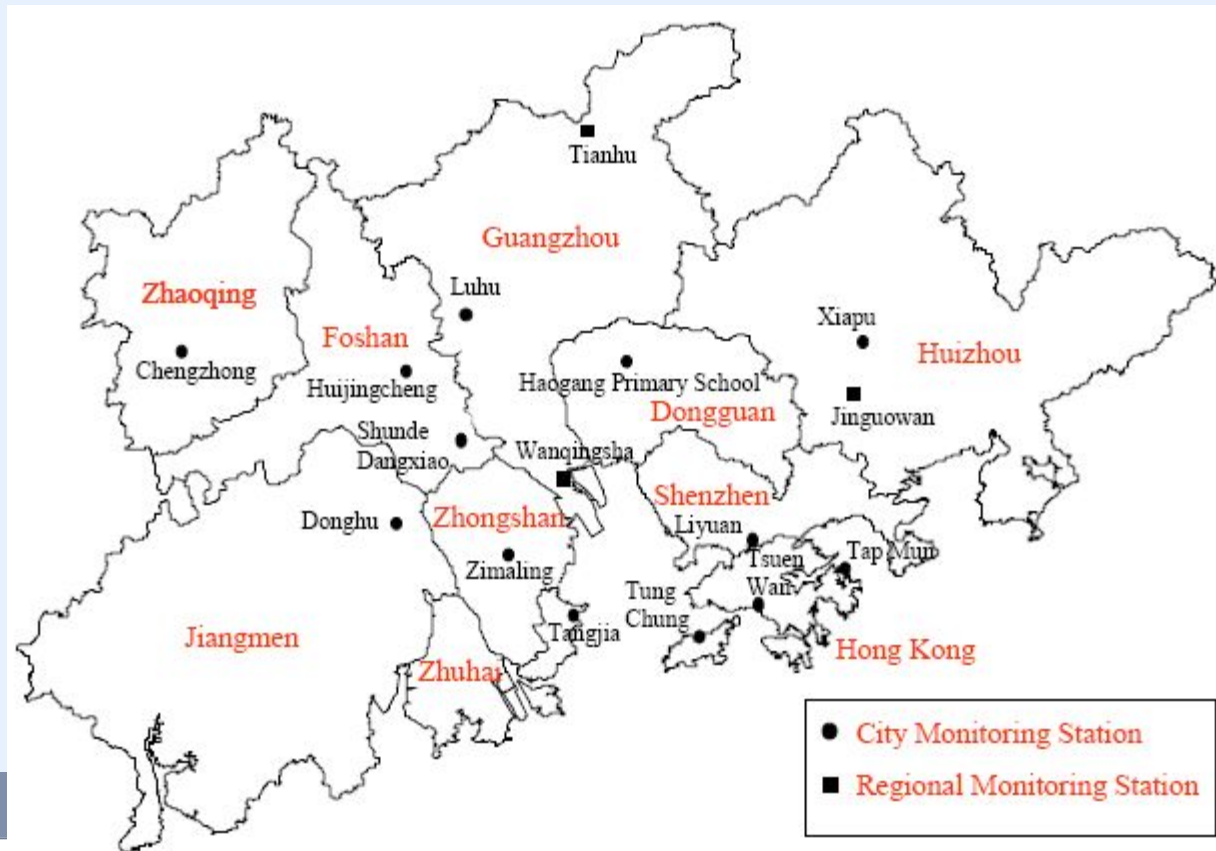
the “Standard Operating Procedures on Quality Assurance and Quality Control of the PRD Air Quality Monitoring System for Hong Kong and Guangdong”  
(**QA/QC Operating Procedures**)

# The Network Structure

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**16 automatic air quality monitoring stations** – 3 of them are located in Hong Kong and managed by the HKEPD.

The Regional Air Quality Index (RAQI).





# Regional Progress in Reducing Air Pollution (2010)

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Pollutant	Reduction in the average annual concentrations	
	Compare to 2006	Compare to 2009
sulphur dioxide	by 47%	by 14%
nitrogen dioxide	by 7%	remained about the same
respirable suspended particulates	by 14%	by 7%

# Annual Averages of the Pollutants

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	Sulphur Dioxide	Nitrogen Dioxide	Ozone	Respirable Suspended Particulates
2006	0.047	0.046	0.048	0.074
2007	0.048	0.045	0.051	0.079
2008	0.039	0.045	0.051	0.070
2009	0.029	0.042	0.056	0.069
2010	0.025	0.043	0.053	0.064

*All units are in milligrams per cubic metre*

# Recent study of Particulate Matter results (February, 2012)

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Over the period 1998-2008:

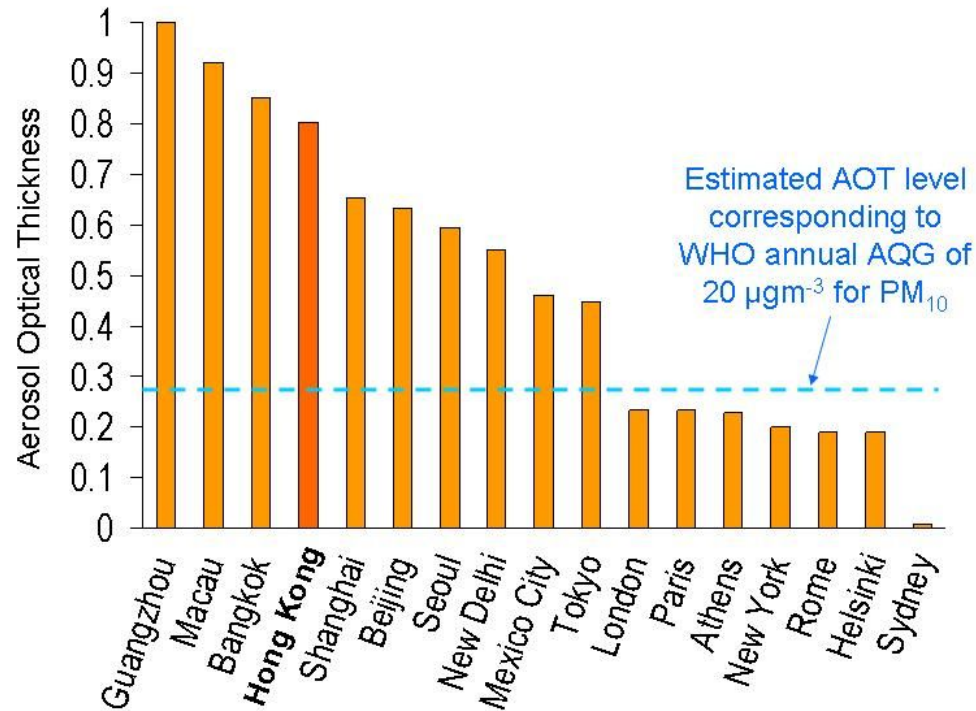
- *the lack of significant change in Hong Kong ambient PM<sub>10</sub> levels over the previous decade arises from a significant increase in non-local sources offsetting the significant reductions in vehicle exhaust PM from Hong Kong emission control measures.*
- *emissions reductions from both the PRD and more distant sources are critical to improving air quality in Hong Kong.*

# Range of Problems

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1. *Poor performance. Some of the worst air quality in the world.*

**NASA data indicate poor air quality in Hong Kong:  
A global snapshot in April 2011**



# Range of Problems (cont.)

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*2. Externalities, pollution cost are often not counted;  
Who should pay?*

- voluntary actions scope is limited
- government regulations may be the least costly solution.

Ordinary citizens are strongly affected (health cost)

Business (competitiveness cost)

Government (healthcare cost)

- Hong Kong ranks 71st in the world in the quality-of-living survey compared with No. 28 for Singapore (2011).
- Around 40% of the American Chamber of Commerce in Hong Kong member companies had trouble recruiting people because of air pollution (2008).

# Range of problems (cont.)

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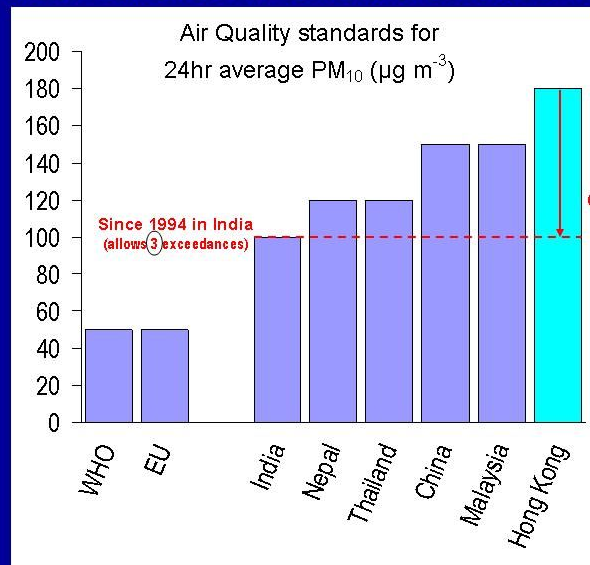
## 3. Monitoring:

- Outdated Air Quality Objectives
- Uneven distribution of monitoring stations in HK
- Data accuracy (*ex. health impact assessment*)
- Data transparency.

*Effectiveness of measures from both sides.*

*Targets, standards and methods used.*

Hong Kong Air Quality Objectives (HKAQO) are very outdated even in Southeast Asia region...



Government proposed new HKAQO in 2009 as 100µg<sup>-3</sup> (allows 9 exceedances)

Our government's proposed AQO is therefore still worse than the standard in India 15 years ago!!

# Comparison of HK AQO (1987) and WHO AQG (2006)

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	Averaging Time	Current AQO	Concentration in micrograms per cubic metre			
			Interim Target - 1	Interim Target - 2	Interim Target - 3	AQG
Sulphur Dioxide (SO <sub>2</sub> )	10-minute	--				500
	24-hour	350	125	50		20
Respirable Suspended Particulates (PM <sub>10</sub> )	24-hour	180	150	100	75	50
	1-year	55	70	50	30	20
Fine Suspended Particulates (PM <sub>2.5</sub> )	24-hour	--	75	50	37.5	25
	1-year	--	35	25	15	10
Nitrogen Dioxide (NO <sub>2</sub> )	1-hour	300				200
	1-year	80				40
Ozone (O <sub>3</sub> )	8-hour	240 <sup>[1]</sup>	160			100
Carbon Monoxide (CO)	15-minute	--				100,000
	30-minute	--				60,000
	1-hour	30,000				30,000
	8-hour	10,000				10,000
Lead (Pb)	1-year	1.5 <sup>[2]</sup>				0.5

Note:

<sup>[1]</sup> 1-hour average

<sup>[2]</sup> 3 month average

# Scope of Changes

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If we take WHO AQG and the highest annual pollutants concentrations, we can roughly calculate that:

- SO<sub>2</sub> emissions is about 7,5 times larger
- NO<sub>2</sub> – 1, 73 times larger
- PM 2,5 – 4,1 times larger
- PM 10 – 3 times larger



# Comparison of 2008 SO<sub>2</sub> concentrations with WHO guidelines

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Air Pollutant	Avg time	WHO AQG / IT (ug/m <sup>3</sup> )	Highest Concentration in 2008 (Ambient)	Highest Concentration in 2008 (Tap Mun)
SO <sub>2</sub>	10-min	AQG: 500	1173	409
	24-hour	IT-1:125	149	71
		IT-2: 50		
		AQG: 20		

## Number of exceedences

Air Pollutant	Avg time	WHO AQG / IT	No. of Exceedences in 2008 (Ambient)	No. of Exceedences in 2008 (Tap Mun)
SO <sub>2</sub>	10-min	AQG: 500	20	0
	24-hour	IT-1:125	2	0
		IT-2: 50	86	1
		AQG: 20	284	63

# Comparison of 2008 NO<sub>2</sub> concentrations with WHO guidelines

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Air Pollutant	Avg time	WHO AQG / IT	Highest Concentration in 2008 (Ambient)	Highest Concentration in 2008 (Tap Mun)
NO <sub>2</sub>	1-hour	AQG: 200	282	119
	Annual	AQG:40	69	14

## Number of exceedences

Air Pollutant	Avg time	WHO AQG / IT	No. of Exceedences in 2008 (Ambient)	No. of Exceedences in 2008 (Tap Mun)
NO <sub>2</sub>	1-hour	AQG: 200	84	0
	Annual	AQG: 40	x	✓

Air Pollutant	Avg time	WHO AQG / IT	Highest Concentration in 2008 (Ambient)	Highest Concentration in 2008 (Tap Mun)
PM <sub>2.5</sub>	24-hour	IT-1: 75	113	99
		IT-2: 50		
		IT-3: 37.5		
		AQG: 25		
	Annual	IT-1: 35	41	35
		IT-2: 25		
		IT-3: 15		
		AQG: 10		

Air Pollutant	Avg time	WHO AQG / IT	No. of Exceedences in 2008 (Ambient)	No. of Exceedences in 2008 (Tap Mun)
PM <sub>2.5</sub>	24-hour	IT-1: 75	39	13
		IT-2: 50	128	87
		IT-3: 37.5	191	160
		AQG: 25	259	219
	Annual	IT-1: 35	x	✓
		IT-2: 25	x	x
		IT-3: 15	x	x
		AQG: 10	x	x

Air Pollutant	Avg time	WHO AQG / IT	Highest Concentration in 2008 (Ambient)	Highest Concentration in 2008 (Tap Mun)
PM <sub>10</sub>	24-hour	IT-1: 150	164	147
		IT-2: 100		
		IT-3: 75		
		AQG: 50		
	Annual	IT-1: 70	60	52
		IT-2: 50		
		IT-3: 30		
		AQG: 20		

Air Pollutant	Avg time	WHO AQG / IT	No. of Exceedences in 2008 (Ambient)	No. of Exceedences in 2008 (Tap Mun)
PM <sub>10</sub>	24-hour	IT-1: 150	4	0
		IT-2: 100	51	19
		IT-3: 75	134	78
		AQG: 50	211	167
	Annual	IT-1: 70	✓	✓
		IT-2: 50	x	x
		IT-3: 30	x	x
		AQG: 20	x	x

# Possible Options (“transition paths”)

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<b>Measures</b>	<b>Socio-economic consequences</b>
<p><b>Energy</b></p> <ul style="list-style-type: none"><li>-Cleaner technologies</li><li>-Renewable energy</li><li>-Nuclear energy</li></ul> <p><b>Transport</b></p> <ul style="list-style-type: none"><li>-Cleaner fuel (electric cars, hydrogen, etc.)</li><li>-Stricter standards for marine transportation</li></ul>	<p>Fewer people have diseases – about 3,200 premature deaths less annually;</p> <p>Less money to be spent on health care, on air pollution control equipment, etc. – around HKD 40 million annual economic loss avoided.</p>

# Implementation

(should target specific sectors)

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## Regulation

- Control for compliance, sanctions

## Economic tools

- Emissions Trading System
- Taxes and subsidies

## Promotion

- Transparency
- Education
- Better information

To set up the price on pollution:  
congestion charge;  
taxes on “dirty” fuel vehicles;

# Timetable

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- EU – 2020 strategy for smart, sustainable and inclusive growth; low-carbon economy in 2050;
- Hong Kong – 2010 air pollution emission reduction targets for PRD region;

Flexibility, but should not postpone too far, otherwise the implementation cost will be higher.

# Current Trends (top-down elements)

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## Local actions –

- Hong Kong tightened limits on sulfur dioxide;
- The Government and the Environment and Conservation Fund provides financial support .
- Revision of Air Quality Objectives – consultations 2009, implemented to 2014, but still outdated.

## Joint PRD Regional Air Quality Management Plan

	Emission Level in 1997 (Tonnes)	Change in Emission Level during 1997-2009 <sup>1</sup>	2010 Emission Reduction Target
SO <sub>2</sub>	66,200	-24%	-40%
NO <sub>x</sub>	124,000	-33%	-20%
RSP	11,500	-57%	-55%
VOC	68,800	-57%	-55%



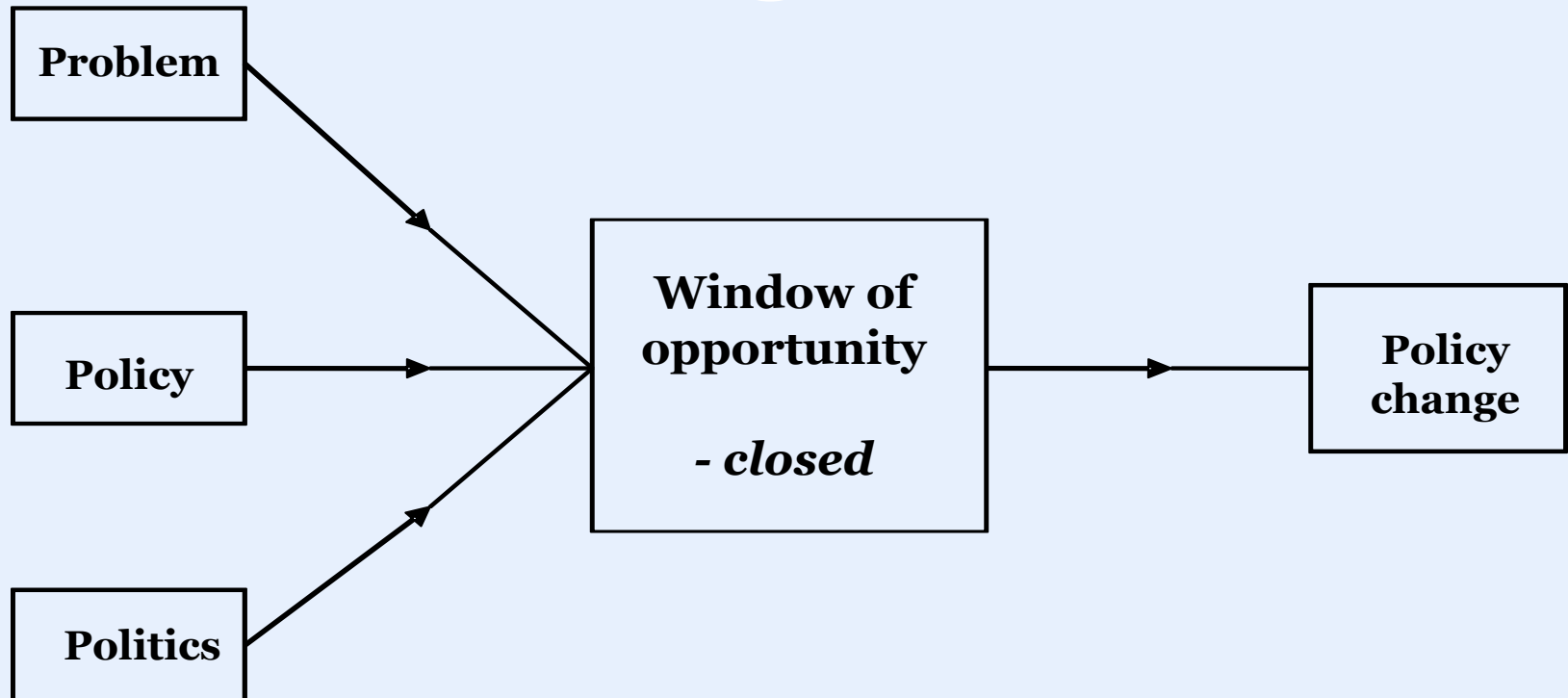
# Bottom-up Elements

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- Environmental groups and think-tanks
- Business initiatives
- Universities

# Threat of Decision-Making Failure

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Source: J. Kingdon's Three Streams Model (1995).

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