

# Making Co-Benefits Work: Clean Air Management Assessment (CAMAT) Application in Jinan and Hangzhou



**Clean Air Initiative for Asian Cities (CAI-Asia) Center  
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## Acronyms and Abbreviations

AQ	air quality
AQM	air quality management
API	air pollution index
CAI-Asia	Clean Air Initiative for Asian Cities (CAI-Asia)
CAMAT	Clean Air Management Assessment Tool
CO	Carbon monoxide
EC	elemental Carbon
EPB	Environmental Protection Bureau
FYP	Five-Year-Plan
GHG	greenhouse gas (es)
GDP	gross domestic product
km <sup>2</sup>	square kilometers
MEP	Ministry for Environmental Protection
MDRC	Municipal Development and Reform Commission
µg/m <sup>3</sup>	microgram per cubic meter
NO <sub>2</sub>	Nitrogen dioxide
OC	organic Carbon
O <sub>3</sub>	ozone
PAHs	poly-aromatic hydrocarbons
Pb	Lead
PM	particulate matter
PM <sub>2.5</sub>	particulate matter with diameter of 2.5 microns or less
PM <sub>10</sub>	particulate matter with diameter of 10 microns or less
P.R. China	People's Republic of China
RMB	Renminbi
SO <sub>2</sub>	Sulfur dioxide
USD	United States Dollars
VOC	volatile organic compounds
WHO	World Health Organization
YRD	Yangtze River Delta



## Executive Summary

Air pollutants and greenhouse gas (GHG) emissions have common sources, with interacting effects and overlapping solutions. The co-benefits approach that aims to address air pollution and climate change in a combined fashion is increasingly being studied and promoted internationally.

The China Ministry for Environmental Protection (MEP) is integrating “co-control” of the two issues in its policies and preparation of the Twelfth Five-Year-Plan. It is necessary to supplement the top-down approach of working with national government and organizations with a bottom-up approach of raising awareness and building capacity of cities and locally operating organizations on climate change mitigation by linking it to air quality management. With support from the China Sustainable Energy Program (Energy Foundation), the Clean Air Initiative for Asian Cities (CAI-Asia) implemented this case study project to understand how to integrate co-benefits in plans and identify policies and measures for air quality management and GHG emissions reduction using the co-benefits approach through implementation of the Clean Air Management Assessment Tool (CAMAT).<sup>1</sup>

The CAMAT was applied to Hangzhou and Jinan, with 2008 as the base year, with the aim to identify

- What needs to be done to improve existing air quality and GHG management through an understanding of strengths and gaps in cities;
- How integrated air quality and GHG management can be improved, *i.e.*, making the co-benefits approach explicit for the city; and
- Barriers to applying the co-benefits approach, lessons learned, and recommendations for other cities.

The main results of the CAMAT application are as follows:

- Hangzhou and Jinan have been classified as having **Maturing (II) Clean Air Management**. This indicates that the key components of clean air management in the city are complete and have some integration with other major sectors (*e.g.*, transport, health and energy sectors). While the policies and actions have achieved some success in reducing air pollution (AP) and/or greenhouse gas emissions (GHG), they still have air quality levels exceeding healthy levels prescribed by the World Health Organization (WHO). Management efforts, then, in all sector sources need to be intensified to bring down emissions further.
- Among the three indices, Hangzhou and Jinan scored very high both in its capacity to manage air quality and its clean air policies and actions. Lowest score received was in the air pollution and health index.

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<sup>1</sup> The **Clean Air Management Assessment Tool** is an objective and comprehensive analysis tool developed by CAI-Asia for understanding the air quality management status in cities incorporating (1) air quality levels, (2) clean air management capacity and (3) clean air policies and actions and is capable of identifying improvement areas for the city.  
<http://cleanairinitiative.org/portal/Scorecard>



- City-specific clean air management gaps have been identified through the CAMAT application. Some of the areas for improvement include—

#### **Jinan**

- Roadside monitoring and ambient monitoring of PM<sub>2.5</sub>
- Include toxics in emissions inventory
- Studies on air pollution impact on health and other sectors (agriculture, tourism and economy)
- Ambient air quality standards for PM<sub>2.5</sub>, ozone, VOC and other toxics
- Transport fuel efficiency and fuel economy standards

#### **Hangzhou**

- Include PM, GHG and point sources (*i.e.*, domestic and commercial) in emission inventory
- Studies on air pollution impact on health and other sectors (agriculture, tourism and economy)
- Ambient air quality standards for PM<sub>2.5</sub>, ozone, VOC and other toxics
- Smog alarm plans
- Transport fuel efficiency and fuel economy standards
- Technology transfer programs and improved measures for energy and industry sectors

#### **Recommendations**

- Use the **CAMAT** to support long term AQ and GHG management in cities by not only using it as an assessment tool but also as a tool to (a) track progress in time (b) prepare City AQM Reports that can be shared through a centralized national website or database which would facilitate sharing of best practices and AQM experiences between cities/ city clusters.
- Ensure that the **CAMAT results** (such as the identified gaps and areas for improvement) lead to policy change in Hangzhou and Jinan by helping them improving Clean Air Action Plans that also explicitly indicate GHG implications, which will also be important if cities begin developing Low Carbon Action Plans (through Municipal Development and Reform Commission, MDRC)
- It is also recommended for MEP to formally recognize Hangzhou and Jinan as pilot cities for AQM and co-benefits so that this process is given priority and support by city governments.
- Upon completion of the clean air management assessment, it is timely to scale up existing measures to achieve greater emission reductions. This can be accomplished through an analysis of the impacts of existing measures on emissions (to measure effectiveness).
- Seek to **expand the impact of the CAI-Asia China city network** by encouraging these cities, as provincial capitals, to establish a Clean Air Forum or other mechanism together with cities in their region/province/city cluster. Assistance can be sought from MEP as this also supports the State Council issued guidance on regional AQM collaboration. The CAMAT could be **expanded with regional indicators** to help in this process.

The experience of CAMAT application in Hangzhou and Jinan showed that the CAMAT **(1)** is very effective in capturing and consolidating critical information from all sectors which has direct and indirect impacts on a city's air quality **(2)** is able to illustrate, in a structured and visual manner the strengths and weaknesses of AQM in a city; **(3)** is able to identify common strengths/weaknesses across cities, and **(4)** hence demonstrated the potential for further and wider application in China, either on an individual city or city cluster scale. An area of improvement is more explicit link to development of an action plan for improvement based on results.

This executive summary should not be read in isolation from the other text of this report.





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# 1. INTRODUCTION

## 1.1 General

Air pollutants and greenhouse gas (GHG) emissions have common sources, interacting effects and overlapping solutions. The co-benefits approach that aims to address air pollution and climate change in a combined fashion is increasingly being studied and promoted internationally.

The China Ministry for Environmental Protection (MEP) is integrating “co-control” of the two issues in its policies and preparation of the Twelfth Five-Year-Plan (FYP). It is necessary to supplement the top-down approach of working with national government and organizations with a bottom-up approach of raising awareness and building capacity of cities and locally operating organizations on climate change mitigation by linking it to air quality management.

At the city level in China, the following is observed:

- A continued demand exists for assistance in cities with addressing air pollution (and other development issues like energy security, costs and traffic congestion), while the focus and funds of donors and development agencies are drawn to climate change.
- When the global climate change negotiations and national policies and targets trickle down to the cities, there will be a tremendous capacity gap to deal with climate change.
- Cities have little experience or knowledge on how to integrate climate change into their air quality plans or on how to link their air quality measures to climate change mitigation.

With support from the China Sustainable Energy Program (Energy Foundation), the Clean Air Initiative for Asian Cities (CAI-Asia) implemented a project which aimed to understand how to integrate plans and identify policies and measures for air quality management and GHG emission reduction at the city level using the co-benefits approach.

## 1.2 Objectives of the Case Study

The purpose of the Case Study is to understand how to integrate co-benefits in plans and identify policies and measures for air quality management and GHG emissions reduction using the co-benefits approach through implementation of the Clean Air Management Assessment Tool (CAMAT).<sup>2</sup>

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<sup>2</sup> The **Clean Air Management Assessment Tool** is an objective and comprehensive analysis tool developed by CAI-Asia for understanding the air quality management status in cities incorporating (1) air quality levels, (2) clean air management capacity and (3) clean air policies and actions and is capable of identifying improvement areas for the city.  
<http://cleanairinitiative.org/portal/Scorecard>





The CAMAT was applied to two Chinese cities with the aim to identify

- What needs to be done to improve existing air quality and GHG management through an understanding of strengths and gaps in cities. This is important because unless basic air quality and GHG management is in place, such as a basic emissions inventory that determines the sources of different air pollutant and GHG emissions, efforts to introduce integrated air quality and GHG management will not be successful.
- How integrated air quality and GHG management can be improved, i.e., making the co-benefits approach explicit for the city. For instance, existing policies and measures for air quality management may also be beneficial for GHG emissions reductions. Determining the air quality, GHG, and other benefits for existing measures for the transport, energy, industry and other sectors may thus be a more effective step in managing air quality and GHG emissions than first developing separate low carbon plans and the needing to integrate them with air quality measures later.
- Barriers to applying the co-benefits approach, lessons learned, and recommendations for other cities.



## 2. CLEAN AIR MANAGEMENT ASSESSMENT TOOL OVERVIEW

### 2.1 General

While various tools exist to measure environmental performance, there is no generally accepted methodology for an objective, comprehensive assessment of a city's management of air pollutants and greenhouse gas emissions that also identifies areas in which it has improved. A city is traditionally evaluated using the good-versus-bad list analysis, merely based on available air quality data, such as *"World's Top 25 Dirtiest Cities"* or *"Most Polluted Cities and Cleanest Cities."*<sup>3</sup> These analyses provide an incomplete picture, because they often focus only on one or two pollutants. Further, they are subjective, as they penalize cities that monitor air quality and rank them without recognizing measures and policies that the cities are currently implementing. As a consequence, these tools then do not provide guidance on areas of air quality management and specific measures on which cities can improve.

Recognizing this need, CAI-Asia developed an objective, comprehensive analysis tool for understanding the air quality management status in cities—the CAMAT.<sup>4</sup> Since its development in early 2010, the tool has been applied in nine Asian cities: Bangkok, Colombo, Hangzhou, Hanoi, Jakarta, Jinan, Kathmandu, Manila and Quetta.

### 2.2 CAMAT Structure

The CAMAT is an Excel-based tool which incorporates three indices: (i) Air Pollution and Health, (ii) Clean Air Management Capacity, and (iii) Clean Air Policies and Actions, which are capable of identifying potential improvement areas for the city.

**Figure 1. Overall Structure of the CAMAT**



Source: CAI-Asia, 2009.

<sup>3</sup> Forbes. 2008. World's 25 Dirtiest Cities. [http://www.forbes.com/2008/02/26/pollution-baku-oil-biz-logistics-cx\\_tl\\_0226dirtycities.html](http://www.forbes.com/2008/02/26/pollution-baku-oil-biz-logistics-cx_tl_0226dirtycities.html); and American Lung Association. 2010. State of the Air: 2010 Report. <http://www.stateoftheair.org/>

<sup>4</sup> Clean Air Management Assessment Tool Version 1.0 was developed under the Sustainable Urban Mobility in Asia Program with support from ADB and the Swedish International Development Cooperation Agency (Sida). See <http://www.cleanairinitiative.org/portal/Scorecard>



Each index consists of relevant questions for which points can be allocated. Higher scores indicate better air quality levels, management capacity, and policies and measures. The three indices contribute 33.3 points each to a total possible clean air score of 100. Similar to previous assessments, cities are also categorized based on their overall score.

The formula for computing the overall clean air score is:

$$\text{Overall Clean Air Score [Total of 100]} = (\text{Air Pollution and Health Index}/3) + (\text{Clean Air Management Capacity Index}/3) + (\text{Clean Air Policies and Actions Index}/3)$$

Whereby, each index has a maximum score of 100, and when divided by 3, can contribute a maximum of 33.3 points to the total score.

The CAMAT is composed of questions that represent subindices and indicators relevant to the three indices.

**Table 1. Score Bands for the CAMAT**

Air Pollution and Health Index		Clean Air Management Capacity Index		Clean Air Policies and Actions Index	
Category	Score Band	Category	Score Band	Category	Score Band
Excellent	81–100	Excellent	81–100	Excellent	81–100
Good	61–80	Good	61–80	Good	61–80
Moderate	41–60	Moderate	41–60	Moderate	41–60
Poor	21–40	Limited	21–40	Limited	21–40
Very Poor	11–20	Minimal	1–20	Minimal	1–20
Critical	1–10				
Overall Clean Air Score					
Category Version 1.0		Category Version 2.0 (New)		Score Band	
Excellent		Fully Developed		81–100	
Good		Maturing		61–80	
Moderate		Emerging		41–60	
Limited		Developing		21–40	
Minimal		Underdeveloped		1–20	

Source: CAI-Asia, 2011.

#### 2.2.1.1 Air Pollution and Health Index

This index assesses air pollution levels of cities against WHO guideline values and interim targets.

A “good air” day in this index, then, is in relation to WHO guidelines rather than the city’s ambient air quality standards, which are generally less stringent. This index includes seven pollutants – particulate



matter (PM<sub>10</sub> and PM<sub>2.5</sub>), Sulfur dioxide (SO<sub>2</sub>), Nitrogen dioxide (NO<sub>2</sub>), Carbon monoxide (CO) and Lead (Pb); a city is required to have, at a minimum, monitoring data for particulate matter with a diameter of 10 microns or less (PM<sub>10</sub>). The WHO guidelines and interim target- 3 (IT-3) were considered as basis for the *excellent* category. Succeeding categories were based on interim targets 1 and 2 as well as annual average levels of Asian cities.<sup>5</sup>

**Table 2. Score Bands for Each Pollutant According to Monitored Levels**

Categories	Score Band	Concentration Levels (µg/m <sup>3</sup> )						
		PM <sub>10</sub> , annual average	PM <sub>2.5</sub> , annual average	SO <sub>2</sub> , annual average	CO, annual ave of maximum daily 8-hr value	NO <sub>2</sub> , annual average	Pb, annual average	O <sub>3</sub> , annual ave of maximum daily 8-hr value
Excellent	81-100	≤ 30	≤ 15	≤ 10	≤10,000	≤ 40	≤0.15	≤ 100
Good	61-80	31 to 50	16 to 25	11 to 20	10,001 to 12,000	41 to 50	0.15 to 0.3	101 to 125
Moderate	41-60	51 to 70	26 to 35	21 to 30	12001 to 14,000	51 to 60	0.31 to 0.45	126 to 150
Poor	21-40	71 to 100	36 to 50	31 to 40	14,001 to 16,000	61 to 70	0.45 to 0.6	151 to 195
Very Poor	11-20	101 to 150	51 to 75	41 to 50	16,001 to 18,000	71 to 80	0.61 to 0.75	196 to 240
Critical	0-10	150 and above	76 and above	51 and above	18,001 and above	81 and above	0.76 and above	241 and above
<b>Black Box - PM<sub>10</sub> is the core pollutant. City without PM<sub>10</sub> data is put in this category.</b>								

Source: CAI-Asia, 2009.

For a city with data for different pollutants, the pollutant with the lowest score is considered the main pollutant of concern, and as such, the score considered in the computation of the city's overall clean air score is based on the pollutant with lowest score under the air pollution and health index. When comparing cities, however, it is required that the cities' air pollution and health indices be based on the same pollutant or set of pollutants.

<sup>5</sup> For example, *excellent* is based on the WHO guideline of 20 µg/m<sup>3</sup> and interim target 3 of 30µg/m<sup>3</sup>. *Good* and *moderate* categories are based on the interim target 2 of 50 µg/m<sup>3</sup> and the interim target 1 of 70 µg/m<sup>3</sup>, respectively. *Poor* and *very poor* categories are based on annual average PM<sub>10</sub> of 101.23 µg/m<sup>3</sup> in 180 cities in Asia and the standard deviation of 50 µg/m<sup>3</sup>.



**Table 3. Score Bands and Category Descriptions for the Air Pollution and Health Index**

Air Pollution and Health Index		
Category	Score Band	Description
Excellent	81–100	Low levels of pollution within WHO-prescribed guidelines. Public health implications for pollutants monitored are limited and hardly noticeable.
Good	61–80	Relatively low levels of air pollution but considerable impacts to sensitive groups.
Moderate	41–60	Elevated levels of air pollution with aggravated symptoms for sensitive groups and contributing to onset of risks for exposed healthy individuals.
Poor	21–40	High levels of pollution with significant health effects to vulnerable populations and contributing to increased risks for exposed healthy individuals.
Very Poor	11–20	Extremely high levels of pollution affecting large share of population.
Critical	1–10	Critical levels of air pollution resulting in adverse health effects to public in general.

Source: CAI-Asia, 2011.

### 2.2.1.2 Clean Air Management Capacity Index

This index assesses a city's capacity to (i) determine sources of emissions and their contribution through an emission inventory; (ii) assess the status of air quality (includes monitoring, modelling, data analysis and reporting); (iii) estimate impacts on health, environment, and economy; and (iv) reduce air pollution and greenhouse gas emissions through an institutional and policy framework and financing (Box 1), each accounting for 25% of the Clean Air Management Capacity Index Score.

This follows the general framework of drivers–pressures–status–impacts–response commonly used for organizing information about the state of the environment and assumes the cause–effect relationships of the interacting components of air quality management.

The results of this index do not qualify the effectiveness of the capacity that is available in a city, only the existence of such a capacity. For example, this index asks about whether air quality staff members are regularly trained but will not score according to the frequency of relevant training and seminars.

Table 4 describes the score banding and the description of the categories under the clean air management capacity index.



Box 1. Subindices and Indicators for Clean Air Management Capacity Index

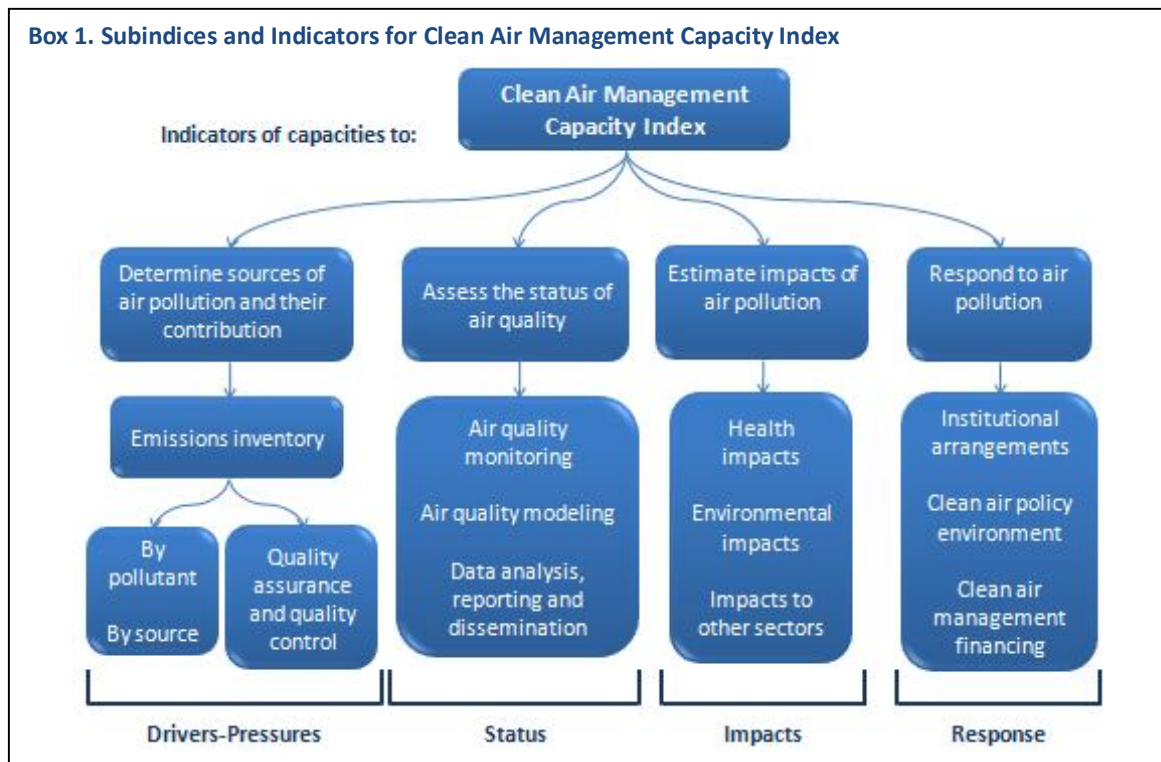


Table 4. Score Bands and Category Descriptions for the Clean Air Management Capacity Index

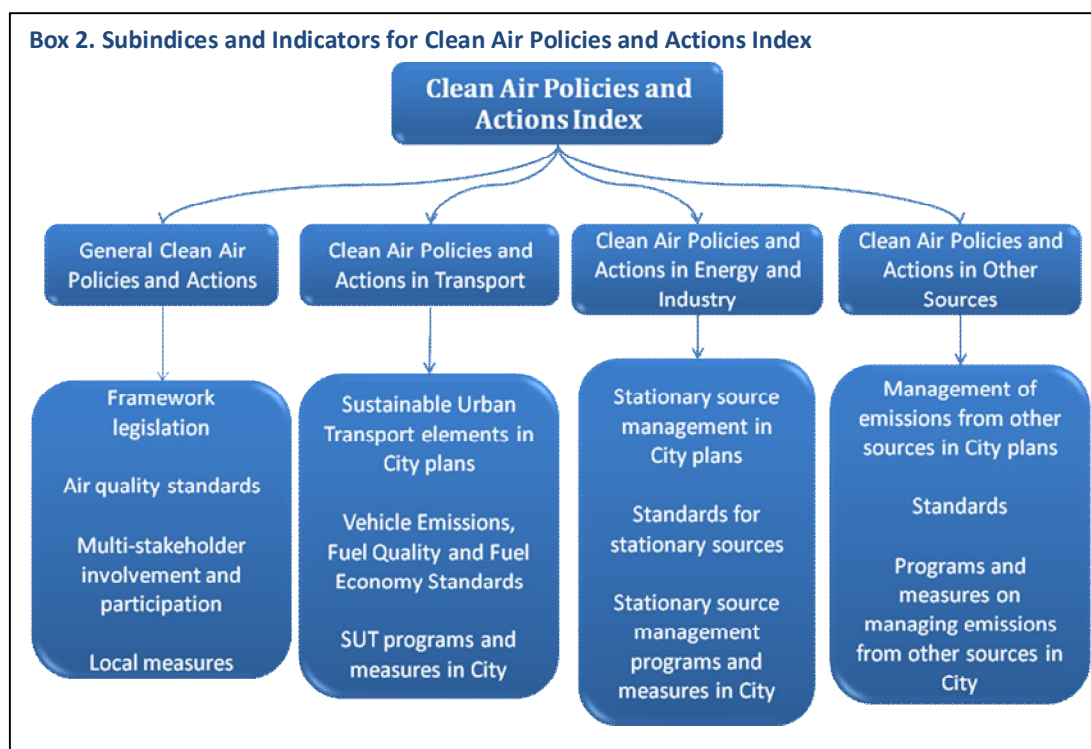
Clean Air Management Capacity Index		
Category	Score Band	Description
Excellent	81–100	Air quality management (AQM) and climate change mitigation is comprehensive and institutionalized in a dedicated organization under the city administration. Other stakeholder organizations are also engaged in collaborative activities within the city.
Good	61–80	AQM activities are comprehensively covered with initial activities on mitigating climate change in dedicated organization in city.
Moderate	41–60	Systematic emissions management procedures established in an identified unit or office.
Limited	21–40	Initial systematic procedures to reduce emissions are applied and integrated in general environment activities.
Minimal	1–20	Air quality management activities ( <i>i.e.</i> , monitoring, emissions inventory, health impact studies) are often project-based or <i>ad hoc</i> .

Source: CAI-Asia, 2011.



### 2.2.1.3 Clean Air Policies and Actions Index

This index assesses the existence and enforcement of national and local policies and actions to address air pollutants and greenhouse gas emissions from mobile, stationary, area, and transboundary sources (Box 2). The score for this index is composed of indicator shares representing the following main areas of policies and actions: (i) 30% for general clean air policy and actions, (ii) 30% for clean air policies and actions in transport, (iii) 25% for clean air policies and actions in energy and industry (representing stationary sources), and (iv) 15% for clean air policies and actions in other sources.



The shares of scores for the transport, and energy and industry sectors were determined by the fact that in most Asian cities, the two main sources of pollution are either transport or energy and industry. Area or other sources are usually the least contributing to emissions. In cases where transport and or industry may not be the major emissions sources, they are the sources with high growth rates.

Table 5 describes the score banding and the description of the categories under the Clean Air Policies and Actions index.



Table 5. Score Bands and Category Descriptions for the Clean Air Policies and Actions Index

Clean Air Policies and Actions Index		
Category	Score Band	Description
Excellent	81–100	Use of market and economic instruments for reducing emissions. Roadmaps for tightening of standards and target emissions <i>at par</i> with international standards and best practices established. High technology application.
Good	61–80	Maturing of cleaner processes and use of cleaner fuels. Stringent emission controls and standards covering different emission sources.
Moderate	41–60	Some standards for ambient air quality, emissions, and fuel quality are in place. Emission control regulations for industries and stationary sources exist.
Limited	21–40	Policies relevant to emissions reductions are limited to general environmental laws.
Minimal	1–20	Measures and activities to reduce emissions are project-related or <i>ad hoc</i> .

Source: CAI-Asia, 2011.

#### 2.2.1.4 Overall Clean Air Score

The overall clean air score provides a quick snapshot on the overall status of clean air management in a city covering the three major indices discussed above. In previous benchmarking exercises and first version of the CAMAT (version 1.0), categories for overall clean air score did not put emphasis on the next steps. In Version 2.0, the Clean Air Score incorporates both the status and the recommended action (see Table 6).





Table 6. Score Bands and Category Descriptions for Overall Clean Air Score

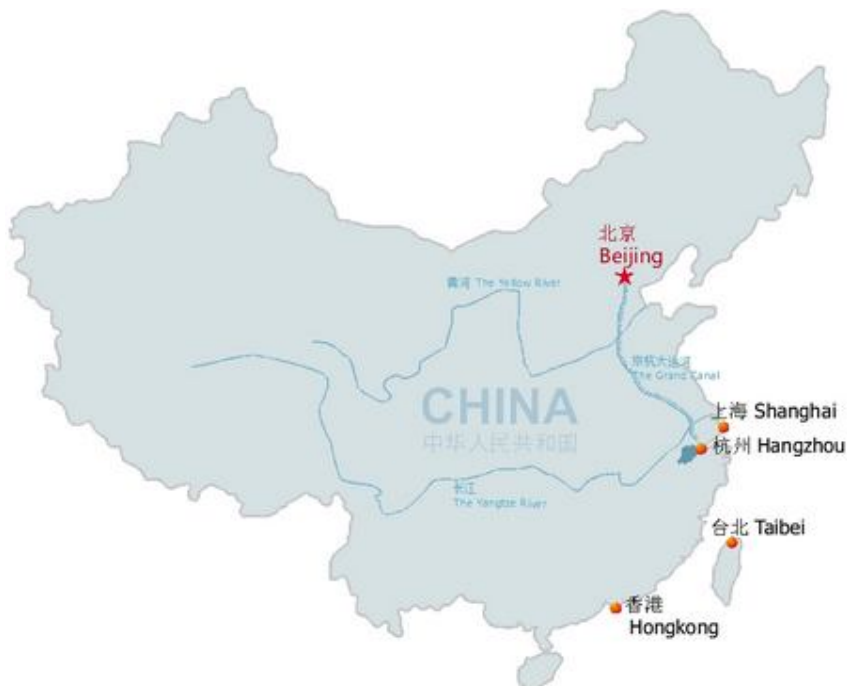
Overall Clean Air Score Category			
Version 1.0	Version 2.0	Score Band	Description
Excellent	Fully developed I	91–100	Key components of clean air management complete. Strong mandate for air pollution and GHG management and strong sector-based and integrated policies, regulations and institutions to address major sources of pollution ( <i>e.g.</i> , transport, industry, energy and area sources). Policies and actions contribute to achieving levels equivalent to prescribed WHO guidelines and interim targets for air pollution.
	Fully developed II	81–90	
Good	Maturing I	71–80	Key Components of clean air management complete and some integration with other major sectors ( <i>e.g.</i> , transport, health and energy sectors). Policies and actions have achieved some success in reducing AP/GHG emissions but air quality levels still exceed healthy levels prescribed by the WHO. Management efforts in all sector sources need to be intensified to bring down emissions further.
	Maturing II	61–70	
Moderate	Emerging I	51–60	Majority of key components of clean air management are in place. Policies and actions to reduce emissions from identified major sources need to be enhanced. Sector-based institutions need to upgrade technical and management capacity.
	Emerging II	41–50	
Limited	Developing I	31–40	GHG and AP emissions are increasing and air quality declining. Clean air management activities are scattered in different organizations with limited collaboration. Needs to invest in strengthening components of basic air quality management and collaboration between stakeholders.
	Developing II	21–30	
Minimal	Underdeveloped	0–20	<i>Ad hoc</i> clean air management; lack in emissions and ambient air quality standards; Needs to build capacity for basic air quality and GHG emissions management.

Source: CAI-Asia, 2011.



### 3. PILOT CITIES: HANGZHOU AND JINAN

#### 3.1 Hangzhou, Zhejiang Province, P.R. China



Source: <http://www.hzstats.gov.cn/web/shownews.aspx?id=UqUHIhAFC%2BY=>

Map Reference:	30°16'N 120°12'E
Total Population (2008) (10 000 persons)	677.64
Total Area (km <sup>2</sup> )	16,596
Province	Zhejiang
Annual precipitation (2008) (millimeters)	1,273.9
Annual average temperature (2009) (°C)	17.8
Gross regional product (2009) (current prices)	5,098.66 (100 million RMB) 769.85 (100 million USD)

Sources: <http://www.hzstats.gov.cn/web/shownews.aspx?id=/99Ys068TZg=>



Hangzhou, capital of Zhejiang Province, is composed of eight districts, three county-level cities, and two counties.<sup>6</sup> It is also of the important cities in the southern wing of the Yangtze River Delta (YRD). In 2008, total year-end population reached 677.64 thousand persons, about 0.51% of the country's total population, with a population density of 408 persons per km<sup>2</sup>.<sup>7</sup>

In 2009, the city's gross domestic product (GDP) (at current prices) reached 5,098 hundred million RMB, reporting a 10% increase for past 19 years.<sup>8</sup> In the same year, Hangzhou accounted for over 22.3% of Zhejiang Province's GDP. Hangzhou has continued to showcase its economic competitiveness, as it ranked 2<sup>nd</sup> among provincial capitals and 8<sup>th</sup> among large and medium-sized cities in 2009 in terms of city's comprehensive economic strength.<sup>9</sup>

Aside from being the provincial centre in economy, culture, science and education, it is also a transportation hub for southeast P.R. China. The city has experienced continued growth in motor vehicles, reaching 1,578,900 (of which 718,700 private cars) at the end of 2008.<sup>10</sup> This corresponds to 13.2% increase in total vehicle numbers and 27.2% increase in private vehicles compared to 2007. It also has an extensive public bus and trolleybus network and successful public bike rental system.

Hangzhou Environmental Protection Bureau (EPB) under the Municipal Government is responsible for all affairs related to environmental protection in Hangzhou including implementing national policies and laws related to environment, formulating and implementing local environmental programs for the city. Aside from EPB, there are also public institutions with distinct responsibilities in managing specific environmental issues, some of which include the Hangzhou Environmental Monitoring Center and Hangzhou Motor Vehicle Exhaust Pollution Management Department.<sup>11</sup>

While Hangzhou has made significant effort in formulating and implementing air pollution reduction programs including the continuous expansion of their public bike rental system, there is still more work to be done. In 2009, the annual average of PM<sub>10</sub> was 97 µg/m<sup>3</sup> – while it satisfies the national Grade II annual standard of 100 µg/m<sup>3</sup>, it is above the WHO air quality guideline of 20 µg/m<sup>3</sup>.

<sup>6</sup> Districts: Shangcheng, Xiacheng, Jianggan, Gongshu, Xihu, Binjiang, Xiaoshan and Yuhang; Country-level cities: Jiande, Fuyang and Lin'an; Counties: Tonglu and Chun'an

<sup>7</sup> Population density: [http://www.hzstats.gov.cn/web/tjnj/nj2009/01/nj\\_.htm](http://www.hzstats.gov.cn/web/tjnj/nj2009/01/nj_.htm); Hangzhou population data: [http://www.hzstats.gov.cn/web/tjnj/nj2009/02/nj\\_.htm](http://www.hzstats.gov.cn/web/tjnj/nj2009/02/nj_.htm)

<sup>8</sup> Hangzhou Municipal Statistics Bureau, Investigation Team of National Bureau of Hangzhou, 2009. "Hangzhou Socio-Economic Survey." (February 16, 2009) Link: <http://www.hangzhou.gov.cn/main/zjhztjsj/tjgb/T281125.shtml>

<sup>9</sup> Hangzhou Statistical Information Network, 2010. "An Overview of Hangzhou: Comprehensive Strength." Hangzhou (June 18, 2010). Page 19-39. Link: <http://www.hzstats.gov.cn/web/shownews.aspx?id=/99Ys068TZg=>

<sup>10</sup> Hangzhou Municipal Statistics Bureau, Investigation Team of National Bureau of Hangzhou, 2009. "Hangzhou Socio-Economic Survey." (February 16, 2009) Link: <http://www.hangzhou.gov.cn/main/zjhztjsj/tjgb/T281125.shtml>

<sup>11</sup> Hangzhou, EPB, (undated). Public Institutions. Hangzhou EPB website (EN) [http://www.hzepb.gov.cn/english/personnel/public/201012/t20101217\\_7468.htm](http://www.hzepb.gov.cn/english/personnel/public/201012/t20101217_7468.htm)



With the State Council plans of intensifying air pollution programs in the Twelfth FYP, including Nitrogen oxide (NO<sub>x</sub>) Total Control and Regional Air Pollution and Air Quality Management Mechanism, Hangzhou can benefit from undertaking an updated air quality management assessment to have a comprehensive understanding of its current status based on its recent activities. It can also help the city identify other areas that it still needs to reinforce and improve. Further, being a national model city for environmental protection, Hangzhou can share its best practices with other cities within China and in the region.

### 3.2 Jinan, Shandong Province, P.R. China



Sources: [http://en.wikipedia.org/wiki/File:China\\_edcp\\_location\\_map.svg](http://en.wikipedia.org/wiki/File:China_edcp_location_map.svg)

Map Reference:	36°40'N, 117°00'E
Total Population (2008) (10 000 persons)	603.99
Total Area (km <sup>2</sup> )	8177
Province	Shandong
Historical Precipitation Range (millimeters)	600 to 700
Annual Average temperature (2008) (°C)	14.6
Gross regional product (current prices)	3,351 (100 million RMB) 506 (100 million USD)

Sources: <http://www.jinan.gov.cn/>



Jinan, the capital of Shandong, is composed of six districts, one county-level city, and three counties. The city has a rich history and has been proclaimed as a national historical and cultural city by the State Council in December 1986.<sup>12</sup> In 2008, total year-end population reached 604 thousand persons, about 0.45% of the country's total population, with a population density of 739 persons per km<sup>2</sup>.<sup>13</sup>

In 2009, Jinan's GDP (at current prices) rose by 12.2% relative to the previous year, reaching 335 billion RMB.<sup>14</sup> Jinan accounted for about 10% of Shandong Province's GDP, the 2<sup>nd</sup> highest contributor for the province, following Qingdao.<sup>15</sup> In the same year, GDP per capita in Jinan reached 50,376 RMB (\$7,607 USD), corresponding an increase of 11.3% relative to the previous year. This is higher than the GDP per capita in the province: 35,894 RMB (\$5,420 USD).

While lower compared to previous years, non-motorized transport (walking and cycling) still maintain to have the largest transport mode share in Jinan. Based on 2004 data from the Jinan Planning Institute, it was forecasted that in 2010, mode share of cycling and walking will be 55%, 25% for public transport and 20% for private cars.<sup>16</sup> Still, public transport and private car shares have increased over the years. In 2009, there were a total of 1.131 million vehicles in the city, which 664,000 was private-owned.<sup>17</sup> Relative to 2008 data, this corresponds to a 9.2% and 23.4% increase in total and private-owned vehicles, respectively.

Jinan EPB, which is under the Municipal Government, is responsible for all affairs related to environmental protection in Jinan including implementing national policies and laws related to environment, formulating and implementing local environmental programs for the city.<sup>18</sup> There are also Environmental Protection Agencies (EPAs) for the different districts within the city.

While Jinan has implemented several programs relating to air quality management, including the Blue Skies Project (1999-2003), establishment of national model city in environment protection (2003-06), air

<sup>12</sup> Jinan Municipal Government, (undated). "About Jinan: Historical Overview." Link: <http://www.jinan.gov.cn/col/col36/index.html>

<sup>13</sup> 2009 China Statistical Yearbook.

<sup>14</sup> Jinan Municipal Bureau of Statistics, Investigation Team of National Bureau of Jinan, 2010. "2009 National Economic and Social Development Statistics." Link: [http://www.jinan.gov.cn/art/2010/3/26/art\\_95\\_230375.html](http://www.jinan.gov.cn/art/2010/3/26/art_95_230375.html)

<sup>15</sup> Hong Kong Trade Development Council (HKDC), 2010. "Profiles of China Provinces, Cities and Industrial Parks: Shandong Province." Link: <http://www.hktdc.com/info/mi/a/mpcn/en/1X06BVNS/1/Profiles-Of-China-Provinces-Cities-And-Industrial-Parks/SHANDONG-PROVINCE.htm>

<sup>16</sup> Montgomery, B., 2008. "Endure or Perish: Cycling Trends and Fate in the Face of BRT: A Case Study of Jinan, Shandong Province, P.R. China." University of California at Berkeley Global Metro Studies. Link: [http://metrostudies.berkeley.edu/pubs/masters/Montgomery\\_PR.pdf](http://metrostudies.berkeley.edu/pubs/masters/Montgomery_PR.pdf)

<sup>17</sup> Jinan Municipal Bureau of Statistics, Investigation Team of National Bureau of Jinan, 2010. "2009 National Economic and Social Development Statistics." Link: [http://www.jinan.gov.cn/art/2010/3/26/art\\_95\\_230375.html](http://www.jinan.gov.cn/art/2010/3/26/art_95_230375.html)

<sup>18</sup> Jinan Environmental Protection Bureau, (undated). "Jinan Environmental Protection Bureau - Responsibility." Link: <http://www.jnepb.gov.cn/moudle/mainsubendelse.aspx?sortid=C7F230FA823DC272&subsortid=D607DE4D0044FA40&endsubsortid=37945B52630222F4>





quality assurance project for national games (2007-09) and clean air action plan (2010), more can still be done. In 2009, the annual average of  $PM_{10}$  was  $123 \mu\text{g}/\text{m}^3$  – above both the national Grade II annual standard (*i.e.*,  $100 \mu\text{g}/\text{m}^3$ ) and the WHO air quality guideline (*i.e.*,  $20 \mu\text{g}/\text{m}^3$ ).

Similar with Hangzhou, Jinan can benefit from undertaking an updated air quality management assessment to have a comprehensive understanding of its current status based on its recent activities. It can also help the city identify other areas that it still needs to reinforce and improve.



## 4. RESULTS AND DISCUSSION

### 4.1 Hangzhou

#### 4.1.1 Overall Clean Air Score

Hangzhou has been classified as having a *Maturing (II) Clean Air Management* (Figure 2). This means that the key components of clean air management are complete and have some integration with other major sectors (e.g. transport, health and energy sectors). While the policies and actions have achieved some success in reducing AP/GHG emissions, cities in the good category still have air quality levels that exceed healthy levels prescribed by WHO. Management efforts, then, in all sector sources need to be intensified to bring down emissions further.

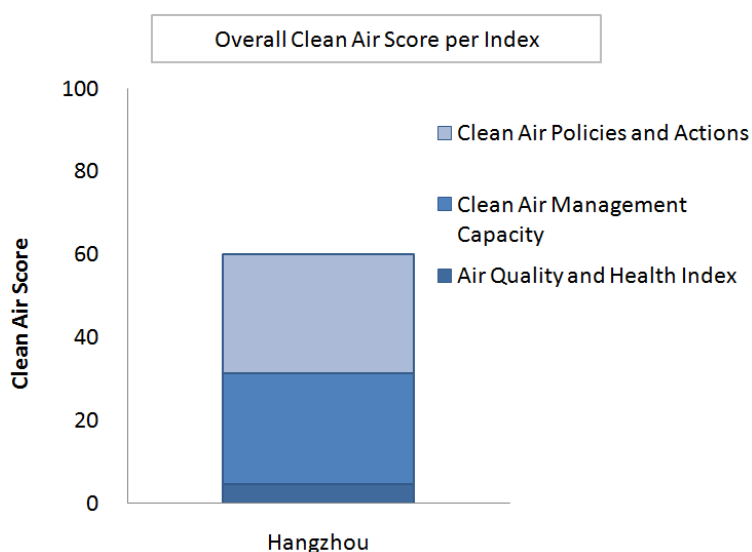
Among the three indices, Hangzhou scored very high both in its capacity to manage air quality and its policies and actions (see Annex A for detailed results for Hangzhou).

Figure 2. Clean Air Score Summary for Hangzhou, 2008

#### Clean Air Scorecard Results

Clean Air Score for Hangzhou in 2008: 60 | Good

	Final Score	Band Category
Index 1 - Air Quality and Health Index	4.7	Very Poor
Index 2 - Clean Air Management Capacity	26.7	Excellent
Index 3 - Clean Air Policies and Actions	28.7	Excellent



#### 4.1.2 Air Pollution and Health Index

For the Air Pollution and Health Index, Hangzhou had air quality data available for PM<sub>10</sub>, NO<sub>2</sub>, and SO<sub>2</sub> for 2008. While Pb, PM<sub>2.5</sub> and CO are also being monitored, data is not yet for dissemination. The Index score of 4.7 is based on SO<sub>2</sub> as the city's main pollutant of concern. According to the same index, the concentrations of PM<sub>10</sub> and NO<sub>2</sub> in 2008 were very poor (Figure 3).

Figure 3. Air Pollution and Health Index Score for Hangzhou

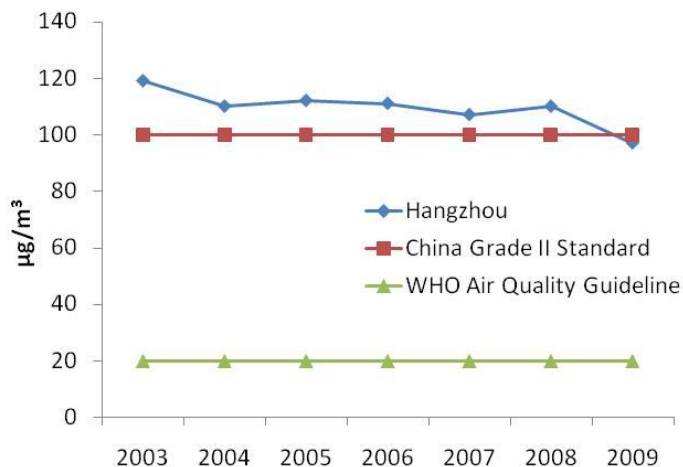
Index 1 - Air Pollution and Health Index					
Pollutant	Score	Category			
PM <sub>2.5</sub>	-	-			
PM <sub>10</sub>	6.1	Very Poor	Final Score	4.7	
O <sub>3</sub>	-	-	Pollutant of Concern	SO <sub>2</sub>	
SO <sub>2</sub>	4.7	Very Poor	Band Category	Very Poor	
Pb	-	-	Pollutants Considered	PM <sub>10</sub> , SO <sub>2</sub> , NO <sub>2</sub>	
NO <sub>2</sub>	20.0	Good			
CO	-	-			

CO = Carbon monoxide, NO<sub>2</sub>= Nitrogen dioxide, O<sub>3</sub> = ozone, Pb = lead, PM<sub>2.5</sub> = particulate matter with a diameter of 2.5 microns or less, PM<sub>10</sub> = particulate matter with a diameter of 10 microns or less, SO<sub>2</sub>= Sulfur dioxide.

To put these scores in historic perspective, the trend of air quality levels of Hangzhou is provided in Figure 4 to Figure 6. From these graphs, Hangzhou's annual PM<sub>10</sub> concentration has slightly decreased since 2003. An annual SO<sub>2</sub> concentration has notably decreased, particularly in the latter years. Likely a result of the total SO<sub>2</sub> emissions control initiative in the State Eleventh Five-Year Plan. Annual NO<sub>2</sub> concentrations have been generally stable since 2002. Still, PM<sub>10</sub>, NO<sub>2</sub> and SO<sub>2</sub> are above the WHO guidelines.



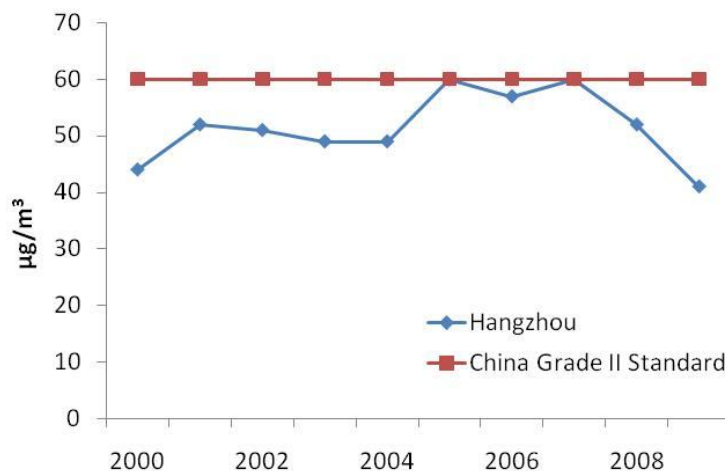
Figure 4. Trend of Ambient PM<sub>10</sub> Concentrations in Hangzhou



µg/m³ = microgram per cubic meter; PM<sub>10</sub> = particulate matter with a diameter of 10 microns or less, WHO = World Health Organization.

Data Source: China Statistical Yearbook

Figure 5. Trend of Ambient SO<sub>2</sub> Concentrations in Hangzhou

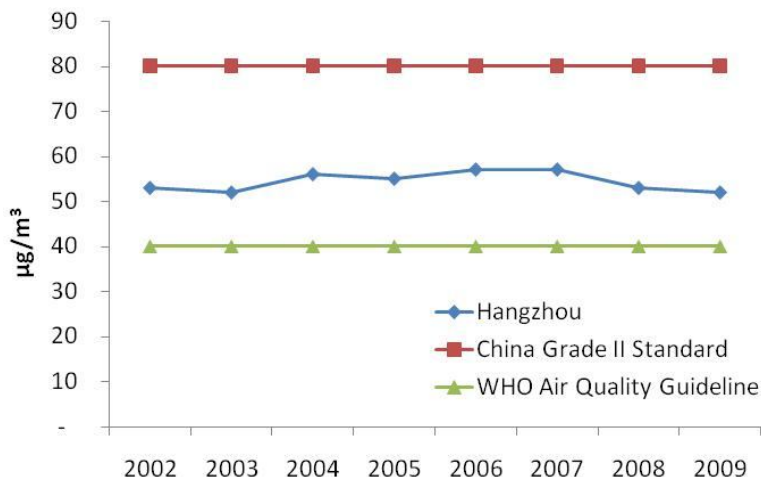


µg/m³ = microgram per cubic meter, SO<sub>2</sub> = Sulfur dioxide, WHO = World Health Organization.

Data Source: China Statistical Yearbook



Figure 6. Trend of Ambient NO<sub>2</sub> Concentrations in Hangzhou



µg/m<sup>3</sup> = microgram per cubic meter, NO<sub>2</sub> = Nitrogen dioxide, WHO = World Health Organization.

Data Source: China Statistical Yearbook

#### 4.1.3 Clean Air Management Capacity Index

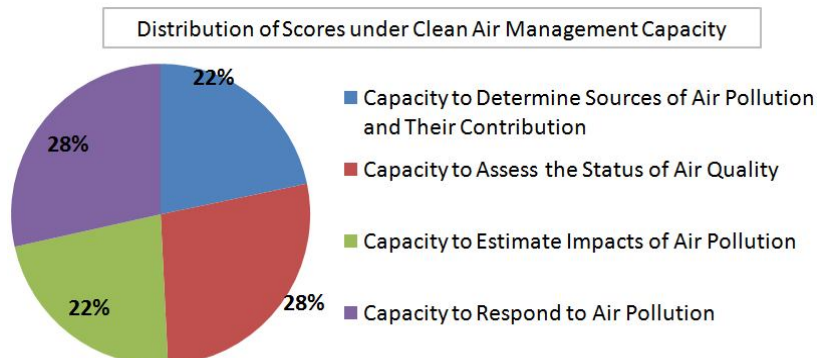
Hangzhou's Clean Air Management Capacity Index score is in the *Excellent* category (26.7 points out of a total of 33.3). An excellent category means that Hangzhou has an air quality management system that is institutionalized in a dedicated organization under the city administration. There are also other stakeholder organizations that are engaged in collaborative activities within city.

Among the four subindices, Hangzhou scored highest in capacity to assess air quality status (*i.e.*, air quality monitoring, modelling and data analysis) and capacity to respond to air pollution (policy environment, budget) (Figure 7).

Figure 7. Clean Air Management Capacity Index Score for Hangzhou

Index 2 - Clean Air Management Capacity Index	
	Final Score
Capacity to Determine Sources of Air Pollution and Their Contribution	5.8
Capacity to Assess the Status of Air Quality	7.3
Capacity to Estimate Impacts of Air Pollution	6.0
Capacity to Respond to Air Pollution	7.6
<b>Total</b>	<b>26.7</b>





Hangzhou is generally capable in its collection of emissions data from mobile, stationary and area sources, scoring 5.8 out of 8.3. Conduct of emission inventories is also fairly regular – conducted every year, every quarter for major sources. It can still improve in compiling emission estimates for criteria and toxic pollutants. For instance, the city does not have PM<sub>10</sub> and PM<sub>2.5</sub> estimates, but only for TSP. Lead and CO are also not included. Several toxics and other pollutants have been covered, including dioxins and furans, arsenic, cadmium, chromium, mercury, nickel and fluorine, but volatile organic compounds (VOCs) and poly-aromatic hydrocarbons (PAHs) are still not included as well. Emission estimates are also not being undertaken for greenhouse gases.

Hangzhou's capacity to assess its air quality status is good (scoring 7.3 out of 8.3). This capacity relies on a good ambient air quality monitoring system. The city has 24 stations monitoring PM<sub>10</sub>, SO<sub>2</sub> and NO<sub>2</sub>. While not required by the State, Hangzhou has also begun monitoring ozone (with 19 monitoring stations)<sup>19</sup>, CO (with five stations), VOCs and PM<sub>2.5</sub> (with one station each).<sup>20</sup>

Hangzhou is also ahead in terms of use air quality modelling, able to provide daily air quality forecasts to the public. Daily air pollution index (API) reports and forecasts for Hangzhou are disseminated through various media including newspapers, websites (e.g., MEP website: [datacenter.mep.gov.cn](http://datacenter.mep.gov.cn), Hangzhou EPB website: [www.hzepb.gov.cn](http://www.hzepb.gov.cn) and EXPO 2010 Air Quality website: [www.semcc.com.cn/expoair/WebFront/intro\\_csj.aspx](http://www.semcc.com.cn/expoair/WebFront/intro_csj.aspx)), television, and radio.

Annual air quality data for Hangzhou, particularly number of days exceeding API exceeds Grade II standards, are also reported in Hangzhou's Statistical Yearbook (<http://www.hangzhou.gov.cn/main/zjhz/tjsj/>).

Similar to other cities in developing Asia, Hangzhou can improve in conduct of health impact studies of air pollution (e.g., exposure assessments and epidemiological studies). Hangzhou received a score of 6.0 out of 8.3 on the capacity to estimate impacts of air pollution. Several studies have been conducted by

<sup>19</sup> Ozone monitoring started in 1999.

<sup>20</sup> PM<sub>2.5</sub> monitoring started in 2004.



universities and research institutions on the estimating environmental impacts and impacts to other sectors of air pollution.

The enabling management capacity for air quality in Hangzhou is considerably high (7.6 points out of 8.3). At the city level, there are about 100 staff members working on various air quality issues. Greenhouse gas management (and other climate change issues) is currently being handled by a separate department – National Development and Reform Commission (NRDC).

In terms of financing, Hangzhou has a budget earmarked for air quality management, generally obtained from central/national and local government. In 2009, Hangzhou government's spending on environmental protection has reached 975 million RMB (about \$147 million USD), a 30.3% increase compared to the previous year.<sup>21</sup> The city receives about 300-400 million RMB a year (about \$45-60 million USD) from the municipal government specifically for air quality management activities.

This budget allows implementation of various air quality management programs and activities, including air quality monitoring, conduct of emission inventories, control measures for transport, industry and other sources, enforcement of legislation, staff training and capacity building, and evaluation of effectiveness of legislation and policies.

In 2009 alone, the city spent 10.06 million RMB (about \$1.52 million USD) to strengthen its environmental monitoring capacity.<sup>22</sup> About 8.9 million RMB (about \$1.34 million USD) was used to purchase new monitoring equipment. To date, the city has 24 sets of automatic air monitoring system, 14 sets of water quality monitoring system, and other 42 kinds of environmental monitoring equipment and monitoring instruments including gas chromatography mass spectrometry, high performance liquid chromatography mass spectrometry, plasma emission spectrometer, and environmental emergency monitoring vehicles.<sup>23</sup>

#### 4.1.4 Clean Air Policies and Actions

Hangzhou scored a total of 28.7 (out of 33.3 points) for the Clean Air Policies and Actions Index, which is categorized as *Excellent*. An excellent category means that Hangzhou's policies and measures on air pollution involve stringent emissions controls and standards for different sources. Hangzhou also makes use of cleaner fuels and has roadmaps for strengthening its vehicle emissions standards (e.g., plan to move from Euro 3 to Euro 4).

<sup>21</sup> Hangzhou Municipal Statistics Bureau, Investigation Team of National Bureau of Hangzhou, 2009. "Hangzhou Socio-Economic Survey." (February 16, 2009) Link: <http://www.hzstats.gov.cn/web/ShowNews.aspx?id=W2oADErp2c=>

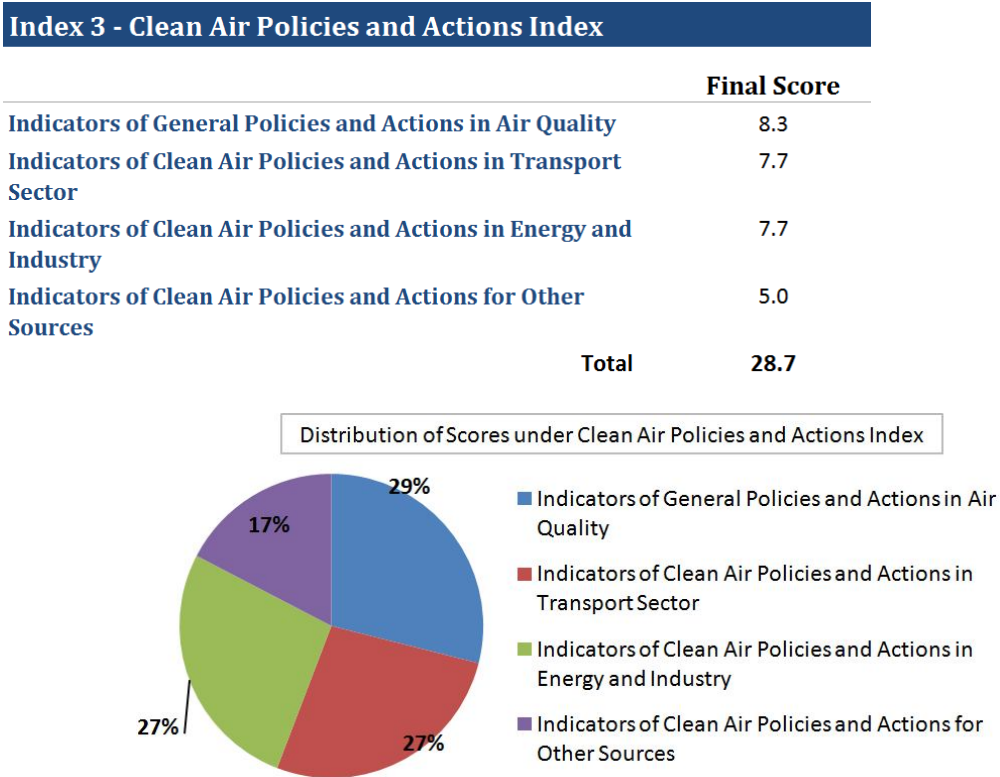
<sup>22</sup> Hangzhou Yearbook 2009. Environmental Protection: Environmental Research and Monitoring. 14 April 2010. Link: <http://www.hangzhou.gov.cn/main/zjhz/hzlj/2009/hjbh/T318490.shtml>

<sup>23</sup> Hangzhou Yearbook 2009. Environmental Protection: Environmental Research and Monitoring. 14 April 2010. Link: <http://www.hangzhou.gov.cn/main/zjhz/hzlj/2009/hjbh/T318490.shtml>



Hangzhou scored the highest for its general policy framework, followed by policies and actions to address transport and stationary emissions (Figure 8).

**Figure 8. Clean Air Policies and Actions Index Score for Hangzhou**



The Hangzhou municipal government has implemented several Clean Air Action plans and programs for the city in line with P.R. China's Air Pollution Prevention Law, including the Dust Pollution Prevention Management Practices and Prevention and Control of Motor Vehicle Exhaust Pollution in Hangzhou, among others.

Hangzhou implements China national ambient air quality standards. There are standards available for PM<sub>10</sub>, O<sub>3</sub>, SO<sub>2</sub>, NO<sub>2</sub> and CO. There is still no standard for PM<sub>2.5</sub>. The country also has limited ambient air quality standards on toxics. Hangzhou received 7.7 out of 10.0 points in the subindex for policies and actions in the transport sector. The framework for sustainable transport contains most of required elements (e.g., transport demand management, public transport, cycling, walking, vehicle traffic system management, inspection and maintenance, alternative or non-renewable energy fuels, fuel efficiency and freight and logistics). The city also implements the national standards for vehicle emissions and fuel quality. Fuel quality and vehicle emission standards currently in place are currently at Euro 3 levels.



The city also implements several sustainable transport programs. As part of their transport demand management measures, there are high parking fees<sup>24</sup> in tourism areas and vehicle plate number coding system is implemented during high tourism months.

In addition, the MRT (Metro Rail Transit) is also expected to be open to traffic in 2012. There are also plans to increase Bus Rapid Transit (BRT) lines in the city.

Hangzhou also has a very successful public bike rental system provided by the municipal government. By end of 2010, Hangzhou has 2,411 public bicycle rental spots and 60,600 public bicycles in service.<sup>25</sup> There are bike stations located every 100 meters in the commercial business district and every 300 to 400 meters for other areas. The rental rate is low – free within the first hour of use, followed by one RMB (about \$ 0.15 USD) for the second hour of use, two RMB for the next hour and three RMB for each additional hour. Purchase of an electronic card with 200 RMB deposit (about \$30.17 USD) is necessary for use.

Hangzhou also implements a single ticketing system for multiple public transport system through the Hangzhou Transportation Smart Card. The Hangzhou Transportation Integrated Circuit (IC) Card for different transport modes, including buses, taxis and for public bicycle renting.<sup>26</sup>

The policies and actions for Hangzhou to manage emissions from energy and industry receive 7.7 points of out a total of 8.3 points. The general framework to manage emissions is available, as this covers most elements such as permitting, compliance monitoring, energy efficiency, siting, and industry prioritization. Emission standards also exist for major sources of stationary pollution in the city such as power-generating facilities; cement manufacturing; incinerators; steel industries; and textile industries (for printing and dyeing).

The measures to control emissions from industries are being continuously improved. Hangzhou has implemented relocation and closing down of polluting enterprises. Desulfurization and dust removal transformation of coal-fired boilers and steel sintering machines have also been conducted.

The government has also been continuously increasing efforts to control dust. The municipal government has issued Decree 190: Measures for the Control of Dust Pollution. They have also been carrying out road washing activities.

<sup>24</sup> 30 RMB per hour = about 4.53 USD per hour

<sup>25</sup> eChinacities.com, 2010. "Public Bicycle Service Hours Extended in Hangzhou." 29 December 2010. Link: <http://www.echinacities.com/hangzhou/city-in-pulse/public-bicycle-service-hours-extended-in-hangzhou.html>

<sup>26</sup> Travel China Guide, (undated). "Hangzhou Transportation Smart Card." Link: <http://www.travelchinaguide.com/cityguides/zhejiang/hangzhou/transportation-smart-card.htm>



## 4.2 Jinan

### 4.2.1 Overall Clean Air Score

Jinan has been classified as having a *Maturing (II) Clean Air Management* (Figure 9). Cities in this category are those that have all the key components for air quality management and have experienced some reductions in emissions and improvements in air quality. The air quality levels however remain higher than those prescribed by WHO guidelines. Cities in this category then need to intensify activities to further reduce emissions and pollution levels.

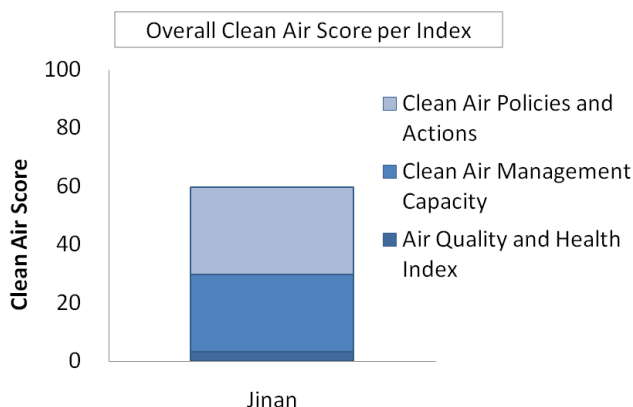
Among the three indices, Jinan scored highest in its clean air policies and actions and lowest in its air quality and health index (see Annex A for detailed results for Jinan).

Figure 9. Clean Air Score Summary for Jinan, 2008

#### Clean Air Scorecard Results

Clean Air Score for Jinan in 2008: 59.8 | Good

	Final Score	Band Category
Index 1 - Air Quality and Health Index	3.2	Critical
Index 2 - Clean Air Management Capacity	26.6	Excellent
Index 3 - Clean Air Policies and Actions	30.0	Excellent



### 4.2.2 Air Pollution and Health Index

For 2008, Jinan had air quality data available for all pollutants except PM<sub>2.5</sub> and Pb. The Index score of 3.2 is based on SO<sub>2</sub> as the city's main pollutant of concern. Jinan also had poor results for PM<sub>10</sub>. For the remaining pollutants, index scores were in the excellent category (Figure 10).



Figure 10. Air Pollution and Health Index Score for Jinan

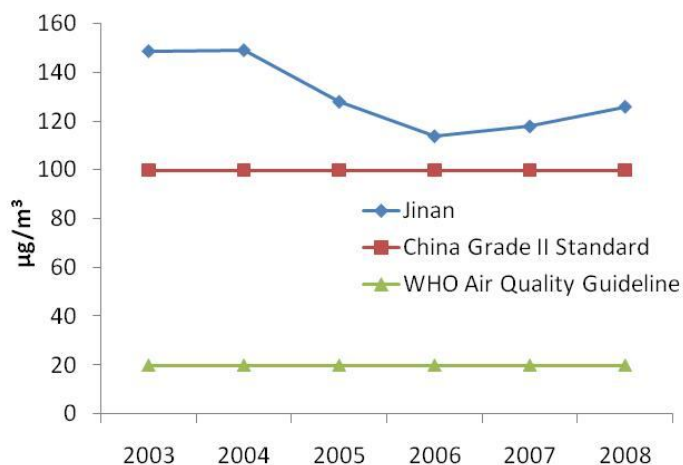
### Index 1 - Air Pollution and Health Index

Pollutant	Score	Category	<b>Final Score</b> 3.2 <b>Pollutant of Concern</b> SO <sub>2</sub> <b>Band Category</b> Critical <b>Pollutants Considered</b> PM <sub>10</sub> , O <sub>3</sub> , SO <sub>2</sub> , NO <sub>2</sub> and CO
PM <sub>2.5</sub>	-	-	
PM <sub>10</sub>	4.9	Very Poor	
O <sub>3</sub>	29.0	Excellent	
SO <sub>2</sub>	3.2	Critical	
Pb	-	-	
NO <sub>2</sub>	29.7	Excellent	
CO	32.5	Excellent	

CO = Carbon monoxide, NO<sub>2</sub> = Nitrogen dioxide, O<sub>3</sub> = ozone, Pb = lead, PM<sub>2.5</sub> = particulate matter with a diameter of 2.5 microns or less, PM<sub>10</sub> = particulate matter with a diameter of 10 microns or less, SO<sub>2</sub> = Sulfur dioxide.

To gain insight on the air quality tendency in Jinan, annual air quality concentrations of PM<sub>10</sub>, SO<sub>2</sub> and NO<sub>2</sub> from 2003 to 2008 are provided in Figure 11 to Figure 13. Annual average PM<sub>10</sub> concentrations decreased from 2004 to 2006, but have been slightly increasing in recent years. Annual PM<sub>10</sub> concentrations in the city are above both the China Grade II Standard and WHO air quality guideline. Annual SO<sub>2</sub> concentrations have been fluctuating since 2000 while annual NO<sub>2</sub> concentrations have decreased in recent years, even below the WHO air quality guideline of 40µg/m<sup>3</sup>.

Figure 11. Trend of Ambient PM<sub>10</sub> Concentrations in Jinan

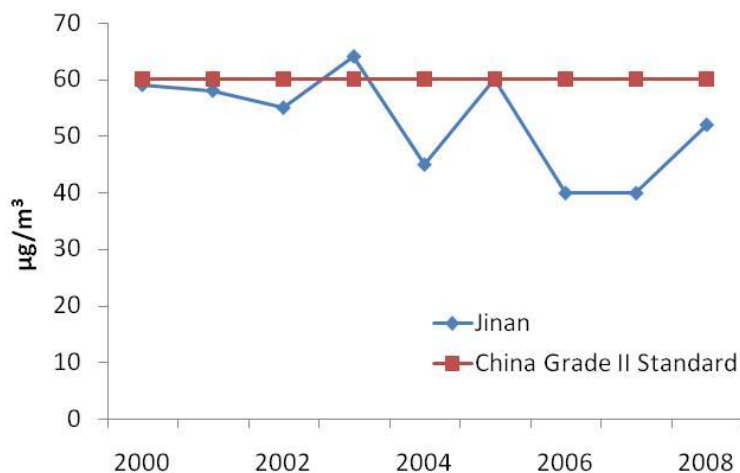


µg/m<sup>3</sup> = microgram per cubic meter; PM<sub>10</sub> = particulate matter with a diameter of 10 microns or less, WHO = World Health Organization.

Data Source: China Statistical Yearbook

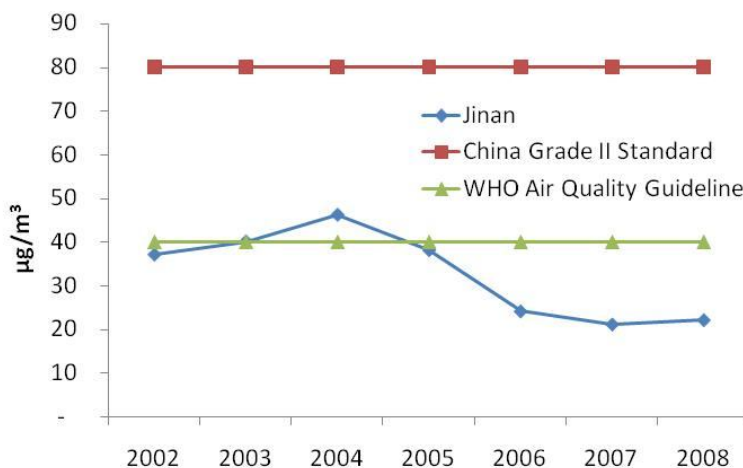


Figure 12. Trend of Ambient SO<sub>2</sub> Concentrations in Jinan



µg/m<sup>3</sup> = microgram per cubic meter, SO<sub>2</sub> = Sulfur dioxide, WHO = World Health Organization.  
Data Source: China Statistical Yearbook

Figure 13. Trend of Ambient NO<sub>2</sub> Concentrations in Jinan



µg/m<sup>3</sup> = microgram per cubic meter, NO<sub>2</sub> = Nitrogen dioxide, WHO = World Health Organization.  
Data Source: China Statistical Yearbook

#### 4.2.3 Clean Air Management Capacity Index

For the Clean Air Management Capacity Index, Jinan also received a score in the *Excellent* category (26.6 points out of 33.3). An excellent category means that Jinan has a dedicated organization that manages the air quality activities in the city and ensuring that all key components of air quality management are covered. This organization works together with other stakeholders and organizations.

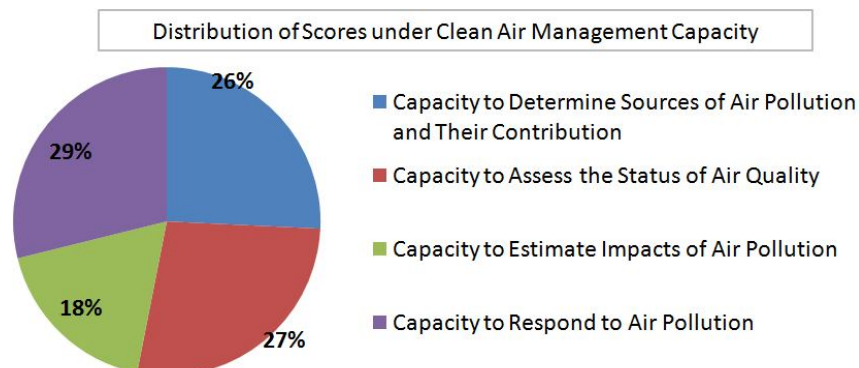


Similar with Hangzhou, Jinan also scored highest in capacity to assess air quality status (*i.e.*, air quality monitoring, modelling and data analysis) and capacity to respond to air pollution (policy environment, budget) (Figure 14). Jinan had relatively low scores for capacity to estimate impacts of air pollution.

Figure 14. Clean Air Management Capacity Index Score for Jinan

#### Index 2 - Clean Air Management Capacity Index

	Final Score
Capacity to Determine Sources of Air Pollution and Their Contribution	6.8
Capacity to Assess the Status of Air Quality	7.3
Capacity to Estimate Impacts of Air Pollution	4.8
Capacity to Respond to Air Pollution	7.7
<b>Total</b>	<b>26.6</b>



Similar with Hangzhou, Jinan is also capable in its collection of emissions data from mobile, stationary and area sources, scoring 6.8 out of 8.3. Emission inventories for the city are conducted every two to three years. They have also conducted source apportionment studied for PM<sub>2.5</sub> in 2008.

In terms of coverage of pollutants, Jinan has covered all criteria pollutants, except for Pb. While for toxics and other pollutants, such as VOCs, PAHs and dioxins and furans are included in emission inventories. Carbon dioxide is also included in the city's emission inventory.

Jinan's capacity to assess its air quality status is *good* (scoring 7.3 out of 8.3). The city has currently has 16 stations monitoring PM<sub>10</sub>, O<sub>3</sub>, SO<sub>2</sub>, NO<sub>2</sub> and CO. They also have four monitoring stations for PM<sub>2.5</sub> and PM<sub>1.0</sub>. Aside from criteria pollutants, VOCs, CO<sub>2</sub>, CH<sub>4</sub>, organic carbon (OC) and elemental Carbon (EC) are also being monitoring in the Sprung City Square monitoring station. Further, they have begun installation of roadside monitoring stations in 2010. Only monitoring of PM<sub>10</sub>, NO<sub>2</sub> and SO<sub>2</sub> are required by the State.

Same with Hangzhou, Jinan also uses air quality modelling and is able to provide daily air quality forecasts to the public. Daily air pollution index (API) reports and forecasts for Jinan are disseminated through various media including newspapers, websites (*e.g.*, MEP website: [datacenter.mep.gov.cn](http://datacenter.mep.gov.cn) and Jinan EPB website: [www.jnepb.gov.cn](http://www.jnepb.gov.cn)), television, and radio.



Annual air quality data for Jinan, particularly (1) annual average ambient concentrations for PM<sub>10</sub>, SO<sub>2</sub> and NO<sub>2</sub>, and (2) number of days exceeding API exceeds Grade II standards, are also reported in Jinan's Statistical Yearbook.<sup>27</sup>

While there is still limited number of health impact studies of air pollution available in the city, there are current projects to enhance knowledge in this area. There is Project 973, a brand for a series of scientific studies, which includes health impacts of air pollution. This is being lead by Nankai University. There are still limited studies available understanding local impacts of air pollution on agriculture, tourism, vegetation and economy.

The enabling management capacity for air quality in Jinan is also considerably high (7.7 points out of 8.3). At the city level, there are about 42 staff members working on various air quality issues: four in EPBs; ten for monitoring stations, eight for environmental research, plus in twenty in ten districts under Jinan (one each for monitoring). Greenhouse gas management (and other climate change issues) is currently being handled by the NRDC.

Jinan has a budget specifically for air quality management. This is generally obtained from central/national and local government and from grants. Air quality management activities covered by this fund include air quality monitoring, conduct of emission inventories, control measures for transport, industry and for other sources, enforcement of legislation, staff training and capacity building, and evaluation of effectiveness of legislation and policies. The budget, however, does not cover conduct of health impact assessments.

#### **4.2.4 Clean Air Policies and Actions**

For the 3<sup>rd</sup> Index, Jinan scored a high of 30 out of 33.3 points – *Excellent* category. An excellent category means that Jinan's policies and actions include stringent emission controls and standards covering different emission sources and are starting to approach internationally accepted levels.. Jinan scored the highest for its general policy framework and policies and actions in transport sector, followed by policies and actions to address stationary emissions (Figure 15).

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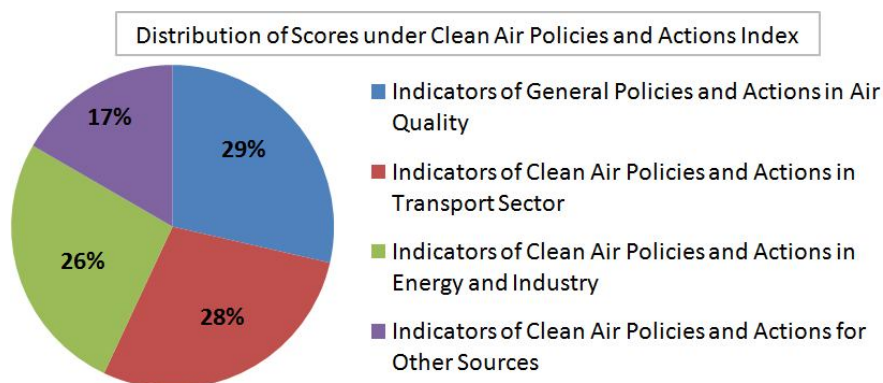
<sup>27</sup> Jinan Statistical Yearbook - [http://www.jntj.gov.cn/E\\_Type.asp?E\\_typeid=28](http://www.jntj.gov.cn/E_Type.asp?E_typeid=28)



Figure 15. Clean Air Policies and Actions Index Score for Jinan

### Index 3 - Clean Air Policies and Actions Index

	Final Score
Indicators of General Policies and Actions in Air Quality	8.6
Indicators of Clean Air Policies and Actions in Transport Sector	8.5
Indicators of Clean Air Policies and Actions in Energy and Industry	7.9
Indicators of Clean Air Policies and Actions for Other Sources	5.0
<b>Total</b>	<b>30.0</b>



Jinan municipal government has promulgated Air Pollution Prevention Act of Jinan City on 14 June 2000<sup>28</sup> in line with P.R. China's Air Pollution Prevention Law. This Act covers specific management measures for stationary sources (from coal-fired power plants and other industries), area sources (dust pollution and open burning) and mobile sources.

Jinan also implements China national ambient air quality standards. There are standards available for PM<sub>10</sub>, O<sub>3</sub>, SO<sub>2</sub>, NO<sub>2</sub> and CO. There is still currently no standard for PM<sub>2.5</sub>. The country also has limited ambient air quality standards on toxics.

Jinan had 8.5 out of 10.0 points in the subindex for policies and actions in the transport sector. The Jinan municipal government has published the Ordinance for Motor Vehicle Emissions Pollution Prevention and Control Regulations in 25 September 2009.<sup>29</sup>

<sup>28</sup> Jinan EPB, (undated). "Prevention and Control of Air Pollution in Jinan." Link: <http://www.jnepb.gov.cn/moudle/mainsubend.aspx?id=DFDDDC999ACB83DC&sortid=45557569B8ACE9C9&subsortid=5D5BB6476AD53870&endsubsortid=8E850932B88F2C97>

<sup>29</sup> Jinan EPB, (undated). "Motor Vehicle Exhaust Pollution Control Ordinance." Link: <http://www.jnepb.gov.cn/moudle/mainsubend.aspx?id=7C3366C8FF08D738&sortid=45557569B8ACE9C9&subsortid=5D5BB6476AD53870&endsubsortid=8E850932B88F2C97>



The framework for sustainable transport contains most of required elements (e.g., transport demand management, public transport, cycling, walking, vehicle traffic system management, inspection and maintenance, alternative or non-renewable energy fuels, fuel efficiency and freight and logistics).

The national standards for vehicle emissions and fuel quality are applied in Jinan. Fuel quality and vehicle emission standards currently in place are currently at Euro 3 levels.

The city also implements several sustainable transport programs. There are currently 1,084 natural gas-fueled buses, over 8,000 natural gas-fueled taxis plying the urban areas of the city. There are also recently-built roads designed with special bicycle lanes.

Jinan received 7.9 points out of 8.3 for the clean air policies and actions for energy and industry. The general framework to manage emissions is available, as this covers most elements such as permitting, compliance monitoring, energy efficiency, siting, and industry prioritization.

There are also a number of emission standards established by local government, including emission standard of air pollutants for cement industry, emission standard of air pollutants for thermal power plants and emission standard of pollutants for iron and steel industry.

The measures to control emissions from industries are being continuously improved. Some of the activities under stationary source emission reduction action<sup>30</sup> include

- Use of wet flue gas desulfurization for boilers
- 2457t/h coal-fired boilers were eliminated
- Energy consumption of per ton steel was 595 kg standard coal in 2008. Dust emission decreased from 21 kilo per ton in 1998 to 0.5 kilo per ton in 2008. 830 thousand ton backward iron-making capability and 1,200 thousand ton backward steel-making capability was eliminated.
- There were 21 shaft kilns demolished, which was 80.2% of all shaft kilns in Jinan City, and 2.1 million ton clinker annual productivity was also eliminated.

Jinan also has basic policies and programs on managing air pollution from area and other sources.

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<sup>30</sup> Han, D., 2010. "Clean Air Management Assessment Tool: Jinan Application." Jinan Academy of Environmental Sciences. Presented at the Clean Air Scorecard Pre-event at the Better Air Quality conference 9-12 November 2010 in Singapore.



## 5. Recommendations

### 5.1 Identified Gaps and Areas for Improvement for Hangzhou and Jinan

From the application of the tool, it is possible to identify actions to improve clean air management in Hangzhou and Jinan. While both cities have covered more than the basic components of AQM, there is still room for further strengthening the management of emissions.

#### Recommendations for Hangzhou to improve its AP and GHG management

Recommendations	Priority
<b>Air Pollution and Health Index</b>	
Making all air quality monitoring data available for analysis (e.g. PM <sub>2.5</sub> , ozone)	High
<b>Clean Air Management Capacity Index</b>	
Air quality monitoring for more pollutants (toxics and heavy metals)	Moderate
Make air quality monitoring for PM <sub>2.5</sub> and ozone official	High
Emissions inventories for more sources (specifically water transport and air transport)	High
Improve dissemination of air quality related information by translating to English (will also benefit expat or international communities)	High
Study on impact of air pollution on agriculture, could be linked to an impacts assessment of climate change on agriculture (food security)	High
Strengthen health impacts studies and maybe involve local universities	High
<b>Clean Air Policies and Actions</b>	
National legislation on mitigating emissions of air pollutants and GHG emissions taking into account co-benefits approach	High
Implement planned Euro 4 vehicle emissions standards	High
Establish air quality standards for PM <sub>2.5</sub> , ozone, VOC, and other toxics and heavy metals	High
Incentives for fuel-efficient vehicles	Moderate
Draft fuel economy/fuel efficiency standards for vehicles	Moderate
Implementing Transport Demand Management Measures that are at no/low cost to government e.g. vehicle plate coding scheme, congestion/cordon pricing, low emission zones	High
Strengthen Technology Transfer by programs that will establish Technology Transfer Networks and compile a database on Best Available Technology (BAT) or appropriate control technologies	High
Strengthen Energy Efficiency Programs through activities such as mandatory audits	Moderate
Preventive Maintenance systems for Energy and Industries	High
Feasibility study on Total Emissions Control and Trading within Industry Parks	Moderate



### Recommendations for Jinan to improve its AP and GHG management

Recommendations	Priority
<b>Air Pollution and Health Index</b>	
Making all air quality monitoring data available for analysis (e.g. PM <sub>2.5</sub> , ozone)	High
<b>Clean Air Management Capacity Index</b>	
Roadside air quality monitoring	High
Make air quality monitoring for PM <sub>2.5</sub> and ozone official	High
Emissions inventories for more pollutants (specifically toxics)	High
Improve dissemination of air quality related information by translating to English (will also benefit expat or international communities)	High
Strengthen health impacts studies and maybe involve local universities	High
<b>Clean Air Policies and Actions</b>	
National legislation on mitigating emissions of air pollutants and GHG emissions taking into account co-benefits approach	High
Establish air quality standards for PM <sub>2.5</sub> , ozone, VOC, and other toxics and heavy metals	High
Incentives for fuel-efficient vehicles	Moderate
Draft fuel economy/fuel efficiency standards for vehicles	Moderate
Implementing Transport Demand Management Measures that are at no/low cost to government e.g. vehicle plate coding scheme, congestion/cordon pricing, low emission zones	High
Strengthen Energy Efficiency Programs through activities such as mandatory audits	Moderate
Preventive Maintenance systems for Energy and Industries	High
Feasibility study on Total Emissions Control and Trading within Industry Parks	Moderate

## 5.2 Potential Challenges and Barriers

The main barrier for policy options at the city level is that a parallel change is needed at the national level. Therefore a bottom-up approach must be combined with a top-down approach.

### 5.2.1 Standards and Policies

National standards or specific policies to control and monitor a number of pollutants are needed – especially PM<sub>2.5</sub> and ozone that impact AQ and climate. Several cities are, in fact, already monitoring PM<sub>2.5</sub> and even PM<sub>1</sub> voluntarily, therefore cities are willing to move to beyond current requirements.

### 5.2.2 Institutions

The mandate for GHG reduction and air pollution control are split: air pollution with MEP and climate change/GHG reduction with the National Development and Reform Commission. The institutional set up in cities mirrors that at the national level: EPBs and MDRCs. Furthermore, many policies/measures relevant to AQM fall under the mandate of other government agencies than MEP and EPBs, therefore multi-agency collaboration is needed. Mayors could be involved to strengthen city level collaboration.



### 5.2.3 Information and Expertise

Information on the benefits (financial and emissions impact) of integrated AQ and GHG policies and measures and national/international expertise are not readily available to most cities, despite successes in for example the EU. MEP, other national institutions and large cities like Beijing and Shanghai could help overcome this barrier.

## 5.3 Policy Recommendations

To ensure that these recommended actions lead to policy change, CAI-Asia can help Hangzhou and Jinan improve their Clean Air Action Plans so that it addresses the identified gaps and areas for improvement (Section 5.1) and it explicitly indicates the GHG implications of these plans. This will be significant if cities begin developing Low Carbon Action Plans (through MDRC). It is also recommended for MEP to formally recognize Hangzhou and Jinan as pilot cities for AQM and co-benefits so that this process is given priority and support by city governments.

Further, the CAMAT can be used by cities to support long-term air quality and GHG management by being able to measure and track their progress through the years as a regular assessment tool. City AQM reports can also prepared using information collected from the CAMAT assessment. The City AQM Reports can also be shared with other Chinese cities through a centralized national website or database which would further facilitate sharing of best practices and AQM experiences between cities/ city clusters.

Upon completion of the clean air management assessment, it is timely to scale up existing measures to achieve greater emission reductions. This can be accomplished though an analysis of the impacts of existing measures on emissions (to measure effectiveness).

The experience of the CAMAT application also highlighted the need for further cooperation with other cities in terms of management AP and GHG emissions, either with the same region or urban cluster or from other countries. The impact of the CAI-Asia China city network can be expanded by encouraging these cities, as provincial capitals, to establish a Clean Air Forum or other mechanism together with cities in their region/province/city cluster. Assistance can be sought from MEP as this also supports the State Council issued guidance on regional AQM collaboration. The CAMAT could be expanded with regional indicators to help in this process.

The experience of CAMAT application in Hangzhou and Jinan showed that the CAMAT **(1)** is very effective in capturing and consolidating critical information from all sectors which has direct and indirect impacts on a city's air quality **(2)** is able to illustrate, in a structured and visual manner the strengths and weaknesses of AQM in a city; **(3)** is able to identify common strengths/weaknesses across cities, and **(4)** hence demonstrated the potential for further and wider application in China, either on an individual city or city cluster scale. An area of improvement is more explicit link to development of an action plan for improvement based on results.





## **Annex A: CAMAT Results for Hangzhou and Jinan**



# Clean Air Scorecard Report

## Hangzhou, P.R. China Year 2008

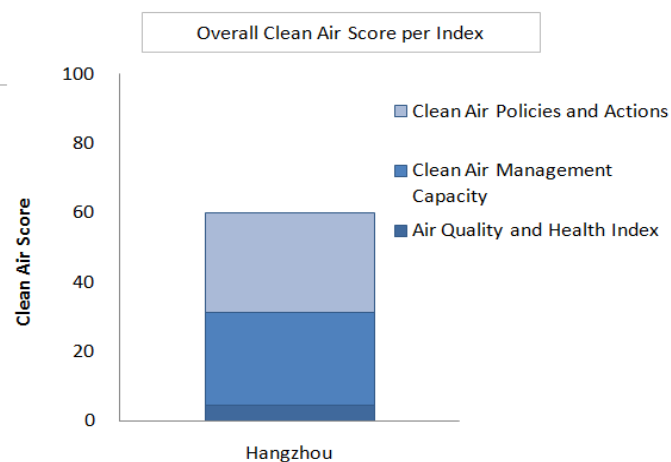
### General Information

City	Hangzhou	Total Land Area of Hangzhou (km)	3068
Region/Province	Zhejiang	GDP for Hangzhou in 2008 (\$) (billion)	478.897
Country	P.R. China	Population in Hangzhou in 2008 (millions)	3.4076

### Clean Air Scorecard Results

Clean Air Score for Hangzhou in 2008: 60 | Good

	Final Score	Band Category
Index 1 - Air Quality and Health Index	4.7	Very Poor
Index 2 - Clean Air Management Capacity	26.7	Excellent
Index 3 - Clean Air Policies and Actions	28.7	Excellent



### Index 1 - Air Pollution and Health Index

Pollutant	Score	Category	Final Score	Pollutant of Concern	Band Category	Pollutants Considered
PM2.5	-	-	4.7	SO2	Very Poor	PM10, SO2, NO2
PM10	6.1	Very Poor				
O3	-	-				
SO2	4.7	Very Poor				
Pb	-	-				
NO2	20.0	Good				
CO	-	-				



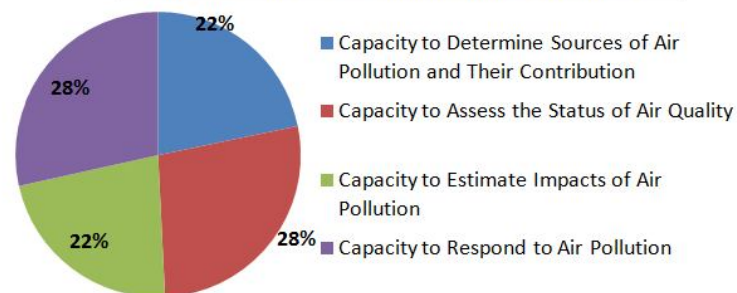


# Clean Air Scorecard Report

## Index 2 - Clean Air Management Capacity Index

	Final Score
Capacity to Determine Sources of Air Pollution and Their Contribution	5.8
Capacity to Assess the Status of Air Quality	7.3
Capacity to Estimate Impacts of Air Pollution	6.0
Capacity to Respond to Air Pollution	7.6
<b>Total</b>	<b>26.7</b>

Distribution of Scores under Clean Air Management

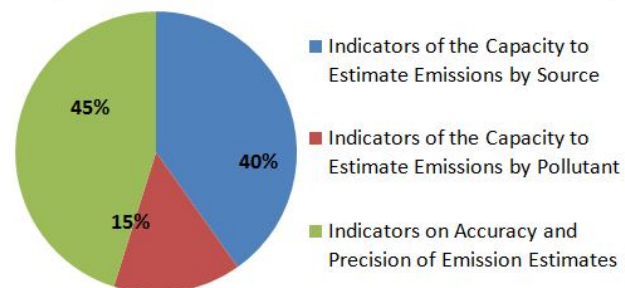


### Capacity to Determine Sources of Air Pollution and Their Contribution

#### Hangzhou's Score Perfect Score

Indicators of the Capacity to Estimate Emissions by Source	2.4	2.8
Indicators of the Capacity to Estimate Emissions by Pollutant	0.9	2.8
Indicators on Accuracy and Precision of Emission Estimates	2.8	2.8
<b>Total</b>	<b>6.1</b>	<b>8.3</b>

Distribution of Scores under Capacity to Determine Sources of Air Pollution and Their Contribution





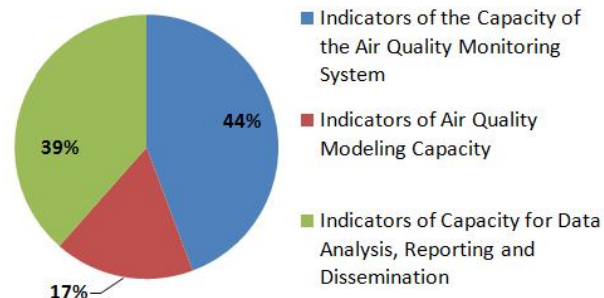
# Clean Air Scorecard Report

## Capacity to Assess the Status of Air Quality

### Hangzhou's Score Perfect Score

Indicators of the Capacity of the Air Quality Monitoring System	3.2	3.8
Indicators of Air Quality Modeling Capacity	1.3	1.3
Indicators of Capacity for Data Analysis, Reporting and Dissemination	2.8	3.3
<b>Total</b>	<b>7.2</b>	<b>8.3</b>

Distribution of Scores under Capacity to Assess the Status of Air Quality

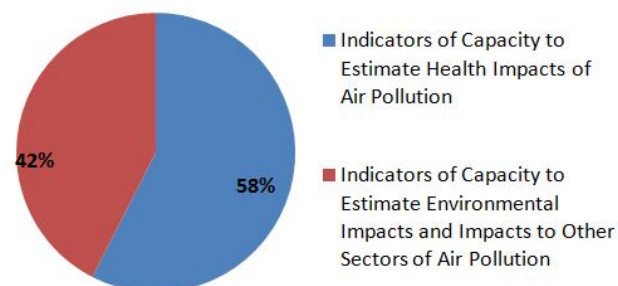


## Capacity to Estimate Impacts of Air Pollution

### Hangzhou's Score Perfect Score

Indicators of Capacity to Estimate Health Impacts of Air Pollutior	3.4	5.8
Indicators of Capacity to Estimate Environmental Impacts and Impacts to Other Sectors of Air Pollution	2.5	2.5
<b>Total</b>	<b>5.9</b>	<b>8.3</b>

Distribution of Scores under Capacity to Estimate Impacts of Air Pollution





# Clean Air Scorecard Report

## Capacity to Respond to Air Pollution

Indicators of Availability and Capacity of Institutional Arrangements to Address Air Pollution in city

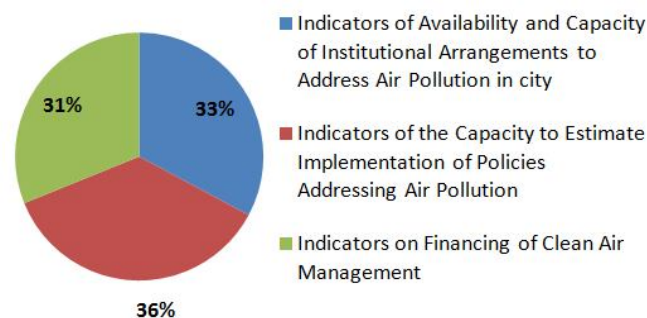
Indicators of the Capacity to Estimate Implementation of Policies Addressing Air Pollution

Indicators on Financing of Clean Air Management

## Hangzhou's Score Perfect Score

	2.5	2.9
	2.7	2.9
	2.3	2.5
<b>Total</b>	<b>7.5</b>	<b>8.3</b>

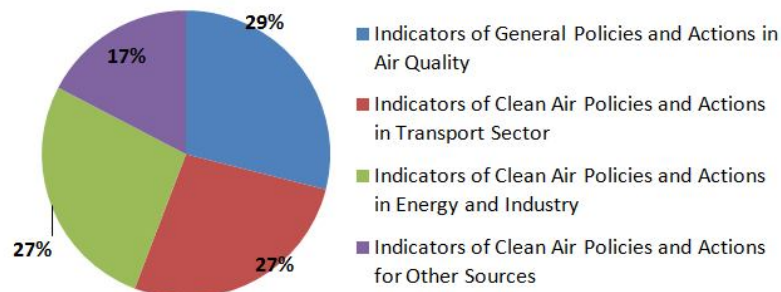
Distribution of Scores under Capacity to Respond to Air Pollution



## Index 3 - Clean Air Policies and Actions Index

	Final Score
Indicators of General Policies and Actions in Air Quality	8.3
Indicators of Clean Air Policies and Actions in Transport Sector	7.7
Indicators of Clean Air Policies and Actions in Energy and Industry	7.7
Indicators of Clean Air Policies and Actions for Other Sources	5.0
<b>Total</b>	<b>28.8</b>

Distribution of Scores under Clean Air Policies and Actions



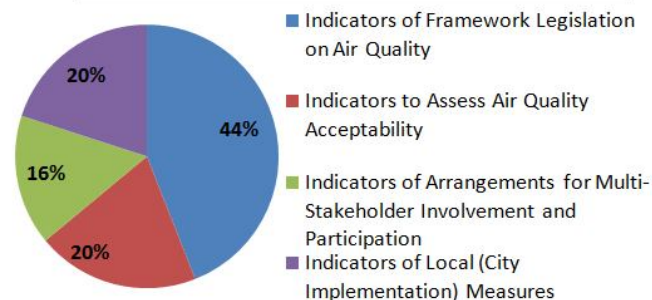


# Clean Air Scorecard Report

## Indicators of General Policies and Actions in Air Quality

	Hangzhou's Score	Perfect Score
Indicators of Framework Legislation on Air Quality	3.7	3.7
Indicators to Assess Air Quality Acceptability	1.7	2.5
Indicators of Arrangements for Multi-Stakeholder Involvement and Participation	1.3	1.3
Indicators of Local (City Implementation) Measures	1.7	2.5
<b>Total</b>	<b>8.3</b>	<b>10.0</b>

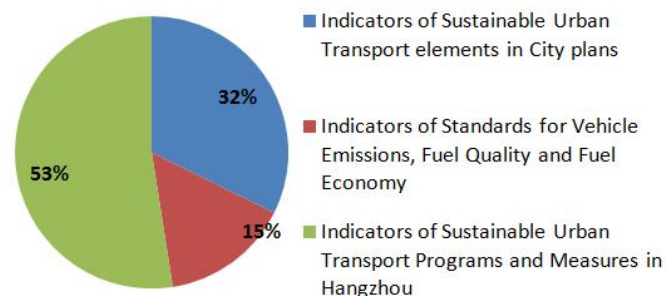
Distribution of Scores under Indicators of General Policies and Actions in Air Quality



## Indicators of Clean Air Policies and Actions in the Transport Sector

	Hangzhou's Score	Perfect Score
Indicators of Sustainable Urban Transport elements in City plans	2.5	2.5
Indicators of Standards for Vehicle Emissions, Fuel Quality and Fuel Economy	1.2	2.5
Indicators of Sustainable Urban Transport Programs and Measures in Hangzhou	4.1	5.0
<b>Total</b>	<b>7.7</b>	<b>10.0</b>

Distribution of Scores under Indicators of Clean Air Policies and Actions in the Transport Sector



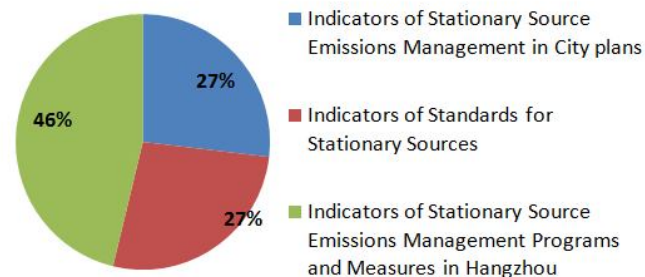


# Clean Air Scorecard Report

## Indicators of Clean Air Policies and Actions in Energy and Industry Hangzhou's Score Perfect Score

Indicators of Stationary Source Emissions Management in City plans	2.1	2.1
Indicators of Standards for Stationary Sources	2.1	2.1
Indicators of Stationary Source Emissions Management Programs and Measures in Hangzhou	3.6	4.2
<b>Total</b>	<b>7.8</b>	<b>8.3</b>

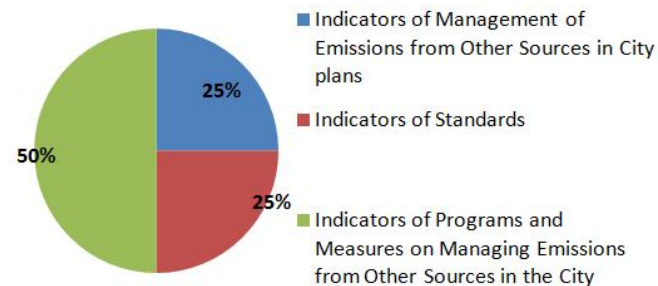
Distribution of Scores under Indicators of Clean Air Policies and Actions in Energy and Industry



## Indicators of Clean Air Policies and Actions for Other Sources Hangzhou's Score Perfect Score

Indicators of Management of Emissions from Other Sources in City plans	1.3	1.3
Indicators of Standards	1.3	1.3
Indicators of Programs and Measures on Managing Emissions from Other Sources in the City	2.5	2.5
<b>Total</b>	<b>5.0</b>	<b>5.0</b>

Distribution of Scores under Indicators of Clean Air Policies and Actions for Other Sources





# Clean Air Scorecard Report

## Jinan, P.R. China Year 2008

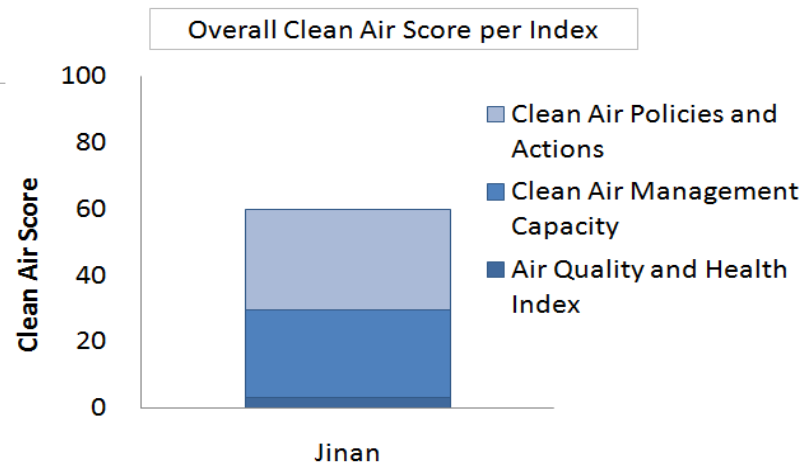
### General Information

City	Jinan	Total Land Area of Jinan (km)	326
Region/Province	Shandong	GDP for Jinan in 2008 (\$) (billion)	3017
Country	P.R. China	Population in Jinan in 2008 (millions)	3.5023

### Clean Air Scorecard Results

Clean Air Score for Jinan in 2008: 59.8 | Good

	Final Score	Band Category
Index 1 - Air Quality and Health Index	3.2	Critical
Index 2 - Clean Air Management Capacity	26.6	Excellent
Index 3 - Clean Air Policies and Actions	30.0	Excellent



### Index 1 - Air Pollution and Health Index

Pollutant	Score	Category
PM2.5	-	-
PM10	4.9	Very Poor
O3	29.0	Excellent
SO2	3.2	Critical
Pb	-	-
NO2	29.7	Excellent
CO	32.5	Excellent

<b>Final Score</b>	<b>3.2</b>
<b>Pollutant of Concern</b>	<b>SO2</b>
<b>Band Category</b>	<b>Critical</b>
<b>Pollutants Considered</b>	<b>PM10, SO2, CO, NO2, O3</b>



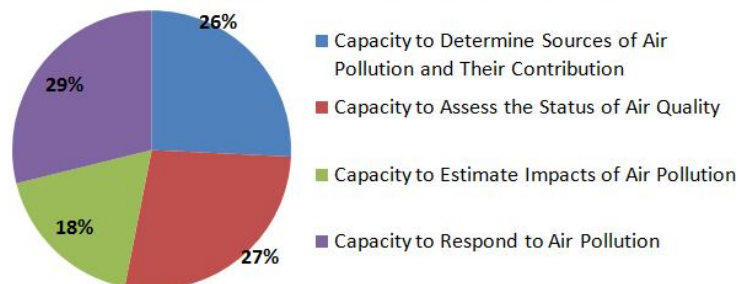


# Clean Air Scorecard Report

## Index 2 - Clean Air Management Capacity Index

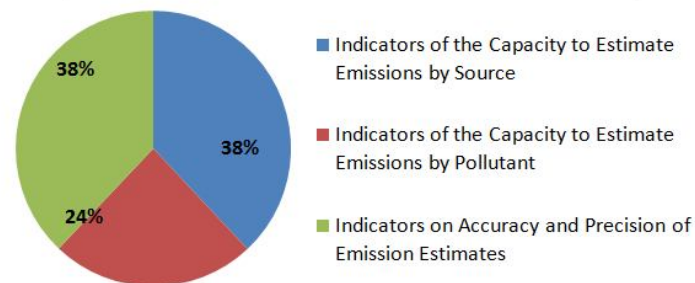
	Final Score
Capacity to Determine Sources of Air Pollution and Their Contribution	6.8
Capacity to Assess the Status of Air Quality	7.3
Capacity to Estimate Impacts of Air Pollution	4.8
Capacity to Respond to Air Pollution	7.7
<b>Total</b>	<b>26.6</b>

Distribution of Scores under Clean Air Management



Capacity to Determine Sources of Air Pollution and Their Contribution	Jinan's Score	Perfect Score
Indicators of the Capacity to Estimate Emissions by Source	2.8	2.3
Indicators of the Capacity to Estimate Emissions by Pollutant	1.7	2.8
Indicators on Accuracy and Precision of Emission Estimates	2.8	2.8
<b>Total</b>	<b>7.2</b>	<b>7.8</b>

Distribution of Scores under Capacity to Determine Sources of Air Pollution and Their Contribution





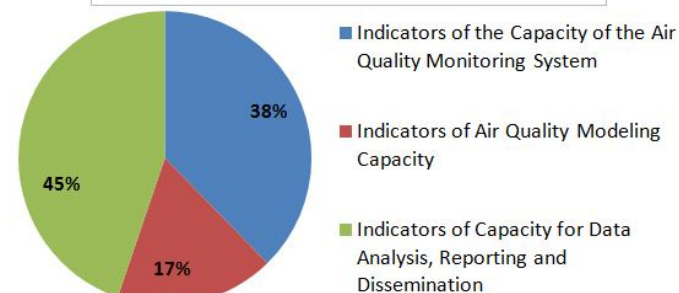
# Clean Air Scorecard Report

## Capacity to Assess the Status of Air Quality

Jinan's Score Perfect Score

Indicators of the Capacity of the Air Quality Monitoring System	2.7	3.8
Indicators of Air Quality Modeling Capacity	1.3	1.3
Indicators of Capacity for Data Analysis, Reporting and Dissemination	3.2	3.3
<b>Total</b>	<b>7.1</b>	<b>8.3</b>

Distribution of Scores under Capacity to Assess the Status of Air Quality

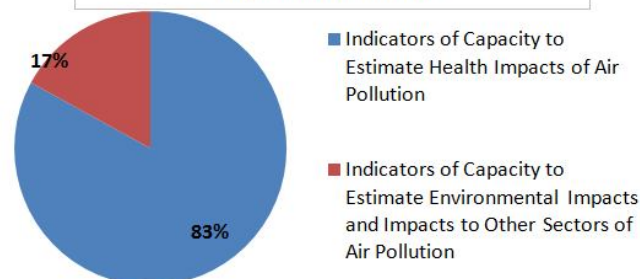


## Capacity to Estimate Impacts of Air Pollution

Jinan's Score Perfect Score

Indicators of Capacity to Estimate Health Impacts of Air Pollution	3.9	5.8
Indicators of Capacity to Estimate Environmental Impacts and Impacts to Other Sectors of Air Pollution	0.8	2.5
<b>Total</b>	<b>4.7</b>	<b>8.3</b>

Distribution of Scores under Capacity to Estimate Impacts of Air Pollution



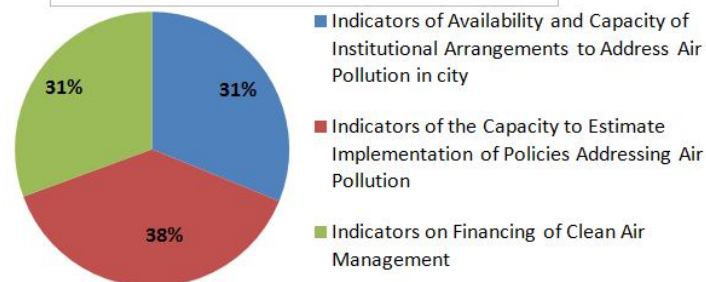


# Clean Air Scorecard Report

## Capacity to Respond to Air Pollution

	Jinan's Score	Perfect Score
Indicators of Availability and Capacity of Institutional Arrangements to Address Air Pollution in city	2.4	2.9
Indicators of the Capacity to Estimate Implementation of Policies Addressing Air Pollution	2.9	2.8
Indicators on Financing of Clean Air Management	2.3	2.5
<b>Total</b>	<b>7.6</b>	<b>8.2</b>

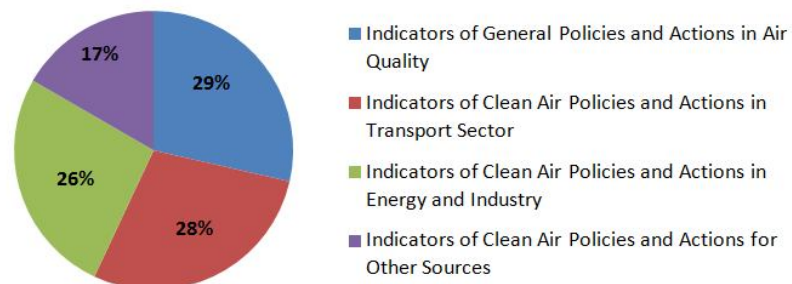
Distribution of Scores under Capacity to Respond to Air Pollution



## Index 3 - Clean Air Policies and Actions Index

	Final Score
Indicators of General Policies and Actions in Air Quality	8.6
Indicators of Clean Air Policies and Actions in Transport Sector	8.5
Indicators of Clean Air Policies and Actions in Energy and Industry	7.9
Indicators of Clean Air Policies and Actions for Other Sources	5.0
<b>Total</b>	<b>30.0</b>

Distribution of Scores under Clean Air Policies and Actions Index





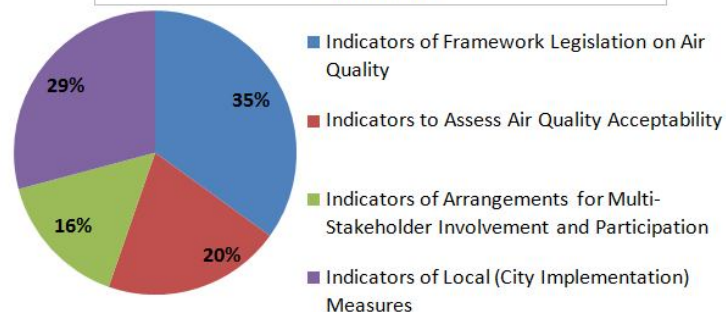
# Clean Air Scorecard Report

## Indicators of General Policies and Actions in Air Quality

### Jinan's Score Perfect Score

Indicators of Framework Legislation on Air Quality	3.0	3.7
Indicators to Assess Air Quality Acceptability	1.7	2.5
Indicators of Arrangements for Multi-Stakeholder Involvement and Participation	1.3	1.3
Indicators of Local (City Implementation) Measures	2.5	2.5
<b>Total</b>	<b>8.6</b>	<b>10.0</b>

Distribution of Scores under Indicators of General Policies & Actions in AQ

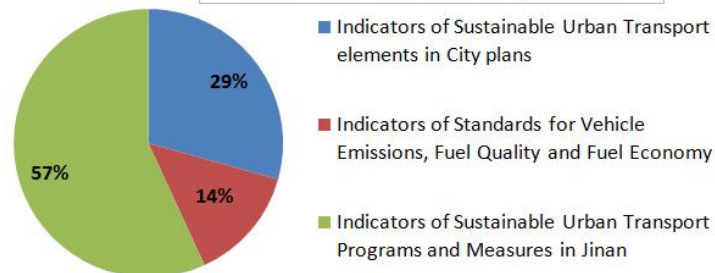


## Indicators of Clean Air Policies and Actions in the Transport Sector

### Jinan's Score Perfect Score

Indicators of Sustainable Urban Transport elements in City plans	2.5	2.5
Indicators of Standards for Vehicle Emissions, Fuel Quality and Fuel Economy	1.2	2.5
Indicators of Sustainable Urban Transport Programs and Measures in Jinan	4.8	5.0
<b>Total</b>	<b>8.5</b>	<b>10.0</b>

Distribution of Scores under Indicators of Clean Air Policies and Actions in Transport Sector



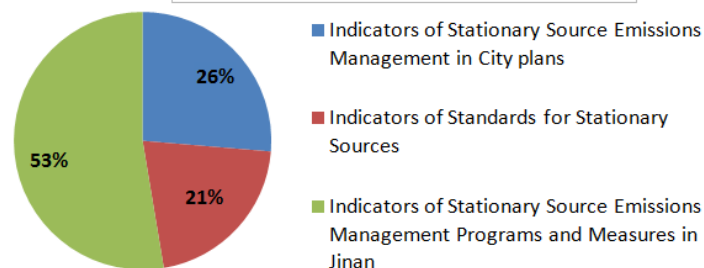


# Clean Air Scorecard Report

## Indicators of Clean Air Policies and Actions in Energy and Industry Jinan's Score Perfect Score

Indicators of Stationary Source Emissions Management in City plans	2.1	2.1
Indicators of Standards for Stationary Sources	1.7	2.1
Indicators of Stationary Source Emissions Management Programs and Measures in Jinan	4.2	4.2
<b>Total</b>	<b>7.9</b>	<b>8.3</b>

Distribution of Scores under Indicators of Clean Air Policies and Actions in Energy and Industry



## Indicators of Clean Air Policies and Actions for Other Sources Jinan's Score Perfect Score

Indicators of Management of Emissions from Other Sources in City plans	1.3	1.3
Indicators of Standards	1.3	1.3
Indicators of Programs and Measures on Managing Emissions from Other Sources in the City	2.5	2.5
<b>Total</b>	<b>5.0</b>	<b>5.0</b>

Distribution of Scores under Indicators of Clean Air Policies and Actions for Other Sources

