Blue Sky Roadmap Phase IV

MANAGING THE 'GAP EFFECT'

IPE 公众环境研究中心
Institute of Public & Environmental Affairs

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Acknowledgments:

The content and recommendations of this report represent solely the views of the authors, and are not representative of the position or policies of supporting organizations.

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Foreword

2015 marks the first year for the implementation of China's new Environmental Protection Law, and new amendments to China's Air Pollution Prevention and Control Law also went into effect beginning in 2016. Under collaborative efforts from many different stakeholders, China's air quality improved in 2015. However, the level of pollution remains relatively high, with smoggy weather frequently affecting some areas during the winter.

To progressively promote air pollution control, the Institute of Public & Environmental Affairs (IPE) is publishing the fourth successive edition of its Blue Sky Roadmap report. For this edition, IPE examined progress achieved in air quality monitoring data published during 2015 and 2016, early warnings and emergency responses, the identification of pollution sources and the furthering of emissions reductions in order to identify the path for needed improvements.

For air quality monitoring and data disclosure, we use the Air Quality Transparency Index (AQTI) to evaluate the level of air quality data disclosure across 120 Chinese cities. In this round of the assessment, Ningbo ranks as number one. Five of the top ten cities are located in Guangdong province, two are situated in Zhejiang, one city is from Hubei and Tianjin is the only city from northern regions. The three provincial-level municipalities of Beijing, Shanghai and Chongqing all did not make the top ten.

This round of the AQTI is the first time that the rate of data disclosure has been considered, revealing that there are significant issues with many cities' disclosure of data for PM_{10} and other indicators. In addition, in some key cities and counties for pollution control, much of monitoring stations' data is withheld, which is not only detrimental toward protecting citizens' health, but also influences joint prevention and control between regions. Moreover, disclosure of monitoring data for volatile organic compounds (VOCs) and some other indicators is extremely deficient.

In terms of emergency responses for severe air pollution, we believe that the current "one size fits all" approach in some regions for early warning standards for heavy pollution episodes is not conducive to realizing joint prevention and control. Using monitoring data and scientifically accurate forecasting methods, enacting systems for ample forecasting and follow-up during severe pollution episodes, and early adoption of emergency response measures are all necessary for effectively and meticulously reducing emissions.

While identifying pollution sources, we continue to believe that industrial production and coal combustion are the main contributors to air pollution, and require comprehensive, up-to-date and complete disclosure of emissions data. This edition of the report confirms that self-monitoring publication platforms have been established across China in key provinces. Nonetheless, IPE statistics show that the disclosure and capture rate of corporate environmental supervision records is only 24.3%, and pollution source supervision information has not yet taken the next step toward improving its comprehensiveness. This report contends that requirements of the new Environmental Protection Law and new amendments to the Air Law for disclosure of information from key pollution-discharging entities provide an important foundation for progressively expanding information disclosure from pollution sources. However, these legal requirements still have yet to be fully implemented.

In terms of achieving emissions reductions, providing access to environmental information has allowed various circles of society to participate and to promote reductions. Apart from using provincial self-monitoring publication platforms and the Blue Map app to supervise and raise “micro-reports,” green supply chain, green stocks and market mechanisms have all begun to play a role. Moreover, the “real estate green supply chain initiative” jointly launched by the China Urban Realty Association (CURA) and the Society of Entrepreneurs & Ecology (SEE), as well as new polices by the China Securities Regulatory Commission (CSRC) that emphasize environmental standards for publicly-listed companies, all highlight the huge potential for using environmental information disclosure to work together to drive emissions reductions.

1. Air Quality Monitoring and Data Disclosure

The third phase for implementation of monitoring duties under new air quality standards came to a close at the end of 2014. Real-time monitoring has expanded to 338 prefecture-level cities, allowing the public to have a clearer perception of the geographic distribution of air pollution. Cities are increasing the number of air quality monitoring stations and have achieved significant progress in data publication. On the other hand, certain issues still remain.

1.1 AQTI evaluation results for 120 cities

The acronym “AQTI” refers to the Air Quality Transparency Index. In 2010, IPE and Renmin University Law School jointly developed the AQTI index system to evaluate the level of air quality information disclosure across different areas. On five occasions in 2011, 2012, 2013 and 2014, IPE used the AQTI to evaluate key national cities for environmental protection. Over the course of this process, we witnessed historical progress in air quality data disclosure from a time when only the daily average of PM_{10} was disclosed to an era where real-time monitoring includes $PM_{2.5}$ and covers a total of six indicators.

This report is the first time the AQTI evaluation has included the data disclosure rate of hourly real-time monitoring data as an important indicator. The accuracy of the evaluation has increased markedly as a result of this inclusion.

Table 1. AQTI Rankings and Scores for 120 Cities

Rank	City	Score	Rank	City	Score
1	Ningbo	72.57	**61**	Changde	47.94
2	Dongguan	70.32	**62**	Nanchang	47.93
3	Wenzhou	70.28	**63**	Yueyang	47.86
4	Shantou	70.08	**64**	Zhangjiajie	47.74
5	Zhuhai	69.92	**65**	Chongqing	47.46
6	Foshan	69.6	**66**	Changsha	47.4
7	Guangzhou	69.17	**67**	Liuzhou	47.19
8	Tianjin	68.63	**68**	Dalian	47.04
9	Taizhou	67.68	**69**	Beihai	47.03
10	Jinzhou	67.62	**70**	Fushun	46.92
11	Nanjing	66.87	**71**	Shenyang	46.76
12	Lianyungang	66.53	**72**	Jinzhou	46.7
13	Changzhou	66.26	**73**	Shaoguan	46.64
14	Xuzhou	66.23	**74**	Jiujiang	46.46

15	Deyang	65.77	**75**	Shizuishan	46.37
16	Nantong	65.74	**76**	Shenzhen	46.32
17	Shaoxing	65.51	**77**	Xining	46.16
18	Beijing	65.46	**78**	Nanning	46.04
19	Jiaozuo	65.42	**79**	Benxi	46.04
20	Haikou	65.22	**80**	Qiqihaer	46.02
21	Tangshan	65.13	**81**	Mudanjiang	45.88
22	Baoding	65.04	**82**	Yinchuan	45.86
23	Wuhan	64.79	**83**	Luoyang	45.72
24	Zhenjiang	64.63	**84**	Daqing	45.59
25	Shijiazhuang	64.54	**85**	Changzhi	45.57
26	Weifang	64.01	**86**	Datong	45.43
27	Yangzhou	63.84	**87**	Yan’an	45.42
28	Weihai	63.53	**88**	Guilin	45.34
29	Huzhou	63.44	**89**	Xi’an	45.3
30	Tai’an	63.42	**90**	Weinan	45.3
31	Suzhou	63.38	**91**	Baoji	45.18
32	Anshan	63.12	**92**	Yangquan	45.06
33	Qingdao	63.06	**93**	Zhanjiang	45.03
34	Zaozhuang	62.93	**94**	Taiyuan	44.98
35	Hangzhou	62.34	**95**	Chengdu	44.91
36	Pingdingshan	62.07	**96**	Tongchuan	44.64
37	Yichang	61.23	**97**	Xianyang	44.59
38	Zhongshan	61.16	**98**	Yibin	44.55
39	Jiaxing	61.15	**99**	Quanzhou	44.39
40	Fuzhou	60.31	**100**	Linfen	44.38
41	Sanmenxia	60.23	**101**	Ordos	44.28
42	Shanghai	60.08	**102**	Jilin	44.25
43	Zibo	60.06	**103**	Hohhot	44.24
44	Jining	59.92	**104**	Zigong	44.14
45	Baotou	59.27	**105**	Mianyang	44.06
46	Kaifeng	58.79	**106**	Chifeng	43.76
47	Wuxi	58.62	**107**	Lanzhou	43.74
48	Yancheng	58.61	**108**	Qujin	43.57
49	Anyang	57.75	**109**	Hefei	43.55
50	Handan	57.54	**110**	Luzhou	43.54
51	Zhengzhou	57.47	**111**	Changchun	43.5
52	Guiyang	55.59	**112**	Harbin	43.31
53	Qinhuangdao	55.39	**113**	Ma’anshan	43.25
54	Jinan	55.3	**114**	Zunyi	43.12
55	Yantai	54.44	**115**	Xiamen	43.11

56	Dezhou	51.67	**116**	Kunming	43.02
57	Panzhihua	49.29	**117**	Wuhu	42.97
58	Zhuzhou	49.28	**118**	Urumqi	40.94
59	Xiangtan	48.75	**119**	Jinchang	36.26
60	Rizhao	48.19	**120**	Karamay	35.64
Average Score					53.58

The top ten cities based on AQTI score are as follows:

Table 2. AQTI Top 10 Cities

Rank	City	Score
1	Ningbo	72.57
2	Donguan	70.32
3	Wenzhou	70.28
4	Shantou	70.08
5	Zhuhai	69.92
6	Foshan	69.60
7	Guangzhou	69.17
8	Tianjin	68.63
9	Taizhou	67.68
10	Jinzhou	67.62

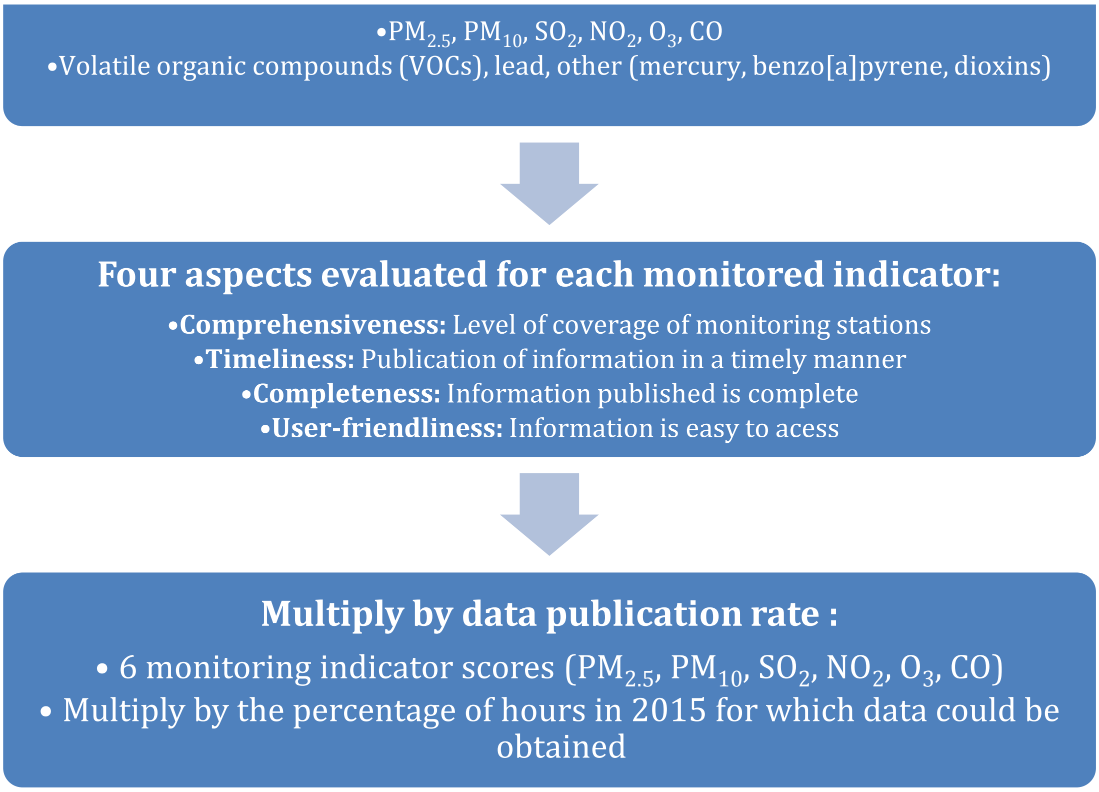
Among the top ten cities, five are from the Guangdong province, two are from Zhejiang province, and one is from Hubei province. Tianjin is the only northern city as well as the only provincial-level municipality that appears on this list. **Beijing, Shanghai and Chongqing – the three other provincial-level municipalities – are all not included on the list.**

AQTI evaluation methodology

Figure 1 elucidates the methodology for the AQTI evaluation. In short, to score highly on the AQTI, cities should fulfill the following three requirements:

- Monitoring and data disclosure indicators should be comprehensive;
- Monitoring stations coverage should reach more areas of cities;
- Ensure a relatively high disclosure rate for hourly data.

Figure 1. Explanation of AQTI Evaluation Standards



1.2 AQTI evaluation findings

1.2.1 Overall rate of data disclosure is relatively high

The data disclosure rate is a new indicator that has been added to the evaluation system for the first time. How does this indicator influence the AQTI index?

The data disclosure rate for monitoring station is calculated for each monitored indicator using the following formula:

$$\text{Data disclosure rate (of monitoring station)} = \frac{\text{Number of hours for which data could be obtained}}{24 \times 365}$$

The "number of hours for which data could be obtained" summarizes how many hours (on a 24-hour basis) a state-monitored station received air quality data for a certain indicator from January 1, 2015 through December 31, 2015. This number is then divided by the total number of hours in a year (24 hours x 365 days) to calculate the data disclosure rate.

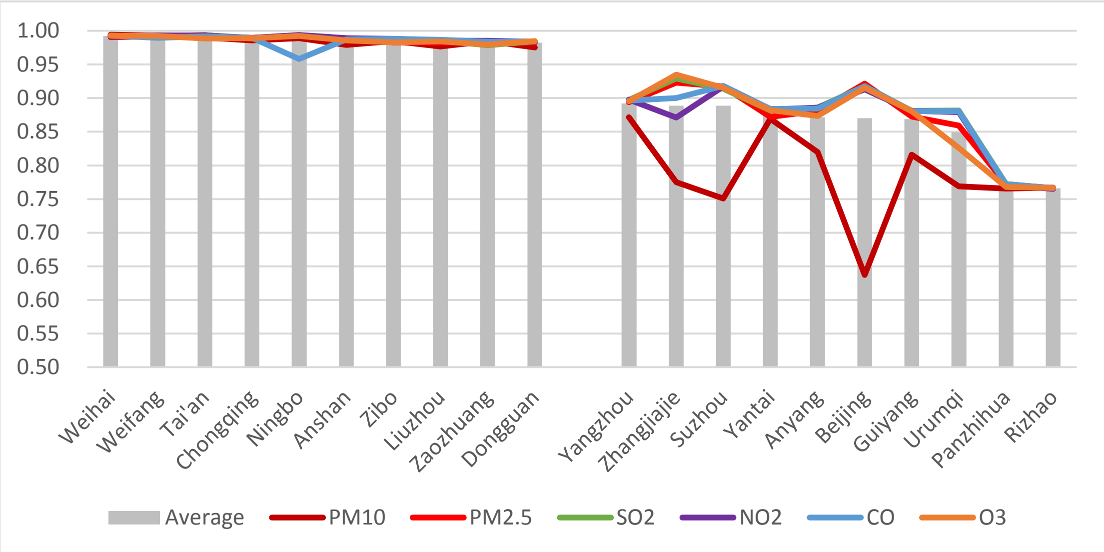
A city's data disclosure rate for a particular indicator is the average of the disclosure rate for that indicator from all state-monitored stations in the city. Take the $PM_{2.5}$ data disclosure rate as an example:

$$\text{City "X" data disclosure rate for PM2.5} = \frac{\text{Sum of data disclosure rate of all state} - \text{monitored stations in the city}}{\text{Number of state} - \text{monitored stations in the city}}$$

This evaluation is the first time the AQTI evaluation standards include the data disclosure rate, with the rationale being that the general public should be able to access the air quality data published by city authorities. According to our statistics, the average data disclosure rate of monitoring stations in the 120 evaluated cities is 93.75%, reflecting a high level of air quality information disclosure in Chinese cities.

However, the evaluation results also show that the data disclosure rate of some cities lags behind, becoming these cities' main barrier to achieving a higher general score.

Figure 2. Comparison of the Data Disclosure Rate for Top 10 and Bottom 10 Cities



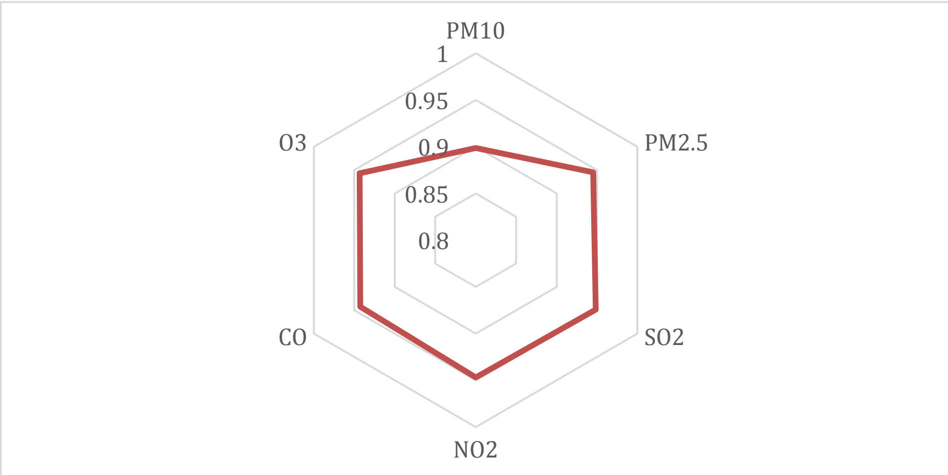
According to Figure 2, the data disclosure rates of Weihai, Weifang, Tai'an, and Chongqing stand at the forefront. The highest-performing city is Weihai, with a 99.25% overall data disclosure rate (the average of the data disclosure rates for all monitored indicators), meaning that among the 365 days in a year, the amount of time in Weihai without air quality monitoring totaled fewer than three days.

On the contrary, Rizhao, Panzhihua, Urumqi, and Guiyang round out the bottom 10 with remarkably low data disclosure rates.

Key reasons for low data disclosure rates

- According to the figure above, the data disclosure rates of all six monitored indicators are relatively balanced in the top ten cities. However, in the bottom ten cities, certain indicators don't perform well. The bold red line showing the performance of PM_{10} in these cities particularly stands out.
- Some monitoring stations with very low data disclosure rates have pulled down their respective city's average score, such as in Rizhao, Panzhihua, Guiyang, Anyang, Yantai, Zhangjiajie, and Yangzhou.
- In Suzhou and Urumqi, multiple stations have low data disclosure rates.

Figure 3. Radar Chart for Publication Rate of the Six Monitored Indicators in 120 Cities



Low data disclosure rate for PM_{10}

Many cities have a low data disclosure rate for PM_{10}. The average disclosure rates of $PM_{2.5}$, SO_2, NO_2, O_3, and CO across 120 cities fall between 94% - 95%, while the average rate for PM_{10} is only 89.85%.

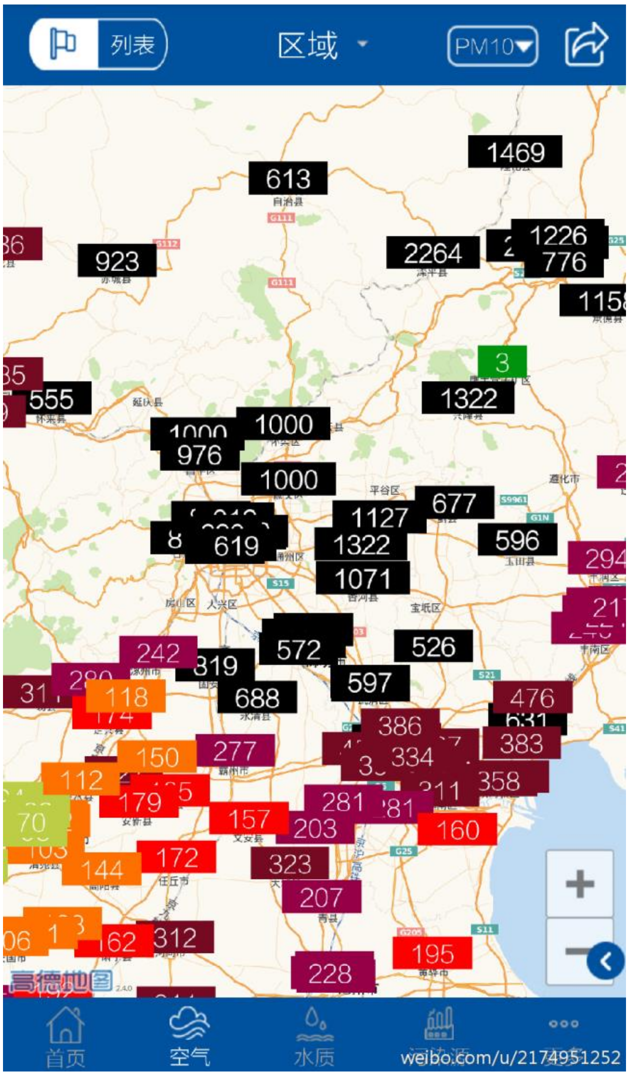
There are two objective causes for the low data disclosure rate for PM_{10}:

- Due to reasons related to monitoring equipment, the measured PM_{10} hourly concentration value is often lower than that of $PM_{2.5}$. Since PM_{10} actually covers all $PM_{2.5}$, this result is obviously unreasonable, so the measured PM_{10} hourly value becomes invalid data based on technical standards. The release ratio of PM_{10} in Beijing is only 63.69%, which based on preliminary analysis can be attributed to the aforementioned reason. The city's low score for PM_{10} is also the main reason why Beijing falls out of the top ten.
- The Specifications and Test Procedures for Ambient Air Quality Continuous Automated Monitoring Systems for PM_{10} and $PM_{2.5}$ stipulate two options for the upper limit setting for the monitoring of PM_{10} and $PM_{2.5}$:

1000μg/m^3 and 10,000 μg/m^3. Some cities choose the 0-1000μg/m^3 measurement range. As a result, when both results reach the upper limits, the hourly values for PM_{10} become null data.

When the limit for PM_{10} is set to the lower value, a more severe impact is that during sandstorms, it is difficult to differentiate the concentration of particulate matters. As shown in the figure below, during a sandstorm on March 28, 2015, several monitoring stations display a result of 1000 μg/m^3. These measurements are obviously inaccurate when compared to those of neighboring stations.

Figure 4. PM_{10} Concentration Distribution in Northern China at 12 p.m. on March 28, 2015

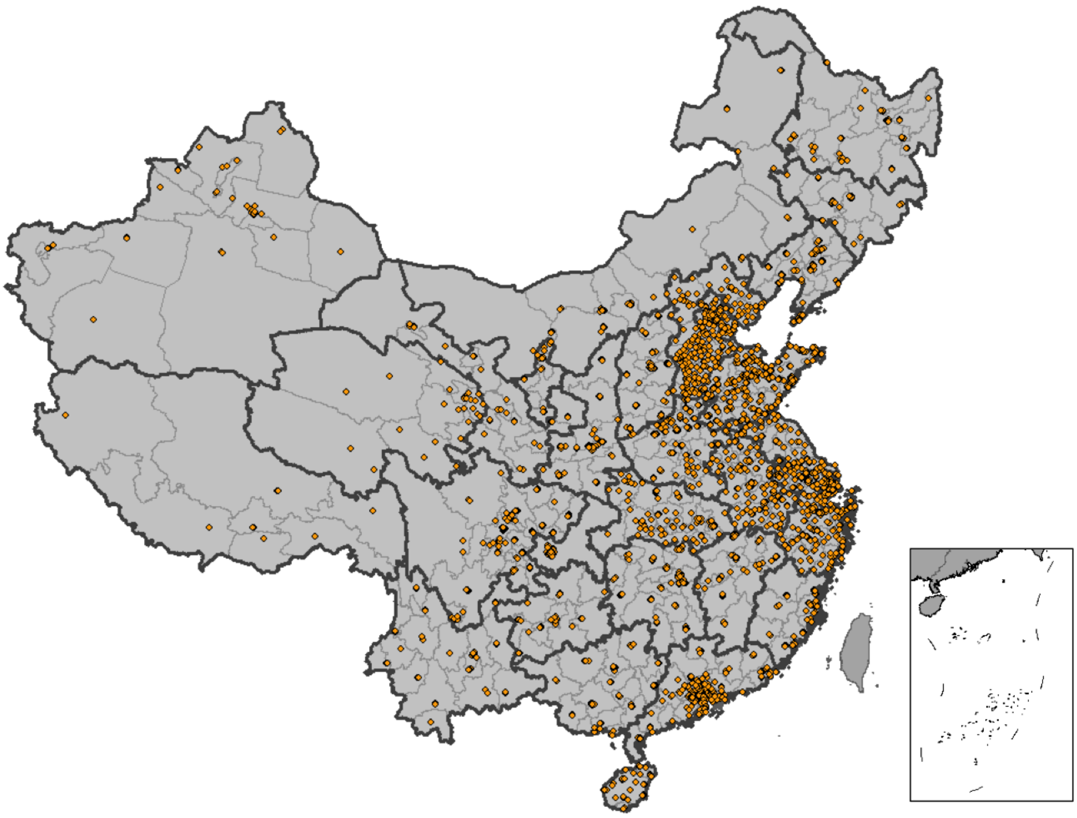


1.2.2 Monitoring station coverage is still not comprehensive

While the data disclosure rate partially reflects the status of air quality data disclosure, another key factor is the distribution of monitoring stations. Generally speaking, the closer a station is to one’s location, the greater the reference value of its air quality monitoring result. Thus, the number of monitoring stations and whether or not they have been distributed appropriately is a key indicator of our index system.

A reasonable distribution of monitoring stations serves as the foundation for acquiring accurate information on air quality status, trends, and impact on human habitats. To better evaluate station distribution, we collected data from national, provincial, city, and county level air quality disclosure platforms for all the state-monitored, provincially-monitored and municipally-monitored stations to produce the following distribution map of air quality monitoring stations in China.

Figure 5. Distribution Map of Air Quality Monitoring Stations in China



Based on the map, the following can be seen:

- China's network of air quality monitoring stations has continued to expand. Compared to 2014, the number of monitoring stations installed at the city, district, and county levels has significantly increased.
- Monitoring stations are especially dense in the Jing-Jin-Ji[1], Yangtze River Delta, and Pearl River Delta areas. In these areas, monitoring stations not only cover the city center and county-level cities, but also cover almost

[1] In this report and in general, the term "Jing-Jin-Ji" refers to the region of Beijing, Tianjin and Hebei.

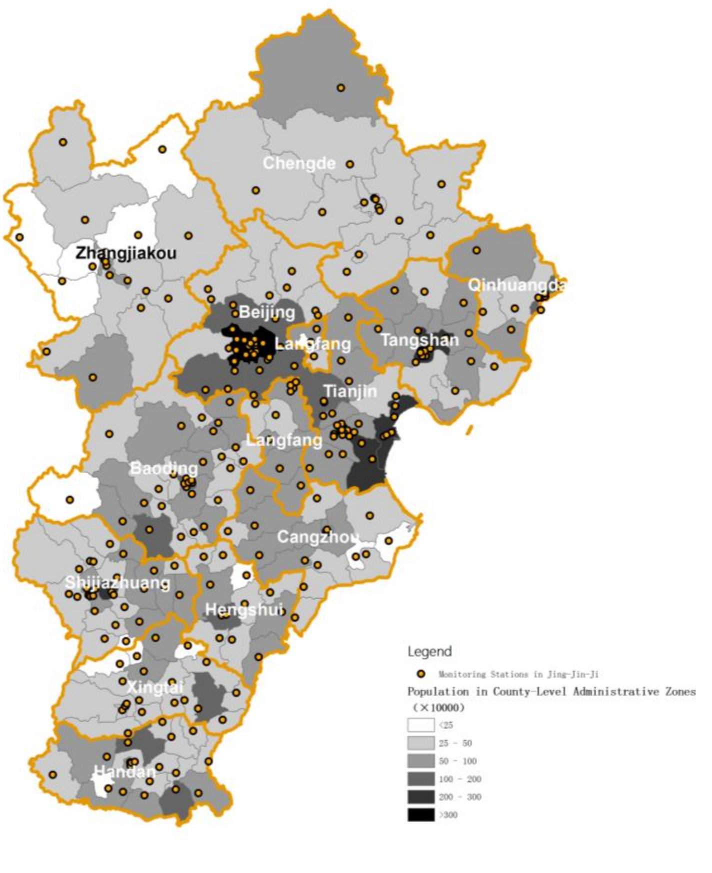
every county.

- In some areas with relatively severe pollution, monitoring stations are scant, with large blank areas even existing in some heavily polluted regions.

Every district and county in Jing-Jin-Ji has been equipped with a monitoring station

Zooming in the map, we can see that monitoring stations are especially dense in the Jing-Jin-Ji area. The provincial seats of the three areas all have a high concentration of monitoring stations in their urban areas, and especially prominent is that each county in the three areas has at least one monitoring stations. As a key area for air pollution prevention and control, the comprehensive coverage of monitoring stations in Jing-Jin-Ji helps the public to be informed and facilitates joint air pollution prevention and control.

Figure 6. Distribution of Monitoring Stations and Population in County-Level Administrative Zones in Jing-Jin-Ji



The darkness in color reflects the population of these counties. It is evident that some of the more populous counties still have a limited number of monitoring stations. In fact, the evaluation discovered that the total number of monitoring stations in some other regions surpasses that of Jing-Jin-Ji.

Shanghai, Guangzhou and Weifang: Catching up from behind

In 2012, following the release of the newly revised Ambient Air Quality Standards, Beijing led the way in adding additional city-level monitoring stations to the city's established state-level monitoring stations, with the city's 35 total stations consistently ranking first among cities nationwide. This round of the AQTI evaluation shows that some cities have surpassed Beijing. The top three cities for total number of monitoring stations are now Shanghai, Guangzhou, and Weifang.

Figure 7. Distribution of 52 Monitoring Stations in Shanghai

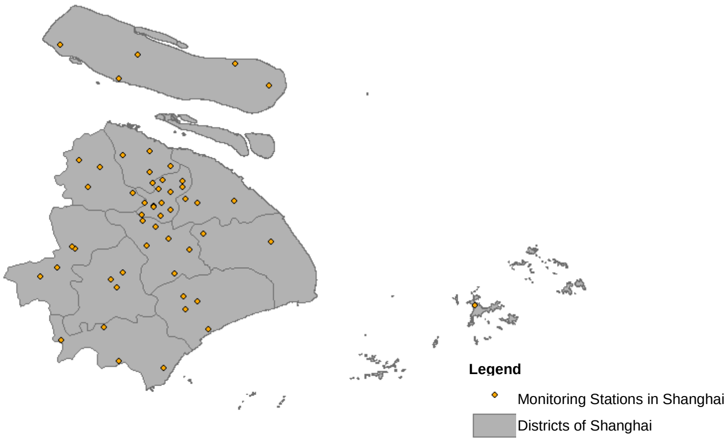


Figure 8. Distribution of 51 Monitoring Stations in Guangzhou

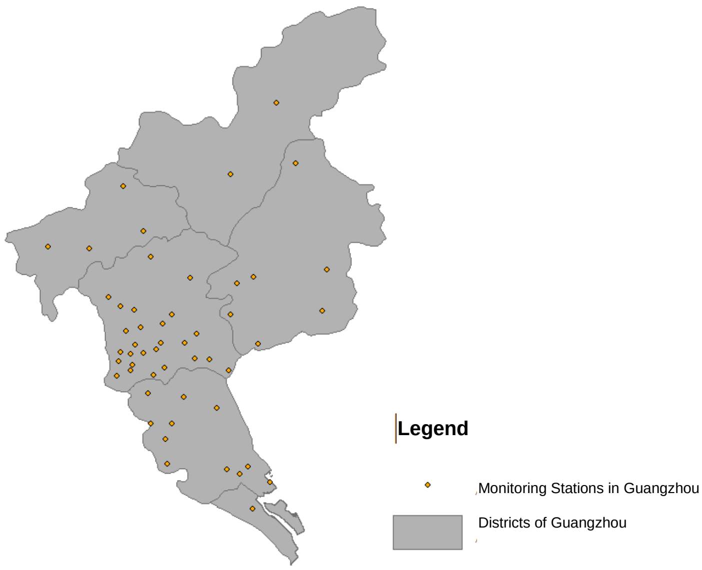
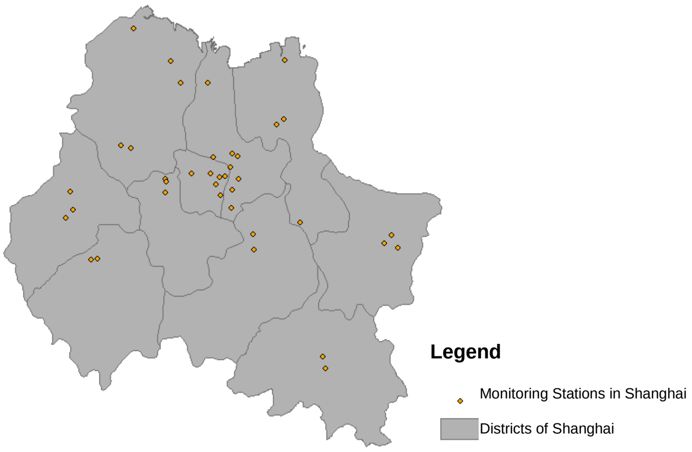


Figure 9. Distribution of 38 Monitoring Stations in Weifang



Blank area between Jing-Jin-Ji and Shandong province

It is not difficult to find some blank areas on the distribution map of monitoring stations in China. Among these, the blank space between severely polluted Jing-Jin-Ji and Shandong province caught our attention.

We can see from the map that even though Jing-Jin-Ji and Shandong both have a dense concentration of monitoring stations, a notable blank area exists between the two areas.

The following figure shows the interface of the Blue Map app at 7 a.m. on June 22, 2016.

Figure 10. Blank Area for Air Quality Disclosure between Jing-Jin-Ji and Shandong Province

This blank area mainly includes the city of Dezhou and the counties subordinate to Jinan. In Dezhou, apart from the city center and the Lincheng district, nine subordinate county-level administrations (Pingyuan, Ningjin, Qinyun, Linyi, Qihe, Xiajin and Wucheng counties as well as the cities of Yucheng and Lelin) are not equipped with any sort of air quality monitoring stations, accounting for most of the blank area.

Dezhou has a total population of 5.83 million, with 1.2 million residents living in the urban area. As a city that is completely located in a plain, most residents live in the counties adjacent to the urban area. According to environmental groups' statistics,[2]

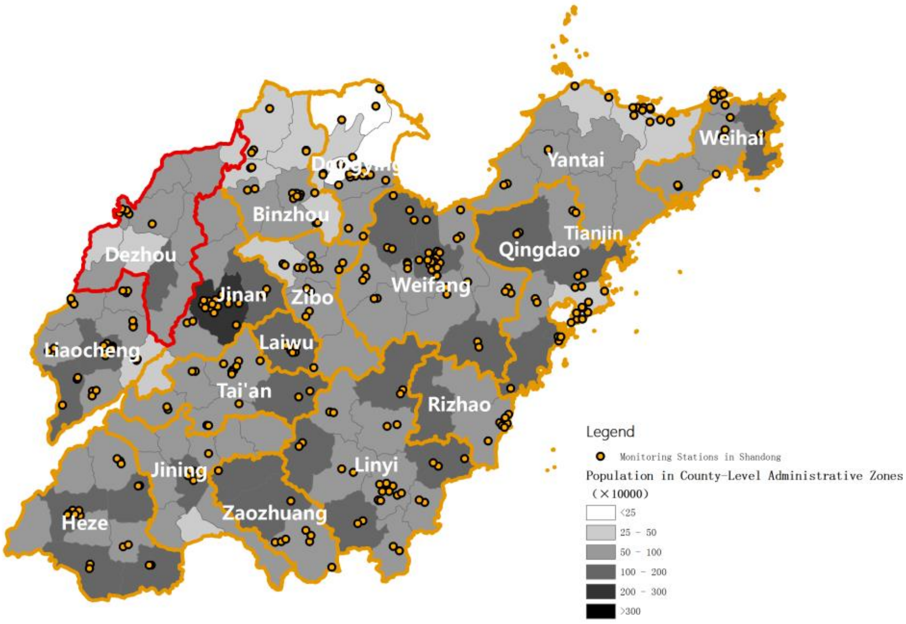
[2] http://www.greenpeace.org.cn/wp-content/uploads/2016/01/2015%E5%B9%B4%E5%BA%A6366%E5%BA%A7%E5%9F%8E%E5%B8%82PM2.5%E6%B5%93%E5%BA%A6%E6%8E%92%E5%90%8D.pdf

Dezhou's average $PM_{2.5}$ concentration in 2015 reached 102.3 μg/m^3, ranking third nationwide. Furthermore, as a transition zone between Jing-Jin-Ji and Shandong province, Dezhou City belongs to the air zone of areas surrounding Jing-Jin-Ji. Thus, comprehensive monitoring and publication of air quality for Dezhou and its counties plays a significant role in both ensuring the health of its population and jointly preventing and controlling the region's heavy air pollution.

The coverage rate of air quality monitoring stations in Shandong province reaches 76%,[3] which ranks 9th overall in China. In Shandong province, counties in Qingdao, Dongying, Weifang, Tai'an, Weihai, Laiwu, Linxi, Liaocheng and Binzhou all have monitoring stations. Among non-first-tier cities in China, Weifang has the highest number of monitoring stations.

Apart from Dezhou and Jinan, Shandong's Jining, Yantai and Rizhao display a lack of monitoring stations, as shown in the figure below.

Figure 11. Distribution of Air Quality Monitoring Stations in Shandong Province



Feedback explanation: After a version of this report was published on WeChat, the official Weibo accounts of the environmental protection bureaus (EBPs) in Dezhou and Jinan respectively issued public feedback statements.

[3] Shandong has a total of 137 districts, counties and county-level cities, and a total of 104 monitoring stations.

德州环境
7月1日 19:31来自iPhone 6
@蔚蓝地图 关于环境监测点位有关问题的回复 德州市现有环境空气自动监测点位31个，其中：国控点3个，省控点4个，市控点24个。国控点、省控点都位于德城区和陵城区，市控点分别位于德城区、陵城区和其它9个县（市）。“全国空气质量点位分布图”中的点位只包括国控点、省控点。
德州市所辖宁津、乐陵、庆云、临邑、齐河、禹城、平原、武城、夏津共有空气自动监测点位20个，其中乐陵、禹城两个县级市各3个，其它县各2个，都为市控点，于2014年11月开始报出数据。环保部与省环保厅只统一管理环境空气国控点、省控点。市控点由所在城市环境保护局管理。德州市环境空气市控点的监测数据由德州市环保局以“环境情况通报”的形式每月对外发布。 收起全文

济南环保
7月1日 16:58来自360安全浏览器
【关于蔚蓝地图《空气质量监测站离你有多远？》一文中环境监测点位问题的回复】 鲁豫部分城市空气监测点位大片空白 目前我市环境空气质量监测站点共有32个，除原有向社会公开的国控、省控16个点位外，2015年我市新增设16个点位：历下区增设2个，分别位于锦屏学校和济南市博物馆；历城区增设1个，位于商业职业技术学院；长清区增设1个，位于长清大学城；章丘、济阳、商河、平阴城区各增加2个点位；槐荫区增设1个，位于槐荫西城区；高新区增设1个，位于奥体中心；另外为了监测区域传输的影响，在市域交界处增设2个点位，分别位于章丘曹庄和黄河河务局。现有的32个环境空气质量监测点位数据已经全部向社会公开，请登陆济南市环保局网站下载相关手机APP软件查询。@公众环境马军 @山东环境 @豫鲁风骨 @生态梦人 @拨云见晴空 @公众环境IPE @中国环境新闻 @微言环保 收起全文

Dezhou's EPB responded stating that at present, the jurisdiction has a total of 31 automatic air monitoring stations, of which three are national-level stations, four are provincial-level stations, and 24 are city-level stations. There are a total of 20 automatic air monitoring stations in Ningjin, Laoling, Qingyun, Linyi, Qihe, Yuncheng, Pingyuan, Wucheng and Xiajin. **These stations' monitoring data is openly published by Dezhou's EPB on a monthly basis in the form of "Environmental Status Bulletins."**

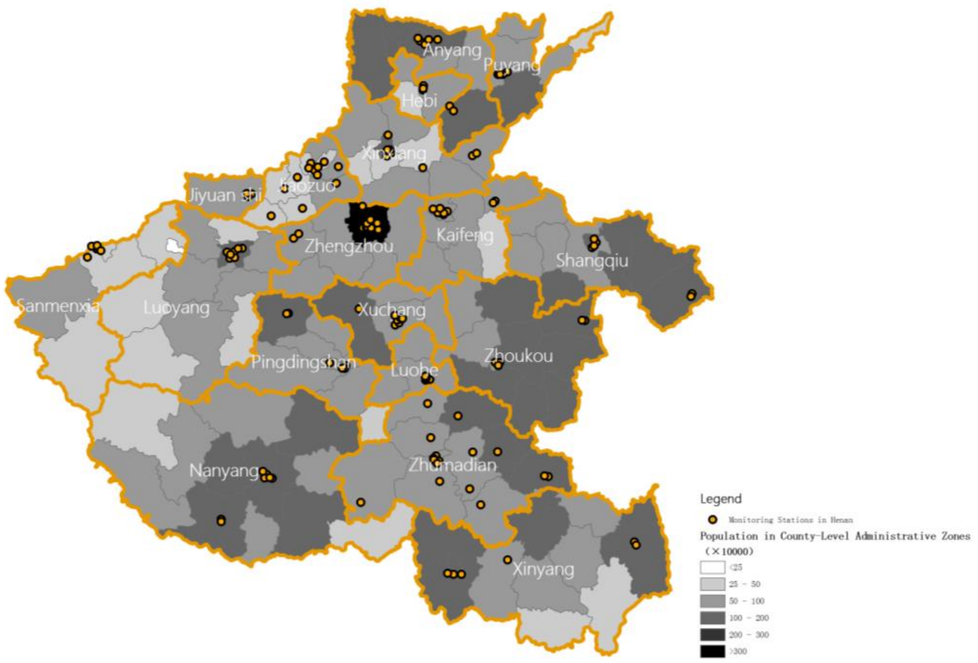
Jinan's EPB responded that the jurisdiction has a total of 32 air quality monitoring stations, 16 of which were newly added in 2015. Environmental air quality monitoring data from all 32 of the existing stations has already been disclosed via the mobile app of Jinan's EPB.

We hope that Dezhou and Jinan can implement real-time disclosure of air quality data on their online disclosure platforms as soon as possible.

Air quality monitoring and data disclosure in Henan Province urgently needs to improve

Henan province, which also neighbors Jing-Jin-Ji and experiences relatively severe pollution, has an even more apparent problem with lack of air quality monitoring stations than Shandong.

Figure 12. Distribution of Air Quality Monitoring Stations in Henan Province



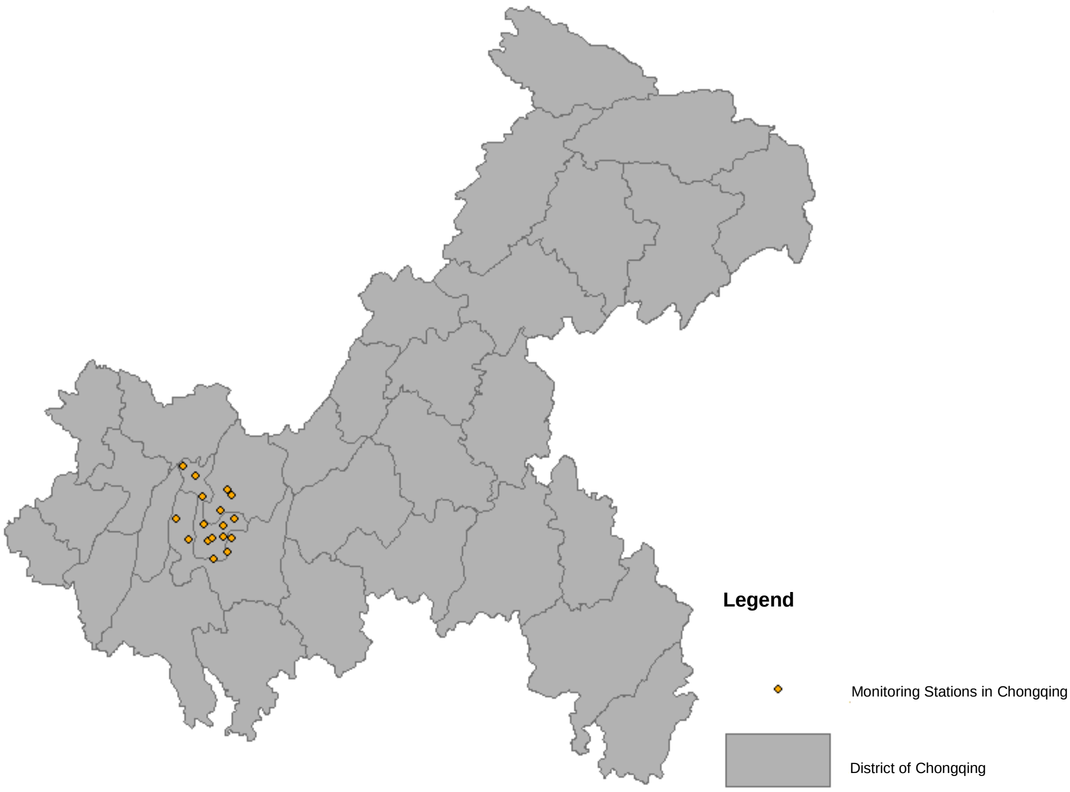
Fifteen cities in Henan, including the capital city Zhengzhou, exhibit blank areas for county-level air quality data disclosure. Jiaozuo and Zhumadian are the only exceptions.

According to a report from the "Henan Business Review" on May 13, 2016, data from the Henan Provincial Environmental Monitoring Center shows that from January to April in 2016, the severity of Henan's air pollution was worse than that of its neighboring provinces. Henan's concentration of PM_{10} and $PM_{2.5}$ ranks the highest among the seven provinces the area (which includes Jing-Jin-Ji and surrounding regions). However, due to the fact that Henan was not listed in the "Action Plan for Prevention and Control of Air Pollution" as one of the early key provinces for control efforts, its air quality monitoring and data disclosure lag behind in comparison to its neighbors such as Jing-Jin-Ji or Shandong. This year, Henan already published its "Blue Sky Project Implementation Plan," which sets specific objectives for the prevention and control of pollution from coal, industry, vehicles and dust. We hope that Henan can also improve its air quality monitoring and data disclosure as soon as possible.

Many cities' scores are adversely influenced by their lack of monitoring stations

Apart from the situation of cities in Henan and Shandong provinces, the AQTI scores of cities such as Chengdu, Chongqing, and Urumqi are also influenced by the lack of monitoring stations in these areas. It is worth mentioning that none of the 31 counties under the jurisdiction of Chongqing, an area with the surface of 527.84 million km^2, are equipped with air quality monitoring stations.

Figure 13. Distribution of Air Quality Monitoring Stations in Chongqing



Feedback statement: In response to the statistical results raised in the report, Chongqing's EPB's official Weibo account published the following feedback:

1. Chongqing currently has a total of 70 automatic air quality monitoring stations, of which 17 are national-level stations (in urban areas) and 53 are city-level stations (13 in urban areas, 40 in surrounding counties and economic development zones), and which provide full coverage for daily reports of air quality.
2. All stations in the urban area of Chongqing are constructed and regularly operated in accordance with new standards. All of the stations outside of the city in surrounding counties and development zones were built to monitor air quality according to old standards, but eight stations have already implemented upgrades to allow them to operate in accordance with new standards. The other 32 stations

are set to be fully upgraded by the end of July. After upgrades have been completed, all of the air quality automatic monitoring stations in the city will monitor air quality based on new standards and disclose this data to the public.

As of August 14, 2016, Chongqing's air quality publication platform only disclosed data from the 17 national-level monitoring stations, and did not yet publish data from the 53 city-level monitoring stations. We recommend that Chongqing complete its monitoring station upgrade plan as soon as possible to publish hourly data from the remaining 53 sites.


重庆环保

6月24日 16:29来自微博 weibo.com

小蓝@蔚蓝地图 发布的地图很棒 重庆是这样子的情况：1.重庆市现有空气质量自动监测站70个，其中国控站点17个（主城）、市控站点53个（主城13个，主城以外区县和经开区40个），实现了空气质量日报全覆盖。

重庆环保

6月24日 16:30来自微博 weibo.com

2.重庆主城全部站点均按照空气质量新标准建设且正常运行。主城以外区县和经开区全部站点按照空气质量老标准监测，其中8个站点已按照空气质量新标准实施改造并投入试运行，其余32个站点预计7月底完成改造。改造完成后，全市所有空气质量自动监测站均实现按照空气质量新标准监测，并对外公开数据。

重庆环保

6月24日 16:35来自微博 weibo.com

3.2015年，重庆主城空气质量优良天数达到292天，自2013年执行新标准以来增加86天，空气中细颗粒物（PM2.5）浓度比2013年下降18.6%；主城以外区县和经开区城区空气质量均达标。

The following table outlines the extent of the coverage of monitoring stations in 120 different cities.

Table 3. List of the Number and Class of Monitoring Stations Publishing Data in 120 Cities

Site Analysis	City
Provincial- and city-level monitoring stations; monitoring stations cover	Shanghai, Guangzhou, Weifang, Beijing, Baoding, Tianjin, Fuzhou, Suzhou, Foshan, Qingdao, Ningbo, Wuhan, Tangshan, Dongguan, Wenzhou, Nantong, Shaoxing, Weihai, Taizhou, Tai'an, Nanjing, Deyang, Xuzhou, Changzhou, Jiaozuo, Huzhou, Jingzhou, Lianyungang, Zhenjiang, Yangzhou, Shantou, Zhuhai, Haikou

every county and county-level city	
Provincial- and city-level monitoring stations; covering some counties and county-level cities	Hangzhou, Handan, Jinan, Yichang, Jiaxing, Guiyang, Zibo, Yancheng, Yantai, Zhengzhou, Anshan, Kaifeng, Qinhuangdao, Zaozhuang, Jining, Baotou, Panzhihua, Zhongshan, Dezhou, Rizhao, Pingdingshan, Sanmenxia, Anyang
National-level stations only; covering some counties	Chongqing, Xi'an, Harbin, Shenyang, Shenzhen, Dalian, Hefei, Ma'anshan, Nanchang, Changsha, Taiyuan, Chengdu, Hohhot, Jiujiang, Nanning, Baoji, Xianyang, Zhuzhou, Xiangtan, Luoyang, Jilin, Kunming, Urumqi, Yueyang, Liuzhou, Fushun, Benxi, Yinchuan, Taipei, Yangquan, Zhanjiang, Yibin, Changde, Jinzhou, Shaoguan, Qiqihar, Mudanjiang, Daqing, Changzhi, Linfen, Lanzhou, Zunyi, Karamay, Luzhou, Zhangjiajie, Beihai, Shizuishan, Xining, Yan'an, Guilin, Weinan, Tongchuan, Quanzhou, Mianyang, Chifeng, Xiamen, Wuhu, Zigong, Jinchang, Qujing

According to the Technical Regulations for the Selection of Ambient Air Quality Monitoring Stations (Trial) (HJ 664-2013), the selection of air quality monitoring stations should meet the following conditions:

- Represent and reflect the air quality of the area covered by the monitoring stations. In general, more sites should be installed in areas where pollutant concentration changes often.
- City population figures and the size of urban areas should be used to determine the lowest permitted number of assessment points.
- For cities or regions where the annual average level of air pollution exceeds the Level 2 national standard by 20% or more, the number of air quality assessment points should be at least 1.5 times the minimum specified number.
- In areas designated as environmental air quality functional zones, each type of zone must have at least one assessment point.

The Technical Regulations for the Selection of Ambient Air Quality Monitoring Stations (Trial) (HJ 664-2013) also stipulate specific guidelines for the minimum number of monitoring stations：

Table 4. Technical Regulations for the Selection of Ambient Air Quality Monitoring Stations

Urban and city population figures (ten thousand people)	Size of urban area (km^2)	Lowest permitted number of monitoring stations
<25	<20	1

25-50	20-50	2
50-100	50-100	4
100-200	100-200	6
200-300	200-400	8
>300	>400	For every 50-60 km^2 of urban area, there must be one monitoring station, with no fewer than 10 in total

Increasing the number of monitoring stations creates greater potential for concrete improvements: Beijing case study

Beijing currently has 35 monitoring stations, 23 of which are assessment points. According to the standards outlined above, calculations based on either population figures or the size of built-up urban area both show that Beijing needs to increase its number of air quality assessment points.[4]

Table 5. Re-evaluating the Number of Air Quality Assessment Points in Beijing

City district	Current number of assessment points	Area of coverage (square km2)	Lowest permitted number of assessment points based on population and size of urban area	Population of townships from 2013 (ten thousand people)	Lowest permitted number of assessment points based on population of townships
Dongcheng	2	42	2	90.9	4
Xicheng	2	51	2	130.3	6
Chaoyang	2	465	10	383.1	10
Fengtai	2	306	8	224.6	8
Shijingshan	1	86	4	64.4	4
Haidian	3	432	10	350.3	10
Fangshan	1	1994		70.4	4
Tongzhou	1	912		84.5	4
Shunyi	1	1021		53.2	4
Changping	1	1352		154.4	6
Daxing	2	1040		102	6
Mentougou	1	1455		26	2

[4] No data is available for the size of the following urban areas: Fangshan, Tongzhou, Shunyi, Changping, Daxing, Mentougou, Huairou, Pinggu, Miyun, and Yanqing. Hence, there are no estimates for these regions based on the size of built-up urban area. Since there is no population data for the size of urban area in these regions, calculations are only provided based on township population.

Huairou	1	2128		26.2	2
Pinggu	1	1075		22.9	1
Miyun	1	2221		26.3	2
Yanqing	1	1993		15.6	1
Total	23		36		74

According to an article in the Beijing Daily on April 4, 2016, Beijing's EPB will further improve the city's air quality monitoring network in 2016 by building 65 to 70 standard monitoring stations, as well as a network of new, smaller monitoring stations.[5] We all look forward to the completion of this project.

1.2.3 Comprehensiveness of air quality monitoring targets still needs to improve

Apart from the rate of data disclosure and the coverage of monitoring stations, it is also extremely important that monitoring indicators be comprehensive. Yet, Chinese cities nationwide still lack sufficient monitoring indicators for volatile organic compounds (VOCs), lead and benzo[a]pyrene (BaP).

Ningbo scored the highest overall on the AQTI assessment. The main reason Ningbo distinguished itself was the city's hourly publication of monitoring results for VOCs.

The term "VOCs" refers to those organic liquids and/or solid compounds that, under normal temperature and air pressure, may spontaneously evaporate or sublimate from the liquid or solid form of the compound and enter the surrounding air (a trait known as "volatility"). When we discuss environmental air quality, we are referring to those VOCs that participate in photochemical reactions.

Sources of VOCs

VOCs come from natural and manmade sources. Manmade sources mainly include industry, transport, and the everyday use of materials such as paint solvents.

- Industrial sources: Manufacturing of petrochemical products, painting of large machinery, etc.
- Transportation sources: Exhaust fumes, gas stations, etc.
- Everyday sources: Common solvents such as paint and other decorating materials; some other general office and consumer products.

Health effects of VOCs

5 http://www.bjepb.gov.cn/bjepb/323265/397983/4387804/index.html

Some VOCs, such as terpenes used in perfumes, are not harmful. However, many compounds are damaging to human health. For instance:

- Regular contact with overpowering smells can seriously affect quality of life;
- People with asthma and respiratory diseases are particularly sensitive, even to low levels of VOCs;
- The solvents and thinners in many kinds of VOCs are lipid-soluble (or fat-soluble) so they are easily absorbed by the lungs. Their ability to cross the blood-brain barrier can result in damage to the central nervous system causing an absence of concentration and tiredness;
- Coming into contact with large quantities of VOCs can result in dizziness, hearing problems, pale complexion, nausea, muscle spasms and in some cases loss of consciousness, convulsions or even death; and
- Long-term exposure to VOCs is also known to cause memory loss, mental health issues and asthma, and may also lead to a higher risk of birth defects and tumors.

Aside from direct health risks, VOCs are also harmful because they are the precursors to ground-level ozone and $PM_{2.5}$. When nitrogen oxides react with VOCs in sunlight, two types of pollutants are formed:

- The first are secondary organic particles, or secondary organic aerosols (SOAs), which are a major contributor to $PM_{2.5}$;
- The second is ozone from photochemical reactions, which increases the concentration of ground-level ozone and exacerbates the severity of smog.

In recent years, ozone has become the chief pollutant during the spring and summer seasons in North China, East China and the Pearl River Delta. The 2015 China Environmental Bulletin shows that 74 cities saw ozone as the only pollutant to increase in concentration on average during the first stage of monitoring for new air quality standards. It was also the only pollutant where the percentage of cities complying with standards decreased. On the days where pollution exceeded standards in the Pearl River Delta's nine prefecture-level cities, the number of days where the primary pollutant was ozone was the greatest, standing at 56.5%. This figure is 17.5% higher than the number of days for $PM_{2.5}$. Upon investigation, the sources are likely nitrogen oxide from vehicle emissions and fixed sources, and VOCs emitted by industry and everyday sources.

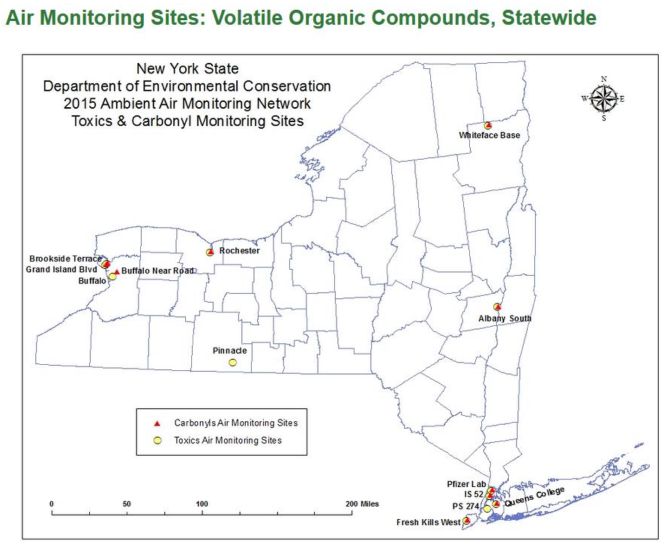
This situation indicates that in order to control the $PM_{2.5}$ count and photochemical smog, VOCs must be controlled. But to control VOC pollution, it is necessary to first determine the types of VOCs in the air and their concentration in order to get to the root of the problem and find a solution.

International Experiences in VOC Monitoring

Some countries already include VOCs as a monitored air quality indicator.

New York: In 2006, the U.S. state of New York started monitoring VOCs. Currently, there are 14 monitoring stations in the state that monitor over 60 types of VOCs. Results are published hourly while the annual average amounts and peak values are published annually.

Figure 14. VOC Monitoring Sites in the State of New York, 2015[6]



[6]Source: http://www.dec.ny.gov/chemical/27370.html

Figure 15. Annual Statistics from a VOC Monitoring Site in New York (Portion)

Buffalo [Site #1401-18, Erie County] An

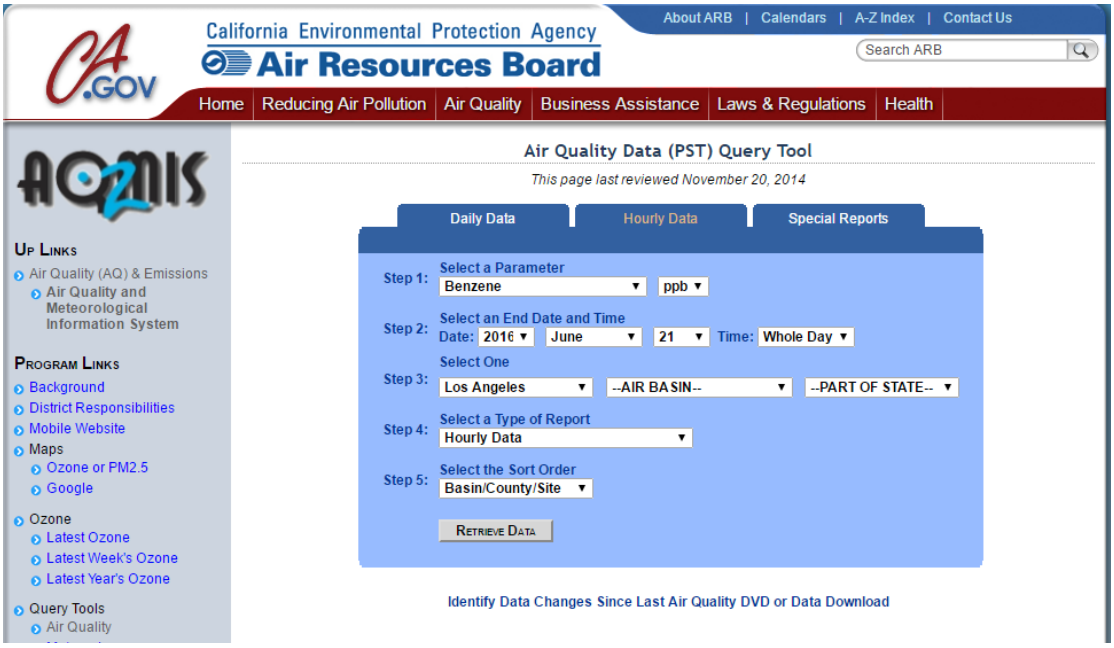
Annual VOC data for Buffalo, ppb

AQS ID	Parameter	2015			2014			2013		
		#	Max	Avg	#	Max	Avg	#	Max	Avg
43207	Freon 113	50	0.085	0.069	45	0.087	0.072	28	0.2	0.150
43208	Freon 114	50	0.021	0.015	45	0.027	0.018	28	0.1	0.100
43218	1,3-Butadiene	50	0.055	0.016	45	0.041	0.016	28	0.1	0.050
43372	Methyl tert-butyl ether	50	0.006	0.001	45	0.012	0.003	28	0.1	0.004
43801	Chloromethane	50	0.587	0.497	45	0.586	0.506	28	0.6	0.514
43802	Dichloromethane	50	0.225	0.081	45	0.929	0.106	28	0.5	0.129
43803	Chloroform	50	0.045	0.023	45	0.044	0.023	28	0	0
43804	Carbon tetrachloride	50	0.093	0.081	45	0.099	0.085	28	0.1	0.100
43811	Trichlorofluoromethane	50	0.27	0.244	45	0.298	0.248	28	0.3	0.296
43812	Chloroethane	50	0	0	45	0.018	0.003	28	0	0
43813	1,1-Dichloroethane	50	0.008	0.002	45	0.014	0.003	28	0	0
43814	Methyl chloroform	50	0.164	0.021	45	0.095	0.018	28	0.1	0.025
43815	Ethylene dichloride	50	0.021	0.015	45	0.028	0.017	28	0	0
43817	Tetrachloroethylene	50	0.11	0.022	45	0.212	0.022	28	0.1	0.021
43818	1,1,2,2-Tetrachloroethane	50	0.008	0.001	45	0.014	0.002	28	0	0
43819	Bromomethane	50	0.013	0.008	45	0.021	0.010	28	0	0
43820	1,1,2-Trichloroethane	50	0.006	0.001	45	0.007	0.001	28	0	0
43823	Dichlorodifluoromethane	50	0.562	0.511	45	0.577	0.522	28	0.6	0.568

Los Angeles: In 1943, 1955 and 1970, respectively, Los Angeles experienced three major incidents of severe smog. After years of implementing controls, Los Angeles' air quality has markedly transformed for the better, but in light of improvements Los Angeles still has a higher level of ozone pollution than any other area in the U.S.

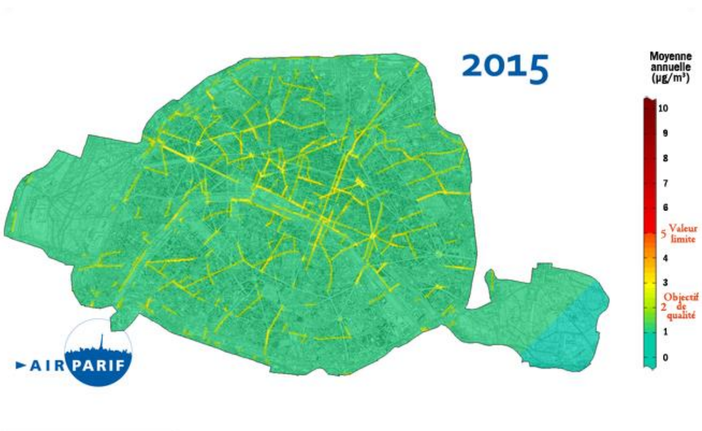
Currently, Los Angeles has 16 air quality monitoring stations in operation, of which five monitor VOCs. Hourly data, daily averages and annual statistical charts are easily accessible on this site: http://www.arb.ca.gov/aqmis2/aqdselect.php?tab=hourly

Figure 16. Search Tool to Access Los Angeles' Air Quality Data



Paris: Paris has as many as 22 VOC monitoring stations: there are city air quality monitoring stations, as well as transport monitoring stations that operate once every 7 days. Monitored indicators include: benzene, methylbenzene, ethylbenzene and dimethylbenzene (xylol). Annual statistical results are downloadable in report form and the online maps are very clearly displayed.

Figure 17. Map Displaying the Concentration of Benzene in Paris, 2015



Ningbo: The Only Chinese City to Release VOC Data in Real-Time

Ningbo has a total of four VOC monitoring stations, all of which are located in Zhenhai district. The stations monitor five types of VOCs –styrene, acrylo-nitrile, benzene, methylbenzene and xylene – as well as hydrogen sulphide (an odorous gas). Zhenhai is an important base for the chemical industry in the Yangtze River Delta since it is home to many large-scale petrochemical enterprises as well as the Zhenhai National Oil Reserve Base. Zhenhai's EPB actually began monitoring special air pollution agents ten years ago and began publishing monthly reports in 2009. The local EPB has published real-time data since October 29, 2014.[7]

Figure 18. Chart of Monitoring Stations for Special Air Pollution Agents in Ningbo's Zhenhai District (Source: Zhenhai's Real-Time Ambient Air Quality Data Release System)

Figure 19. Results from Monitoring of Special Air Pollution Agents in Ningbo's Zhenhai District (Source: Zhenhai's Real-Time Ambient Air Quality Data Release System)

首页 AQI实时报 AQI日报 **特殊因子** 相关知识 2016年5月23日13时 阴 21℃

时均值 更新时间：2016年05月23日13时

站点名称	苯乙烯(μg/m³)	丙烯腈(μg/m³)	苯(μg/m³)	甲苯(μg/m³)	二甲苯(μg/m³)	硫化氢(mg/m³)
标准限值	10	50	110	200	200	0.2
镇海区	0.280	3.986	3.007	3.033	2.455	0.008
镇海中学	0.046	0.609	1.780	1.293	0.000	0.007
澥浦镇	0.000	0.012	0.158	1.572	9.281	0.011
国昱局	0.266	3.166	9.949	5.820	0.094	0.005
蛟川小学	0.809	12.157	0.140	3.447	0.445	—

注：一表示缺测或无效

月均值 2016年04月

站点名称	苯乙烯(μg/m³)		丙烯腈(μg/m³)		苯(μg/m³)		甲苯(μg/m³)		二甲苯(μg/m³)		硫化氢(mg/m³)	
	均值	达标率	均值	达标率	均值	达标率	均值	达标率	均值	达标率	均值	达标率
标准限值	10		50		110		200		200		0.2	
镇海区	0.634	99%	2.061	100%	3.081	100%	5.114	100%	3.077	100%	0.004	100%
镇海中学	0.207	100%	0.610	100%	3.203	100%	5.436	100%	1.376	100%	0.004	100%
澥浦镇	0.171	100%	0.018	100%	0.787	100%	1.064	100%	8.356	100%	0.004	100%
国昱局	0.529	99%	5.737	99%	8.090	100%	9.936	100%	1.200	100%	0.005	100%
蛟川小学	—	—	—	—	—	—	—	—	—	—	—	—

7 "Zhenhai is the Country's First City to Publish Special Concentrations of Pollutants in Real-time," Ningbo Daily, November 21, 2014, http://daily.cnnb.com.cn/nbrb/html/2014-11/21/content_815027.htm?div=-1

Since VOCs pose a significant impact on ambient air quality and human health, and also because developed countries set an early precedent for the real-time monitoring and publication of data, real-time VOC monitoring and data publication have been incorporated into the investigation scope since the first year of the AQTI assessment in 2010.

We regret that the degree of awareness toward VOCs in China and prevention and control efforts still lag far behind those toward $PM_{2.5}$. The Ambient Air Quality Standards GB3095-1996 and GB3095-2012 have no regulations concerning VOCs and we have yet to see monitoring of VOCs rolled out across Chinese cities. Ningbo is certainly not the only area to experience unpleasant odors from the chemical industry, yet is the only city to publish monitoring values for VOCs in real-time. The remarkable headway made by Ningbo is a valuable example that other cities facing VOC pollution can follow.

Sections of the Pollution Index are Still Blank

In the first section of the AQTI report, we explained that the AQTI assessment evaluates nine indicators. In addition to PM_{10}, $PM_{2.5}$, sulfur dioxide, nitrogen dioxide, carbon monoxide, ozone, and VOCs, the two other indicators are lead and "other" (mercury, benzo[a]pyrene (BaP) and dioxin). These pollutants have been incorporated into the assessment because of their clear effects on public health, and some countries have already launched monitoring systems and begun publishing information about VOCs. China has also established a management and monitoring mechanism.

Over the course of five years of tracking and investigating VOCs, we have realized that although lead and BaP are written into China's ambient air quality standards, few cities actually monitor them. In the 2011 and 2012 annual assessments, Beijing and Ningbo earned points for publishing data in their annual environmental bulletins on the daily average values for lead and BaP. However, since the Ambient Air Quality Standards GB3095-2012 came into effect, not one city has continued to release data on the monitoring of lead and BaP. This has led all cities in the index to lose 10 points and, therefore, is the reason why no cities' scores exceed 80 points.

1.2.4 Progress in air quality forecasting

With continued growth in awareness toward protecting public health – especially after the publication of air pollution monitoring information greatly expanded in 2013 – the public have a need to understand air quality in order to plan their travel and daily activities in areas where dense smog is a common occurrence. In tandem with this, many areas have introduced emergency measures for severe pollution episodes. These measures include prohibiting outdoor sports in primary and secondary schools, limiting or shutting down factory production, shutting schools and limiting transport. These measures thus highlight the drastic influence that air quality data can have on day-to-day life.

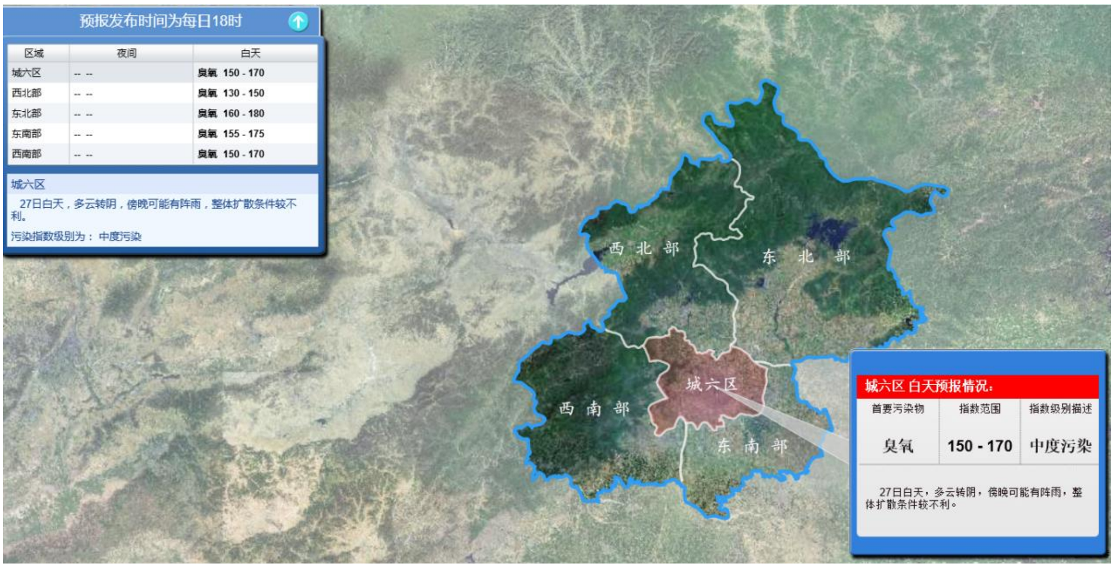
We believe that if there is a need for developing air quality forecasting, then forecasting must be included in our AQTI index evaluation. The most recent results from the AQTI demonstrate that in many areas air quality forecasting has improved and in over 100 cities air quality forecasts can now be obtained from official sources.

Beijing Takes the Lead in Air Quality Forecasting

Before the new Ambient Air Quality Standards were published in 2012, a small number of Chinese cities released air quality forecasts based on the old standard. Since the implementation of the new standard in 2012, regular forecasting has slowed down and many areas only publish forecasts for severe pollution.

On January 1, 2013 Beijing took the lead to launch air quality forecasting based on the new Ambient Air Quality Standards. Beijing's EPB divided the city into five regions that publish next-day air quality index (AQI) forecasts: the area that includes the six central districts, as well as the northeast, southeast, northwest, and southwest regions. Beijing also tracks changes in the meteorological conditions of different regions and the changes that result from weather-related factors.

Figure 20. Scope of Beijing's Air Quality Forecasting



MEP Issues Uniform Requirements

China's Ministry of Environmental Protection (MEP) introduced the National Ambient Air Quality Forecasting and Early Warning Action Plan in April 2015. It states that all provinces (including autonomous regions and provincial-level municipalities), sub-provincial cities and provincial capitals must adopt air quality and early warning forecasting systems for their respective administrative districts before October 2015. As a result, ambient air forecasting in all areas gained momentum.

On January 1, 2016, the National Air Quality Forecasting Publication System officially went live. The system publishes air quality forecasts for three key regions – Jing-Jin-Ji, the Yangtze River Delta and the Pearl River Delta – each day at 5 p.m. It also publishes provincial air quality forecasts, as well as 24-hour and 48-hour air quality forecasts for four provincial-level municipalities, 28 provincial capitals and some other cities, including Dalian, Qingdao, Ningbo and Shenzhen.

Figure 21. Map of Air Quality Conditions in Jing-Jin-Ji (Source: National Air Quality Forecasting Publication System)

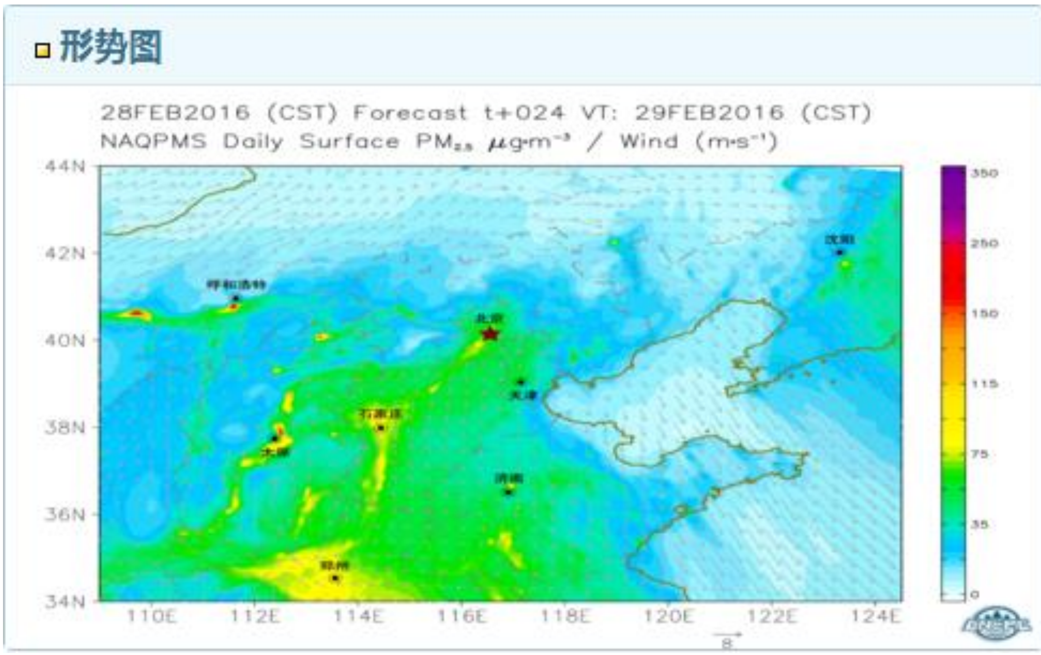
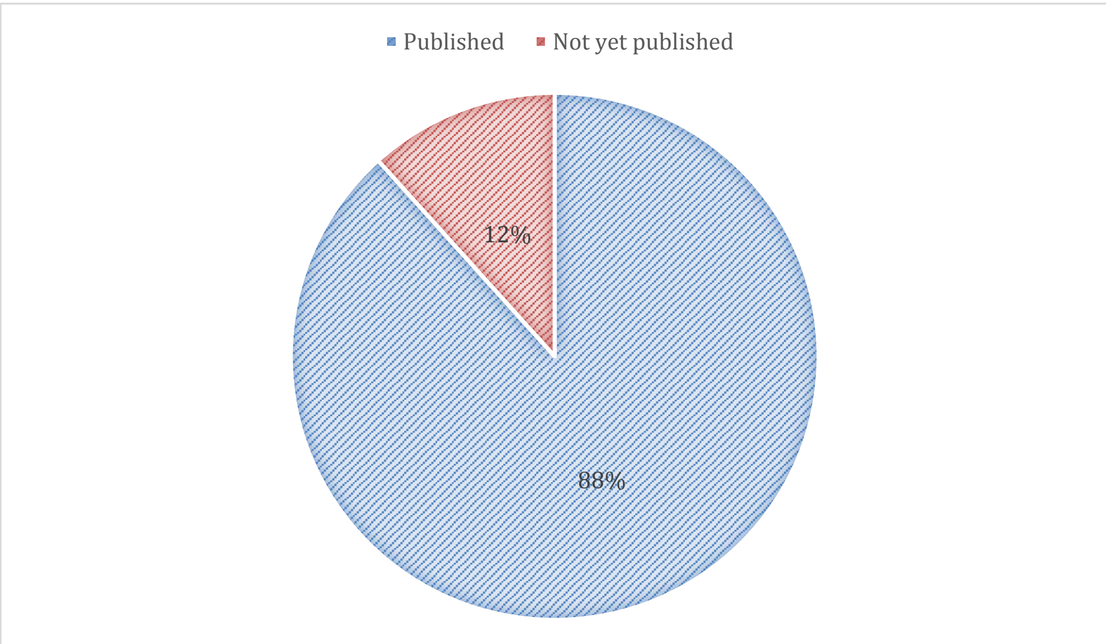


Figure 22. Air Quality Forecasting for Chinese Cities (Source: National Air Quality Forecasting Publication System)

106 participating cities begin air quality forecasting

This round's AQTI assessment confirmed that out of the 120 evaluated cities, as many as 106 cities have established city-level air quality forecasting publication systems or use provincial-level platforms to publish their air quality forecasting information.

Figure 23. Status of Air Quality Forecasting Publication in 120 Cities



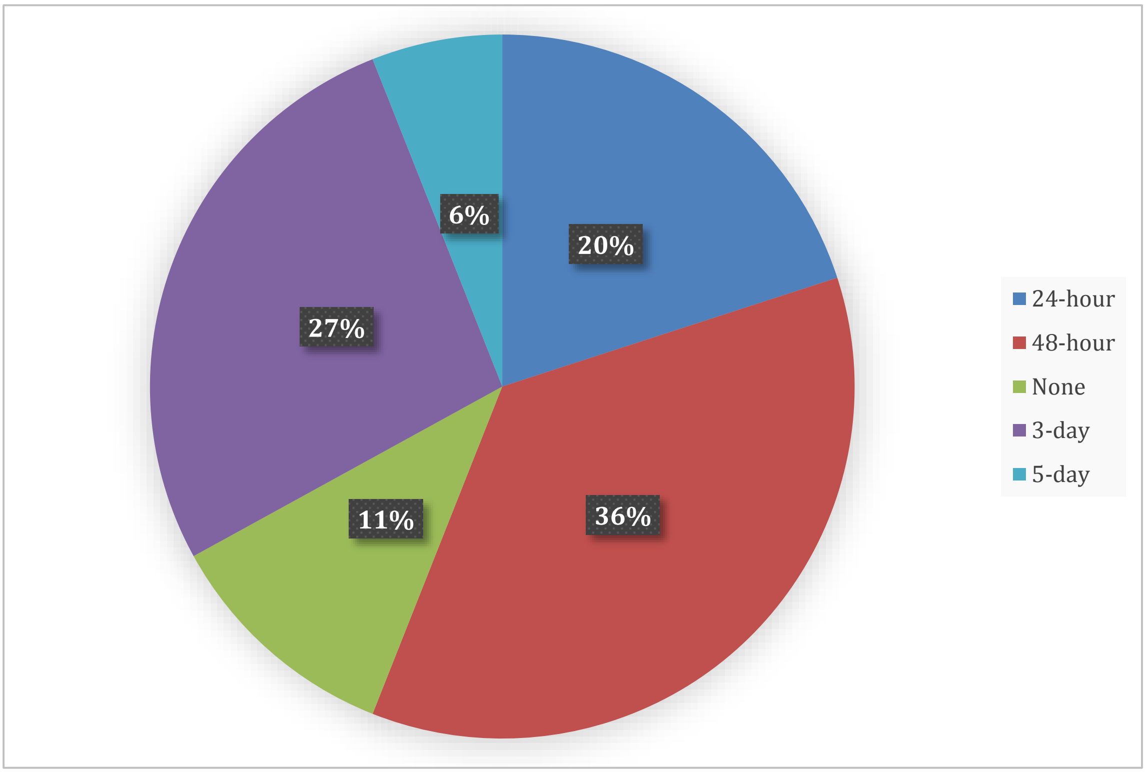
In 2015, the air quality in six cities that have not yet established air-quality forecasting - Anshan, Fushun, Benxi, Jinzhou, Mudanjiang and Deyang – achieved ‘excellent’ or ‘good’ quality less than 80% of the time, signifying that in one year there were more than 73 polluted days in these cities. We therefore recommend these cities to rapidly improve their air quality forecasting systems.

However, there are major differences between the status of air quality forecasting in different areas.

- Some forecasting times are short, while others are long

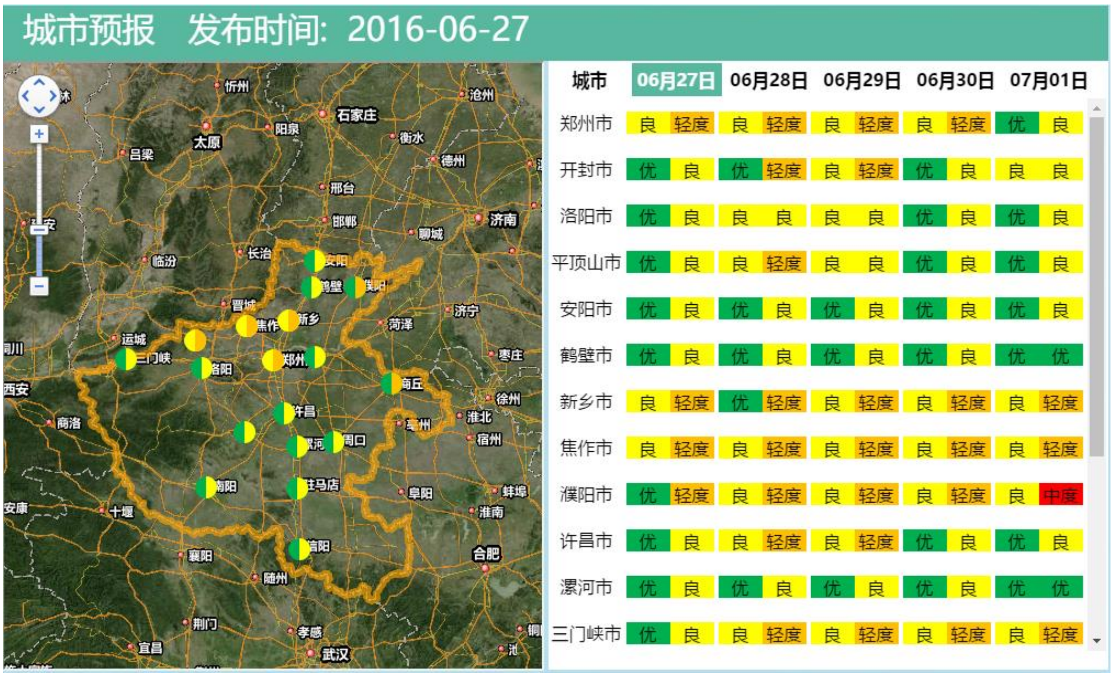
The table below summarizes information about forecasting times from the best case scenarios of national-, provincial- and municipal-level publication platforms for cities evaluated on the AQTI index.

Figure 24. Comparison of Differences in the Time Length of Cities’ Forecasts



See below Henan’s lengthy 5-day forecast.

Figure 25. Henan's Interface for Air Quality Forecasting



- Information can be very rough or very detailed.

Some provincial-level platforms are able to zoom in to assess particular cities in these regions. Shaanxi province is one such example:

Figure 26. Scope of Air Quality Forecasting in Shaanxi

发布时间：2016-6-26 16:00:00

市区名称	空气质量类别	AQI指数范围	首要污染物
西安市	轻度-中度污染	105～155	O3-8h
宝鸡市	良-轻度污染	65～115	O3-8h
咸阳市	良-轻度污染	90～140	O3-8h
铜川市	良-轻度污染	90～140	O3-8h
渭南市	良-轻度污染	70～120	O3-8h
延安市	良-轻度污染	70～120	O3-8h
榆林市	良-轻度污染	80～130	O3-8h
汉中市	良-轻度污染	55～105	O3-8h
安康市	良	51～100	O3-8h
商洛市	良-轻度污染	60～110	O3-8h
杨凌示范区	良-轻度污染	55～105	O3-8h
西咸新区	轻度-中度污染	105～155	O3-8h
韩城市	良-轻度污染	60～110	O3-8h

However, there are also a number of provincial-level platforms that do not accurately assess the specific conditions of cities within the region. The provincial-level platforms of Liaoning, Jilin, Helongjiang, Jiangxi, Guangxi, Hainan and Sichuan are quite sparse and only supply 24-hour or 72-hour forecasts for the province or autonomous region as a whole. Below is Guangxi's very brief forecast, detailing that in a 48-hour period "air quality in the south, east and center of Guangxi is good, other areas' air quality is good to moderate, and the main pollutants are PM_{10} or ozone”:

Figure 27. Scope of Air Quality Monitoring in Guangxi

广西未来48小时区域空气质量预报

来源 广西空气质量预报预警中心 作者 广西空气质量预报预警中心 时间：2016-06-26

2016年6月26日15时发布

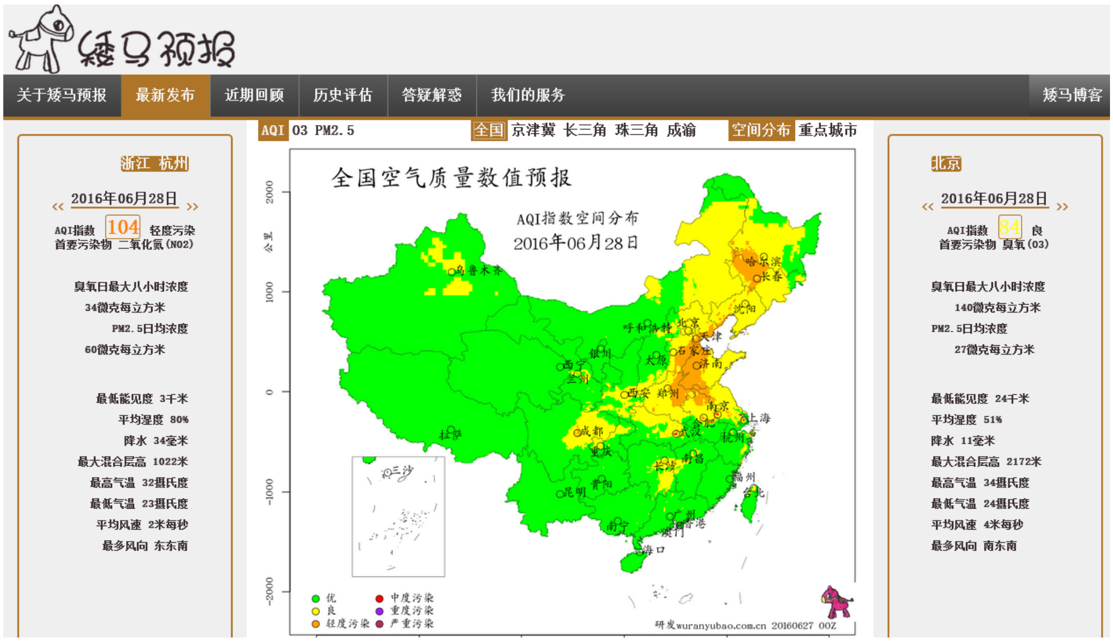
[区域空气质量预报]预计27-28日，桂南部、东部和中部空气质量优，其他地区优到良，首要污染物为PM10或臭氧。

Certain cities on the AQTI index located in these provinces, such as Changchun, Harbin and Chengdu, have independently established their own air quality forecasting publication platforms to provide local air quality forecasts. However, some cities, including Anshan, Daqing and Beihai, have no local forecasting systems in place and the forecasting for the whole province does not go into sufficient detail. Thus, we are unable to give these cities points for air quality forecasting.

Research organizations develop air quality forecasting

Excluding the “national” and “regional” teams, some specialized research organizations, such as the “pony” pollution forecasting system and Nanjing University, have developed air quality forecasting systems.

Figure 28. Interface for “Pony” Pollution Forecasting



Blue Map app collates local air quality forecasts

As a specialized air quality app, the Blue Map collects and displays information from all of the aforementioned data sources to provide the public with the most comprehensive and complete air quality forecasting.

The homepage displays air quality forecasts for five days. Data from the earliest two days comes directly from MEP's national forecasting system and the later three days' data comes from the "pony" pollution forecasting system.

Figure 29. Interface of Blue Map Forecasting

2. Responding to Early Warnings

In 2014, 20 provinces and close to two-thirds of all prefecture-level cities drew up emergency response contingency plans. Over 200 heavy pollution weather warnings were also issued and corresponding advance response measures adopted. In 2015, many cities made further revisions and adjustments to their early warning emergency response plans for heavy air pollution.

Since winter 2015, as a result of polluting emissions and unfavorable meteorological conditions, the Jing-Jin-Ji region and surrounding areas have experienced three episodes of severely polluted weather. This severe pollution has further heightened the necessity of early warnings and emergency response plans. However, the effectiveness of response plans is still inhibited by deficiencies, which mainly include incomplete data and insufficient detail in emergency responses plans.

2.1 Incomplete data may affect joint prevention and control

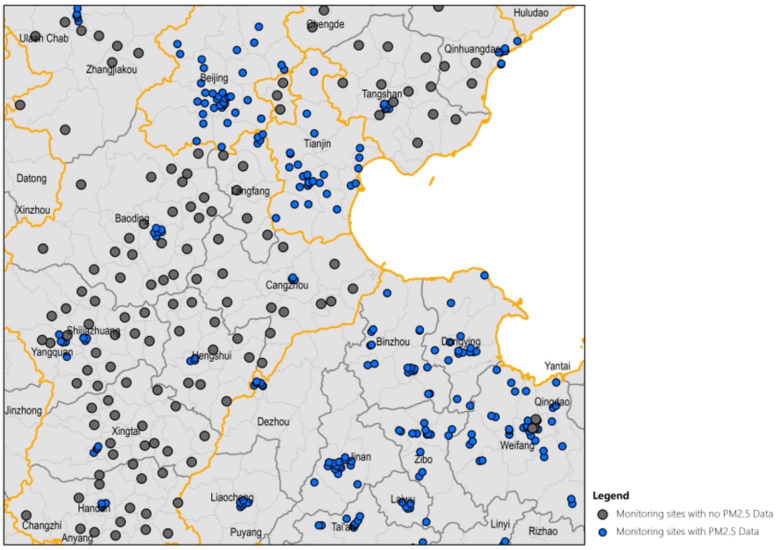
The AQTI evaluation found that each county in the Jing-Jin-Ji region has its own monitoring station. However, a closer investigation of the information disclosed by these stations shows that the municipal- and provincial-level monitoring stations in Hebei province do not publish detailed values for pollutants, including for $PM_{2.5}$. This lack of data not only compromises the release of regional warnings for heavy polluted weather, but also adversely affects joint prevention and control.

2.1.1 Many provincially- and municipally-monitored stations in Hebei do not publish complete monitoring data

According to the Technical Regulations on Ambient Air Quality Index (AQI) (Trial), real-time data published by air quality monitoring sites shall include the concentration of six types of air pollutants, separate air quality indices, and air quality index. Most important are the level of pollutants and the air quality level, for which indices for the following pollutants shall be made public: $PM_{2.5}$, PM_{10}, sulfur dioxide, nitrogen dioxide, ozone, and carbon monoxide.

However, a large portion of Hebei's provincially- and municipally-monitored sites do not publish data on these six types of pollutants and only publish their AQI. The following map shows statistics analyzed by IPE from a portion of monitoring sites in the Jing-Jin-Ji region. The blue points indicate sites that have already disclosed their $PM_{2.5}$ data while the grey points are those sites that have not disclosed their $PM_{2.5}$ data.

Figure 30. Disclosed and Undisclosed $PM_{2.5}$ Data in the Jing-Jin-Ji Region



In general, air quality monitoring sites in Beijing, Tianjin, and Shandong all publish AQI indices and publish the values for the six types of monitored pollutants. Prefecture-level towns and cities in Hebei province with particularly heavy pollution, including Shijiazhuang, Baoding, Tangshan, Xingtai, Handan, Langfang, Hengshui, and Cangzhou, do not have state monitoring sites and only publish the results of AQI calculations.

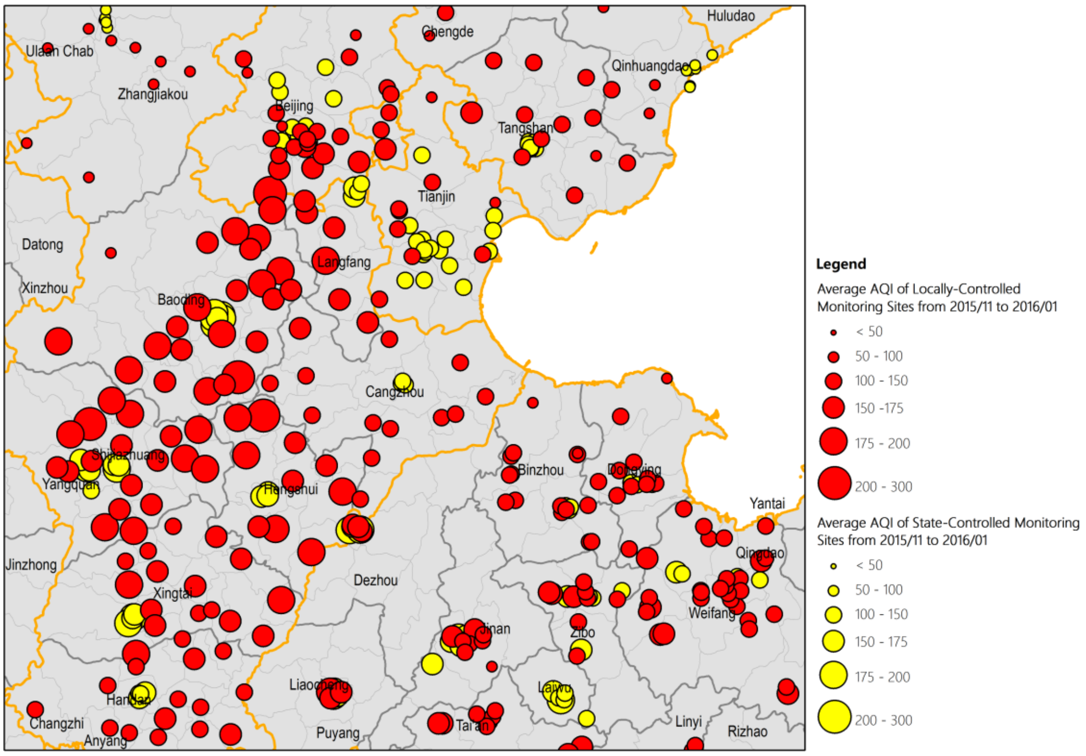
During bouts of severe air pollution, the air quality information published by each area's air quality monitoring network outlines steps that the public can adopt to protect against the effects of severe air pollution. Areas also draft important early warnings and emergency steps that related departments can refer to during times of severe pollution. In that case, in terms of the region's joint protection and control, is Hebei's vast network of county monitoring stations valuable?

2.1.2 County-level regions experience higher concentrations of pollution

In the beginning of November 2015, as a result of pollution discharge and unfavorable meteorological conditions, Jing-Jin-Ji and its surrounding areas experienced three instances of extensive pollution. In 2015, from November 15 to December 31, Beijing's $PM_{2.5}$ concentration was 75.9% greater than the $PM_{2.5}$ concentration on corresponding days in 2014.

IPE calculated the average AQI of monitoring sites in Beijing, Tianjin, Hebei, and Shandong from November 1, 2015 through January 31, 2016 to design a map of the average AQI values for monitoring stations in the four provinces. (IPE used AQI data since provincially- and municipally-controlled monitoring sites in Hebei often only disclose AQI data and not $PM_{2.5}$ data. Even though there is no method to obtain $PM_{2.5}$ average values, average AQI remains a meaningful reflection of the air quality levels during these three months.)

Figure 31. Average AQI of Jing-Jin-Ji Monitoring Sites from November 2015 through January 2016



The yellow points on the map represent the average AQI of state-controlled air quality monitoring sites (those sites administered at the national level). The red points represent the average AQI of provincially- and municipally-controlled monitoring sites (administered at the local level). One can see from the map that the AQI of provincially- and municipally-controlled monitoring stations of Shijiazhuang, Langfang, Hengshui, and Baoding in Hebei have higher average AQI levels than those of the highest averages of state-controlled stations.

The rate of pollution in areas with monitoring sites controlled at the local level is relatively high. The table below lists the three-month average AQI of monitoring stations in various cities in Hebei whose average AQI exceeds 100. The table lists the average AQI, the number of monitoring sites, and the amount and percentage of monitoring stations controlled at local levels that had a higher average AQI than state-controlled monitoring sites.

Table 6. Average AQI of Locally-Controlled and State-Controlled Monitoring Sites

City	Average AQI of State-Controlled Monitoring Sites	Total Number of Monitoring Sites/State Controlled Monitoring Sites /Locally Controlled Monitoring Sites	Number of Locally-Controlled Monitoring Sites with Average AQI Exceeding State-Controlled Monitoring Sites	Rate of Locally-Controlled Monitoring Sites with Average AQI Surpassing that of State-Controlled Monitoring Sites
Shijiazhuang	160	26 / 8 / 18	14	77.8%
Langfang	150	12 / 4 / 8	6	75.0%
Cangzhou	127	16 / 3 / 13	7	53.8%
Hengshui	173	14 / 3 / 11	6	54.5%
Baoding	181	29 / 6 / 23	7	30.4%
Xingtai	170	21 / 4 / 17	3	17.6%
Handan	156	20 /4 / 16	1	6.3%

As the table shows, among the locally-controlled monitoring stations in Shijiazhuang, Langfang, Cangzhou, and Hengshui, more than 50% of these stations have an average AQI exceeding that of state-controlled monitoring stations.

This statistic indicates that during the evaluated period, for areas not covered by state-controlled monitoring sites, there is a higher proportion of situations when air pollution is relatively bad. Therefore, protecting the health of the public necessitates the disclosure of details about pollutant statistics.

2.1.3 Cities in Jing-Jin-Ji with the most intense smog share common borders

Disclosure of detailed monitoring values by locally-controlled monitoring stations is also necessary for joint prevention and control of pollution. While creating the map it became apparent that these types of monitoring sites are largely located in areas where cities share borders, such as the areas between Beijing and Baoding, Baoding and Hengshui, Baoding and Shijiazhuang, Shijiazhuang and Xingtai, and Xingtai and Handan. Since the concentration of pollution in these inter-city regions changes each hour, for joint prevention and control within the Jing-Jin-Ji area, it is especially important to have accurate pollution statistics.

On February 24, 2016, at a conference on confronting heavy pollution in the Jing-Jin-

Ji region organized by MEP, Vice Director of the Chinese Research Academy of Environmental Sciences Chai Fahe pointed out that the districts in Jing-Jin-Ji with the most air pollution are located in the southeast area of Baoding, the northeast region Shijiazhuang, the southeast region of Hengshui, and the southern region of Canzhou; these four areas share a common boundary. Another hotspot for air pollution also exists in south Beijing, northeast Baoding, and the three bordering cities in Langfang. In those common border areas that frequently are the first to experience heavy pollution, those that experience heavy pollution lasting for a longer duration and those with comparatively severe pollution, implementing strong and precise pollution controls will require less investment to achieve comparatively significant results.

In order to accurately govern, local governments and the public must first understand air quality statistics for their own region and surrounding territories. Understanding this information creates a basis for public to take action to protect their own health, as well a foundation for responding to early warnings of air pollution. Hebei invested a lot of human and financial resources to build a pollution monitoring network, which currently has over 200 monitoring sites. However, the deficiency in pollution concentration statistics from Hebei's provincially-controlled and municipally-controlled monitoring stations restricts the use of these numbers, and is not beneficial toward joint prevention and control measures in the Jing-Jin-Ji region.

2.2 Air pollution early warnings and emergency responses require meticulous regional management

In 2015, from November to December pollution was so severe that the red warning alert was utilized and millions of people were forced to make a decision between going out and their health. At the conclusion of the period of severe smog, out of concern China's MEP created a uniform set of standards for early warning red signals – but will this step be sufficient to resolve issues with jointly managing early warnings between regions?

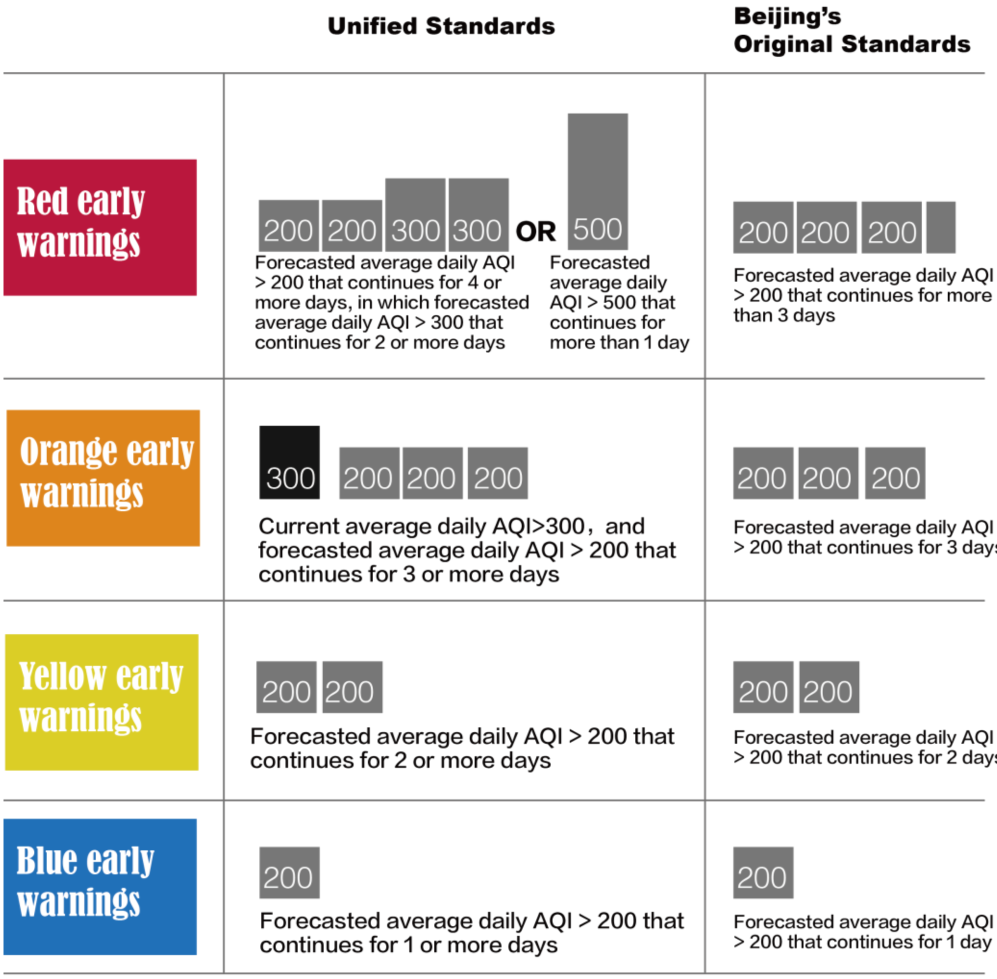
2.2.1 In unifying standards for severe pollution early warnings, Beijing's red alert threshold substantially increases

In December 2015, right after Beijing twice enacted a red alert for pollution levels, Hebei and Tianjin also enacted red alerts. Societal reactions markedly differed. On one hand, some people approved of the "noise" from the warnings to positively protect public health. On the other hand, some people worried that the disturbance from frequent "noise" of early emergency warnings may significantly disrupt daily life.

On February 4, 2016, the MEP and the China Meteorological Administration jointly issued standards for levels of severe pollution warnings for provincial-level cities in the Jing-Jin-Ji region. Beijing, Tianjin, Tangshan, Baoding, Langfang, and Cangzhou all took the lead in implementing the new standards.

The table below shows a comparison in AQI levels under the previous standards and the new early warning standards:

Figure 32. Comparison Between Beijing's Original Standards and New Unified Standards for Early Warnings



Compared to the standards used previously in Jing-Jin-Ji, the uniform standards described above largely increased Beijing's threshold for red early warnings and also led to the establishment of prerequisites for issuing an orange early warning alert. Apart from the previous conditions for red alerts in Tianjin and Hebei, a red warning can also be issued for "average daily AQI > 200 that continues for four or more days, or average AQI > 300 that continues for two or more days."

Unifying emergency standards does not equate to joint prevention and control

According to these standards, it will be difficult for a situation to reoccur where Beijing repeatedly raises red alerts. However, increasing the emergency threshold will also weaken the effectiveness of efforts to protect public health, especially that of children, the elderly, the sick, and other vulnerable groups.

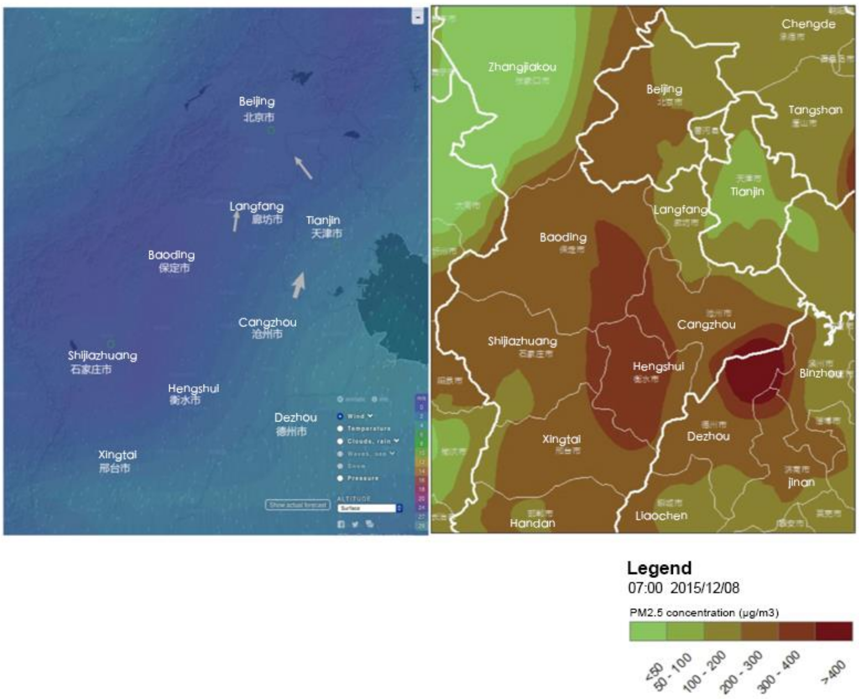
More importantly, unifying emergency standards does not equal joint prevention and control, but merely brings each area's threshold for launching emergency measures to the same level. True joint prevention and control measure requires analyzing each region's pollutant transmission and predicting of the direction that the pollution will travel, and then launching targeted emergency measures in advance to reduce pollution and thereby alleviate the extent of the pollution. This absolutely cannot be achieved by merely unifying emergency standards.

2.2.2 Resolving regional heavy air pollution requires stepping away from the "one city one region" model

While examining heavy air pollution, IPE discovered that more often than not, the problem of smog had no relation to the "one city one region" problem.

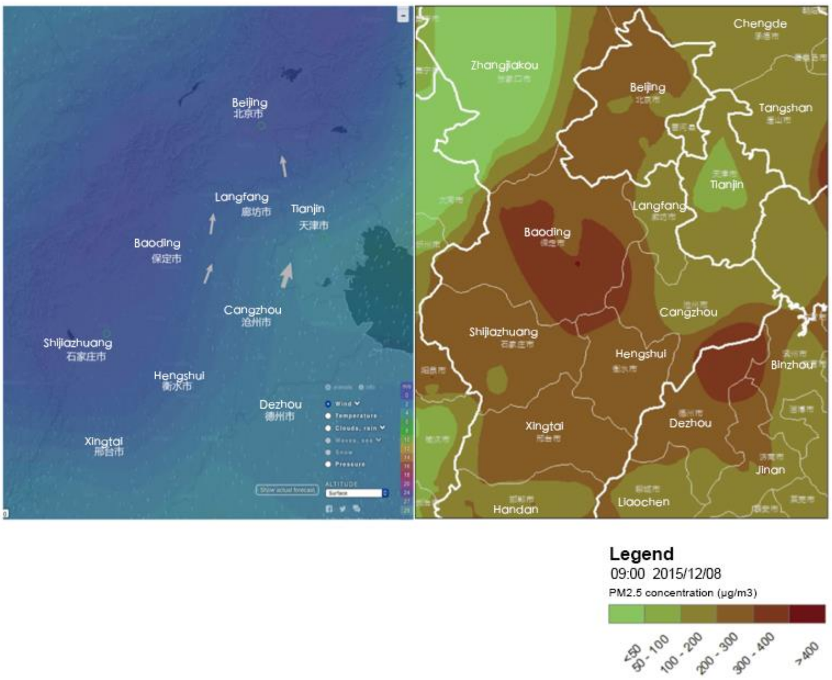
Using the Jing-Jin-Ji region as an example, during the period from November 2015 through December 2015, each observed instance of heavy pollution could be attributed to regional pollution transmission. For example, on December 8, 2015, the changes in $PM_{2.5}$ concentration correspond with the strength and direction of the wind, which can be seen by comparing and analyzing the maps below.

Figure 33. Map of the Force and Direction of Wind and $PM_{2.5}$ Concentration in Jing-Jin-Ji on December 8, 2015 at 7 a.m.



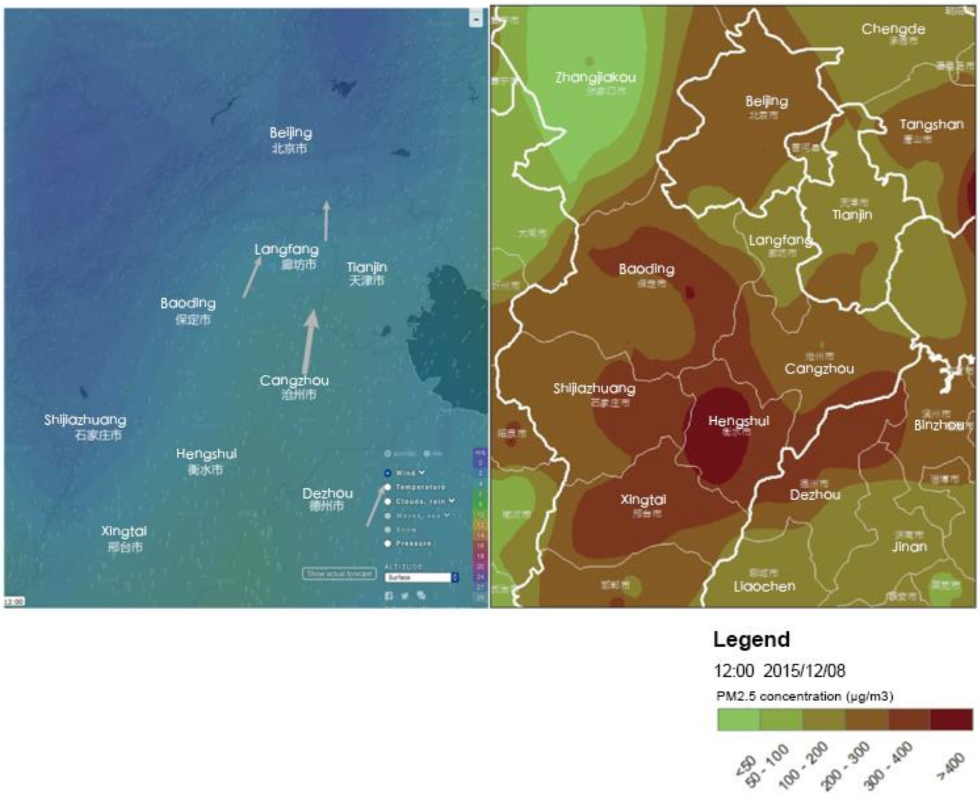
▪ At 7 a.m., the weather conditions in the region are calm. Baoding, Hengshui, Cangzhou, Dezhou, and other areas are hot spots of high $PM_{2.5}$ concentration, while Beijing has about half the PM concentration, in the range of 50-100μg/m3.

Figure 34. Map of the Force and Direction of Wind and $PM_{2.5}$ Concentration in Jing-Jin-Ji on December 8, 2015 at 9 a.m.



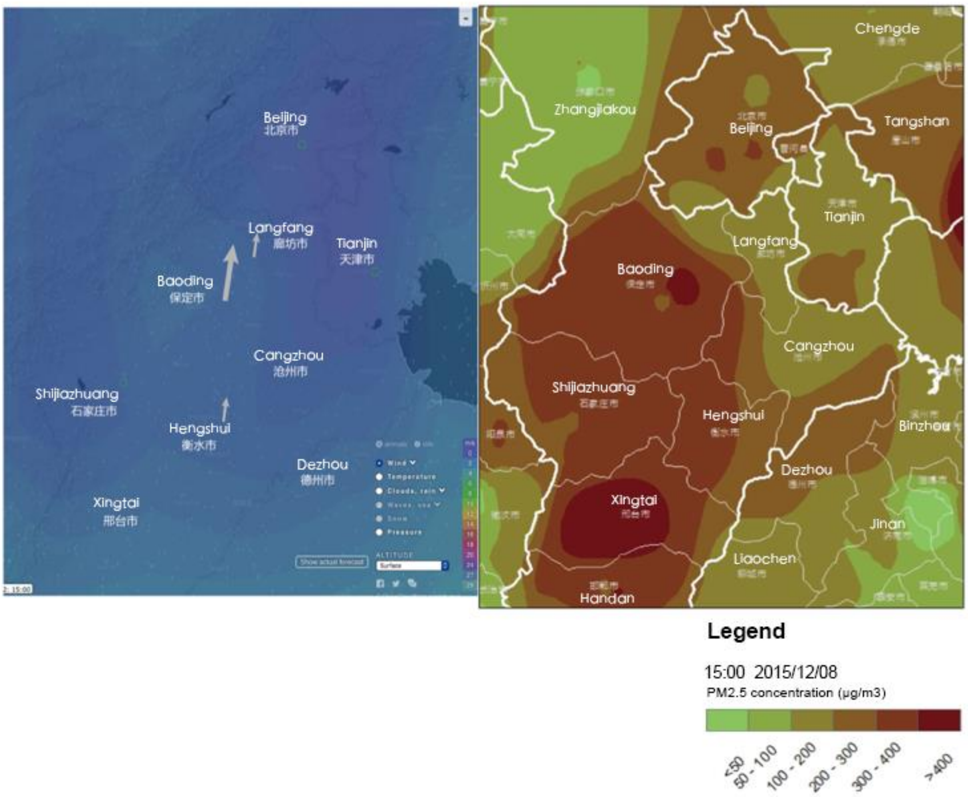
▪ At 9 a.m., the region's weather conditions are at normal levels, wind speeds are at or below 2m/s, and the dominant wind direction is a weak southern wind. In Baoding and the Cangzhou-Dezhou border region, heavy smog is beginning to form (PM concentration >300μg/m^3)

Figure 35: Map of the Force and Direction of Wind and $PM_{2.5}$ Concentration in Jing-Jin-Ji on December 8, 2015 at 12 p.m.



▪ By 12 p.m., the southern wind is becoming stronger, heavy pollution in the region is beginning to expand, and $PM_{2.5}$ concentration of above 300μg/m^3 is beginning to approach Beijing. Nearly all regions of Beijing now exhibit average $PM_{2.5}$ concentrations of 100-200μg/m^3.

Figure 36. Map of the Force and Direction of Wind and $PM_{2.5}$ Concentration in Jing-Jin-Ji on December 8, 2015 at 3 p.m.



- At 3 p.m., the southerly wind becomes weak, and the Cangzhou-Tianjin-Beijing line returns to a calm state. The pollutants transmitted by the southern wind further accumulate, leading heavy pollution to expand throughout the region.

2.2.3 Results of advance emergency measures to reduce pollution differ markedly from when measures lag behind

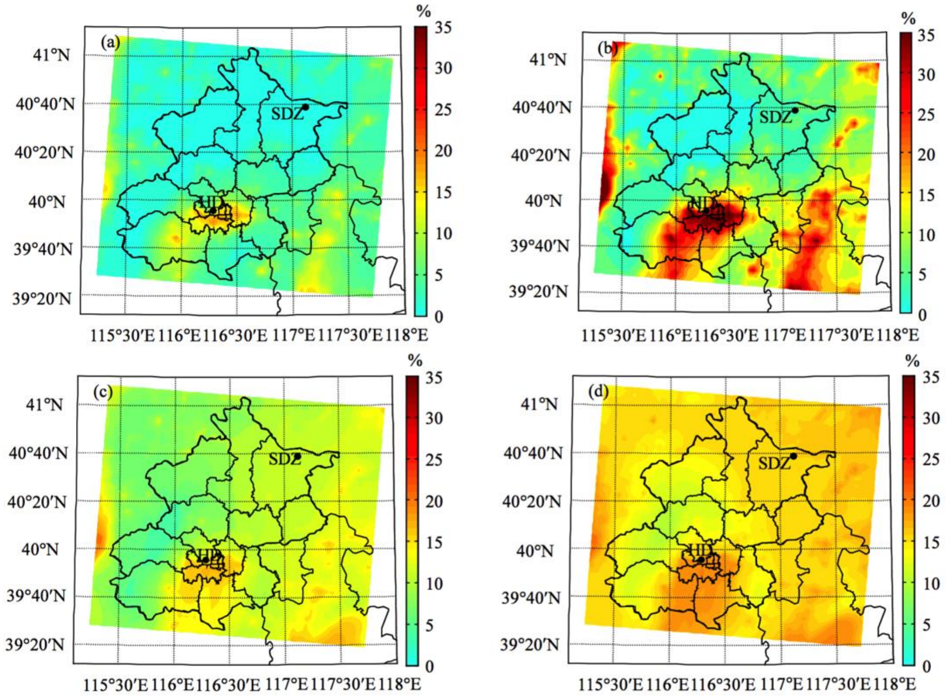
When facing significant impact from regional pollution transfer, it is necessary to integrate regional meteorological forecasts and analyze the source and pattern of regional pollution in order to jointly adopt targeted emergency measures for cities in the region.

Zhai Shixian from the Chinese Academy of Meteorological Sciences initiated a study on previous efforts for emergency pollution reduction. The study used the Model-3/CMAQ model which shows and lists the sources of pollution in the Jing-Jin-Ji region in high resolution. The model used an instance of heavy pollution in Beijing in 2012 to simulate the difference in results between two hypotheticals: "beginning emissions reduction a day before peak values" and "greatly reducing emissions the day of peak values."

Figure 37. Distribution of $PM_{2.5}$ Concentration Reduction Rate in Beijing Under Different Emissions Reduction Models:

(a) 50% emissions reduction the day of peak values (b) 75% emissions reduction the day of peak values

(c) 25% emissions reduction one day prior to peak values (d) 25% emissions reduction two days prior to peak values



The results of the models are clear: when pollution sources are cut by 25% both one day and two days in advance of peak values, Beijing's $PM_{2.5}$ concentration declines on the whole. The earlier pollution reduction begins, the more evenly distributed the $PM_{2.5}$ concentration reduction rate in Beijing. Comparing the peak $PM_{2.5}$ concentration when implementing "50% emissions reduction the day of peak values," "25% emissions reduction one day prior to peak values," "75% emissions reduction the day of peak values," and "25% emissions reduction two days prior to peak values ," the four models exhibit respective $PM_{2.5}$ concentration reduction rates of 5%, 11%, 12%, and 16%.

As the research clearly shows, to help Beijing's air quality comply with standards, "adopting appropriate emissions reductions prior to peak pollution" is more effective than "greatly reducing emissions only beginning on the day of pollution." Adopting suitable emergency emissions reduction measures in advance can also lower the direct impact on daily life and industrial production.

2.2.4 Moving towards more meticulous requirements for early warning and responses

In sum, unifying emergency response standards for the same airspace remains relatively high-level from a management perspective. In order to balance the contradictory demands between protecting public health and maintaining normal life and production in cities, and achieve effective early warning and response management, there is a need to uniformly move from extensive early response towards a more meticulous emergency forecast system.

Some of the requirements for refining management are as follows:

- Improve the capacity of air quality monitoring and meteorological surveying, and reasonably expand the installation of air quality monitoring stations, especially making sure there is sufficient coverage in key regions and meteorological transfer areas. Also, through the accumulation of large amounts of data, increase understanding of regional air quality status and laws of transmission to find key points for preventing and controlling air pollution.
- Promote mechanisms for data disclosure and sharing between departments, and expand the level of information disclosure of each government department so as to allow for third parties to have the opportunity to use atmospheric, environmental protection, and transportation data from different departments. Data disclosure and information sharing will open up room for related research, allowing for the pooling of resources, and will help improve the capacity of early warning forecasts and related policy decisions.
- On the basis of research and development, when introducing advanced weather forecasting and air pollution diffusion prediction models, it is necessary to incorporate real-time emissions data from regional key pollution sources into air forecast models. In order to minimize the societal costs of pollution reduction, the process of dynamically recognizing each instance of heavily polluted weather requires a priority list of enterprises for emergency emissions reduction measures.

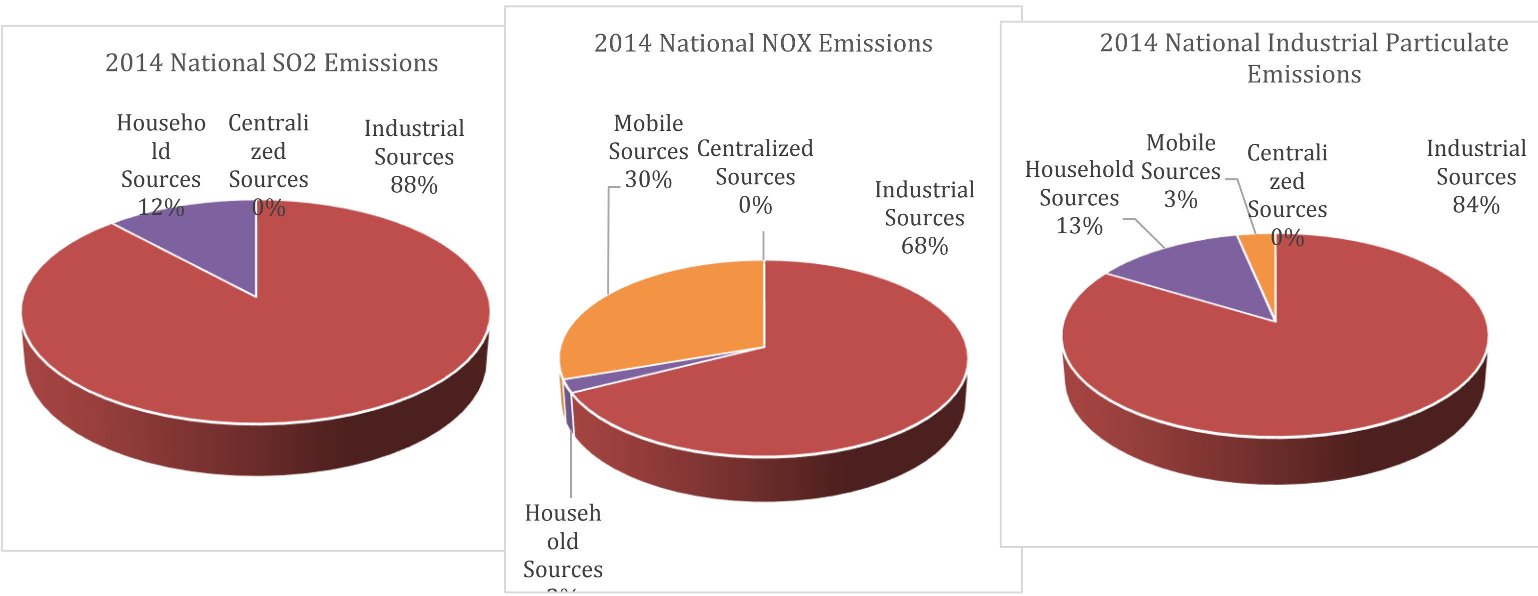
3. Identifying Sources of Pollution

3.1 New data further reveals the contribution from industrial emissions and coal to air pollution

In the three previous Blue Sky Roadmap reports, IPE has repeatedly suggested that industrial production and coal burning are the main contributors to air pollution and pollutant emissions. National and regional environmental statistics disclosed in the latest annual report further confirm this point of view.

According to the 2014 China Environmental Bulletin, China's sulfur dioxide emissions from industry reached 174.04 million tons, comprising 88.1% of the China's total sulfur dioxide emissions. Industrial nitrogen oxide emissions reached 140.48 million tons, accounting for 67.6% of the country's total nitrogen oxide emissions. Particulate matter emissions reached 145.61 million tons, 83.6% of the country's total smoke and dust emissions.

Figure 1. National Sulfur Dioxide, Nitrogen Oxide, and Particulate Matter Emissions in 2014



Of these, in key areas for air pollution prevention and control (three regions and ten city clusters), sulfur dioxide emissions in 2014 totaled 8.863 million tons, of which emissions from industry accounted for 7.977 million tons, or 90% of these areas' sulfur dioxide emissions. Nitrogen oxide emissions totaled 10.018 million tons, of which emissions from industry accounted for 6.932 million tons, or 78.2% of nitrogen oxide emissions. Particulate matter emissions totaled 7.625 million tons, of which emissions from industry accounted for 6.522 million tons, or 85.5% of the areas' particulate matter emissions.

Table 7. Status of Pollutant Emissions in Three Regions and Ten City Clusters

Region (city cluster)	Total emissions of sulfur dioxide (ten thousand tons)	Sulfur dioxide emissions from industrial sources (ten thousand tons)	Sulfur dioxide emissions from industrial source as a percentage	Total emissions of nitrogen oxide (ten thousand tons)	Nitrogen oxide emissions from industrial sources (ten thousand tons)	Nitrogen oxide emissions from industrial sources as a percentage	Total emissions of particulate matter (ten thousand tons)	Emissions of particulate matter from industrial sources (ten thousand tons)	Emissions of particulate matter from industrial sources as a percentage
Jing-Jin-Ji	147.8	128.3	86.81	194.6	126.9	65.21	199.5	158.6	79.50
Yangtze River Delta	166.7	158.6	95.14	225.3	163.6	72.61	128.5	121.1	94.24
Pearl River Delta	40.6	40.1	98.77	71.6	43	60.06	21.6	18.6	86.11
Central and South Liaoning	52.5	49.4	94.10	51.3	37.7	73.49	71.1	61.5	86.50
Shandong Peninsula	159	135.9	85.47	159.3	112.3	70.50	120.8	102.4	84.77
Wuhan Area	32.5	29	89.23	33.2	22.2	66.87	31.8	28.7	90.25
Chang-Zhu--Tan	10.9	10	91.74	12.6	7.5	59.52	11.1	10.3	92.79
Chengdu-Chongqing	110.7	99.8	90.15	83	53.9	64.94	49.1	45.6	92.87
West Coast of Taiwan Straits	35.6	33.8	94.94	41.2	30.1	73.06	36.8	34.9	94.84
North and Central Shanxi	41.4	34.6	83.57	38.9	29.8	76.61	35.7	27	75.63
Shaanxi - Guanzhong	47.4	40.1	84.60	43.8	32.1	73.29	31.6	22.1	69.94
Gansu	24.8	23.3	93.95	26	18.3	70.38	12.2	10.3	84.43
Xinjiang - Urumqi	16.3	14.9	91.41	21.2	15.8	74.53	12.7	11	86.61

3.2 Progress and challenges for environmental information disclosure from industrial pollution sources

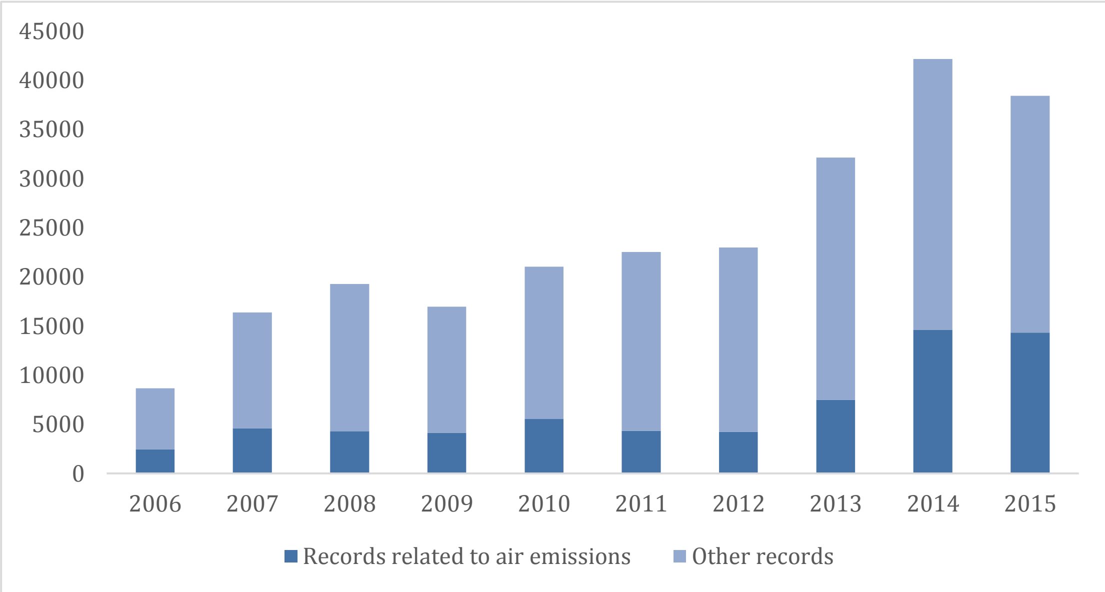
Keeping in line with the past three editions of the Blue Sky Roadmap, this edition firmly maintains that information disclosure – especially up-to-date and comprehensive information disclosure from pollution sources – is fundamental for public supervision and participation in solving environmental problems, and is a prerequisite for effective multi-party governance.

3.2.1 Progress in disclosure of pollution source environmental monitoring information

Environmental information transparency in China has improved steadily since the 2008 implementation of the Measures on Environmental Information Disclosure (Trial). Progress in disclosure of information about pollution sources has been rapid, especially since the Measures on Pollution Source Supervisory Monitoring and Information Disclosure for Key State-Monitored Enterprises (Trial) went into effect on January 1, 2014. After the 2014 Measures (Trial), environmental protection departments at all levels began to comprehensively, regularly, and completely disclose supervisory monitoring results for key state-monitored (and in some areas provincially- and municipally-monitored) pollution sources to the public through supervisory monitoring quarterly reports and other means.

The Pollution Map Database, established by IPE in 2006, collects pollution source supervision information published by environmental protection departments (EPBs) since 2004. Looking at the number of environmental supervision records entered for each calendar year, it is evident that the supervision information published by EPBs has steadily increased, especially since 2013, when there was a significant breakthrough in the number of published records.

Table 8. Number of Supervision Records Entered Each Year into the Pollution Map Database[8]

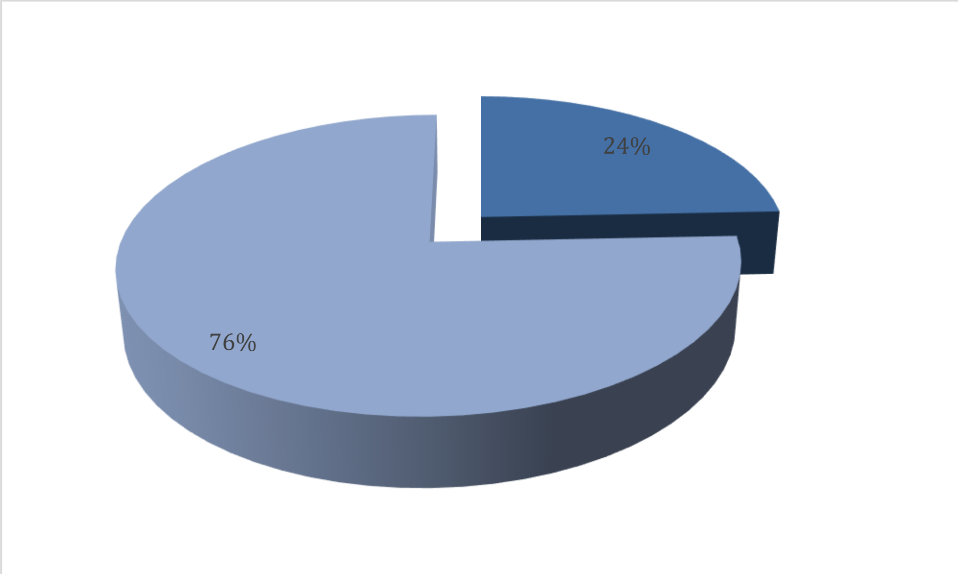


3.2.2 Disclosure of pollution source environmental supervision information is still insufficient

Although supervisory information on sources of environmental pollution has made tremendous progress over the past few years, information disclosure is still not complete and is insufficient to satisfy the public's right to know. This March, while responding to questions from domestic and foreign reporters related to "strengthening ecological and environmental protection," China's Minister of Environmental Protection, Chen Jining, stated that "last year we inspected 1.77 million enterprises, of which we handled cases of illegal behavior at 191,000 enterprises, shut down 20,000 enterprises, stopped production at 34,000, and set a correctional deadline for 89,000." However, according to information gathered by the Pollution Map Database, up through July 20, 2016, the database had only collected 46,506 corporate environmental supervision records published in 2015. The database's acquisition rate is therefore only 24.3%, indicating that pollution source supervision information is yet to be comprehensively disclosed.

[8] Deadline for data collection: April 1, 2016. Environmental protection departments at all levels are still updating and releasing 2015's annual supervision information, and therefore, there are currently fewer supervision records in the database for 2015 than for 2014.

Table 9. Proportion of Pollution Source Supervision Information that is Disclosed



3.3 Enormous opportunities and challenges for the disclosure of pollution source environmental information

According to public information, China currently has 68,000 environmental supervision and enforcement officials. Among these officials, 20% have a background in environmental protection and on average each office has only 20 officials. With the increasing number of polluting enterprises in regions under supervision, in order to have effective supervision, apart from systematic safeguards, technical and scientific methods must also be used. Pollution sources should install online monitoring equipment so that environmental big data can be used to carry out “online data, offline enforcement.” As mentioned above, the comprehensive and timely public disclosure of big data will improve the level of public participation, thereby facilitating effective online and offline interaction between the public, enterprises and supervisory agencies and forming a participatory environment to foster environmental protection.[9]

3.3.1 Huge turning point for pollution source information disclosure

Since 2013, China has issued a series of laws, regulations, measures and norms on information disclosure for key pollution-discharging entities. These policies include the Measures on Self-Monitoring and Information Disclosure for Key State-Monitored Enterprises (Trial) that went into effect on January 1, 2014; amendments to China’s

[9] “Insufficient Environmental Monitoring - can a satellite network make up for it?” China Environmental News, April 21, 2015, http://www.gootech.com/topics/72010183/detail-10254283.html (Accessed April 7, 2016)

Environmental Protection Law and the Measures on Environmental Information Disclosure for Enterprises and Institutions, which both went into effect on January 1, 2015; and amendments to China's Air Pollution Prevention and Control Law, which began to be implemented on January 1, 2016. In particular, the new amendments to the Air Law stipulate, "key pollution-discharging entities for air emissions shall install and use equipment to automatically monitor their emissions of atmospheric pollutants, and the equipment shall be connected to the monitoring equipment networks of environmental protection authorities to ensure regular operation of monitoring equipment and disclosure of emissions information according to law." Otherwise, such entities shall face "fines of more than RMB 20,000 but less than RMB 200,000. If the entity refuses to make corrections, the authorities shall order the entity to halt production for rectification."

The specific requirements of the above regulations for information disclosure are outlined below:

Figure 39. Legal Requirements for Pollution Environmental Information Disclosure

2014 《国家重点监控企业自行监测及信息公开办法（试行）》

第十八条 企业应将自行监测工作开展情况及监测结果向社会公众公开，公开内容应包括：

（一）基础信息：企业名称、法人代表、所属行业、地理位置、生产周期、联系方式、委托监测机构名称等；

（二）自行监测方案；

（三）自行监测结果：全部监测点位、监测时间、污染物种类及浓度、标准限值、达标情况、超标倍数、污染物排放方式及排放去向

……

第二十条 企业自行监测信息按以下要求的时限公开：

……

（三）自动监测数据应实时公布监测结果，其中废水自动监测 设备为每 2 小时均值，废气自动监测设备为每 1 小时均值；

（五）突发环境事件应急预案；

（六）其他应当公开的环境信息。列入国家重点监控企业名单的重点排污单位还应当公开其环境自行监测方案。

2015 《中华人民共和国环境保护法》

第五十五条　重点排污单位应当如实向社会公开其主要污染物的名称、排放方式、排放浓度和总量、超标排放情况，以及防治污染设施的建设和运行情况，接受社会监督。

2015 《企业事业单位环境信息公开办法》

第七条　设区的市级人民政府环境保护主管部门应当于每年3月底前确定本行政区域内重点排污单位名录，并通过政府网站、报刊、广播、电视等便于公众知晓的方式公布。

第八条　具备下列条件之一的企业事业单位，应当列入重点排污单位名录：

（一）被设区的市级以上人民政府环境保护主管部门确定为重点监控企业的；

（二）具有试验、分析、检测等功能的化学、医药、生物类省级重点以上实验室、二级以上医院、污染物集中处置单位等污染物排放行为引起社会广泛关注的或者可能对环境敏感区造成较大影响的；

（三）三年内发生较大以上突发环境事件或者因环境污染问题造成重大社会影响的；

（四）其他有必要列入的情形。

第九条　重点排污单位应当公开下列信息：

（一）基础信息，包括单位名称、组织机构代码、法定代表人、生产地址、联系方式，以及生产经营和管理服务的主要内容、产品及规模；

（二）排污信息，包括主要污染物及特征污染物的名称、排放方式、排放口数量和分布情况、排放浓度和总量、超标情况，以及执行的污染物排放标准、核定的排放总量；

（三）防治污染设施的建设和运行情况；

（四）建设项目环境影响评价及其他环境保护行政许可情况；

（五）突发环境事件应急预案；

（六）其他应当公开的环境信息。列入国家重点监控企业名单的重点排污单位还应当公开其环境自行监测方案。

2015 中华人民共和国大气污染防治法（主席令第三十一号）

第二十四条　……重点排污单位应当安装、使用大气污染物排放自动监测设备，与环境保护主管部门的监控设备联网，保证监测设备正常运行并依法公开排放信息。

……

第一百条　违反本法规定，有下列行为之一的，由县级以上人民政府环境保护主管部门责令改正，处二万元以上二十万元以下的罚款；拒不改正的，责令停产整治：

……

（四）重点排污单位不公开或者不如实公开自动监测数据的

……

3.3.2 Two key issues with legal implementation

In order to uphold the requirements of the Environmental Protection Law and the Air Law, including to safeguard the public's right to know and to supervise, and to promote large-scale reductions in pollutant emissions, IPE, Friends of Nature, SEE Foundation, EnviroFriends, and 29 other organizations launched the initiative *Promoting Regional Control of Air and Water Pollution: Proposal for Information Disclosure from Key Pollution-Discharging Entities*. Key points from the proposal are displayed in the chart below.

Figure 40. Key Points from Promoting Regional Control of Air and Water Pollution: Proposal for Information Disclosure from Key Pollution-Discharging Entities

01

- Provincial environmental protection departments and environmental protection departments of prefecture-level cities across the entire nation shall, as soon as possible, determine a directory of key pollutant-emitting entities for air emissions and wastewater in their respective jurisdictions and publish it according to law.

02

- According to the requirements of the Air Pollution Prevention and Control Law, key pollution-discharging entities for air emissions shall install and use equipment to automatically monitor their emissions of atmospheric pollutants, and the equipment shall be connected to the monitoring equipment networks of environmental protection authorities to ensure regular operation of monitoring equipment and disclosure of emissions information according to law.

03

- According to the requirements of the Measures on Environmental Information Disclosure for Enterprises and Institutions, key pollutant-discharging entities for air emissions and wastewater shall, by means of provincial-level platforms for the release of automatic monitoring information for key monitored enterprises, publish environmental information.

At the same time, the project team also investigated the disclosure status of the lists of key pollution-discharging entities, as well as the disclosure status of online monitoring data from key pollution-discharging entities for air emissions. The project team discovered that these two programs have both encountered relatively significant challenges during the phases of implementation.

3.3.2.1 Challenges in disclosing lists of key pollution-discharging entities

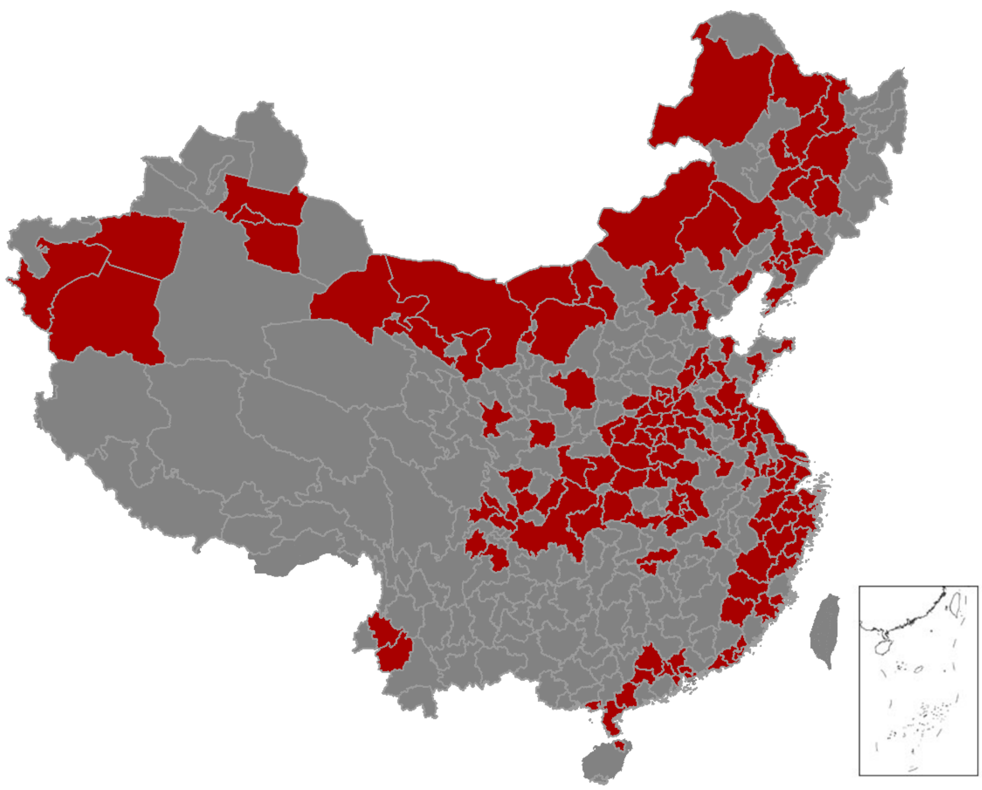
As mentioned earlier, the new Environmental Protection Law and its accompanying Measures on Environmental Information Disclosure for Enterprises and Public Institutions (hereafter referred to as the Disclosure Measures) clarify that municipal-level government environmental protection departments should determine a list of key pollution-discharging entities for their respective administrative region before the end of March each year. This list should be released via government websites, newspapers, radio and television broadcasts, and other mediums that are easy for the public to access.

In order to shed light on the implementation of the Environmental Protection Law and its accompanying Disclosure Measures, the project team sorted through the disclosure status of lists of key pollution-discharging entities for 338 cities at the prefecture level or above in 2015. The results were far from perfect, exhibiting the following issues:

- Some regions have not yet met the requirements of the Environmental Protection Law and Air Law, and have not yet formulated lists of key pollution-discharging entities or disclosed them to the public.

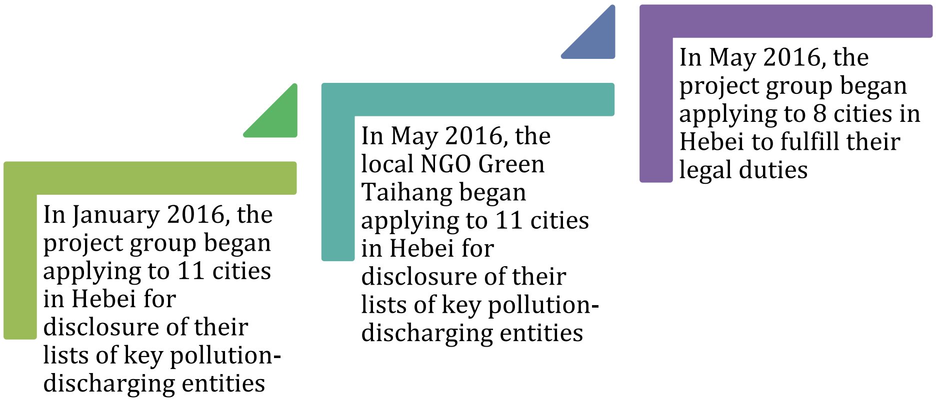
Out of the 338 cities at the prefecture level or above that were investigated, only 146 had actually disclosed their lists of key pollution-discharging entities, representing only 43.2% of the total. There are still 192 cities that have not yet carried out their legal requirements. These cities are primarily located in northwest and southwest regions.

Figure 41. Disclosure Status of Lists of Key Pollution-Discharging Entities for 338 Cities



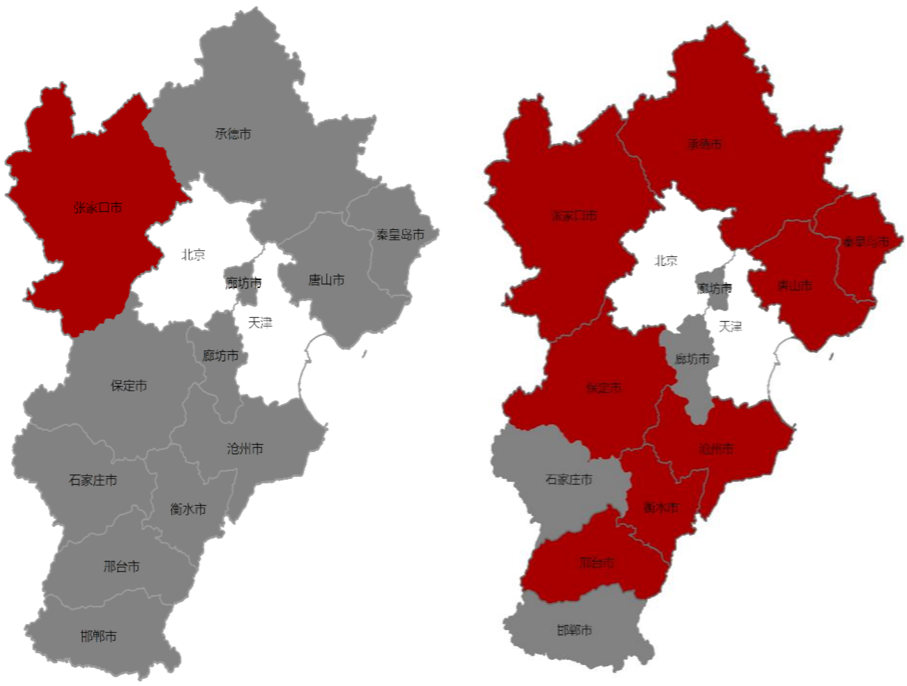
In the Jing-Jin-Ji region, Beijing and Tianjin disclosed their lists in compliance with the legal requirements, but out of 11 cities in Hebei, only Zhangjiakou had disclosed its list. Hebei represents a key link in the administration of Jing-Jin-Ji's joint air pollution prevention and control area. The fact that it had still not carried out its legal requirement to fully disclose its key pollution source information makes it harder for public supervision to reduce regional air pollution. As a result, the project team selected Hebei as the first site for the "key pollution-discharging entity information disclosure promotion project."

Figure 42. Process for Promoting the Disclosure of Key Pollution-Discharging Entity Lists in Hebei



With encouragement from the project team and the environmental protection group Green Taihang, cities in Hebei successively drew up and disclosed their lists of key pollution-discharging entities in May and June of 2016. By the end of June 2016, only Shijiazhuang, Handan, and Langfang[10] had not yet disclosed their lists. However, these cities had communicated to environmental groups that they have already begun preparing their lists.

Figure 43. Comparison of 11 Cities in Hebei Before and After Promoting the Disclosure of Lists of Key Pollution-Discharging Entities



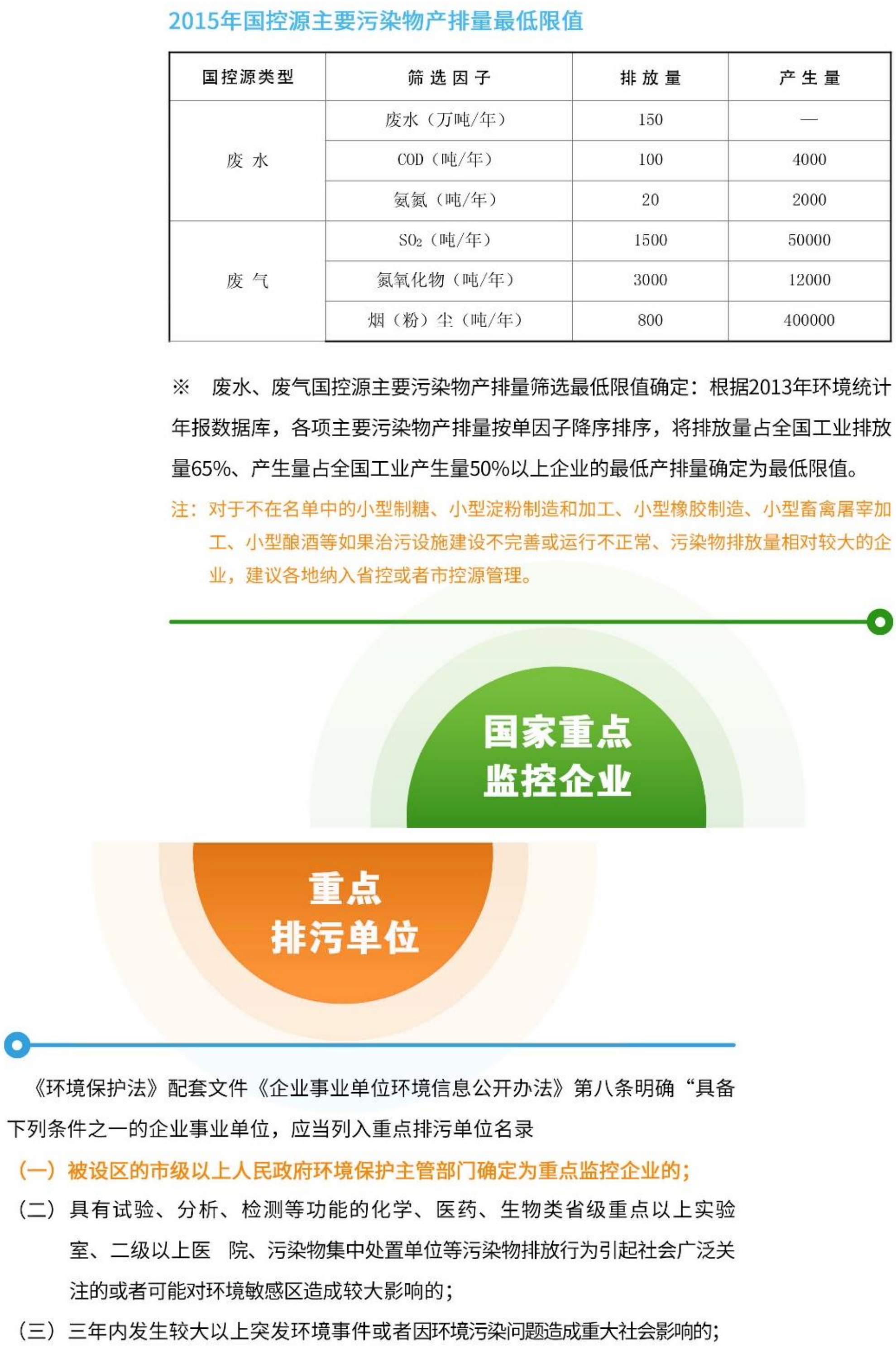
10 As of July 6. Based on applications to EPBs and subsequent disclosure of key pollution-discharging 廊坊 entities lists.

- The selection criteria for each region's list of key pollution-discharging entities, particularly regarding key monitored entities, is not clear. The lists also lack unified standards and requirements.

According to the requirements outlined in the Measures on Environmental Information Disclosure for Enterprises and Public Institutions, lists of key pollution-discharging entities should include "key monitored enterprises determined by regional environmental protection departments at the prefecture level or above." However, with the exception of the selection criteria for nationally-determined key state-monitored entities, there aren't any clear or uniform standards for selecting key monitored enterprises.

The Disclosure Measures do offer a clear requirement by specifying that "chemical, medical, and biological key laboratories at the provincial level or above that possess experimental, analysis, sensing and other such capabilities; hospitals at grade 2 and above; entities for the centralized treatment of pollutants; and other such entities with pollution emissions activity that might arouse widespread societal concern or may cause a comparatively large impact to environmentally sensitive areas" should be added to lists of key pollution-discharging entities. However, based on the results of the project team's investigation, many such enterprises that, according to the requirements of the Disclosure Measures, should be included on these lists and/or are of particular concern to the public – particularly centralized treatment units like waste incinerators – have not been added to lists of key pollution-discharging entities. Some areas have also failed to include pollution-discharging entities that have been the subject of public complaints or that have a history of violating pollution regulations.

Figure 44. National Selection Criteria for Key State-Monitored Enterprises and Key Pollution-Discharging Entities



2015年国控源主要污染物产排量最低限值

国控源类型	筛选因子	排放量	产生量
废水	废水（万吨/年）	150	—
	COD（吨/年）	100	4000
	氨氮（吨/年）	20	2000
废气	SO_2（吨/年）	1500	50000
	氮氧化物（吨/年）	3000	12000
	烟（粉）尘（吨/年）	800	400000

※　废水、废气国控源主要污染物产排量筛选最低限值确定：根据2013年环境统计年报数据库，各项主要污染物产排量按单因子降序排序，将排放量占全国工业排放量65%、产生量占全国工业产生量50%以上企业的最低产排量确定为最低限值。

注：对于不在名单中的小型制糖、小型淀粉制造和加工、小型橡胶制造、小型畜禽屠宰加工、小型酿酒等如果治污设施建设不完善或运行不正常、污染物排放量相对较大的企业，建议各地纳入省控或者市控源管理。

《环境保护法》配套文件《企业事业单位环境信息公开办法》第八条明确“具备下列条件之一的企业事业单位，应当列入重点排污单位名录

（一）被设区的市级以上人民政府环境保护主管部门确定为重点监控企业的；

（二）具有试验、分析、检测等功能的化学、医药、生物类省级重点以上实验室、二级以上医 院、污染物集中处置单位等污染物排放行为引起社会广泛关注的或者可能对环境敏感区造成较大影响的；

（三）三年内发生较大以上突发环境事件或者因环境污染问题造成重大社会影响的；

3.3.2.2 Information disclosure challenges for enterprises that discharge air emissions

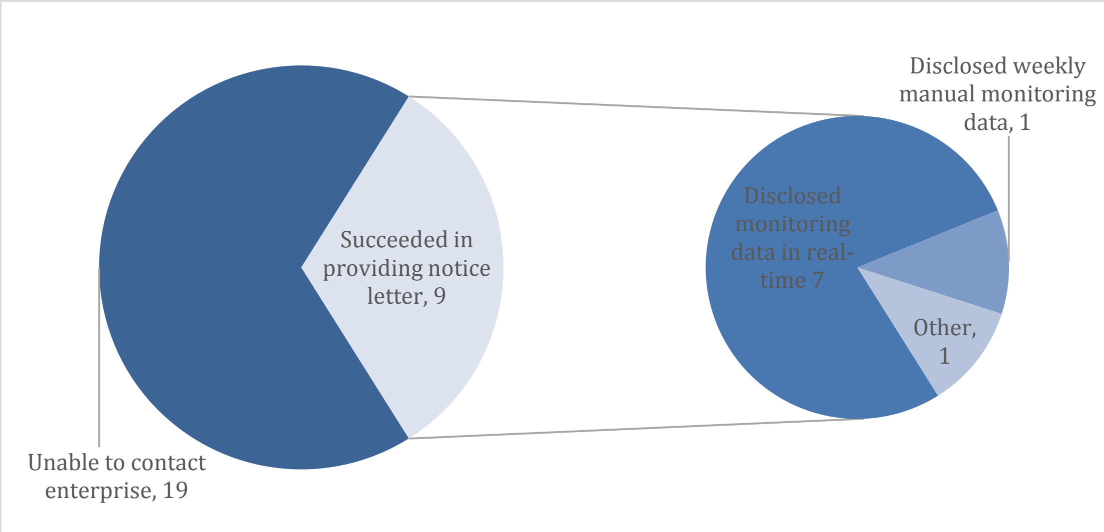
According to requirements in China's Air Law, key pollution-discharging entities shall install and use automatic monitoring equipment for atmospheric pollutant emissions, and the equipment shall be connected to the monitoring equipment networks of environmental protection authorities to ensure that equipment operates regularly and emissions data are disclosed according to law. For key pollution-discharging entities that do not disclose or do not truthfully disclose self-monitoring data, the local government department in charge of environmental protection at the county level or above shall order the entity to make corrections, and impose fines of more than RMB 20,000 but less than RMB 200,000. If the entity refuses to make corrections, the authorities shall order the entity to stop production for rectification

Nationally, although close to half of the required regions have released their lists of key pollution-discharging entities, many of the entities on these lists have still not released their online data according to law. With this in mind, we began by pushing enterprises in Beijing.

At the end of 2015, Beijing's environmental protection bureau required key pollution-discharging entities to disclose all their environmental information on the department's online platform by January 31, 2016. The EPB also encouraged the public to make use of channels to apply for disclosure, requiring that enterprises carry out their obligation to release information.

In January 2016, the five environmental groups SEE Foundation, IPE, Friends of Nature, Envirofriends, and Nature University jointly submitted an appeal for information disclosure to 28 enterprises in Beijing requiring that they release their environmental information on the "Beijing Environmental Information Disclosure Platform for Enterprises and Public Institutions," especially online monitoring information. Nine companies confirmed receipt of the appeal, and seven of them then disclosed their online monitoring data in real-time on Beijing's platform.

Figure 45. Results of Applications to Key Pollution-Discharging Entities for Online Monitoring Information Disclosure



By April 13, 2016, all of Beijing's state-monitored pollution sources had already published their environmental information on the "Beijing Environmental Information Disclosure Platform for Enterprises and Public Institutions." Apart from nationally-monitored key pollution-discharging entities, some other entities have also published their online monitoring data on the platform. Especially relevant are thermal power companies: of the 20 non-nationally monitored thermal power enterprises, 14 have already begun publishing their online monitoring data on the platform.

Figure 46. Online Monitoring Information Disclosure for Beijing's Key Pollution-Discharging Thermal Power Enterprises

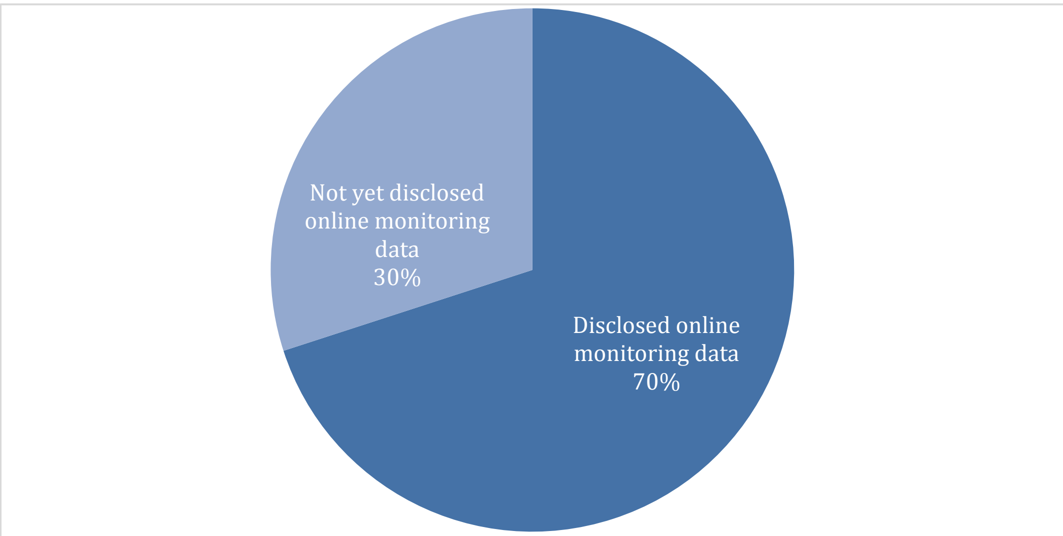
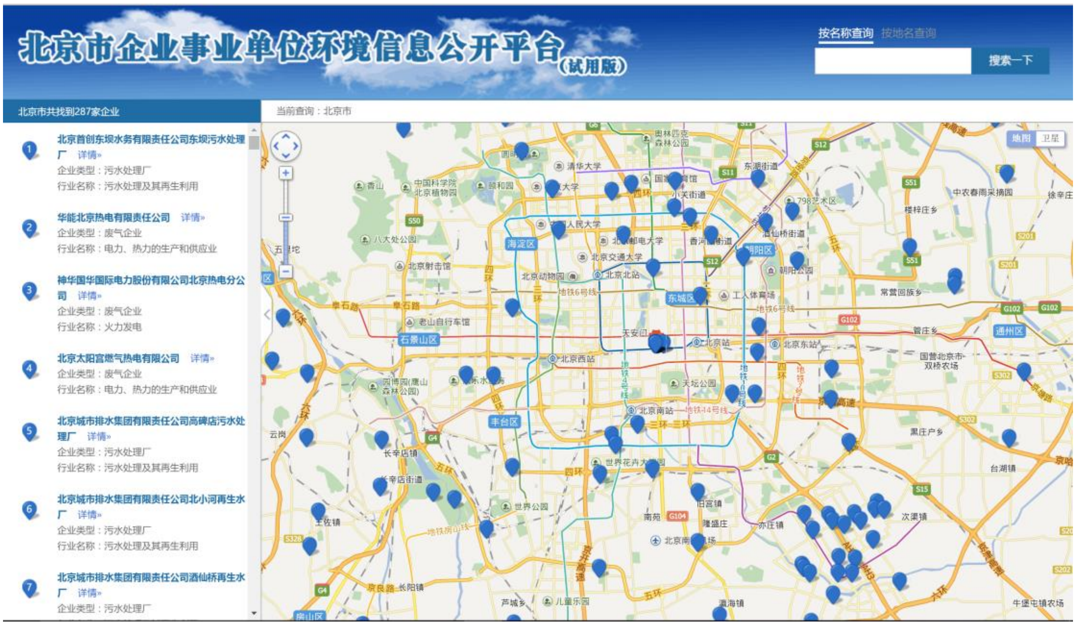


Figure 47. Beijing Environmental Information Disclosure Platform for Enterprises and Public Institutions



Other regions urgently await promotion efforts

Until now, the project team has only seen the Beijing EPB arrange for key pollution-discharging entities (including state-monitored pollution sources) to publish their environmental information on the "Beijing Environmental Information Disclosure Platform for Enterprises and Public Institutions," including online monitoring data and manual monitoring data. The implementation of information disclosure for key pollution-discharging entities in other regions has not developed at the same pace.

Some areas already require key pollution-discharging entities to install online monitoring equipment, but online monitoring data can only be seen at the factory itself or via the online monitoring systems of local environmental protection departments to which this equipment is already connected. Without accurate public disclosure, public knowledge is limited. Take the city of Linyi in Shandong as an example: a total of 575 key pollution-discharging enterprises installed 1227 sets of pollution source automatic monitoring equipment, including 763 automatic air emissions monitoring systems and 464 automatic wastewater pollution monitoring systems. However, with the exception of nationally and provincially-monitored enterprises,[11] none of these entities have yet published their online monitoring data on any public platforms. The public therefore has no way to obtain real-time pollution data through a single platform, making public supervision difficult.

11 Shandong and Zhejiang see key monitoring enterprises under provincial control or higher, undergo real-time online data disclosure through a unified "Automatic Monitoring Information Disclosure Platform for Enterprises".

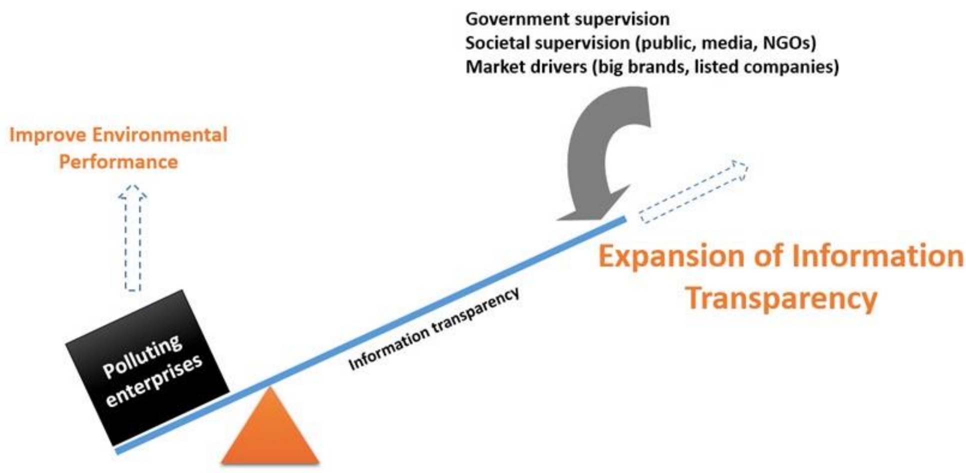
Some of these areas have set up "Environmental Information Disclosure Platforms for Key Pollution-Discharging Entities," but have yet to use them to disclose any online monitoring data from non-nationally monitored key pollution sources or other key pollution-discharging entities. Take Henan as an example: after the implementation of the 2015 Environmental Protection Law, Henan formulated the Implementation Plan on Environmental Information Disclosure for Provincial Enterprises and Public Institutions to specify the requirements for drawing up lists of key pollution-discharging entities, as well as for information disclosure more generally. This plan outlines the following method for disclosing information: "the provincial environmental department sets up a unified platform for environmental information disclosure by enterprises and public institutions; those enterprises and public institutions on the key pollution-discharging entities list must disclose their environmental information through this platform." However, observation shows that, other than disclosure of pollutants produced by key pollution-discharging entities, environmental impact assessments for construction projects, and other basic environmental information concerning administrative permits, this platform has not been used to disclose any pollutant emission information (like monitoring data) relevant to the public. In particular, not many companies specified by the Air Law as key pollution-discharging entities for air emissions have disclosed online monitoring data. Furthermore, some of the information disclosed on the platform overlaps with some of the functions of the "Henan Province Key State-Monitored Enterprise Automatic Monitoring Information Publication Platform"; wasting financial resources and also making it difficult for the public to obtain environmental data all at once from a unified source.

4. Progressively Reducing Emissions

In order to improve upon current environmental pollution issues, in 2013, China's State Council passed the Air Pollution Prevention and Control Action Plan (hereby referred to as the "Air Ten"). The Air Ten require "**the formation of air pollution prevention and control mechanisms that are led by the government, implemented by companies, driven by the market, and supported by public participation**." They also mandate targets for total emissions reductions and qualitative improvements.

With comprehensive disclosure of environmental information, each segment of society will be able to fully participate, thereby forming cooperative supervision of pollution to spur emissions reductions.

Figure 48. Theory of How Information Disclosure Promotes Environmental Governance



4.1 Public participation pushes corporations to keep within legal bounds

Since the Blue Map app went live in June 2014, it has collected online monitoring data from over 10,000 key pollution sources. The public not only can access real-time pollution data whenever they want, but they can more easily share this data through social media.

As more and more environmental departments establish their own official Weibo accounts, Blue Map users can use Weibo's "@" function to share instances of enterprises' pollution exceeding limits with these environmental protection personnel via "micro-reports."

As of June 2016, the Blue Map has pushed over 600 key pollution sources to provide explanations about issues of their online monitoring data exceeding pollution standards.

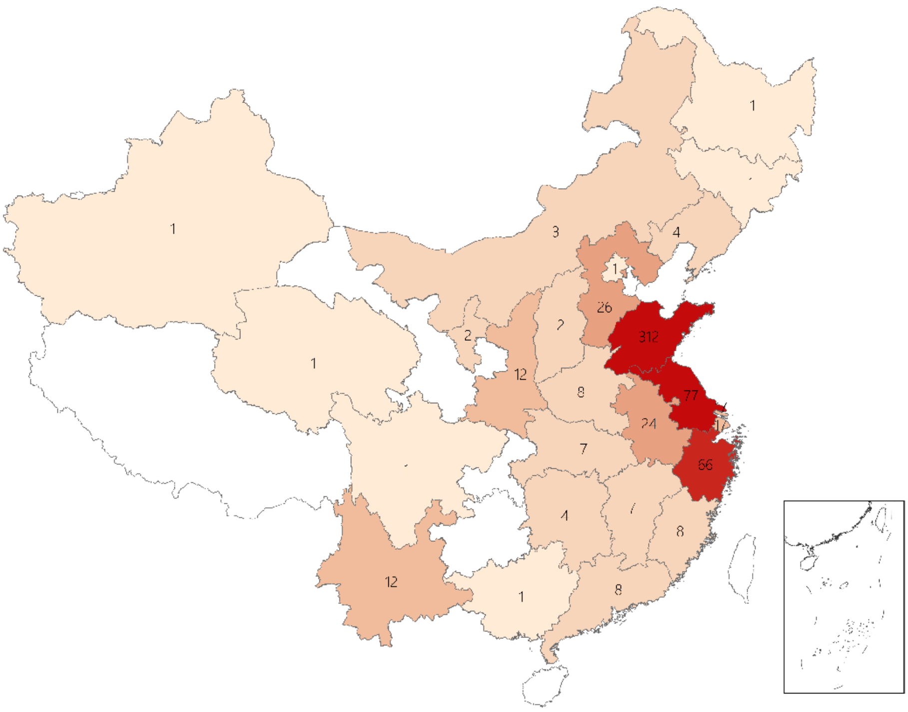
This includes a number of large state-owned enterprises, and some of these enterprises have already implemented corrective actions to achieve reductions in pollutant emissions.

In addition, the public uses the Blue Map to submit micro-reports to support local environmental enforcement. On a number of occasions, when the public has raised complaints about enterprises' online monitoring data exceeding standards, the environmental department has verified the legal compliance status of enterprises and imposed penalties on the companies. Some companies have faced daily penalties or have even been forced to cease operation.

- Companies in China's eastern regions have provided more feedback

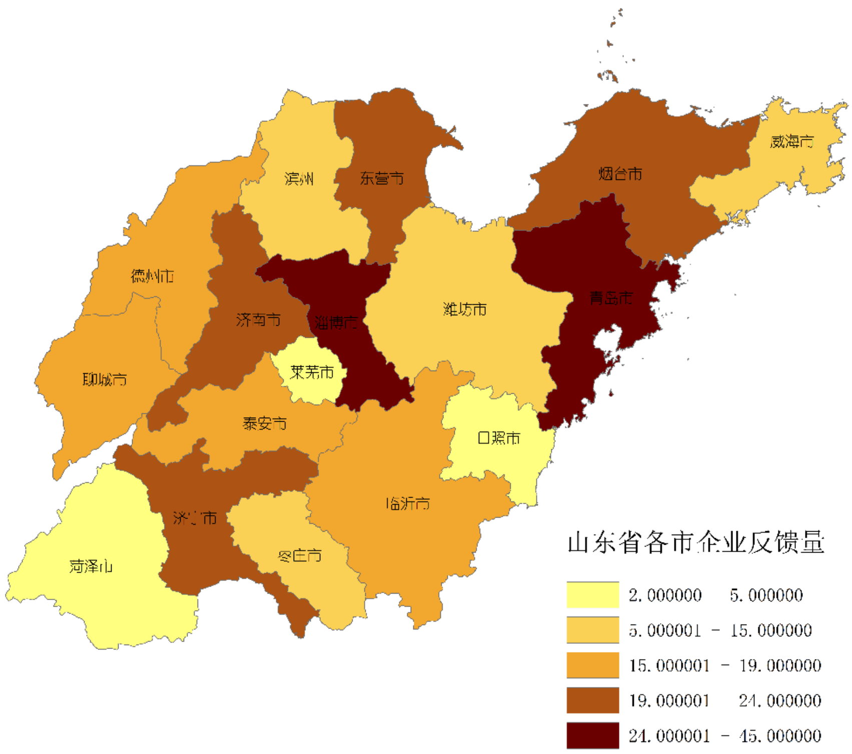
The majority of responses to Blue Map complaints related to online monitoring data exceeding pollution standards have come from Shandong, Zhejiang, and Jiangsu. These three regions have seen a total of 455 companies respond to complaints from Blue Map users, representing 75% of all companies that have responded. Shandong has been especially notable.

Figure 49. Number of Responses and Frequency of Communication by Blue Map Enterprises



In Shandong, 17 cities have received and responded to complaints raised via the Blue Map. Over two years, in response to complaints submitted over the internet, 312 companies in Shandong have provided explanations about their online monitoring data exceeding standards. According to data at the time of writing, Shandong has seen at least 550 instances of communication between companies and the public, representing 58.1% of total instances of communication.

Figure 50. Number of Responses from Blue Map Enterprises – Shandong Region

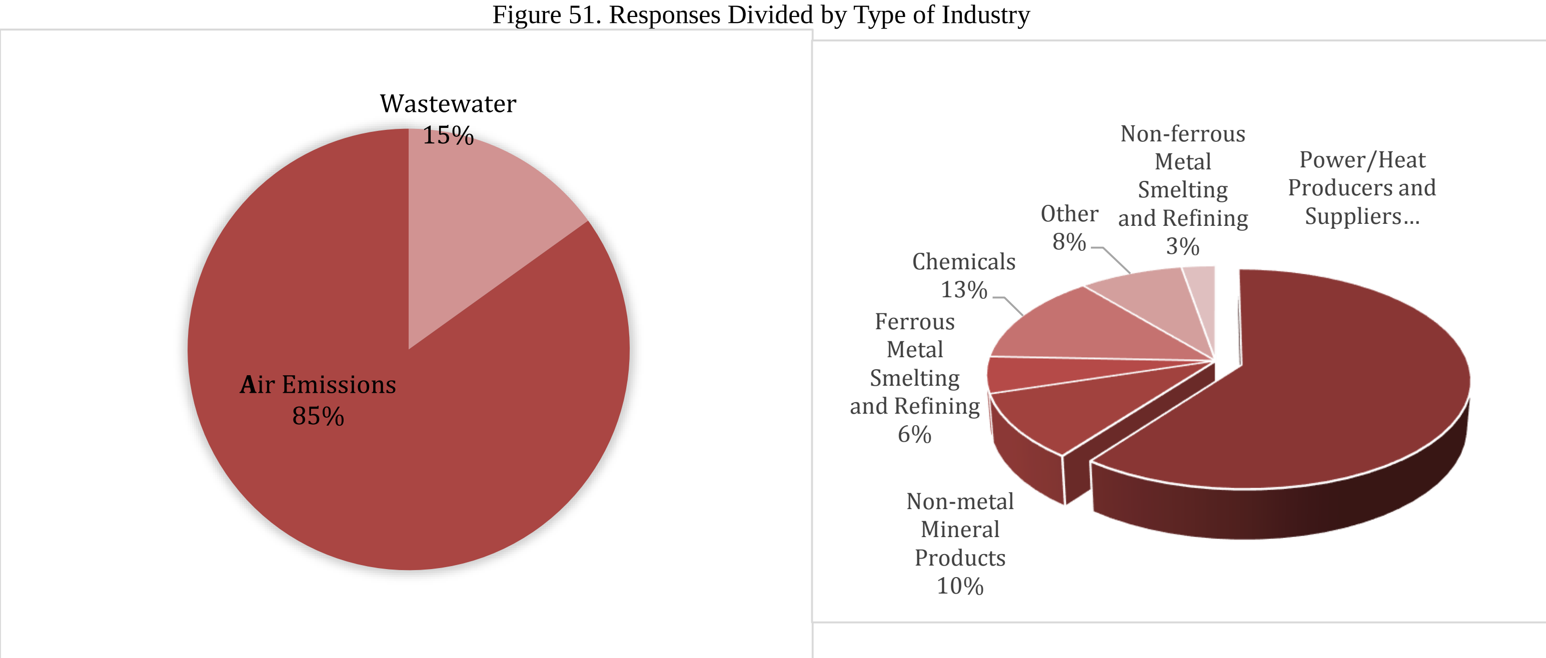


- Air emissions pollution sources have provided the bulk of responses

Among companies that have responded to complaints submitted over Weibo by Blue Map users, 517 have been companies responding to issues with their air emissions, comprising 85% of the total number of companies that responded.

This figure reflects the severity of the current air pollution issues, as well as the public's deep concern for their air and environment. Among the 517 companies that have responded to Weibo complaints about their air emissions, more than 300 are electricity and thermal power companies (60% of the total). Next highest have been chemical companies, followed by non-metal mineral products companies (primarily glass and cement).

Figure 51. Responses Divided by Type of Industry



4.2 Market drivers

Under circumstances of comprehensive environmental information disclosure, large-scale brands, investors, and financial institutions can integrate environmental data into their purchasing, investment, and credit processes, thus using market mechanisms to drive reductions in pollution emissions.

4.2.1 Green supply chain

Since IPE and 20 other environmental organizations launched the Green Choice Alliance (GCA) initiative in 2007, a green procurement workflow process for screening, verification, and disclosure has come into shape. The Corporate Information Transparency Index (CITI) has also been created to allow for more detailed evaluation. More than 40 large-scale international and domestic brands, including Apple, Adidas, Dell, Levi's, and Huawei, regularly use the Blue Map Database to manage their suppliers, and have succeeded in pushing close to 2000 suppliers to improve their environmental performance and close to 1000 suppliers to disclose their environmental emissions data.

Recent Development: Real Estate Green Supply Chain Initiative

In June 2016, the China Urban Realty Association (CURA), the Society of Entrepreneurs & Ecology (SEE), and the China Real Estate Chamber of Commerce teamed up with property developers Landsea and Vanke to launch the "Real Estate Green Supply Chain Initiative" and to begin using the Blue Map Database to manage steel and cement suppliers. Owing to the real estate industry's high consumption of steel and cement and the high emissions connected to the production of these two goods, the potential for emission reductions in this space are especially promising.

4.2.2 Green stocks

Publicly-listed companies collect funds from society through open capital markets, so they should also bear a corresponding level of social responsibility. IPE's Green Stocks Database has already collected environmental supervision records for over 1100 publicly-listed companies. IPE also collaborated with the Securities Times to launch the "Publicly-Listed Company Online Monitoring Data Pollutant Index" project. Over the course of 2015, the project team tracked 1365 key monitored enterprises that belong to 519 public companies. A total of 141 publicly-listed companies and their affiliates were placed on the index, of which 28 companies issued public responses to their being listed. More than 80% of the responding companies have now stabilized their emissions within legal limits.

Figure 52. Publicly-Listed Company Online Monitoring Data Pollutant Index


排污榜上榜企业应对积极 部分企业受罚

Company 公司 A7

国中水务下属公司多项水污染物排放超标
申能星火热电锅炉改造如期完成

A6

申能股份整改期限将至

Recent Development: China Securities Regulatory Commission (CSRC) proposes setting a clearer environmental threshold for IPOs

In July 2016, the CSRC openly emphasized the need to "strictly enforce national environmental legislation during the IPO review process, as well as to strengthen the responsibility of issuers to disclose information and for intermediary organizations to take responsibility for verification." Companies that have violated environmental laws or government regulations, have been the subject of administrative penalties for severe circumstances or have been subject to criminal punishment within the last 36 months should not be allowed to circulate stocks. The oversight and supervision of public companies' disclosed environmental information should be strengthened, and the quality of the disclosed data should be improved. This policy would provide a new breakthrough point for the media and the public to develop societal oversight.

5. Recommendations

Over the course of the first three third phase Blue Sky Roadmap exercises, the project team continued to explore and research how the public can exert their supervisory power to play a role in reducing emissions from pollution sources. We continue to believe that information disclosure is the foundation of effective public supervision. Therefore, we offer the following recommendations for publication of monitoring information, emergency and early warnings, identifying sources of pollution and emphasizing emissions reductions:

Publication of monitoring information

- Improve the quality of data that is released, and continually and comprehensively publish monitoring indicators for each air pollutant. Each local monitoring point should closely track the monitoring and publication status of indicators for $PM_{2.5}$, PM_{10}, NO_x, SO_2, ozone, and VOCs, and instances of faulty or incomplete data should be reduced.
- Increase the level of coverage of air quality monitoring stations. Starting with each prefecture-level city's central area, gradually expand coverage toward county-level regions to ensure that the status of air quality is fully disclosed.

Early warnings and emergency responses

- Consistently analyze the data from each air quality monitoring station and use advanced scientific equipment to identify areas that have particularly high levels of smog. Strengthen management of these "hot spot" regions, such as regions between city borders, and make them a primary component of emergency planning.
- Achieve advance emergency emissions reductions. Integrate each area's more detailed emissions lists, air quality monitoring data, meteorological data, and more advanced early-warning analysis measures. Improve the focus, scientific capacity, and level of accuracy for responses to heavy pollution.

Identifying pollution sources

- Environmental departments should reference Shenyang's selection criteria for key polluting entities to standardize selection criteria across regions.
- Each environmental department should consider Beijing's method of information disclosure for enterprises and public institutions and publish environmental information to a unified platform, particularly in regards to online monitoring data. One way this could be done is by disclosing related information through the " Self-Monitoring Information Disclosure Platforms for Key State-Monitored

Enterprises" that provinces have already established. This would be a convenient way to standardize the sites where pollution and environmental data can be obtained and to facilitate supervision of polluters.

Progressively reducing emissions

- Environmental departments should establish a four-level environmental services Weibo work system at the national-, provincial-, municipal- and county-levels in order to publicize environmental information and promote environmental education, as well as to receive Weibo reports.
- Government departments responsible for the environment, credit and stocks should devise improved policies to support the development of green supply chains and green finance, and encourage corporations to improve their environmental performance.
- Large-scale corporations and brands, including real estate, automobiles, and other industries with production that uses a high amount of energy, should use green procurement as a means of promoting corrective actions and improvements in companies along their production chains.