

# Clean Air Action Planning in Chinese Cities: Hangzhou and Jinan Cases



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#### **About CAI-Asia**

The Clean Air Initiative for Asian Cities (CAI-Asia) promotes better air quality and livable cities by translating knowledge to policies and actions that reduce air pollution and greenhouse gas emissions from transport, energy and other sectors. CAI-Asia was established in 2001 by the Asian Development Bank, the World Bank and USAID, and is part of a global initiative that includes CAI-LAC (Latin American Cities) and CAI-SSA (Sub-Saharan Africa).

Since 2007, this multi-stakeholder initiative is a registered UN Type II Partnership with more than 200 organizational members and eight Country Networks (China, India, Indonesia, Nepal, Pakistan, Philippines, Sri Lanka, and Vietnam). The CAI-Asia Center is its secretariat, a non-profit organization headquartered in Manila, Philippines with offices in China and India. Individuals can join CAI-Asia by registering at the Clean Air Portal: [www.cleanairinitiative.org](http://www.cleanairinitiative.org). Its flagship event, the Better Air Quality conference, brings together over 500 air quality stakeholders.

LIST OF ABBREVIATIONS

ADB	Asian Development Bank
API	Air Pollution Index
AQ	Air quality
AQM	Air Quality Management
AQMP	Air Quality Management Plan
CAAP	Clean Air Action Plan
CAI-Asia	Clean Air Initiative for Asian Cities
CAMAT	Clean Air Management Assessment Tool
EF	Energy Foundation
EPB	Environmental Protection Bureau
EPD	Environmental Protection Department
GHG	Greenhouse gas emissions
HFCs	Hydrofluorocarbons
HZ	Hangzhou
JN	Jinan
MEP	Ministry of Environmental Protection
NO <sub>2</sub>	Nitrogen dioxide
O <sub>3</sub>	Ozone
Pb	Lead
PM	Particulate matter
PM <sub>10</sub>	Particulate matter with diameter ≤ 10 microns
PM <sub>2.5</sub>	Particulate matter with diameter ≤ 2.5 microns
SO <sub>2</sub>	Sulfur dioxide
TSP	Total Suspended Particulate
VOCs	Volatile Organic Compounds

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## Introduction

The project “Make Co-Benefits Work: Clean Air Action Plans” focus on translating awareness on co-benefits to integrating air pollution and GHG emissions management in city Clean Air Action Plans (CAAP) and reports. The CAAPs for Hangzhou and Jinan include actions that address the main gaps identified previously (from CAMAT).

The project is sought to lead to policy change in pilot cities - Hangzhou and Jinan, by helping them developing/improving more comprehensive CAAPs (long-term policies/measures within the plan), and increasing the scale of capacity. It will highlight the benefits of transparency on format and process, as well as collaborations across different stakeholders. In the meantime, interests and adoption from other cities and MEP in developing the recommended CAAP is another key objective of the project.

This report documents the activities and results that transpired during the project in relation to recommending improvements of the Clean Air Action Planning for Jinan and Hangzhou. Figure 1 below is a quick summary of the steps and activities followed in the project. The report will generally follow the order at which these chronology of activities transpired including: scoping of Clean Air Action Plans in CAI-Asia’s City members, desktop research on International and Local Best Practices of Clean Air Action Plans and prepared an overview of what could/should be included in CAAPs by Chinese cities. City visits were organized to hold discussion with city EPBs and other government agencies, to determine the objectives, scope, and contents of the plan. Then we gathered information and data for the analysis.

Methodology of the project related to CAAP is shown in Figure 1:



Figure 1. Methodology of the project related to CAAP

## Step 1 – Designing a City Survey on Clean Air Action Plan

### Activities:

- A quick survey was designed in June as a framework to as a scoping step on clean air action plans in terms of content and process
- This survey was implemented as an activity during the 7<sup>th</sup> City AQM Workshop held in Dalian <http://cleanairinitiative.org/portal/node/7391>
- The quick survey covered items listed under Table 1

**Table 1.** Quick Survey Template for Clean Air Action Plan Scoping

City Name:	
Does the city have a clean air action plan? (Y/N indicate official name)	
Covered Period: (year x to year y)	
Status: indicate whether a) in preparation b) Completed, c) Currently in Implementation d) undergoing revision	
Date Completed/Approved: <i>Date (at least month/year)</i>	
Geographic Coverage urban/ urban + rural, city, municipal, district, etc	
Pollutants Covered <i>enumerate PM10, PM2.5, SO2, NO2, etc</i>	
Targets/Objectives <i>Enumerate/List</i>	
Components of Plan <i>Enumerate Table of Contents/Sections</i>	
Agency/Office who Prepared Plan List/Identify	
Agencies Involved in Implementation (Major)	
Previous Plan available?	

### Results:

- The results showed that of the 11 cities represented, only 5 of them had air quality related action plans.
- The plans of the Chinese cities had similarities and differences.
- It confirms that the action plans were focused on traditional pollutants – PM10, SO2 and NO2 with minimal. And none of them is integrated plan but mainly about pollution control, and not very clear about the implementation assessment.
- The cities presented also challenges pertaining to the preparation and implementation of the action plans.
- See Annex 1 for more detailed results using above framework.

## **Step 2 – International and Local Best Practices on Clean Air Action Planning**

### Activities:

- Collected a number of international and Chinese air quality related action plans
- The cities included the following:
  - China:7
  - Internationally:9
- Review how Clean Air Action Plans are prepared internationally and in Chinese cities as inputs to a recommended outline of a Clean Air Action Plan using best practices and existing experience
- Prepared a framework of analysis following similar framework used in Scoping for the workshop
- This will help inspire HZ and JN in what their city report could look like and include, and build on existing experience.

### Results:

- Annex 2 - Clean Air Action Planning: A Survey of International and Local Best Practices
- Most if not all of the action plans targeted multiple pollutants most commonly covered are PM10 and NO<sub>2</sub>, followed by SO<sub>2</sub>. Very few are addressing PM<sub>2.5</sub> and fewer still for toxics (PAH). Less than half of the cities surveyed covered O<sub>3</sub> and VOCs. Only Vancouver had an explicit mention to address greenhouse gases. Most of the Chinese cities generally target PM<sub>10</sub>, SO<sub>2</sub>, NO<sub>2</sub> and dust with a few exceptions like Beijing which also included CO, HFCs and Pb.
- The scope of the action plans varies from a short one year period to more than 5 years but a large share of cities surveyed have action plans with a validity of 5 years. A few cities did not identify validity period of their action plans.
- The action plans of Chinese cities were lagging in a number of components that were common in the non-Chinese cities, in particular: Executive Summary and Foreword, Introduction and Background, Impacts on Public Health and Environment as well as in describing the process of development of the plans and the institutional arrangements for implementation
- The targets of CAAPs mainly contain air quality improvements like API and concentrations reduction, and few city like Qingdao aims to improve management/governance systems.
- Restructure of industry and energy consumption as well as vehicle emission control measures were the most common. And the restructure measures were common in Chinese Cities but not in International Cities.
- According to the survey and research results, the arrangement in preparing and implementation of the action plans is rarely mentioned in the city CAAP.
- City clean air action plan of Urumqi and Johannesburg come closest to the recommended outline.

## **Step 3 – Designing a Recommended Clean Air Action Plan Outline**

- Activity:
- Recommended Clean Air Action Plan Outline was developed based on the analysis provided by the Survey of International and Local (China) Practices on Air Quality or Clean Air Action Plans including other references on how to prepare air quality/clean air action plans
- The recommended outline also considered which components were common in Chinese cities: such as

- Formulation Basis and Guidelines
- Supporting Policies
- The outline also considered existing guidelines for preparing clean air action plans
  - 10 Step Approach of Preparing Clean Air Action Plan (by Energy Foundation) – Annex 3
  - US EPA Air Quality Management Portal- <http://www.epa.gov/air/aqmportal/index.htm>
  - Handbook of Air Quality Management - <http://www.aqbook.org/>
  - Common Information to European Air - <http://www.citeair.eu>

**Results:**

- A recommended outline composed of 11 main components (as described in Table 2)
- Refer to Annex 4 for a more detailed description of the Clean Air Action Plan Outline

**Table 2.** Recommended Clean Air Action Plan Outline

1. Executive Summary and Foreword
2. Introduction and Background
3. Legal Framework/Legislative and Policy Context
4. Roles and responsibilities in AQ management
5. Baseline Assessment and AQ Management System
– Current status, API and comparisons to objective/standard
– Emissions inventory and key pollutants
– Analysis of effects and attribution to individual sources
– Modeling and projections for the future
– Air pollution trends and tendencies analysis;
– Impact on public health and the environment
6. Formulation Basis and Guidelines
7. Target and goals
8. Development of the Action Plan
– Process of development
– Focus Areas and Main Tasks
– Expected impacts
9. Implementation of the Action Plan
– Analysis of costs and feasibility
– Institutional Arrangements (enforcement procedures)
– Steps, working periods, timeline
10. Supporting Policies
– Monitoring and Evaluation
– Resource commitment (Institution, financing, policy, technology, social)
11. Key Projects
– Analysis of costs and feasibility
– Expected impacts



## Step 4 – City Visit

### Activities

- 2- day city visits to Jinan and Hangzhou were conducted in addition to email and telephone communications to work with Jinan and Hangzhou based on previous assessment results, to improve policies/measures, increase the scale of capacity, and highlight the benefits relating to the development of the CAAP.
- The city visits included meeting with important stakeholder teams in both cities, understand the state of knowledge on clean air action plans and related air quality management processes as well as understand challenges in preparing and implementing action plans and also follow-up work on data needs
- Present recommended Clean Air Action Plan outline and initial analysis on the comparison of Jinan and Hangzhou action plans

### Results:

- Stakeholder Teams were formed (see Annex 5 for the team composition)
- The meeting of the stakeholders allowed sharing of activities and projects that were initially not known to each other. Stakeholder meetings of this kind especially involving the municipal DRC in EPB or EPD meetings are not usual.
- Hangzhou stakeholders were more familiar with each other's work than in Jinan.
- When the initial analysis on the comparison of the city plans with recommended outline was presented, the cities shared that there were other existing documents that contain the required information.
- Hangzhou, to be specific, was interested in getting best practices of cities similar in characteristics as Hangzhou (economic situation, population, main sources, among others).
- The cities shared that challenges in clean air action planning and implementation include:
  - Hangzhou has 4 different action plans in relation to air quality. These are:
    - 7th Phase Implementation Plan for Atmospheric Environment Improvement (on Haze)
    - Total emission reduction plan for major pollutants during 12th FYP
    - Air Pollution Control "12th FYP" Special Planning
    - 2011 Action Plan from municipal and provincial level
  - Conflict between environment targets and city economic performance indicators
  - Rapid growth of mobile sources (vehicles) may offset achievements from stationary sources
  - Meteorological conditions sometimes are not favorable for air quality
  - Various agencies are involved in enforcing control measures – e.g. construction pollution is managed by Urban Management Bureau and traffic police for black smoke from vehicles. Other agencies also include Commission of Economy and Information, Land resources and Construction committee
  - Studies to support action planning take a long time – e.g. for 12<sup>th</sup> FYP in Jinan studies took at least 1.5 years
  - Some measures are expensive (e.g. electric buses, desulphurization and nitrate removal for stationary sources) and that cities rely on subsidies from the national government

## **Step 5 – Recommendations to Improve Hangzhou and Jinan Action Plans**

Activities:

- 2- days city visits to Jinan and Hangzhou were conducted in addition to email and telephone communications to work with Jinan and Hangzhou based on previous assessment results, to improve policies/measures, increase the scale of capacity, and highlight the benefits relating to the development of the CAAP.

Results:

- Initial Analysis – Comparison of Jinan and Hangzhou Clean Air Action Plans with the Recommended Clean Air Action Plan Outline (Annex 6)
- Two reports containing Recommendations for Improvement of Jinan Clean Air Action Plan (Annex 7) and Recommendations for Improvement of Hangzhou Clean Air Action Plan (Annex 8)

## **Step 6 – Data Validation and Review Process**

Activities:

- Communication with Hangzhou and Jinan contacts to review and validate the analysis on CAAP for their respective cities

Results:

- Hangzhou and Jinan EPBs both have good overview about the emission sources data through cooperation with other agencies and on-line 24 hours CEM and CAI-Asia team helps with integrating and reviewing the information into CAAP.

## **Step 7 – Dissemination and Communication**

Activities:

- Share results with 8<sup>th</sup> City AQM Workshop participants
- Assist
- Discuss with Hangzhou and Jinan and MEP

Results:

- Provided hard copy for 8th City AQM Workshop participant's reference and discussion.
- Review in detail the substantive documents EPBs provided, help Hangzhou and Jinan draft the first version of action plan including most of the key components.
- Based on their current plans and discussions, improve the plan with detailed list of questions per component including references they used, examples CAI-Asia provided, type of information required.

## **Annex**

1. Analysis of Results Quick Survey on Clean Air Action Plans Scoping
2. Clean Air Action Planning: A Survey of International and Local Best Practices
3. Energy Foundation's 10-Step Process for Clean Air Action Planning
4. Recommended Clean Air Action Plan Outline: A Template for Chinese Cities
5. Jinan and Hangzhou Clean Air Action Plan Teams
6. Initial Analysis – Comparison of JN and HZ Clean Air Action Plans with the Outline
7. Recommendations for Improvement of Jinan Clean Air Action Plan
8. Recommendations for Improvement of Hangzhou Clean Air Action Plan

## ANNEX 1 - Analysis of Results Quick Survey on Clean Air Action Plans Scoping

### Survey of Clean Air Action Plans in CAI-Asia's city network

The survey on state of clean air action planning in cities were conducted in mid 2011 with the aim of understanding the current situation, fostering learning and sharing of best practices, and strengthening the capacity of the cities. The survey respondents included CAI-Asia's 13 Chinese city members. All cities submitted their answers during the 7<sup>th</sup> China Air Quality Management City Workshop. Key results are summarized and documented here:

- *The names of clean air action plan?*
  - o Hangzhou: 7th Phase Implementation Plan for Atmospheric Environment Improvement (on Haze and Smog)
  - o Guiyang: Special project of air pollution control
  - o Chongqing: Action Plan for Central City Blue Sky Initiative (2008-2012)
  - o Harbin: 12th Five Year Plan, Clean Air Act Plan
  - o Qingdao: 2011 Action Plan for Automobile Exhaust Pollution Control
- *The content of existing/planned clean air action plan.*

Guiding principles
Objective and targets
Main tasks
Supporting policy

- *Organizations and departments involved in clean air action plans development and their roles.*

Organization Name	Role
Urban Management	Road dust control
Development and Reform Commission	Clean energy
Economic Bureau	Structural adjustment
Construction Committee	Dust from construction site
Traffic management in Public Security System	Vehicle emission control
Transportation Committee	Transport management
Land, waste management, clean-coal technology center	clean-coal technology development

## ANNEX 2 - Clean Air Action Planning: A Survey of International and Local Best Practices

CAAPs (or in other names) from 7 Chinese cities and 9 international cities were reviewed, to summarize the best practices from real cases and experiences, and identify possible gaps between different plans (see Table 3. List of Plans reviewed below for list of cities reviewed).

The plans were reviewed according to the following components.

- Content
  - Background Information
  - Geographic Coverage
  - Targets/Objectives
  - Pollutants Covered
  - Sources Covered
  - Control measures
- Process of Preparation
  - Agency/Office who Prepared Plan
  - Date Completed/Approved; Status
  - No. of Pages
  - Previous Plan available?
  - Integration with Other Plans

**Table 3. List of Plans reviewed**

China	Qingdao	2011 Action Plan for Automobile Exhaust Pollution Control
	Hangzhou	7th Phase Implementation Plan for Atmospheric Environment Improvement (on Haze and Smog)
	Jinan	Jinan Air Pollution Control "12th Five-Year" Special Planning
	Chongqing	Action Plan for Central City Blue Sky Initiative
	Beijing	Clean Air Action Plan (Air Pollution Control Measures)
	Tianjin	2008 Implementation of Blue Sky Project
	Urumqi	Comprehensive prevention and treatment planning
UK	Birmingham	Air Quality Action Plan
	Dublin	Regional Air Quality Management Plan
	Newham, London	London Borough of Newham Air Quality Action Plan
Canada	Vancouver	Integrated AQ and GHG Management Plan
	Ontario	Clean Air Action Plan: Protecting Environmental and Human Health in Ontario
South Africa	Johannesburg	Air Quality Management Plan
Australia	Perth	Air Quality Management Plan
Asia	Colombo	Clean Air 2000- Action Plan for Air Quality Management in the Metropolitan Area
	Istanbul	Air Quality Strategy

### Background Information

#### a) Covered Period

We recommend a plan not just on the immediate future but on the longer term, thus it's possible to achieve steady and continuous progress with a systematic approach.

In our review, we found that some cities developed their CAAP covering short-term, while other set the examples of have a vision for long-term goals and strategies. In China, many cities chose a five-year period, aligning with the “Five-Year Plan” for economic and social development. The city of Urumqi, however, developed and implemented the CAAP covering 2008-2020, with 2006 as the base year, and dividing the period with 3 timeframes of short-term, mid-term and long-term. Ontario of Canada set their target in 2004 for the year of 2015 in their CAAP. Australia’s Perth Air Quality Management Plan (AQMP) was launched in December 2000 and to “ensure that clean air is achieved and maintained over the next 30 years”.

1 year: Qingdao, Tianjin	3 years: Hangzhou	~5 years: Jinan, Beijing, Chongqing, Dublin, Johannesburg	More: Urumqi, Colombo	Open: Birmingham, Ontario, Perth, İstanbul
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**Survey results for Covered Period:**

City Name	1 year	2 years	3 years	5 years	>5 years	Unspecified
Qingdao	√					
Hangzhou			√			
Jinan				√		
Chongqing				√		
Beijing				√		
Tianjin	√					
Urumqi					√	
Birmingham						√
Dublin			√			
Newham, London						√
Vancouver					√	
Ontario					√	
Johannesburg				√		
Perth					√	
Colombo					√	
Istanbul						√
Seoul (Korea)						√

**b) Geographic Coverage**

The integration of regional economic and pollution transport effects across cities caused by atmospheric circulation bring great challenge to the existing environmental management pattern. Successful experience proves that adopting regional joint prevention and control measures as early as possible is critical to tackle the emerging acid rain, haze, photochemical smog pollution.

Most CAAPs cover their own administrative areas. But in some plans, trans-boundary emissions are addressed specifically even as they are also the responsibilities of other parties. For instance, Ontario shares its air shed with approximately 200 coal-fired power stations and assorted industries in the Midwestern U.S. In their plan, roles of and assistance from Federal government and the US are stated, similar to the regional air quality management approach China trying to adopt and implement.

**c) Pollutants Covered**

Through the co-benefits approach, cities will be better able to link (often already identified) air pollution control measures and plans with climate change mitigation and thus reduce the overall costs of dealing

with both issues. This will then lead to faster adoption of GHG mitigation measures, resulting in earlier reductions in both GHG and air pollutant emissions.

In the course of economic development, an area may experience a specific series of challenges brought by different air pollutants. For example, in China, TSP (Total Suspended Particular) was the first particular matter (PM) being controlled under the ambient air quality standard. Then after years was the PM10 and followed by PM2.5 as the most recent one. The involvement of air pollutants reflected both the changing situation of economic growth and our knowledge on pollutants' impact.

Vancouver's "Integrated Air Quality and Greenhouse Gas Management Plan", as a recent case, recognizes the inextricable link between air quality, climate change and energy issues, and accordingly, integrates goals, strategies and actions related to both emissions (pollutants and GHGs). Through the co-benefits approach, cities will be able to link air pollution control measures with climate change mitigation. It would reduce the overall costs of dealing with both issues and result in earlier reductions in both GHG and air pollutant emissions.



**Survey results for Pollutants Covered:**

City Name	PM10	PM2.5	SO2	NO2	O3	CO	VOCS	PAH	Others	GHGs
Qingdao										
Hangzhou	√	√*	√		√*		√*			
Jinan	√		√	√						
Chongqing										
Beijing	√		√	√	√	√			Pb	
Tianjin	√		√	√					Soot and dust	
Urumqi	√	√*	√	√	√*				Soot and dust	
Birmingham	√			√						
Dublin	√			√						
Newham, London	√		√	√		√	√		Pb	
Vancouver	√	√	√	√	√	√				√
Ontario		√	√	√	√		√			
Johannesburg	√			√	√				Dust	
Perth	√		√	√	√	√			Pb	
Colombo	√		√	√		√	√		Pb	
Istanbul	√		√	√		√	√			

\* For research purpose or indirect control

**Key Components of Plans**

Then the key components of plans and the outlines of contents are also summarized across the 16 plans, with the same level of details. This part was used to compare the real-world cases with key components mentioned above from the reference books, and find out the necessary and common components adopted by cities/areas.

We went through all the 16 CAAPs, and listed all components included in different plans (Table 4.). The structure of these key components reflects the DPSIR framework we introduced above:

- **Driving forces:** “Introduction and Background”,
- **Pressures:** “Causal analysis of effects and attribution to individual sources” as,
- **States:** “Current status, API and comparisons to objective/standard” and “Emissions inventory and key pollutants”
- **Impacts:** “Impact on public health and the environment”
- **Responses:** “Development and Implementation of the Action Plan” and following components

For the number of components we counted, there’re some significant differences between Chinese cities and international cities, including:

- Executive Summary
- Introduction and Background
- Current status, API and comparisons to objective/standard
- Emissions inventory and key pollutants
- Impact on public health and the environment
- Process of development
- Institutional Arrangements

For Chinese cities, these components are the missing links from the DPSIR framework and other references. They are key considerations of a transparent and consistent CAAP. We also noted that content inside each existing component may be different. Rather than general description of what have been and should be done, detailed arrangement of steps, working periods, timeline, institution, financing, policy and technology could be more understandable for other related parties and implementable in the future.

**Table 4. Number of Chinese and International cities contain the component**

Key Components	Chinese cities		International cities	
	# out of 7	% out of 7	# out of 9	% out of 9
Executive Summary	0	0%	8	88%
Introduction and Background	1	14%	9	100%
Legal Framework/Legislative and Policy context	2	29%	6	67%
Roles and responsibilities (National/Provincial/Municipal)	1	14%	3	33%
Current status and challenges of air quality Baseline Assessment				
– Current status, API and comparisons to objective/standard	2	29%	7	78%
– Emissions inventory and key pollutants	2	29%	8	88%
–Causal analysis of effects and attribution to individual sources	3	43%	7	78%
– Air pollution trends and tendencies analysis	3	43%	5	56%
– Impact on public health and the environment	0	0%	7	78%
Guiding principle	5	71%	2	22%
Target and goals	7	100%	6	67%
Development of the Action Plan				
– Process of development	0	0%	4	44%
– Focus Areas and Main Tasks	7	100%	7	78%
– Expected impacts	1	14%	4	44%
Implementation of the Action Plan				



Key Components	Chinese cities		International cities	
	# out of 7	% out of 7	# out of 9	% out of 9
– Analysis of costs and feasibility	0	0%	3	33%
– Institutional Arrangements (enforcement procedures) / Roles, responsibilities	3	43%	8	89%
– Steps, working periods, timeline	4	57%	6	67%
Supporting policies	6	86%	0	0%
– Monitoring and Evaluation	5	71%	5(+2 separated)	56%
– Resource commitment (Institution, financing, policy, technology, social)	4	57%	7	78%
Key projects	3	43%	1	11%
– Analysis of costs and feasibility	1	14%	0	0%
– Expected impacts	2	29%	0	0%

On the other hand, the number of steps required and degree of detail in each step will vary, depending on local situation and current air quality status. Baseline assessment, goal setting and evaluation are the essential steps for either a detailed CAAP or a basic one.

### Control Measures

Lastly, control measures and intervention strategies, as one of the most important components for implementing the CAAPs were also analysed in terms of sources and policy instruments.

Control measures are usually implemented in three categories: transport, industry, and area sources of air pollution. The following sections examine various strategies for each of these sectors for the CAAPs. The measures are listed in the order of frequencies appeared in the plans (Table 5). A key to implementation is an assessment of the priorities of the issues associated with emissions from each sector. In most cases, the emissions with the greatest health effects are targeted first.

**Table 5. Control measure for different sources from reviewed plans**

Transport and Land Planning	Stationary	Area (Other) Sources
<ul style="list-style-type: none"> <li>✓ New vehicle emission standards and clean energy</li> <li>✓ Vehicle Inspection and Maintenance</li> <li>✓ Fuel Reformulation, Pricing</li> <li>✓ Improving public transport to reduce traffic volumes</li> <li>✓ Transportation Planning and Traffic Management; Using area planning measures to reduce traffic volumes</li> </ul>	<ul style="list-style-type: none"> <li>✓ Industrial and cooking emissions</li> <li>✓ Air pollution control from coal-fired</li> <li>✓ Reduce air contaminant emissions from residential heating sources</li> <li>✓ Waste (Incineration, Landfills and Wastewater treatment)</li> </ul>	<ul style="list-style-type: none"> <li>✓ Dust pollution prevention</li> </ul>

There are many types of instruments available to policy-makers to address issues of pollution prevention and control. Each instrument has particular strengths and weaknesses, and a combination of instruments usually offers the best approach to most air quality issues (World Bank, 2000). The measures are also listed in the order of frequencies appeared in the plans (Table 6).

Energy and climate are highlighted in the table as the co-benefits approach. The approach can reduce the costs, accelerate the timing, and enhance the effectiveness of integrated actions compared to treating these issues separately. Despite this potential, the region has yet to see significant benefits from a co-benefits approach (CAI-Asia, 2009).

**Table 6. Policy instruments and special measures**

General AQM	Pollutant Specific Control
<ul style="list-style-type: none"> <li>✓ Community Education; Increase public understanding of air quality (and climate change) issues and public engagement in clean air programs</li> <li>✓ Enhance capacity building and management</li> <li>✓ Health Research</li> <li>✓ AQ Monitoring, Emission Inventory, Modeling Improvements</li> <li>✓ Standard Setting</li> </ul>	<ul style="list-style-type: none"> <li>✓ VOCs</li> <li>✓ Ozone and fine particle</li> <li>✓ Stench pollution</li> <li>✓ Haze and Smoke; Air contaminants and precursors that can degrade visual air quality</li> </ul>
Institutional Changes	Energy & Climate
<ul style="list-style-type: none"> <li>✓ Industrial restructuring</li> <li>✓ Adjustment of industrial layout, Cleaner Production</li> <li>✓ Ecological construction and restoration, environmental protection and application of new technology projects</li> <li>✓ Visual air quality management program</li> </ul>	<ul style="list-style-type: none"> <li>✓ Adjustment of energy structure</li> <li>✓ Central heating planning</li> <li>✓ Energy Efficient Buildings</li> <li>✓ Reduce the carbon footprint of the regional economy</li> <li>✓ Reduce emissions of short-lived climate forcers</li> <li>✓ Explore opportunities for carbon sequestration</li> </ul>

## **ANNEX 3 - Energy Foundation's AQ Planning Cookbook: 10-Step Process for Clean Air Action Planning**

In 2010, Energy Foundation supported a project "Making Co-benefits Work for Chinese Cities" that aimed to raise awareness and build capacity of cities and locally operating organizations on climate change mitigation by linking it to air management (AQM). The AQ Planning Cookbook is one of the outputs.

**Based on Version 2 – Feb 7 2011**

### **Summary Outline of 10 Step Process to Prepare an Initial Urban Area Air Quality Plan**

**Step 1** - Review and Assess Existing Air Quality Data

**Step 2** - Review and Assess Existing Information on Sources of Emissions

**Step 3** - Collect Indicators of Economic, Energy Use and Population Growth over Next 15-20 Years

**Step 4** - Prepare Baseline Emissions Inventory for Targeted Pollutants for Current and Future Years in Five Year Increments

**Step 5** - Develop Draft List of Priority Air Quality Improvement Measures -- Apply Reasonably Available Control Measures to "Top Ten" Priority Source Categories; Apply Efficiency Measures to Major Categories of Energy Use

**Step 6** - Prepare Revised (after full implementation of priority measures) Future Year Emission Inventories for Targeted Pollutants in Five Year Increments

**Step 7** - Estimate Cost of Measures, Co-Benefits and Expected Change in Air Quality and/or Emissions Resulting from Priority Measures

**Step 8** – Determine if Changes are needed to Achieve Greater Reductions or to Address Excessive Costs; Amend/Augment Measures as Appropriate;

**Step 9** – Based on Step 8 Results, Move to Step 10 or Prepare Revised Plan to include more Measures and Repeat Steps 6 and 7

**Step 10** – Propose Plan and Gain Approval to Implement Measures; Identify Mechanisms and Responsibilities for Implementing Measures and for Tracking Progress

(A more detailed outline is provided below, followed by a discussion of potential problems and issues.)

**Expanded Outline of 10 Step Process to  
Prepare an Initial Urban Area Air Quality Plan**

**Step 1 - Review and Assess Existing Air Quality Data**

- Identify monitoring network sites and pollutants
- Collect data from most recent three years to identify
- Distribution of pollutants by site
- Peak values and annual averages
- Levels compared to national standards for each pollutant
- Identify more qualitative indicators of problems, especially relate to localized high impact sources
- Determine what pollutants are above standards and which are the highest priority for control

**Step 2 - Review and Assess Existing Information on Sources of Emissions**

- Determine if emission inventory exists; if so, assess its quality and comprehensiveness
- Identify other indicators of emissions that are available, examples include:
- Lists of power and industrial sources with estimates of annual outputs and fuel usage and source characteristics such as age and technology type
- Area wide annual use of fuels by major category (power sector, industry, domestic, transportation)
- Vehicle registration data
- Population and economic data

**Step 3 - Collect Indicators of Economic, Energy Use and Population Growth over Next 15-20 Years**

- Identify available sources of data on expected growth through 2030
- Extract data on:
- Population Growth
- Projections of energy use by major sector (electricity, industry, transportation, domestic)
- Changes in vehicle ownership and use
- Economic growth – Area GDP and per capita income
- Power sector and industrial expansions (or contractions) expected in the urban area
- If multiple sources on data are available, determine which are best to use for emissions forecasts
- Put information in a format that allows emissions to be projected over five year increments through at least 2020, and 2030 if possible

**Step 4 - Prepare Baseline Emissions Inventory for Targeted Pollutants for Current and Future Years in Five Year Increments**

- Use information assembled in Steps 2 and 3 to prepare:
- Pollutant and source category specific inventories for 2010<sup>1</sup>

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<sup>1</sup> Or for most recent year that can be estimated

- List of major significant individual sources and their emissions in 2010
- Projected levels of emissions and energy use (by pollutant, fuel type and source category) for 2015 through 2030 assuming no additional control or energy efficiency measures (beyond those already in place or required under existing regulations)
- List of major significant individual new or expanded sources expected in the urban area; list of sources that are candidates for shutdown/replacement
- Use the information developed above to:
- Rank source categories and individual major sources by importance in terms of emissions in 2020
- Determine top priority sources and categories to be considered for control; estimate the amount of the forecasted emissions represented by these source/categories
- Assemble source and category specific information needed to assess impact of potential priority controls

**Step 5 - Develop Draft List of Priority Air Quality Improvement Measures -- Apply Reasonably Available Control Measures to “Top Ten” Priority Source Categories; Apply Efficiency Measures to Major Categories of Energy Use**

- Cross reference priority sources/categories to:
- “required” measures in MEP guidance
- energy efficiency measures applicable to the source type or category<sup>2</sup>
- other “reasonably available” or “best available” control measures applicable to the source type or category<sup>3</sup>
- Calculate the emissions impact of applying the available efficiency measures by measure, source and category
- Calculate the emissions impact of applying the available emission control measures by measure, source and category

**Step 6 - Prepare Revised (after full implementation of priority measures) Future Year Emission Inventories for Targeted Pollutants in Five Year Increments**

- Use the information developed in Step 5 and in the baseline forecast to:
- Forecast the effect of the set of emission control measures on future year inventories of each pollutant
- Forecast the effect of the set of energy efficiency measures on future year energy use and inventories of each pollutant
- Estimate the combined effect of emission control measures and energy efficiency measures on future year inventories of each pollutant; eliminating “double-counting” of benefits and reflecting appropriate allocation of benefits when two measures interact
- Describe the over impact of all measures together and present revised estimates of future emissions

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<sup>2</sup> It would be a significant effort to develop this in a manner that is easy to use and defensible

<sup>3</sup> ditto footnote 2

**Step 7 - Estimate Cost of Measures, Co-Benefits and Expected Change in Air Quality and/or Emissions Resulting from Priority Measures**

- Cost Estimate
- Use estimates of each measure's cost-effectiveness and expected reductions to provide a rough estimate of the measure's cost on an annual basis
- Estimate the investment/capital cost of each measure
- Estimate the "co-benefits value" of measures where they occur (for example -- energy costs reduced due to efficiency)
- Sum the annual and capital costs of all measures; adjusting for co-benefits as appropriate
- Put costs into perspective. For example:
- Show annual costs as a fraction of the region's annual GDP growth
- Show capital costs as a fraction of the region's overall investments for the next five to ten years
- Change in Air Quality and/or Emissions
- Identify the percent change in emissions for each pollutant in the plan for each five year forecast period on a regional basis
- At least qualitatively describe how these changes are expected to affect ambient levels of pollutants. At a minimum:
- Compare the percent change in emissions for each pollutant to the percent air quality in 2010 exceeded the target standard for that pollutant
- Opine on the degree to which emission changes are expected to improve air quality over time

**Step 8 – Determine if Changes are Needed to Achieve Greater Reductions or to Address Excessive Costs; Amend/Augment Measures as Appropriate**

- Based on results from Step 7 determine if emission reductions achieved from priority measures provided the desired improvement in air quality
- If not, return to the list of "Reasonably Available Control Measures" and identify those that were not proposed under Step 5.
- For additional measures identified:
- Calculate the emissions impact of applying the available efficiency measures by measure, source and category
- Calculate the emissions impact of applying the available emission control measures by measure, source and category

**Step 9 – Based on Step 8 Results, Move to Step 10 or Prepare Revised Plan to Include more Measures and Repeat Steps 6 and 7 for all measures now included in plan**

**Step 10 – Propose Plan and Gain Approval to Implement Measures; Identify Mechanisms and Responsibilities for Implementing Measures and for Tracking Progress**

- Propose Air Quality Improvement Plan and submit to agencies with review/approval responsibility

- Detail the timeline for implementing plan measures with assignment of implementation responsibility
- Define process of periodic review to track and report on:
  - Measure implementation
  - Overall changes in emissions occurring from the plan
  - Change in monitored air quality

### **Potential Problems and Issues with “10 Step Approach”**

Some Potential Major Problems:

- The large amount of effort needed to develop a useful, technically sound and defensible listing of “Reasonably Available Control Measures” to be used in Steps 5 and 9 (See Attachment 1 for a list of needed elements)
- The reliance on judgment/expertise in Steps 1, 3, 7 and 8 related to:
  - Interpreting air quality monitoring data (in Step 1)
  - Applying economic/demographic data to construct an inventory (in Step 3)
  - Estimating cost impacts and especially co-benefits (in Step 7)
  - Estimating how changes in emissions will likely affect air quality (in Step 8)
- The process is complicated for officials in an urban area that have never done air quality planning and has limited technical expertise – substantial outside resources/assistance would likely be needed to assist in implementation.
- The approach is not explicit:
  - How and who approves the plan
  - How to fund and implement measures and
  - How to ensure the measures are enforced.

### **Other Issues and Questions**

This is a much more complicated approach than a “cookbook” method focusing on highest priority measures that would just “Identify the top ten measures and provide basic information on their benefits and how they would be designed and implemented”. I don’t know if we can simplify the process to that level and still create a context that presents how the measures might actually benefit air quality and what they would cost.

I sense that the priority areas in China are using a much more sophisticated approach with complex inventories and AQ modeling, etc. Would a simple approach based on achieving substantial emission reductions and presenting just a qualitative assessment of the progress be acceptable?

How can progress be made in an area that lacks some or much of the information sought in Steps 1, 2 and 3? Can an effort that just focuses on reducing emissions from the largest sources using available control measures actually be implemented in an area with limited data?

Attachment 1

**Information Needed for Reference List of  
Reasonably Available Control Measures**

- Measure description including a cross reference on how the measure relates to the MEP requirements and guidelines
- Sources to which measure would be applied
- Pollutants reduced and percent emission reductions expected
- Estimated cost of the implementing the measure
  - Capital costs
  - Ongoing costs for operation, maintenance, fuel, etc.
  - Typical cost-effectiveness (cost per ton of pollutant reduced)
- Implementation timeframe
- Method of monitoring implementation and/or enforcing measure



## ANNEX 4 – Recommended Clean Air Action Plan Outline

Table 7. Recommended contents for CAAP

Executive Summary	
Introduction and Background	<p>City Overview:</p> <ul style="list-style-type: none"> <li>- Geography and meteorology</li> <li>- Population and urbanization</li> <li>- Economic and Industrial</li> <li>- Energy and Transport</li> </ul>
Legal Framework/Legislative and Policy context	
Roles and responsibilities (National/Provincial/Municipal)	
Current status and challenges of air quality	
Baseline Assessment	
– Current status, API and comparisons to objective/standard	
– Emissions inventory and key pollutants	
–Causal analysis of effects and attribution to individual sources	
– Air pollution trends and tendencies analysis	- Trends in air pollutant concentration (Eleventh Five-Year)
– Impact on public health and the environment	<ul style="list-style-type: none"> <li>- Evaluation of health effects, exposure to pollution investigation</li> <li>- Environmental, economic impact</li> </ul>
Guiding principle	
Target and goals	- Long-term environmental planning (plan made in 2003 for 2020, and ongoing planning for 2030)
Development of the Action Plan	- Steps, time span, participants and process
– Process of development	
– Focus Areas and Main Tasks	- Specific planning linked with/refer to other government departments plan, indicating that the basis and source
– Expected impacts	- Probability of success and risk factors for control measures, and possible economic and social impact
Implementation of the Action Plan	
– Analysis of costs and feasibility	<ul style="list-style-type: none"> <li>- Reachability analysis (qualitative)</li> <li>- Cost and impact on air quality</li> </ul>
– Institutional Arrangements (enforcement procedures) / Roles, responsibilities	
– Steps, working periods, timeline	

Supporting policies	
– Monitoring and Evaluation	<ul style="list-style-type: none"> <li>- Annual self-review</li> <li>- Mid-term (of 5 years) evaluation by independent party</li> </ul>
– Resource commitment (Institution, financing, policy, technology, social)	
- Key projects	<ul style="list-style-type: none"> <li>- Key projects and their relevance to control measures (indicated by number)</li> <li>- Specific sources of funding, how to guarantee the investment</li> </ul>
– Analysis of costs and feasibility	
– Expected impacts	

## ANNEX 5 – Jinan and Hangzhou Clean Air Action Plan Teams

### 1. Jinan Team

Name	Organization	Position
LIU Jianjun	Jinan Academy of Environmental Science	
HAN Daowen	Jinan Academy of Environmental Science	
LIU Guanghui	Jinan Academy of Environmental Science	
YANG Limin	Jinan Municipal Development and Reform Commission	Director in the Section of Regional Environmental Resource
MIU Aibin	Jinan Municipal Statistics Bureau	Section of Social Science
XUAN Shengwu	Jinan Municipal Transportation Bureau	Deputy Director-General
MENG Kefei	Jinan Municipal Environmental Protection Bureau	Director
LIU Peiqi	Jinan Municipal Environmental Protection Bureau	Director
DU Shiyong	Jinan Municipal Environmental Protection Bureau Control Center	Associate Counsel

### 2. Hangzhou Team

Name	Organization	Position
Ying Wei	Hangzhou EPB	Director
Zou Conghao	Hangzhou EPB	
Zhao Jun	Hangzhou Development and Reform Commission	
Chen Fengmang	Hangzhou Municipal Economic Information Committee	
Guan Lili	Hangzhou Center for Vehicle Emission Pollution Management	
Jiao Li	Hangzhou Environment Monitoring Central Station	
Hong Shengmao	Hangzhou Environment Monitoring Central Station	

## ANNEX 6 – Initial Analysis – Comparison of JN and HZ Clean Air Action Plans with the Recommended Clean Air Action Plan Outline

The Jinan (Insert name of Plan) and the Hangzhou (insert name/s of plans) were reviewed against the Recommended Clean Air Action Plan Outline. This analysis was shown to the cities in the City Visit in November 2011.

City name	Hangzhou	Jinan
Executive Summary		
Introduction and Background		
Legal Framework/Legislative and Policy context		√
– Roles and responsibilities (National/Provincial/Municipal)		
Current status and challenges of air quality		
Baseline Assessment		
– Emissions inventory		√
–Causal analysis of effects and attribution to individual sources	Smog	√
– Projections for the future		√
– Air pollution trends and tendencies analysis; comparisons to air quality objective		√
– Impact on public health and the environment		
Guiding principle	√	√
Target and goals	√	√
Goal setting	√	√
Development of the Action Plan		
– Process of development		
– Focus Areas and Main Tasks	√	√
– Expected impacts		
Implementation of the Action Plan		
– Analysis of costs and feasibility		
– Institutional Arrangements (enforcement procedures) / Roles, responsibilities	√	
– Steps, working periods, timeline		
Supporting policies	√	√
– Monitoring and Evaluation	Monitoring, evaluation and reporting	Enhance evaluation and environmental tasks
– Resource commitment (Institution, financing, policy, technology, social)	√	√
Key projects		√
– Analysis of costs and feasibility		
– Expected impacts		√

## ANNEX 7 – Initial Analysis – Comparison of JN and HZ Clean Air Action Plans with the Recommended Clean Air Action Plan Outline

1. Including 2 recent cases (12 FYP from MEP and Shandong province)

In China, a CAAP can end up being no more than a collection of control ideas by air pollution scientists that will sit on a shelf and have little impact. As shown in the AQM framework, the CAAP planning process should not be seen as a one-time effort which ends after implementation but rather as a process that focuses on the long term goal of improving air quality and maintaining a healthy environment. This requires tracking progress of the plan on a routine basis to establish if intervention strategies have been effective, and revising it every few years to take into account changes in growth, data, and rulemaking activities.

The successful implementation of a CAAP is also dependent on the involvement of all stakeholders and the acknowledgement and endorsement from them will yield many benefits for all. Because of the comprehensive nature of the air quality management process, virtually everyone in the society will be impacted by the CAAP in some way.

China has been making its efforts and building its capacity plan development. We've observed the trend in China towards those key considerations mentioned above. One of the most recent examples is along with the release of China's "Environmental Protection 12th Five-Year Plan", the Ministry of Environment Protection also published an interpretative material, explaining the background, development process and key features of the plan. Related points are shown in the box below.

### State Environmental Protection "12th Five-Year Plan "interpretation of material

- Background of the preparation
- Process and highlights of the preparation  
Planning and preparation work started at the end of 2008, by the "open the door to compile planning "principle, in-depth fundamental research, full consultation and deliberation, extensive solicitation of opinions, constantly revised and improved, the final plan was drafted and issued by the State Council for consideration and implementation. Six points were explained in detail:
  - Leadership and efficient organization.
  - Summarized experiences from previous work
  - Independent research and cohesion
  - Consultation and public participation.
  - Thorough and scientific reviewing process
  - Consensus across different government agencies and stakeholder groups
- Main features of the "planning"
- How to ensure the implementation of the "planning", and achieved good results.

Another recent example is from Shandong Province, where Jinan is the capital city of it. Shandong Province issued its provincial "Environmental Protection 12th Five-Year Plan", as the only pilot province

from MEP for developing the plan<sup>4</sup>. Shandong issued the plan including a whole set of objectives, strategies and projects, with the principle of systematic and scientific “running through”. They identified about 4,000 engineering projects in ten categories with investment of 135.6 billion RMB. The plan will be implemented under 13 special sub-plans and the 17 cities within the province. One of the sub-plans is the air pollution control projects, consisting of industrial emissions and dust pollution control and vehicle exhaust pollution control project with total investment of 22.7 billion RMB. Commitments from high-level, transparency, collaboration across department and performance review were the key words during the process.

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<sup>4</sup> [http://www.mep.gov.cn/zhxx/hjyw/201202/t20120210\\_223318.htm](http://www.mep.gov.cn/zhxx/hjyw/201202/t20120210_223318.htm)

## REFERENCES

James Lents, Michael Walsh et al., Handbook of Air Quality Management, <http://www.aqbook.org/>

Schwela, D. and Haq, G., 2008. "Foundation Course on Air Quality Management in Asia." Module 6: Governance. Stockholm Environment Institute. <http://www.sei.se/cleanair/>

World Bank, 1999. "Pollution prevention and abatement handbook 1998: Towards cleaner production." World Bank, Washington. <http://go.worldbank.org/E6G093QFZ1>

World Bank, 2000, Urban Air Pollution, Health, and Policy Instruments

Air Pollution in the Megacities of Asia (APMA)/ CAI-Asia, 2004. "A Strategic Framework for Air Quality Management in Asia." CAI-Asia. URL: [www.cleanairinitiative.org/portal/node/4673](http://www.cleanairinitiative.org/portal/node/4673)

CAI-Asia, 2009, Co-Benefits Network Meeting, <http://cleanairinitiative.org/portal/node/2301>