Blue Sky Roadmap Report II

Real-time Disclosure Begins

The Institute of Public and Environmental Affairs

Society of Entrepreneurs & Ecology

Renmin University of China Institute of Environmental Policy and Planning

Friends of Nature

Envirofriends

Nature University

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Contents

Summary

In 2013 China's urban atmospheric air pollution problems caught the attention of the general public. Many regions experienced severe smog, which was especially bad in the heavily populated regions of Beijing, Tianjin and Hebei, stretching all the way to Shandong and Henan, where the smog often did not disperse for days on end. The severe outbreaks of smog in North-East Region of China and the Yangtze River Delta areas also had a huge impact locally, making blue skies seem just as unattainable as ever.

So how do we get back to having blue skies? In a report published by the Institute of Public and Environmental Affairs (IPE) in December 2011 we put forward a step by step roadmap to get us to that target of blue skies. The roadmap consisted of the following steps: publish monitoring data, formulate and implement emergency measures, understand pollution sources, and reduce emissions from key enterprises. In 2013, China made important progress in terms of information disclosure and emergency planning, which created an opportunity for a historically important breakthrough in understanding pollution sources, which is a crucial step in the roadmap.

Through our Air Quality Information Transparency Index (AQTI) evaluation, which evaluated how comprehensive, timely, complete and user friendly the disclosure of information on air quality was, we found that the level of disclosure in over 100 Chinese cities had continued to substantially increase. The average score of 21.5 points in the 2012 evaluation had increased to 58.8 points in 2013. As of January 2nd, 2014 a total of 179 cities have started real time disclosure of air quality data and residents can use their computer or smartphone to access this information.

Real-time disclosure has highlighted the severity of pollution, which in turn has prompted many regions to formulate emergency plans for times when the smog is particularly severe. During times when these emergency measures are implemented schools stop outdoor activities and enterprises are forced to reduce their emissions, which are key measures that help to protect the health of the general public and prevent the pollution worsening. We found that after a fairly long run-in period these measures had started to be implemented during periods of severe smog. However, because of a lack of public reporting on the measures it's often difficult to determine how effectively they are being carried out and implemented.

Publishing monitoring data and emergency contingency plans are of course very important; however, to get our blue skies back large scale emissions reduction must be implemented, and for emissions reduction to take place we must first identify the major sources of pollution. Through data analysis our report concludes that current pollution has obvious regional characteristics. Therefore, the understanding of pollution sources must also be expanded to regional analysis, rather than just individual cities. The areas of Beijing, Tianjin and Hebei, as well as the Yangtze River Delta, have many energy intensive industries that consume large amounts of coal and generate huge amounts of pollution emissions. In order to reduce emissions, discharge from this group of big emitting enterprises must first of all be controlled.

We believe that to fully understand and control regional pollution sources we must take the principle behind the disclosure of $PM_{2.5}$ data and extend this to pollution source information disclosure. Since the Yabuli Entrepreneurs Forum in February 2013, environmental NGOs and entrepreneurial groups have been pushing for pollution source information disclosure, and have received active and official responses from both Beijing and Hebei. Furthermore, on July 30th, 2013, the Ministry of Environmental Protection (MEP) issued regulations requiring each province in China to set up a platform to publish real-time online monitoring data.

Real-time disclosure of online monitoring data is most advanced in Shandong, Zhejiang and Hebei Provinces. We believe that the good practice shown in Shandong, Zhejiang and Hebei Provinces helps fulfil the public's right to know, and also helps to identify the main pollution sources within that geographical region. However, online disclosure platforms in other important provinces and municipalities, such as Tianjin, Guangdong and Hunan, have not been published as required, which is regrettable.

From preliminary analysis of this online data, we found that in provinces such as Shandong and Hebei in the North of China, a group of large scale thermal power plants and steel factories had emissions that were in serious breach of discharge standards. Even when the local area was experiencing a period of severe pollution, some of these enterprises were continuing to breach discharge standards almost every hour. The direct impact of these variations in discharge volumes from main pollution sources deserves further discussion.

Real-time disclosure helps in understanding the pollution sources located in a particular region. By comparing online data, we found that the level of industrial pollution source emissions varied significantly from region to region. Looking at the emissions from some of the major enterprises in Shandong, Hebei and Beijing for the period October to December 2013, nitrogen oxide (NO_x) emission volumes for eight major pollution sources in Shandong, and eight in Hebei, were respectively 37 and 30 times greater than the emissions from eight main pollution sources in Beijing for the same period. This shows that these pollution sources should be the focus for emissions reductions.

It should be noted that Shandong province has already brought forward the implementation of stricter emission standards for key industries like thermal power and steel production, and Hebei has also recently implemented new stricter standards for the steel industry. However, key provincial and municipal emission standards in Jiangsu, Zhejiang and Liaoning Provinces, as well as emission standards for thermal power production and cement factories in Hebei Province, and NO_x standards in Tianjin Municipality, have yet to be made more stringent. Even though there is less than a year before new national emission standards for power and iron and steel industries are implemented, many companies are still not fully prepared. Whether or not these companies can reach the national standards within six months is a worry.

The widespread smog that engulfed China in 2013 has helped to push forward an aggressive government action plan. On September 10th, the State Council issued the "Atmospheric Pollution Prevention Action Plan," which through 10 measures (hereafter referred to as the Ten National

Measures), aims to distinctly improve air quality over a five year period and over a further five years completely eliminate periods of severe smog.

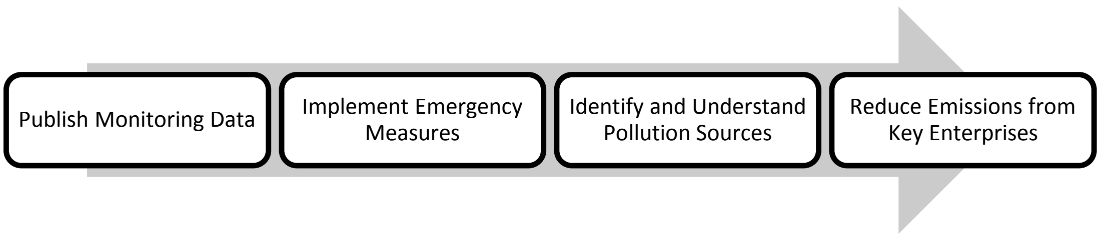
We believe that when faced with so many sources of emissions, we must focus on where best to reduce these emissions, and this should start with the control of pollution from industrial and coal fired enterprises. Through our research we found that if some enterprises in key regions like Shandong and Hebei were to comply with discharge standards, including the new standards to come in within the next year, then their NO_x emission volumes would be significantly reduced.

It’s difficult to escape the fact that the “Ten National Measures,” and regional efforts to reduce emissions, will touch on powerful vested interests, so the challenge in implementing them should not be underestimated. All parties interested in the control of atmospheric pollution cannot sit idly by, which is why we call on government, courts, enterprises, media, environmental organizations, and citizens, to seize the historic opportunity created by pollution source information disclosure, and together push for the reduction in pollution emissions, so that the smog that hangs over Chinese cities can be dispersed as quickly as possible.

In 2013, atmospheric air pollution problems in Chinese cities attracted a lot of attention from the general public. On the one hand over 100 Chinese cities release real-time monitoring data for pollutants like $PM_{2.5}$, and central and local government have publicized large scale action plans to reduce emissions. On the other hand, however, air pollution problems are still spreading and a large number of cities still experience periods of severe smog, which is especially bad in the heavily populated regions Beijing-Tianjin-Hebei, stretching all the way to Shandong and Henan, where the smog often does not disperse for days on end. The severe outbreaks of smog in Heilongjiang and Jilin, as well as the Yangtze River Delta areas have also had a huge impact locally.

Amongst all this smog, the worries and anxieties of residents continues to grow and blue skies seem just as unattainable as before. So what route can we take to get our blue skies back?

In China where the process of industrialization and urbanization is ongoing, the control of atmospheric pollution cannot be attained in just one step. In a report released in December 2011 we put forward a step by step roadmap to get us to that target of blue skies. The roadmap consisted of the following steps: publish monitoring data, formulate and implement emergency measures,[1] understand pollution sources, and reduce emissions from key enterprises.



The four steps of the roadmap in detail are:

- Step 1: increase air quality information disclosure so that more comprehensive and complete monitoring data is released to the public;
- Step 2: provide the general public with relevant health alerts, as well as strong emergency measures to alleviate the most severe pollution;
- Step 3: understand main pollutant emission sources and confirm where the main focus for emissions reduction should be;
- Step 4: formulate a focused plan and timetable to implement large scale emissions reduction

This report aims to compare current progress against the roadmap, identify those key bottlenecks that we need to break through and identify key points so that we can strive quickly towards large scale emissions reduction.

[1] In the Phase I Report released in 2011 the second step was referred to as “”

1. Rapid Progress on Monitoring Disclosure and Emergency Measures

In many regions of China significant progress has been made with monitoring disclosure and emergency measures, which are the first two steps in the roadmap.

1.1 Monitoring Disclosure has Expanded Rapidly

Since January 1st 2013, 74 Chinese cities have been monitoring and publishing concentration and AQI data for the following six pollutants:[2]

SO_2 | NO_2 | PM_{10} | O_3 | CO | $PM_{2.5}$

According to the “Implementation of the Phase II Monitoring Plan under the New Air Quality Standards”, by October 31st 2013, there should have been data available for 449 monitoring points in 116 cities. These points added to the points in the Phase 1 monitoring plan means there is now a total of 945 monitoring points in 190 cities.

As of January 2nd 2014, there were 161 cities publishing hourly concentration values on the MEP “National Urban Air Quality Real-time Disclosure Platform,” including the 74 cities required to in the “Implementation of the Phase I Monitoring Plan under the New Air Quality Standards,” and the 87 cities in the “Implementation of the Phase II Monitoring Plan under the New Air Quality Standards”. Out of 29 county-level cities, 18 have started to disclose monitoring data according to the Phase II requirements and 11 have not yet started. In total 179 cities have started to publish real-time air quality information.

The table below shows the status of Phase I and Phase II implementation:

Table 1 - Phase 1 and Phase II implementation of new air quality standards[3]

Comparison of Implementation of Phase I/Phase II disclosure (As of January 2nd, 2014)							
Province	City	Discloses Yes/No	Phase	Province	City	Discloses Yes/No	Phase
Beijing	Beijing	√	I	Shandong	Ji’nan	√	I
Tianjin	Tianjin	√	I		Qingdao	√	I

[2] The disclosure platform is the China National Environmental Monitoring Center. Except for Xinjiang and Shanxi, 31 provincial, municipal, and autonomous regions all have their own disclosure platform.

[3] On January 15th, 2014, the Yantai EPB contacted the IPE to discuss the disclosure of air quality information for county level cities. It was found that on January 15th 2014 11 county cities including Penglai, Laizhou and Zhaoyuan were releasing real-time air quality data. We have therefore added this footnote.

Comparison of Implementation of Phase I/Phase II disclosure (As of January 2nd, 2014)							
Province	City	Discloses Yes/No	Phase	Province	City	Discloses Yes/No	Phase
Shanghai	Shanghai	√	Ⅰ		Zibo	√	Ⅱ
Chongqing	Chongqing	√	Ⅰ		Zaozhuang	√	Ⅱ
Hebei	Shijiazhuang	√	Ⅰ		Yantai	√	Ⅱ
	Tangshan	√	Ⅰ		Weifang	√	Ⅱ
	Qinhuangdao	√	Ⅰ		Ji’ning	√	Ⅱ
	Handan	√	Ⅰ		Taian	√	Ⅱ
	Baoding	√	Ⅰ		Rizhao	√	Ⅱ
	Chengde	√	Ⅰ		Dongying	√	Ⅱ
	Cangzhou	√	Ⅰ		Weihai	√	Ⅱ
	Hengshui	√	Ⅰ		Laiwu	√	Ⅱ
	Xingtai	√	Ⅰ		Linyi	√	Ⅱ
	Zhangjiakou	√	Ⅰ		Dezhou	√	Ⅱ
	Langfang	√	Ⅰ		Liaocheng	√	Ⅱ
Shanxi	Taiyuan	√	Ⅰ		Binzhou	√	Ⅱ
	Datong	√	Ⅱ		Heze	√	Ⅱ
	Changzhi	√	Ⅱ		Rongcheng	×	Ⅱ
	Linfen	√	Ⅱ		Wendeng	×	Ⅱ
	Yangquan	√	Ⅱ		Rushan	×	Ⅱ
Inner Mongolia	Huhhot	√	Ⅰ		Jimo	√	Ⅱ
	Baotou	√	Ⅱ		Laixi	√	Ⅱ
	Ordos	√	Ⅱ		Pingdu	√	Ⅱ
	Chifeng	×	Ⅱ		Jiaonan	√	Ⅱ
Liaoning	Shenyang	√	Ⅰ		Jiaozhou	√	Ⅱ
	Dalian	√	Ⅰ		Shouguang	√	Ⅱ
	Dandong	√	Ⅱ		Laizhou	×	Ⅱ
	Yingkou	√	Ⅱ		Zhaoyuan	×	Ⅱ
	Panjin	√	Ⅱ		Penglai	×	Ⅱ
	Huludao	√	Ⅱ		Zhangqiu	×	Ⅱ
	Anshan	√	Ⅱ	Henan	Zhengzhou	√	Ⅰ
	Fushun	√	Ⅱ		Pingdingshan	√	Ⅱ
	Benxi	√	Ⅱ		Sanmenxia	√	Ⅱ
	Jinzhou	√	Ⅱ		Luoyang	√	Ⅱ
	Wafangdian	×	Ⅱ		Anyang	√	Ⅱ
Jilin	Changchun	√	Ⅰ		Kaifeng	√	Ⅱ
	Jilin	√	Ⅱ		Jiaozuo	√	Ⅱ
Heilongjiang	Harbin	√	Ⅰ	Hubei	Wuhan	√	Ⅰ
	Qiqihaer	√	Ⅱ		Yichang	√	Ⅱ
	Daqing	√	Ⅱ		Jinzhou	√	Ⅱ

Comparison of Implementation of Phase I/Phase II disclosure (As of January 2nd, 2014)							
Province	City	Discloses Yes/No	Phase	Province	City	Discloses Yes/No	Phase
	Mudanjiang	√	II	Hunan	Changsha	√	I
Jiangsu	Nanjing	√	I		Zhuzhou	√	II
	Suzhou	√	I		Xiangtan	√	II
	Wuxi	√	I		Changde	√	II
	Changzhou	√	I		Zhangjiajie	√	II
	Yangzhou	√	I		Yueyang	√	II
	Zhenjiang	√	I	Guangdong	Guangzhou	√	I
	Nantong	√	I		Shenzhen	√	I
	Taizhou	√	I		Zhuhai	√	I
	Xuzhou	√	I		Foshan	√	I
	Lianyungang	√	I		Jiangmen	√	I
	Huaian	√	I		Dongguan	√	I
	Yancheng	√	I		Zhongshan	√	I
	Suqian	√	I		Huizhou	√	I
	Wujiang	√	II		Zhaoqing	√	I
	Kunshan	√	II		Shaoguan	√	II
	Changshu	√	II		Shantou	√	II
	Zhangjiagang	√	II		Heyuan	√	II
	Taicang	√	II		Qingyuan	√	II
	Jurong	×	II		Zhanjiang	√	II
	Jiangyin	×	II		Maoming	√	II
	Yixing	×	II		Meizhou	√	II
	Jintan	√	II		Shanwei	√	II
	Liyang	√	II		Yangjiang	√	II
	Haimen	√	II		Chaozhou	√	II
Zhejiang	Hangzhou	√	I		Jieyang	√	II
	Ningbo	√	I		Yunfu	√	II
	Huzhou	√	I	Guangxi	Nanning	√	I
	Jiaxing	√	I		Beihai	√	II
	Shaoxing	√	I		Liuzhou	√	II
	Zhoushan	√	I		Guilin	×	II
	Wenzhou	√	I	Hainan	Haikou	√	I
	Jinhua	√	I		Sanya	×	II
	Quzhou	√	I	Sichuan	Chengdu	√	I
	Taizhou	√	I		Mianyang	√	II
	Lishui	√	I		Yibin	√	II
	Lin'an	√	II		Panzhihua	√	II
	Fuyang	√	II		Luzhou	√	II

Comparison of Implementation of Phase I/Phase II disclosure (As of January 2nd, 2014)							
Province	City	Discloses Yes/No	Phase	Province	City	Discloses Yes/No	Phase
	Zhuji	√	II		Zigong	√	II
	Yiwu	√	II		Deyang	√	II
Anhui	Hefei	√	I		Nanchong	√	II
	Wuhu	√	II	Guizhou	Guiyang	√	I
	Maanshang	√	II		Zunyi	√	II
Fujian	Fuzhou	√	I	Yunnan	Kunming	√	I
	Xiamen	√	I		Yuxi	√	II
	Quanzhou	√	II		Qujing	√	II
Jiangxi	Nanchang	√	I	Shanxi	Xi'an	√	I
	Jiujiang	√	II		Xianyang	√	II
Tibet	Lhasa	√	I		Tongchuan	√	II
Gansu	Lanzhou	√	I		Yan'an	√	II
	Jiayuguang	√	II		Baoji	√	II
	Jinchang	√	II		Weinan	√	II
Qinghai	Xining	√	I	Xinjiang	Urumchi	√	I
Ningxia	Yinchuan	√	I		Karamay	√	II
	Shizuishan	√	II		Korla	√	II

The IPE conducted an evaluation of 113 Chinese Environmental Protection Cities in accordance with the Air Quality Transparency Index evaluation methodology to determine how complete, timely, comprehensive and user friendly their disclosure of air quality information was.

The table below compares the results of the 2012 and 2013 AQTI evaluation.[4]

Table 2 - AQTI rankings for 113 cities

Rank	City	2013 Score	2012 Score	Rank	City	2013 Score	2012 Score
1	Beijing	77.4	64.8	44	Xi'ning	64.6	14.4
2	Dongguan	76.8	69	59	Yinchuan	62.4	15
3	Nanjing	76.4	56	60	Changzhi	61.2	15.8
3	Suzhou	76.4	55.2	60	Shantou	61.2	16.2
3	Chongqing	76.4	30.6	62	Hohhot	61	8.4
6	Dalian	74.8	9	62	Shenyang	61	11.4
6	Ningbo	76	54.8	62	Changchun	61	11.4
6	Jiaxing	74.2	28.6	62	Yancheng	61	18.6
6	Qingdao	74.8	16.2	62	Nanchang	61	18.6
6	Guangzhou	74.8	76	62	Changsha	61	13.8

4 The cut-off date for 2013 evaluation data was January 1st, 2014

Rank	City	2013 Score	2012 Score	Rank	City	2013 Score	2012 Score
11	Tianjin	73.2	33.6	62	Xiangtan	61	13.8
11	Hangzhou	73.2	20.4	62	Urumchi	61	14.4
11	Wenzhou	73.2	24	70	Datong	57.6	17.4
11	Shaoxing	73.2	37.8	70	Yangquan	57.6	17.6
11	Fuzhou	73.2	15	70	Linfen	57.6	18.2
11	Yantai	73.2	18.6	73	Beihai	53.8	16.2
11	Wuhan	73.2	47.4	74	Baotou	52.2	8.4
11	Chengdu	73.2	42.6	74	Maanshan	52.2	11.4
11	Kunming	73.2	16.8	74	Quanzhou	52.2	15.6
20	Xiamen	71.6	43	74	Shaoguan	52.2	14.4
20	Ji’nan	71.6	13.8	74	Liuzhou	52.2	14.4
22	Shanghai	71	50.2	74	Guilin	52.2	13.8
23	Taizhou	70.2	22	74	Mianyang	52.2	9
24	Changzhou	70	39.6	74	Yibin	52.2	15.6
24	Nantong	70	44.2	74	Baoji	52.2	16.8
24	Lianyungang	70	28.8	74	Xianyang	52.2	13.8
24	Yichang	70	18.6	84	Ordos	50.4	4.2
28	Huzhou	68.4	18	84	Anshan	50.4	11.4
28	Zibo	68.4	11.4	84	Tongchuan	50.4	19.8
28	Zaozhuang	68.4	13.8	84	Yan’an	50.4	9.6
28	Weifang	68.4	0	88	Wuhu	46.6	14.4
28	Jining	68.4	0	88	Jingzhou	46.6	19.2
28	Taian	68.4	19.2	90	Jinzhou	38	14.4
28	Weihai	68.4	7.2	91	Chifeng	37.6	11.4
28	Rizhao	68.4	0	91	Fushun	37.6	22.8
36	Xian	68.2	38.6	91	Benxi	37.6	0
37	Foshan	67.6	64.8	91	Jinlin	37.6	11.4
38	Shenzhen	67.4	75	91	Qiqihaer	37.6	11.4
39	Zhuhai	66	56.4	91	Daqing	37.6	11.4
39	Zhongshan	66	64.6	91	Mudanjiang	37.6	9
41	Taiyuan	65.2	25.4	91	Jiujiang	37.6	16.2
41	Zhengzhou	65.2	13.8	91	Luoyang	37.6	14.4
41	Kaifeng	65.2	14.4	91	Pingdingshan	37.6	14.4
44	Shijiazhuang	64.6	19.2	91	Anyang	37.6	18
44	Tangshan	64.6	19.8	91	Jiaozuo	37.6	4.2
44	Qinhuangdao	64.6	5.4	91	Yueyang	37.6	13.8
44	Handan	64.6	11.4	91	Changde	37.6	14.4
44	Baoding	64.6	18.6	91	Zhangjiajie	37.6	11.4
44	Harbin	64.6	27	91	Zhanjiang	37.6	14.4
44	Wuxi	64.6	31.8	91	Panzhihua	37.6	11.4
44	Xuzhou	64.6	22.2	91	Luzhou	37.6	11.4
44	Yangzhou	64.6	31.2	91	Zunyi	37.6	11.4

Rank	City	2013 Score	2012 Score	Rank	City	2013 Score	2012 Score
44	Hefei	64.6	30.6	91	Qujing	37.6	0
44	Zhuzhou	64.6	16.8	91	Jinchang	37.6	0
44	Nanning	64.6	38.6	91	Shizuishan	37.6	15.6
44	Guiyang	64.6	19.8	91	Karamay	37.6	11.4
44	Lanzhou	64.6	14.4				

By comparing the scores for both years we can see that air quality information disclosure in China has rapidly increased. For example the average October 2013 evaluation score is much higher than that for 2012.

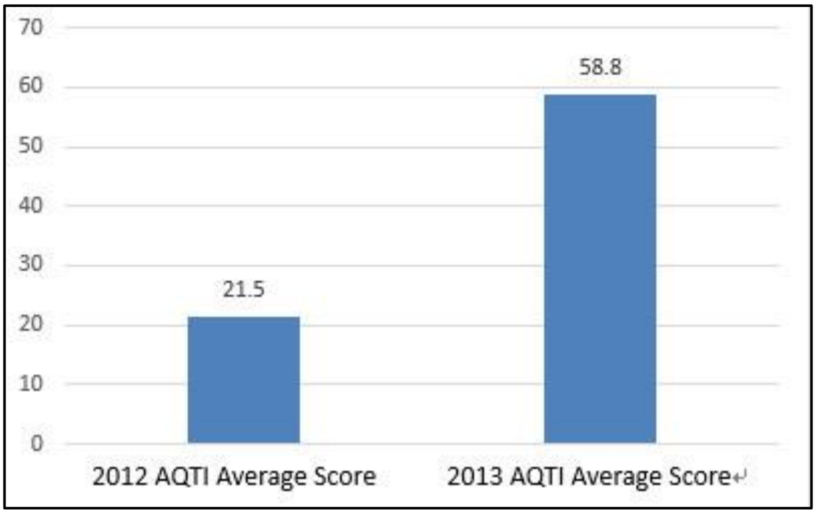


Figure 1 - 2012, 2013 AQTI average score comparison

1.2 Real-time Disclosure Facilitates Greater Public Access to Information

Many regions employ user friendly maps to publish data making it easier for the general public to access information.

The Guangdong disclosure platform uses different colors which not only shows data for monitoring points in cities but also lets the public understand regional data.

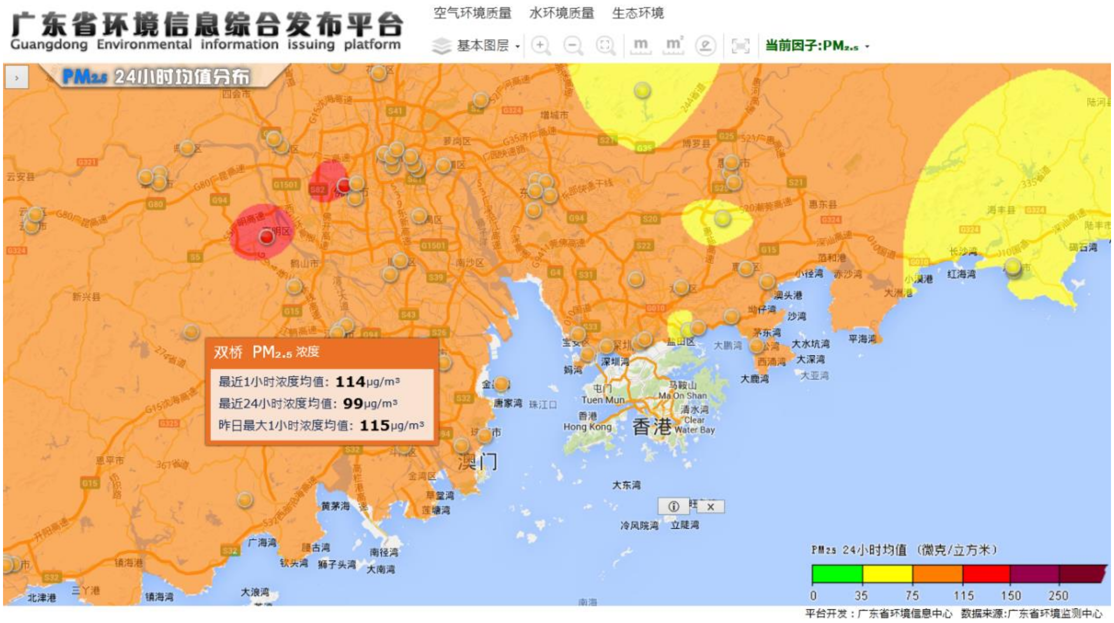


Figure 2 – Guangdong Province disclosure platform map[5]

Hebei has an image showing the

Figure 3 – Hebei Province automatic disclosure system[6]

The Environmental Protection Bureaus in Beijing and Shanghai launched mobile apps making it easy for people to access data on the move.

[5] http://www-app.gdepb.gov.cn/EQpubplatform/Home.mvc/Index#GDEIC.SilverGIS.Widgets.Pm25.Pm25Page,GDEIC.SilverGIS.Widgets.Pm25Widget

[6] http://121.28.49.85:8080/

Figure 4 – Beijing air quality smartphone APP (left), and the Shanghai air quality smartphone APP (right)

The disclosure of official data, especially data made available for download has really helped stimulate public participation.

Figure 5 – National air quality smartphone APP

The real-time disclosure of monitoring data, especially through mobile communications, means that the public can quickly and conveniently access local air quality information. This means that urban residents can make rational and informed decisions about taking part in outdoor activities, and so can reduce the harm that smog can cause to them.

1.3 Real-time Disclosure Highlights the Severity of Pollution Problems

The real-time publishing of discharge data means that the general public can immediately understand the state of air quality. The screenshot below shows the China National Environmental Monitoring Center's national urban air quality real-time disclosure platform. By clicking on the map the public can check the 24 hr. AQI value, and the hourly concentration value for six pollutants, as well as 24 hr. emissions trends.

Figure 6 - China National Environmental Monitoring Center's national urban air quality real-time disclosure platform

Real-time disclosure shows that the level of pollution in some regions is extremely high. The screenshot below is for 5 am on December 25th, 2013 and shows severe levels of pollution in the main regions and cities of Beijing, Tianjin, Hebei, Shanxi, Shandong, and Henan. Furthermore, the monitoring site at Xingtai Normal College in Xingtai shows the concentration of $PM_{2.5}$ to be 1000 μg/m^3.

Figure 7 – Graph showing air quality at the Xingtai Normal College monitoring site in Xingtai

Publication of monitoring data in accordance with the new air quality standards has meant that air quality data more accurately reflects the severity of air pollution. Statistics from the MEP show that in 2012, 74 cities had "Good Days" 92.1% of the time. However, in the first half of 2013, the rate of good days in the 74 cities had fallen to 54.8% so they were failing this standard 45.2% of the time.[7] There were only four cities, Zhoushan, Huizhou, Haikou and Lhasa whose $PM_{2.5}$ concentrations were equal to or better than the annual Level II Air Quality Standard (35μg/m^3).

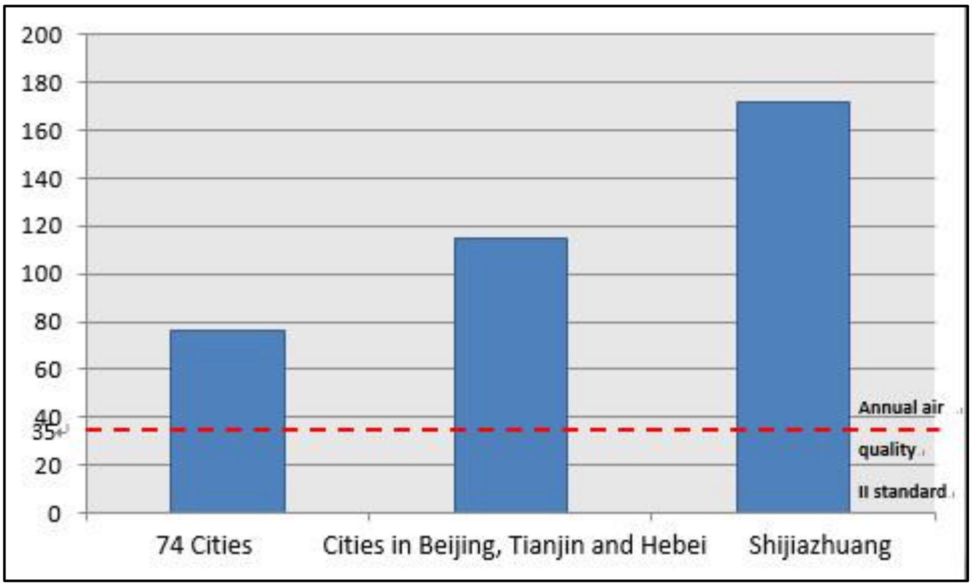


Figure 8 – Comparison of average $PM_{2.5}$ concentrations in the first half of 2013

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7 http://www.zhb.gov.cn/gkml/hbb/qt/201307/t20130731_256638.htm

Every month the MEP releases a list of the cities with the worst air quality.[8] The 10 cities with the worst monthly AQIs from Jan - Nov 2013 are shown below:

Table 3 – The 10 cities with the worst monthly AQIs from Jan - Nov 2013

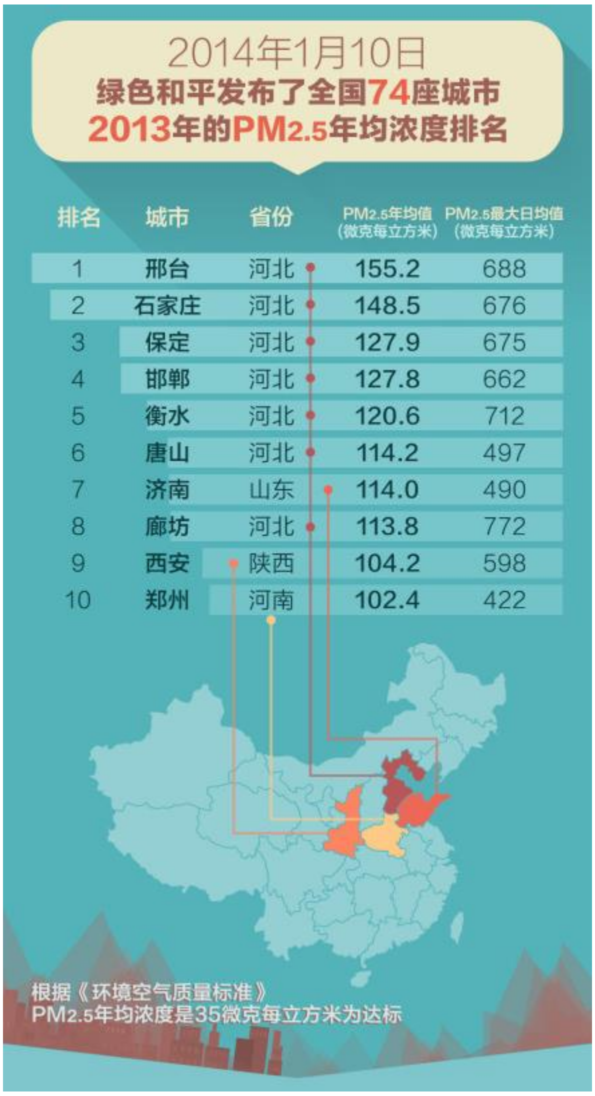
	January	February	March	April	May	June	July	August	September	October	November
1	Xingtai	Shijiazhuang	Tangshan	Shijiazhuang	Shijiazhuang	Tangshan	Tangshan	邢台	邢台	Shijiazhuang	Shijiazhuang
2	Shijiazhuang	Xingtai	Shijiazhuang	Xingtai	Tangshan	Shijiazhuang	Handan	Tangshan	Shijiazhuang	Xingtai	Baoding
3	Baoding	Baoding	Xi'an	Tangshan	Xingtai	Xingtai	Shijiazhuang	Shijiazhuang	Tangshan	Baoding	Xingtai
4	Handan	Xi'an	Chengdu	Handan	Handan	Handan	Ji'nan	Ji'nan	Handan	Handan	Tangshan
5	Weifang	Handan	Xingtai	Xi'an	Jinan	Baoding	Xingtai	Handan	Ji'nan	Tangshan	Handan
6	Hengshui	Urumchi	Baoding	Baoding	Baoding	Hengshui	Tianjin	Tianjin	Hengshui	Ji'nan	Ji'nan
7	Ji'nan	Ji'nan	Xi'ning	Ji'nan	Zhengzhou	Ji'nan	Baoding	Hengshui	Baoding	Harbin	Taiyuan
8	Tangshan	Hengshui	Handan	Xi'ning	Beijing	Tianjin	Lanzhou	Xi'an	Weifang	Hengshui	Weifang
9	Beijing	Tangshan	Weifang	Taiyuan	Hengshui	Zhengzhou	Zhengzhou	Baoding	Tianjin	Xi'an	Urumchi
10	Zhengzhou	Zhengzhou	Taiyuan	Zhengzhou	Tianjin	Taiyuan	Hengshui	Weifang	Xi'an	Wuhan	Hengshui

Note: The Air Quality Index (AQI) is a measure of the overall air quality and is a dimensionless value. The index takes into account the levels of SO_2, NO_2, PM_{10}, $PM_{2.5}$, CO, and O_3. The higher the AQI score is the more sever the overall level of pollution.

[8] http://www.zhb.gov.cn/gkml/hbb/qt/201307/t20130731_256638.htm

The prompt disclosure of monitoring data makes it possible for anyone to carry out data analysis. Using data from the environmental authorities, Greenpeace calculated a $PM_{2.5}$ concentration ranking table for the 74 cities.

Table 4 - $PM_{2.5}$ concentration ranking table for 74 cities across China (created by Greenpeace)


2014年1月10日

绿色和平发布了全国74座城市

2013年的PM2.5年均浓度排名

排名	城市	省份	PM2.5年均值（微克每立方米）	PM2.5最大日均值（微克每立方米）
1	邢台	河北	155.2	688
2	石家庄	河北	148.5	676
3	保定	河北	127.9	675
4	邯郸	河北	127.8	662
5	衡水	河北	120.6	712
6	唐山	河北	114.2	497
7	济南	山东	114.0	490
8	廊坊	河北	113.8	772
9	西安	陕西	104.2	598
10	郑州	河南	102.4	422

根据《环境空气质量标准》

PM2.5年均浓度是35微克每立方米为达标

1.4 Emergency Measures

Because the process of bringing atmospheric air pollution under control requires a fairly long time period, health warnings and emergency measures are extremely important.[9] During this period the level of atmospheric air pollution can still be relatively high and can still result in serious pollution. Therefore, health warnings must be used to reduce people's exposure to the pollution and thus the damage it can do to their health. Emergency measures should also be used to prevent

[9] For example, according to the "2012-2020 Beijing Atmospheric Pollution Control Plan," using 2010 valuues as a base, by 2015 PM2.5 concentrations are planned to be reduced by 15%, 30% by 2020 and only by 20130 will they reach the international standard of having an annual average of 35μg /m^3.

pollution becoming even more severe at times of unfavorable weather conditions.

1.4.1 Many Regions have already Implemented Emergency Measures

In April 2013, the MEP released the "Guidelines on Formulating Emergency Measures for times when Urban Atmospheric Pollution is Severe," which provided guidance to local governments in prefecture level cities and above on how to formulate emergency measures for times when atmospheric pollution was particularly severe. Following this, cities in the regions of Beijing, Shanghai, Tianjin, Shaanxi, Hebei, Shandong, Guangdong, Hubei, Sichuan, and Shanxi issued emergency measures.

Judged against the MEP guidelines, each key city has implemented emergency measures as follows:

Table 5 – Emergency measures in different cities for times of sever pollution

City			Shanghai	Wuhan	Chengdu	Xi'an	Beijing	Shijiazhuang	Taiyuan	Tianjin	Ji'nan	Guangzhou
Emergency Plan Classification			2	3	3	3	4	3	3	3	3	2
Announcement / Effective Date			2013 4.1	2013 4.12	2013 10.3	2013 10.16	2013 10.21	2013 10.31	2013 11.1	2013 11.12	2013 11.21	2013 12.18
Protective Measures		Remind the vulnerable to minimize or to avoid outdoor activities	√	√	√	√	√	√	√	√	√	√
		Schools and kindergartens should avoid outdoor activities or be closed	√	√	√	√	√	√	√	√	√	×
		Minimize or suspend open-air events	√	×	√	√	√	√	√	√	√	×
		Propose vacations or flexible work arrangements for employees	×	×	√	√	×	√	√	√	×	√
Advisory Pollution Control Policies		Travel less or take public transport	√	√	√	√	√	√	√	√	√	√
		Increase the sprinkling frequency on construction sites	√	√	√	√	√	√	√	√	√	√
		Increase the road sweeping frequency	√	√	√	√	√	√	√	√	√	√
		Polluters should decrease their emissions	√	√	√	√	√	√	√	√	√	√
		Regulate and reduce setting off fireworks	√	×	√	√	√	√	×	√	√	√
		Shut off the engine when parking	×	×	√	√	√	√	√	√	×	
Mandatory Pollution Control Policies	**Vehicle emission reduction measures**	Selectively extend traffic restrictions	√	√	√	√	√	√	√	√	√	√
		Even-odd license plate plan	×	×	√	√	√	√	√	√	√	√
		Reduce official vehicles on the road by 30%	√	√	×	√	√	×	√	×	×	×

City			Shanghai	Wuhan	Chengdu	Xi’an	Beijing	Shijiazhuang	Taiyuan	Tianjin	Ji’nan	Guangzhou
	Industrial emission reduction measures	Limit or halt production of relevant factories	√	√	√	√	√	√	√	√	√	√
		Forbid family-style factories to use coal-fired boilers	√	×	×	×	×	×	×	√	×	√
		Increase the frequency of supervision	×	√	×	√	×	√	√	×	×	√
		Renovate the polluters violating mandatory policies	×	×	×	×	×	×	×	×	×	×
	Dust control measures	Stop demolishing buildings	√	√	√	√	√	√	√	√	√	√
		Reduce the scale of earth excavation	√	√	√	√	√	×	√	√	√	√
		Introduce dust suppression or covering for material piles on construction sites	×	√	√	√	√	√	√	√	√	√
		Increase the frequency of sprinkling on the bare ground of construction sites	√	√	√	√	√	√	√	√	√	√
		Increase the frequency of sweeping and sprinkling on the roads	√	√	√	√	√	√	√	√	√	√
		Claim the stacking requirements for the coal and cinder	×	√	√	√	√	×	√	×	×	×
	Other measures	Open-air straw burning should be banned in and around cities	√	√	√	√	√	√	√	√	√	√
		Asphalt melting should be banned	×	×	×	×	×	×	√	×	×	×
		Restaurants without cooking fume purification should be temporarily closed	×	×	×	√	×	√	√	×	×	√
		Outdoor barbecues should be banned	√	√	√	×	√	√	√	√	√	√

1.4.2 To Deal with Severe Air Pollution Many Cities have Activated Emergency Plans for Periods of Serious Pollution

After a long run-in period, we see that many areas have started to implement emergency measures in accordance with their contingency plans during periods of severe pollution.

For example, during the nine day period from December 16th to 24th, 45 cities experienced severe or worse than severe pollution. At the time, to reduce the effects of air pollution on people's health as much as possible, the MEP required every local government to increase the intensity of air quality information disclosure, respond actively to public needs, and promptly implement emergency plans drawn-up for periods of severe pollution.

According to statistics from the MEP, local emergency measures that have been taken in clude:[10]

- Beijing Municipality
  - Activated the Level IV blue warning for severe pollution
    - Warned primary school and kindergarten pupils to reduce outdoor activities

- Tianjin Municipality
  - Activated the Level III warning for severe pollution
    - Shut down the production of some blast furnaces and stopped all rock excavation and backfilling
    - Suspended the collective outdoor activities of students and advocated green travel

- Hebei Province
  - Shijiazhuang City
    - Activated the Level II warning for severe pollution
      - Strengthened supervision of enterprise emissions and increased the penalty for secret discharge and discharging in breach of the standard
      - Restricted some motor vehicle use

  - Xingtai City
    - Activated the Level II warning for severe pollution
      - Limited emissions from industrial enterprises by 30% or more, closed coal-fired industrial boilers of less than 20 tons
      - Stopped construction on construction and demolition sites

[10] http://www.mep.gov.cn/gkml/hbb/qt/201312/t20131225_265573.htm

- Restricted motor vehicles by the odd/even license plate policy, road cleaning
- Stopped outdoor activities for primary and secondary schools and kindergarten students

- Handan City
  - Activated the Level III warning for severe pollution
    - Restricted motor vehicle use
    - Suggested that the public reduce outdoor activities and working times
    - Kept indoor air conditioning temperatures no higher than 19℃ in office of party and government organs, as well as enterprises and public institutions
    - Turned off landscaping lights to reduce energy consumption

- Hengshui City
  - Activated the Level II warning for severe pollution
    - Temporarily limited the production and emission of industrial enterprises, closed coal-fired industrial boilers under 20 tons
    - Stopped construction at construction sites and stopped operations at concrete mixing stations
    - Stopped the use of 80% of party and government office cars, as well as enterprises and public institutions; restricted motor vehicle by odd/even license plate policy

- Henan Province
  - Zhengzhou City
    - Activated the Level II warning for severe pollution
      - Reduced outdoor activities for primary and secondary schools and kindergarten students
      - Warned the public to reduce outdoor activities and working times

- Shaanxi Province
  - Xi'an City
    - Activated the serious air pollution emergency response measure
    - Stopped outdoor activities of primary and secondary schools and kindergarten students
    - Stopped concrete mixing stations from operating
    - Restricted motor vehicle use

1.4.3 Key Emergency Measures Need to be Implemented

Measures that force schools to stop outdoor activities and enterprises to reduce emissions are key to protecting public health and preventing pollution from worsening. However, in many areas that have started to implement emergency measures, the implementation of emergency measures to reduce emissions is often lacking

The following table shows what we believe to be the importance, possible problems and recommendations for implementing measures in the emergency plans:

Table 6 - Importance, possible problems and recommendations for implementing measures in the emergency plans

Emergency Measure		Importance	Possible Problems in Implementation	Recommendations
Health Protection Measures	Stopping outdoor activities at Schools and Kindergartens	Helps protect the health of vulnerable groups	Whether or not there is close cooperation between the educational system (including departments of education and school teachers) and the environmental and meteorological departments.	Every level in the educational system should establish a communication mechanism with the environmental and meteorological departments, where they promptly release a list of schools and kindergartens where outdoor activities should be stopped.
Measures to reduce Motor Vehicle emissions	Reduce the use of official motor vehicles by 30%.	Reducing official vehicles helps build credibility with the public and leads to a reduction in vehicle exhaust emissions.	No effective way of identifying license plates so public supervision is not easy.	After the emergency measures have been activated a list of the license plate numbers and work units of restricted cars should be published.

Emergency Measure		Importance	Possible Problems in Implementation	Recommendations
Measures to Reduce Emissions from Industry	Relevant enterprises should stop or reduce production to reduce emissions. Punish those polluting companies who have not followed the mandatory reduction plan to stop or reduce production.	Industry and coal fired plants are the biggest emissions sources in many cities.	The number of enterprises is very large and they are widely distributed so it's not easy for the public to determine if they have limited production to reduce their emissions.	Authorities should release a list of enterprises that have been required to stop or limit production and they should also release real-time on-line monitoring data to determine if the enterprise has reduced their emissions to the rate required.[11] Should publish a list of enterprises that have failed to comply and those that have received penalties.

[11] Those enterprises without automatic monitoring can provide manual monitoring data.

2. From Real-time $PM_{2.5}$ Disclosure to Real time Pollution Source Information Disclosure

Publishing monitoring data and putting in place contingency plans is of course important, but it's clear that the public are not satisfied with just understanding what days they should be wearing face masks, or what days their children should not be playing outside. Reduction of emissions must be the long term goal in which passive behavior can change to active solutions. For a reduction of emissions to take place we must first understand the sources of those emissions.

2.1 Understanding Pollution Sources

2.1.1 The Regional Characteristics of Atmospheric Air Pollution and Pollution Discharge Sources

By looking at external research and our own observations we found that there are three main differences between air pollution in China and air pollution in other countries:

- Smog can cover multiple provinces creating large areas of regional based pollution;
- Smog can be formed from the combination of coal burning and vehicle exhaust fumes;
- Urban pollution that is typical in developed countries, industrial pollution that occurs in emerging market countries, and agricultural and domestic pollution that is typical in developing countries, all coexist within China.

Out of the three points mentioned above, the first illustrates the most striking difference between China and other countries. Since 2011, when large scale smog events have occurred they have covered large areas and affected a large group of people, which has rarely been seen in the past.

Extent of Pollution

In January 2013, China experienced continuous and prolonged periods of smoggy weather. This smog touched on 17 provinces, municipalities and autonomous regions, covered more than one quarter of China's land mass, and affected a total of approximately 600 million people.[12]

[12] Smog at the start of this year covered one quarter of China's land mass and affected a total of 600 million people, Beijing Evening News, October 29th, 2013.

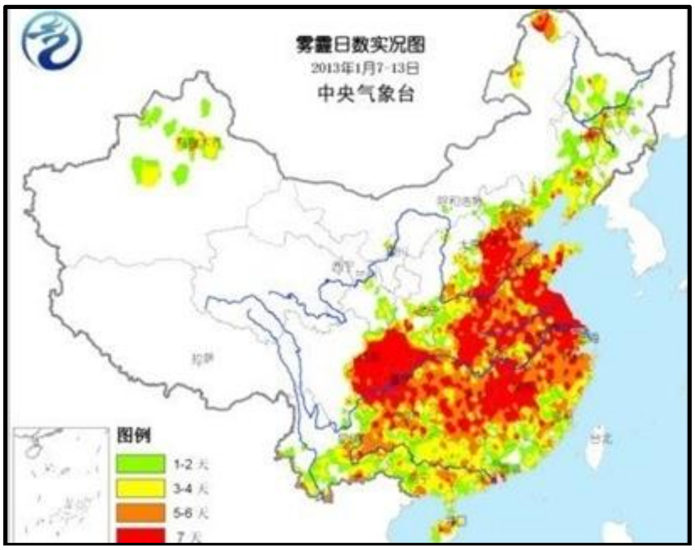


Figure 9 – No. of smoggy days in the period January 7th – 13th 2013[13]

At the start of December 2013, smog events had a serious impact on the Yangtze River Delta Region. Jiangsu, Shanghai, Zhejiang, as well as central and southern Hebei, Tianjin, Shandong, central eastern Henan, eastern Hubei, north-eastern Hunan, northern Jiangxi, central Anhui, and the western and south east part of the Sichuan Basin, were affected by between 6-7 days of smog.

Figure 10 - No. of smoggy days in the period December 2nd – 8th, 2013[14]

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13 Smog that has been Wreaking Havoc on 17 Provinces for 16 Continuous Days Starts to Ease, Xinhua, January 14th, 2013, http://news.hbtv.com.cn/2013/0114/189852.shtml

14 http://weibo.com/p/1001062015108055/mblog?is_search=0&visible=0&is_tag=0&profile_ftype=1&page=2#feedtop

The effects of this smog event can be seen on the satellite image below released by the U.S. National Aeronautics and Space Administration (NASA) on December 7th, 2013. The bright white area shows cloud cover and the darker grey colored area shows the area affected by pollution. From the satellite image we can see that the pollution stretched approximately 1200km from north to south and covered an area of land that included Beijing, Tianjin, Hebei and the Yangtze River Delta. On December 6th, average daily $PM_{2.5}$ readings for Beijing and Shanghai were 125μg/m^3 and 461μg/m^3 respectively. On December 7th the readings for Beijing and Shanghai were 248μg/m^3 and 167μg/m^3 respectively,[15] which is way higher than the WHO's 24-hour mean guideline of 25μg/m^3.[16]

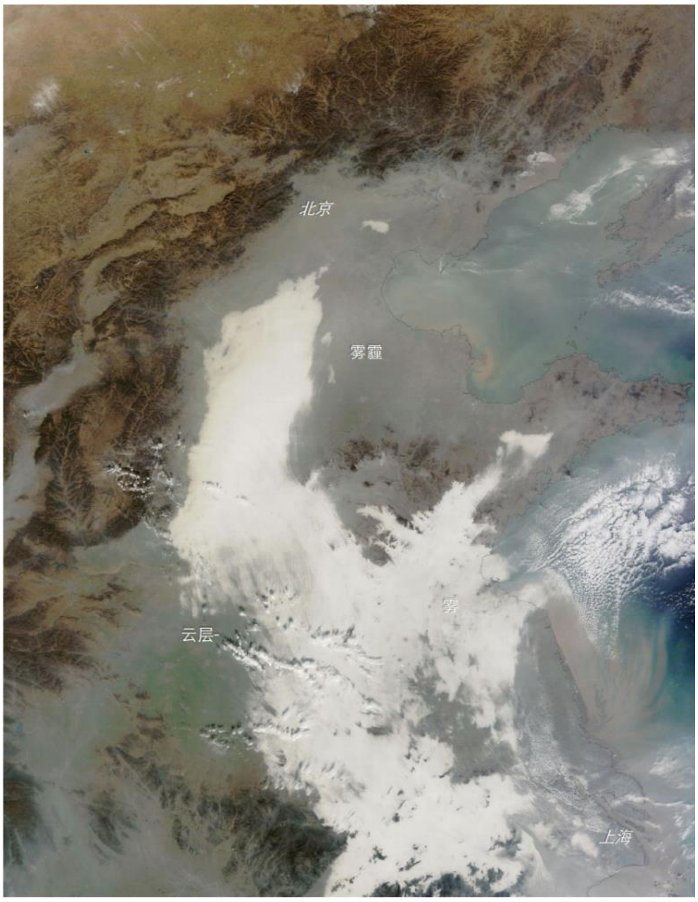

Figure 11 – Satellite image showing smog covering China released by NASA on December 7th[17]

Smog also covered a large area from mid to late December. For nine days between the 16th and 24th, 45 cities experienced heavy, or very heavy pollution. Amongst these, Shijiazhuang, Xingtai and Hengshui suffered nine continuous days of severe or worse pollution. The main pollutants were $PM_{2.5}$ and PM_{10}.

[15] http://www.tianqihoubao.com/aqi/beijing-201312.html， http://www.tianqihoubao.com/aqi/shanghai-201312.html

[16] http://whqlibdoc.who.int/hq/2006/WHO_SDE_PHE_OEH_06.02_eng.pdf

[17] http://earthobservatory.nasa.gov/NaturalHazards/view.php?id=82535

Table 7 - Cities with high pollution levels from 2013/12/16 to 2013/12/24[18]

No. of days with high pollution levels	Cities
9	Shijiazhuang, Xingtai, Hengshui
8	Harbin, Xi'an, Wuhan, Handan, Baodin
7	Zhengzhou
6	Changchun, Hefei, Huaian
5	Shenyang, Changsha, Cangzhou, Langfang
4	Tianjin, Ji'nan, Taiyuan
3	Nanjing, Nanning, Lianyungang, Xuzhou, Suqian

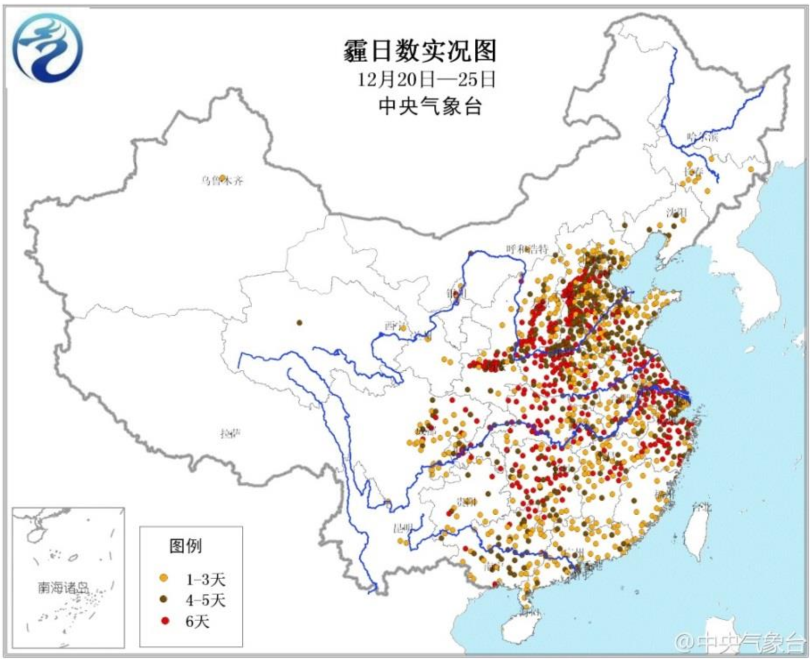

Figure 12 - No. of smoggy days in the period December 20th – 25th, 2013[19]

The Pollution Showed Regional Characteristics

From preliminary analysis of the data for a number of periods of heavy pollution in Beijing, Tianjin and Hebei, as well as the Yangtze River Delta, we can see that the air pollution situation for each of the regions showed definite levels of trans-boundary connectedness and synchronicity.

[18] A Number of Cities in China have suffered Serious Air Pollution, MEP, December 24th, 2013, http://www.mep.gov.cn/gkml/hbb/qt/201312/t20131225_265573.htm
[19] http://www.mep.gov.cn/gkml/hbb/qt/201312/t20131225_265573.htm

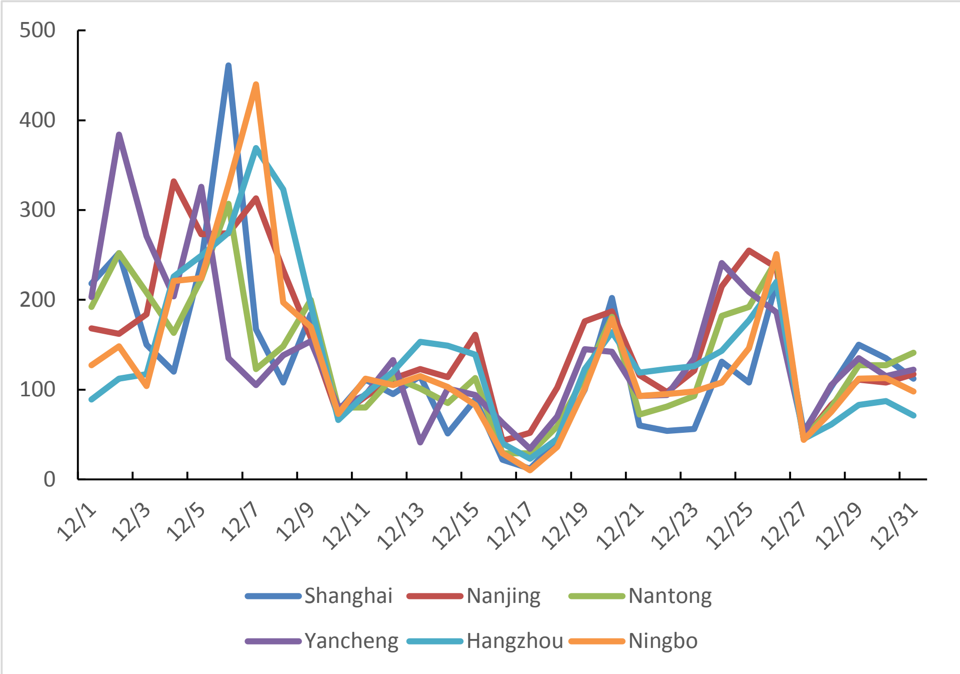

Figure 13 – December 24-hour mean concentrations of $PM_{2.5}$ in key cities in the Yangtze River Delta (μg/m^3)

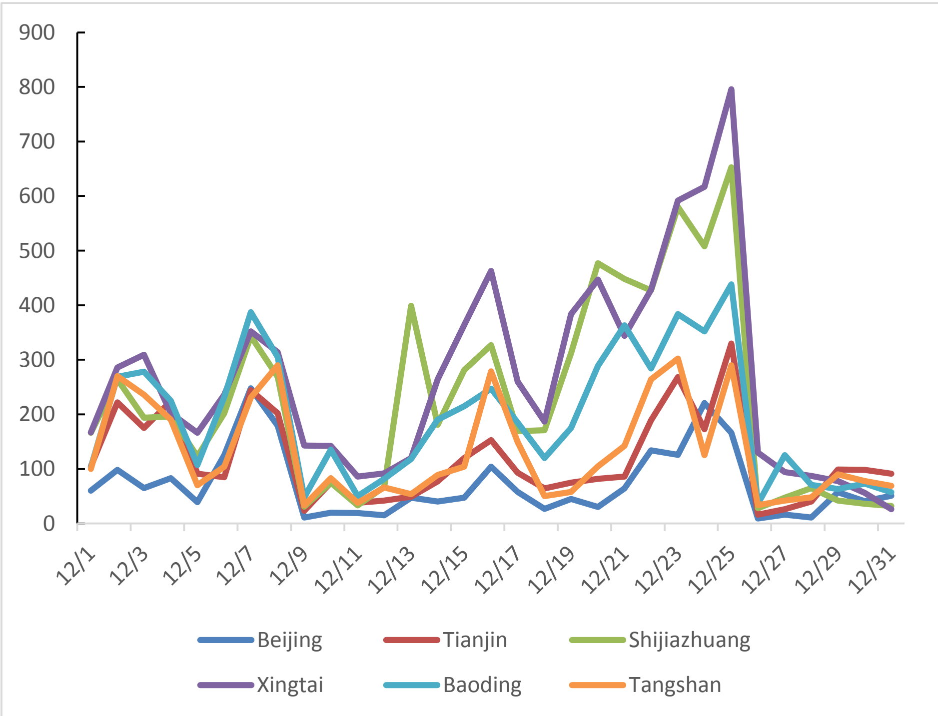

Figure 14 – December 24-hour mean concentrations of $PM_{2.5}$ in key cities in the Beijing, Tianjin and Hebei Region (μg/m^3)

Regional Characteristics of Emission Sources

Regional pollution formed in Beijing, Tianjin and Hebei, as well as the Yangtze River Delta, comes not only from changing patterns of diffusion conditions, but also from the transmission of regional trans-boundary pollution. According to Professor Hao Jiming, who is a fellow at the Chinese Academy of Engineering and Dean of the School of Environmental Science and Engineering at Tsinghua University, in his research on controlling atmospheric pollution, regional SO_2 emissions were responsible for 80% of sulfate in Beijing and 40% of sulfate in Shanghai. Furthermore, regional NO_x emissions were responsible for 50% of nitrate in both Beijing and Shanghai.[20]

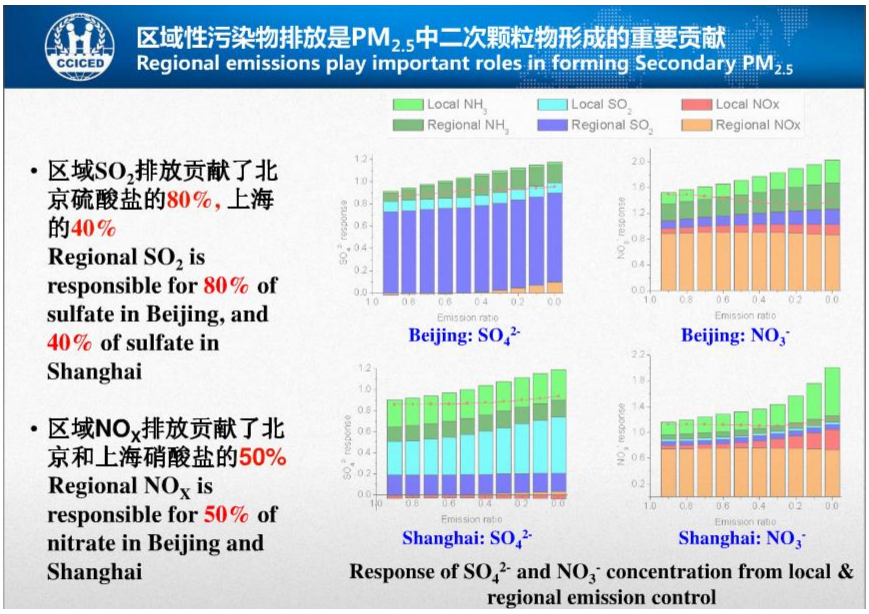

Figure 15 – Results of Professor Hao Jiming's research into regional atmospheric pollution

When looking at regional pollution conditions it is not sufficient to just analyze a particular city's own pollution discharge as regional pollution sources must also be analyzed and understood. Recently, a group headed by Zhang Renjian at the Institute of Atmospheric Physics at the Chinese Academy of Science released a paper discussing some of the potential pollution problems that can affect air quality in Beijing. However, this part of the study was largely ignored by the public who instead concentrated on the controversial conclusions of the paper that stated that automobile exhaust only plays a very small role in Beijing's air pollution problems.

The study uses a Potential Source Contribution Factor (PSCF) method of analysis to extrapolate potential pollution sources that can affect air quality. PSCF is an analysis method based on the Hybrid Single Particle Lagrangian Integrated Trajectory Model. The whole of the study area is divided into a uniform grid and the PSCF value for each grid square calculated by comparing the pollution trajectory figure for that grid square and the total trajectory figure. A high PSCF value indicates that the probability that the pollution source in that grid square contributes to the target

[20] Annual meeting of the China Council for international cooperation on environment and Development, Research on the Control of Regional Atmospheric Air Pollution, December 12-14th, 2012

location.[21]

We have blown-up the Beijing PSCF area diagram for annual average sulfate and nitrates as shown in the report. The purple areas show that the PSCF value was close to zero and blue, green and red areas show that the probability of potential pollution sources is steadily increasing. Sulfate and nitrate aerosols are two types of secondary particulate pollutants and their potential sources can be seen to have similar distribution. Most of the potential sources are stretched out towards the south east, south and south west of Beijing covering the areas of Tianjin, central and south east Hebei and up to the areas adjacent to Hebei and Shandong. This means that the SO_2 and NO_x produced in these areas are transformed into secondary pollutants sulfates, nitrates and ammonium after being discharge into the atmosphere where they can be transported by air currents and affect the air quality in Beijing.

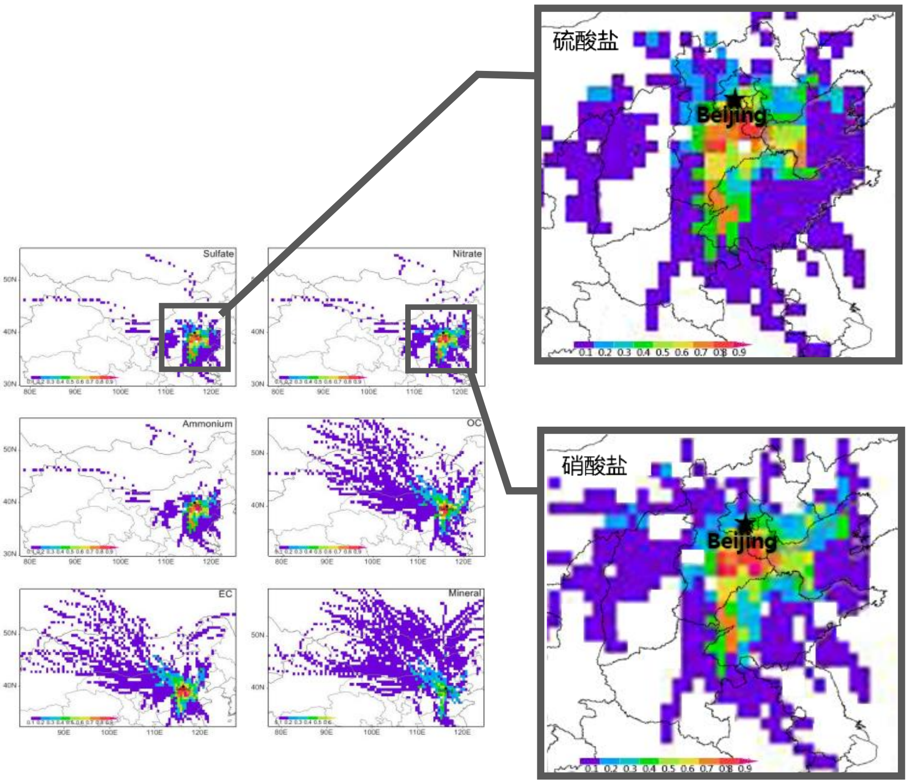

Figure 16 – Diagrams showing probability of sources of sulfates and nitrates in Beijing's PM2.5 particulates

Industrial Sources are the Major Source of Regional Emissions

Faced with so many sources of atmospheric pollution we must understand the key ones. In the Phase I Blue Sky Roadmap Report we analyzed coal combustion and industrial emissions sources and found that they accounted for a high share of total emissions.

According to data from the 2006-2011 Annual Statistical Reports on the Environment in China,

21 Liu Na, Yu Ye, Chen Jinbei, Lanzhou Springtime Sand Storms PM10 Transportation routes and Potential Source Areas, Transactions of Atmospheric Sciences, 2012, 35(4): 477-486.

industrial SO_2 emissions account for 84-91% of total national SO_2 emissions and industrial NO_x emissions account for 71.9-79.1% of total national NOx emissions. Furthermore, industrial fume emissions account for 82.3-88.2% of total national fume emissions.

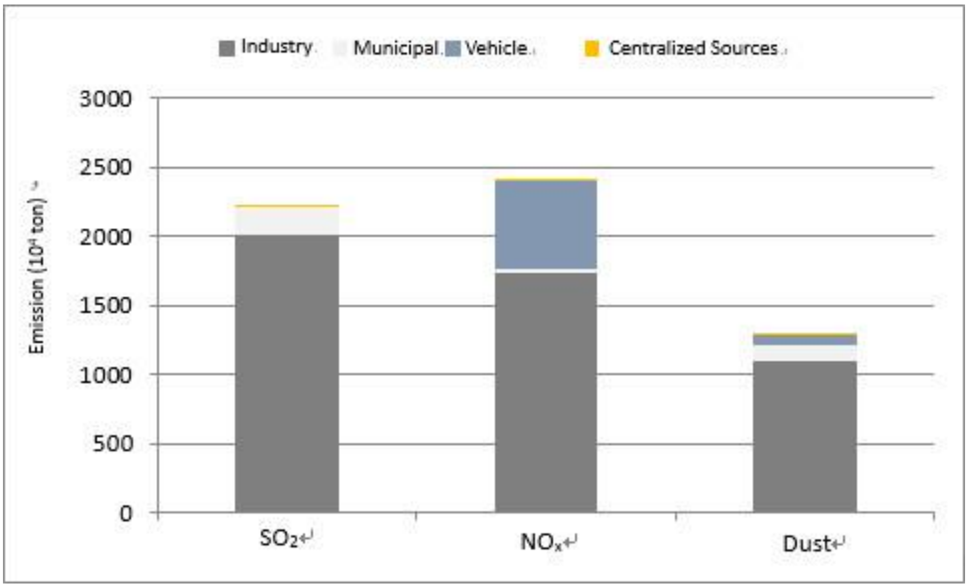

Figure 17 – 2011 sources of major air pollutants[22]

Note: Pollution from centralized pollution treatment facilities including domestic garbage treatment plants, hazardous waste (medical waste) treatment plants and discharge of combustion emissions from factories

Research on key regions has also shown that industrial sources are also an important contributor to local pollution emissions.

Using the areas of China where smog is most severe, Beijing, Tianjin and Hebei, as an example, a report by Professor He Kebin from the School of Environment at Tsinghua University, titled, "Characteristics of $PM_{2.5}$ in the Beijing, Tianjin and Hebei Areas and Measures for its Control," came to the conclusion that the primary and secondary pollutants that made up $PM_{2.5}$ in the area mainly came from industrial pollution sources.

[22] Annual Statistical Reports on the Environment in Chin, p. 21-22, table 10, section 12.

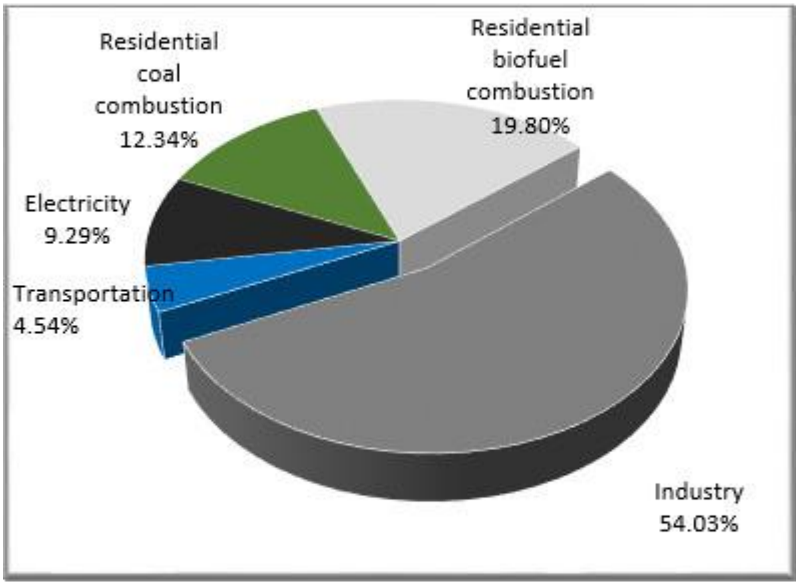

Figure 18 – Sources of primary $PM_{2.5}$ emissions

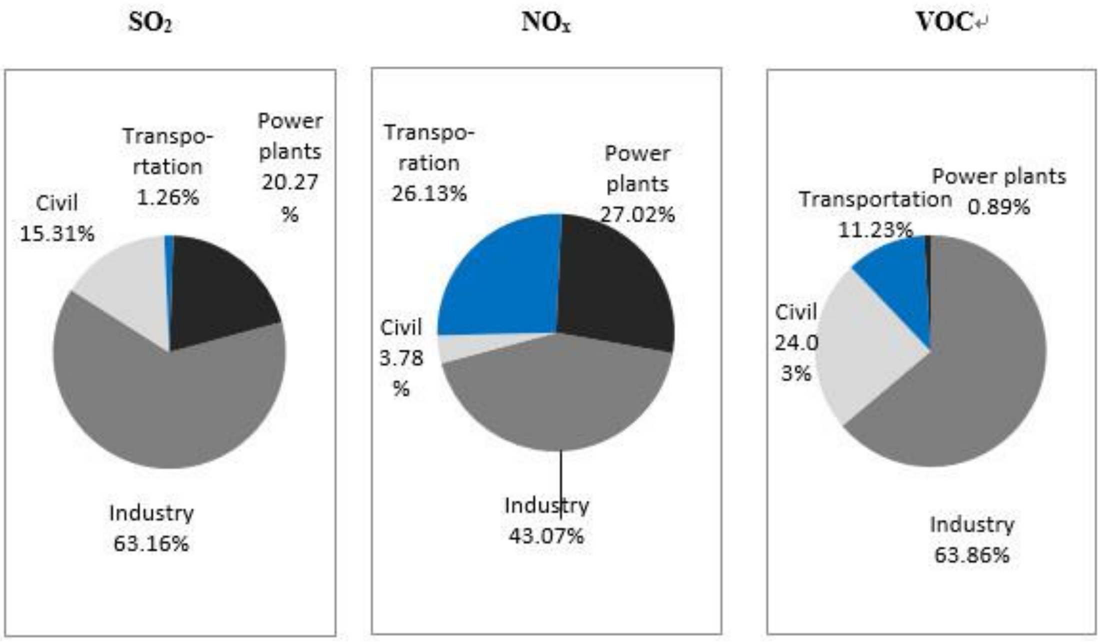

Figure 19 – Contribution of different sectors to secondary $PM_{2.5}$ precursor gasses

The consumption of coal in Beijing, Tianjin, Hebei and the surrounding area is very high and industry is structured in a poor way, so atmospheric air pollution is therefore extremely severe. Beijing, Tianjin and Hebei, as well as surrounding areas use 1.5 billion tons of coal per year, accounting for 43% of the national total. Thermal power installed is 220 million kilowatts, which accounts for 30% of the national total. Steel and coke production capacity is 500 million tons and 300 million tons respectively, which accounts for 50% of national capacity. Atmospheric pollutant emissions from Shandong, Hebei and Shanxi, are ranked No.1, No. 2 and No.5 nationally.[23]

[23] Air Quality Report for regional, municipal and provincial cities in Beijing, Tianjin, Hebei, Yangtze River Delta, and Pearl River Delta for the first half of 2013, China National Environmental Monitoring Center, July 9th, 2013.

Furthermore, in the areas around the Yangtze River Delta that have recently also experienced severe smog, industrial emissions also make up significant part of the problem. Contrary to common belief, the Yangtze River Delta area's industrial consumption of coal is very high and coal is the main source of fuel. The consumption of coal by industry in Jiangsu, Zhejiang and Shanghai is 256 million tons, 148 million tons and 59.35 million tons respectively. Thermal power production is the biggest consumer using almost 300 million tons.

Table 8 – Coal consumption in the Yangtze River Delta Area[24]

Province	Industrial Coal Consumption (10^4 ton)	Fuel Coal Consumption (10^4 ton)	Thermal power Coal Consumption (10^4 ton)
Jiangsu	25581	23514	16350.9
Zhejiang	14826	13772	10352.4
Shanghai	5935	4390	3437.0
Total	46342	41676	30140.3

The makeup of energy and industry in the Yangtze River Delta creates a huge amount of SO_2, NO_x and fume discharge. Professor He Kebin's study found that the unit area discharge intensity of primary particulate pollutants, and precursor gasses for secondary particulate pollutants in Beijing, Tianjin, Hebei, the Yangtze River Delta and Pearl River Delta were substantially higher than in other parts of the country. Primary pollutant discharge in Beijing, Tianjin and Hebei was particularly high and the discharge of precursor gasses for secondary pollutants in the Yangtze River Delta was extremely prominent.

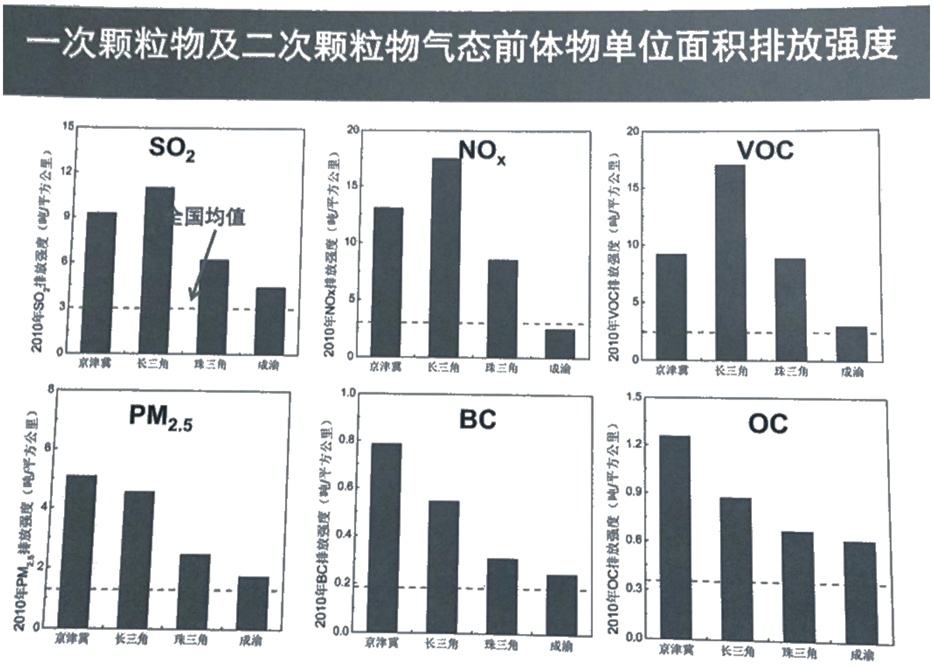

Figure 20 - Discharge intensity of primary particulate pollutants, and precursor gasses for

24 2011 Annual Statistical Reports on the Environment in China, P.61 and P. 203

secondary particulate pollutants in different areas of China[25]

The Management of Coal Combustion and Industrial Sources must be a Priority

Coal combustion and industrial sources generate a massive volume of emissions; however, unlike transport and domestic sources their discharge points are fixed and there are clear laws and standards, so supervision should be relatively easy.

Fixed Discharge Outlets	Industrial sources often have very obvious and fixed discharge outlets. Compared to the millions of non-point source pollution source like transportation and agriculture, industrial point source targets are clear and so government and societal supervision are relatively easy.
Discharge Standards are Clear	There can be found clear and specific emission standards for industrial air pollutants for the following industries: thermal power, coke, cement, coal-mining, ceramics, glass-making, iron & steel making, rolling, iron alloy, iron ore selection, brick making, coke chemical and electro-glass industry

Industrial Sources that should be Focused on

Industrial pollution sources number in the hundred thousand so there must be a focus for effective emissions reduction. In the Phase I Blue Sky Roadmap Report we suggested that the focus should be on those companies included in the list of Key State Monitored Enterprises for Air Emissions, published by the Ministry of Environmental Protection. In 2013 the MEP released an updated list. According to the evaluation criteria from the MEP, if an enterprise is included on the list as an air emissions source then it means that:

- It is in the top 65% of industrial emitters nationally for industrial SO_2, NO_x or fume emissions volume;
- It is in the top 50% of industrial emissions generators nationally for industrial SO_2, NO_x or fumes generated;
- If the volume of major pollutants produced or discharged reaches the threshold shown in the table below.[26]

[25] From "Reconstructing Blue Skies: An International Forum on Air Quality Management" Professor He Kebin's Characteristics of $PM_{2.5}$ in the Beijing, Tianjin and Hebei Areas and Measures for its Control, November 16th, 2013.
[26] Minimum thresholds for main state monitored pollutants for wastewater, air emissions and heavy metals were determined according to the 2011 Environmental Statistical Database. Companies generating and discharging main pollutants were listed in descending order and the

Figure 9 - Minimum thresholds for main pollutant emission and production volumes[27]

Type	Pollutant	Emission V olume	Production Vol ume
Air Emissions	SO_2 (ton/year)	1200	20000
	NO_x (ton/year)	4000	10000
	Fume (ton/year)	400	—

Most of these pollution source enterprises come from the thermal power, cement, steel, and chemicals industries. According to research conducted by the Natural Resources Defense Council (NRDC), included in the 2013 list of Key state Monitored Enterprises are 968 combined heat and power generation plants, accounting for 23.11% of the total number of Key State Monitored Enterprises listed for Air Emissions. Thermal power generation, cement manufacturing, the iron and steel smelting industry, chemical industry and non-ferrous metallurgy industry account for 873, 420, 388, 254 and 246 enterprises respectively.

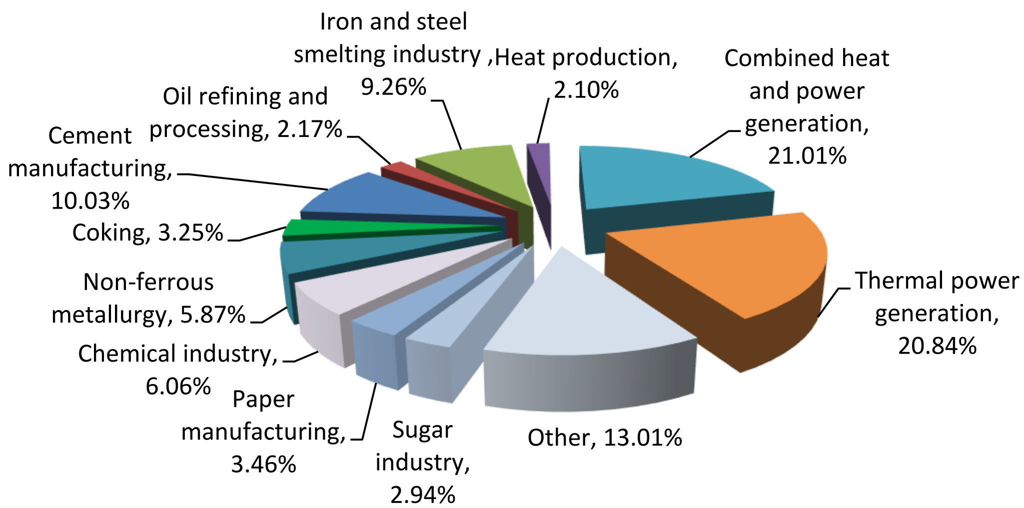

Figure 21 - Breakdown of air polluters in the list by industry

As of January 10th, 2014, the IPE, NGO partners, and volunteers had positioned a total of 2506 Key State Monitored Enterprises listed for Air Emissions, 59.9% of the total of 4181 listed for 2013.

The screenshot below shows the location of these Key State Monitored Enterprises listed for air emissions. It's possible to see that many of air emission source enterprises are largely concentrated in the densely populated areas of Beijing, Tianjin, and Hebei, and the surrounding provinces of Shandong, Shanxi, Henan and the Yangtze River Delta.

[27] Env. Notice [2012] No. 1455 regarding the updating of the 2013 list of key state monitored enterprises, Office of the MEP, December 13, 2012.

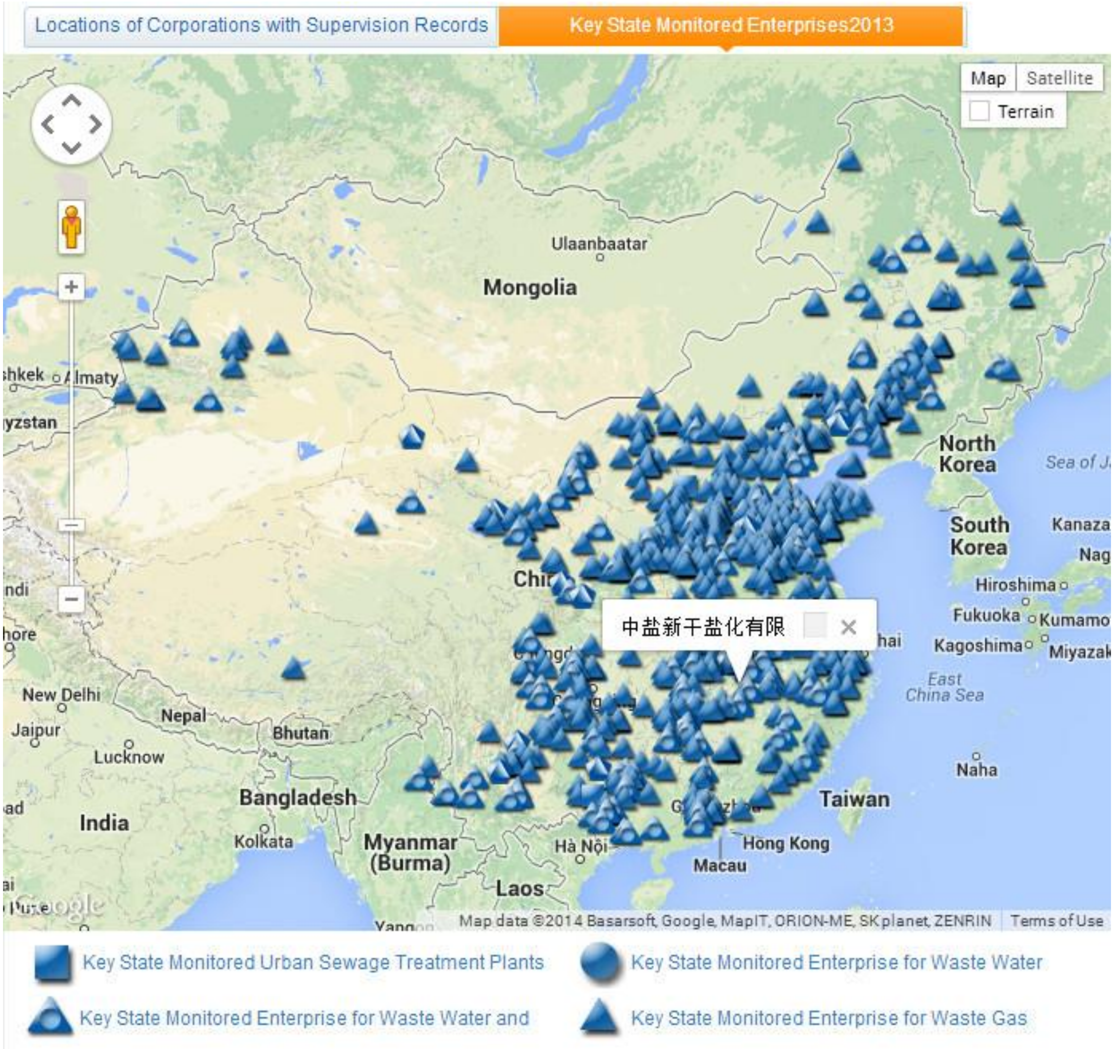

Figure 22 – Screenshot of a map on the IPE website showing the position of 2013 key state monitored enterprises listed for air emissions

2.1.2 Towards Real-time Disclosure of Pollution Source Information

To control regional pollution there must be a large scale reduction of pollution emissions in that region. For this reduction in emissions to take place we must first understand what the sources are. We can then, borrowing from the successful experiences of western industrialized countries, locate these pollution sources so that the public can participate in their supervision. Therefore, we must expand on the principles of $PM_{2.5}$ disclosure and increase this to include pollution source information disclosure.

Since 2009, the IPE and NRDC have carried out an annual evaluation of pollution source information disclosure in 113 cities called the Pollution Information Transparency Index (PITI).[28] The evaluations show that although there has been obvious progress made since 2008, pollution

[28] 2012 PITI results, http://www.ipe.org.cn/Upload/IPE%20report/PITI2012-0409.pdf

source information is still extremely limited, scattered, not timely, incomplete, difficult to obtain, and as a result does not motivate enterprises to really reduce their emissions. For this reason, since the Yabuli Entrepreneurs Forum in February 2013, environmental NGOs and entrepreneurial groups have been pushing for pollution source information disclosure.

The Importance of Real-time Disclosure

Why is real-time disclosure so crucial?

Can conquer the lack of enforcement	•Real-time disclosure greatly increases the cost of local officials interveneing in enforcement
Promotes regional collaboration in governance	•Pollution sources in the region receive supervision from all those areas affacted by the pollution
Identifies pollution sources within a region	•Identify enterprises discharging emissions in breach of discharge standards and identify big emitters during times of adverse weather

Pushes from Civil Society has Resulted in Active Responses from Officials

On the basis of regulatory requirements, including the "Cleaner Production Promotion Law," "Disclosure of Government Information" and "Open Environmental Information (for Trial Implementation)", 26 industry and environmental protection organizations including the SEE Foundation, the China Urban Realty Association, Friends of Nature and the IPE jointly released the Total Transparency Initiative on March 28th, 2013.

The Total Transparency Initiative requires that annual monitoring, supervision and discharge data for all key state monitored enterprises should be disclosed in a systematic, timely, comprehensive and user friendly way. Based on the need to increase public participation in supervision we recommend starting with the following three points:

- Key State, Provincial, and Municipal Monitored Pollution Source Enterprises' online monitoring data should be published on the internet, and historical data should also be made available;
- Administrative penalty information and confirmed complaint information on polluting enterprises should be published in a systematic, timely and comprehensive way.
- Enterprises should regularly publish pollutant discharge data. The scope of the data should include no less than those pollutants identified in the company's environmental impact assessment.

The push for more information disclosure from entrepreneurial and environmental groups has resulted in an active response from some officials, including, within the last six months, meetings with local officials from Beijing and Hebei, where they were encouraged to release supervision data and also make a commitment to real time disclosure. At the same time the MEP has also been very active and has published notices and formulated regulations requiring enterprises to improve their information disclosure.

Figure 23 – Entrepreneurs leading the push for environmental information disclosure

Top-left: Yabuli Forum Current President and Vanke Group Chairman - Wang Shi
Top-right: Society of Entrepreneurs and Scholars Secretary General - Liu Xiaogang
Middle-left: Member of National Committee of the CPPPC and Artron Chairperson - Wan Jie
Middle-right: National People's Congress Representative and TCL Group Chairman of the Board – Li Dongsheng
Bottom-left: Society of Entrepreneurs and Scholars Former President and Dacheng Group Chairman – Han Jiahuan
Bottom-right: Yabuli Forum Founder and Lifetime Member and Meitong Group Chairman Wang Weijia

Table 10 – Rapid progress made after the February 2010 Yabuli Forum

February 2013	• **During the Winter Yabuli Forum 15 organizations published the "Yabuli Environmental Protection Joint Action Commitment" in which the entrepreneurial groups and environmental NGOs came together to promote pollution source information disclosure.**
March 2013	• Li Dongsheng and Wan Jie submitted recommendations and proposals on the implementation of total transparency for pollution sources to the NPC and NCPPCC.
March 28th	• 26 entrepreneurial groups and environmental NGOs jointly launched the Total Transparency Initiative which called for the total disclosure of pollution source information and that annual monitoring, supervision and discharge data for all key state monitored enterprises should be disclosed in a systematic, timely, comprehensive and user friendly way.
April 11th	• Submitted an application of disclosure to the Beijing, Tianjin and Hebei Environmental Protection Bureaus and the next day submitted a meeting request with the Beijing EPB.
April 18th	• Representatives from Friends of Nature, IPE and the SEE Foundation held talks with the Beijing EPB officials, including Fang Li, the deputy director and a number of other officials.
April 19th	• Beijing published supervision monitoring data for the 1st quarter.
April 27th	• The Beijing EPB replied to the environmental NGOs application for information and stated that they had already published supervision monitoring data for the 1st quarter. Promised that before the end of the year they would also publish online monitoring data.
May 7th	• The MEP released the public consultation on "Key State Monitored Enterprises Automatic Monitoring and Information disclosure Methods (for Trial Implementation") Key State Monitored Enterprises Pollution Source Supervision Monitoring Information Disclosure Methods (Trial Implementation) "http://www.zhb.gov.cn/gkml/hbb/bgth/201305/t20130509_251876.ht m
May 24th	• Friends of Nature, SEE Foundation and IPE presented recommendations to the MEP.
July 5th	• Beijing started to publish online monitoring data for six air emission key monitored enterprises. See: http://zfxxgk.beijing.gov.cn/columns/89/5/441350.html
July 16th	• The MEP released the “Notice Regarding the Strengthening of Pollution Source Environmental Information Disclosure” and also the “List of Pollution Source Environmental Information Disclosure” requiring environmental authorities at all levels to start disclosure from September 2013. (http://www.mep.gov.cn/gkml/hbb/bwj/201307/t20130717_255667.ht

	m)
July 31st	• The MEP released a notice on "Key State Monitored Enterprises Automatic Monitoring and Information disclosure Methods (for Trial Implementation") Key State Monitored Enterprises Pollution Source Supervision Monitoring Information Disclosure Methods (Trial Implementation) http://www.zhb.gov.cn/gkml/hbb/bwj/201308/t20130801_256772.htm
August 9th	• Hebei EPB called the environmental NGOs requesting a meeting. On the same day they also released the first and second quarter supervision monitoring results.
August 14th	• Three representatives from Hebei EPB met with Friends of Nature, IPE and Tianjin Green Leaders in Beijing. The Tianjin EPB expressed regret that they had not responded sooner and also thanked the NGOs for their inquiries. They also stated that they would start disclosing online data on Jan 1st 2014.

2.1.3 Real time Disclosure in Provinces like Shandong and Zhejiang Leads the Way

We were very happy to see that some provinces had already started to implement the requirements from the MEP and have made an attempt at real-time pollution source information disclosure. Using the Pollution Information Transparency Index evaluation system[29] the IPE conducted a preliminary evaluation of their disclosure platforms. The results can be seen in the table below:[30]

Table 11 Evaluation results of monitoring platforms of key enterprises for emissions in 31 provinces

Rank	Province	Systematic	Timely	Comprehensive	User-friendly	Total
1	Shandong	4	2.4	4.8	4.8	16
1	Zhejiang	4	2.4	4.8	4.8	16
3	Inner Mongolia	4	1.2	4.8	4.8	14.8
4	Hebei	3	1.8	3.6	3.6	12
4	Liaoning	3	1.8	3.6	3.6	12
4	Anhui	3	1.8	3.6	3.6	12
7	Henan	4	1.8	4.8	1.2	11.8
7	Hubei	4	2.4	2.4	2.4	11.2
9	Guizhou	3	1.2	2.4	3.6	10.2
10	Jiangsu	4	2.4	1.2	2.4	10
10	Jiangxi	4	2.4	1.2	2.4	10

29 Jointly developed by IPE and the Natural Resources Defense Council

30 Only evaluated the provincial and municipal level cities on the online monitoring platform disclosure for key state monitored enterprises listed for air emissions. Because the platforms were set up not long time ago, there are issues such as data missing and the lack of historical data, which require further observation. This evaluation shows approximately the state of these disclosure platforms as they currently stand. The IPE will soon conduct a more in depth and detailed evaluation of key environmental protection cities using the PITI evaluation system.

Rank	Province	Systematic	Timely	Comprehensive	User-friendly	Total
12	Fujian	3	1.8	2.4	2.4	9.6
12	Sichuan	2	1.2	2.4	3.6	9.2
14	Guangxi	2	1.8	2.4	2.4	8.6
15	Chongqing	2	1.2	2.4	2.4	8
16	Qinghai	2	0.6	2.4	2.4	7.4
17	Beijing	2	0.6	2.4	1.2	6.2
18	Yunnan	1	0.6	1.2	1.2	4
18	Shanxi	1	0.6	1.2	1.2	4
18	Jilin	1	0.6	1.2	1.2	4
18	Heilongjiang	1	0.6	1.2	1.2	4
22	Shanghai	0	0	0	0	0
22	Guangdong	0	0	0	0	0
22	Hainan	0	0	0	0	0
22	Tibet	0	0	0	0	0
22	Shanxi	0	0	0	0	0
22	Gansu	0	0	0	0	0
22	Ningxia	0	0	0	0	0
22	Xinjiang	0	0	0	0	0
22	Hunan	0	0	0	0	0
22	Tianjin	0	0	0	0	0

Good practice in several regions deserves to be used as a reference.

Shandong is ranked at the top because their automatic monitoring disclosure platform not only publishes a large amount of real-time disclosure data for key state monitored enterprises, but also for key provincially monitored enterprises. The frequency of missing data was low and data was updated in a timely fashion. Furthermore, the platform used a clear layout and tables to indicate those companies that had breached discharge standards.

Figure 24 – Main page for the Shandong key monitored enterprise automatic monitoring disclosure platform

Zhejiang and Shandong Provinces came joint first in the evaluation. In addition to monitoring and publishing both the key state monitored enterprises, and key provincially monitored enterprises in a complete and timely way, the Zhejiang disclosure platform is fast and easy to use and has impressive functions such as a comprehensive historical database and a powerful search tool.

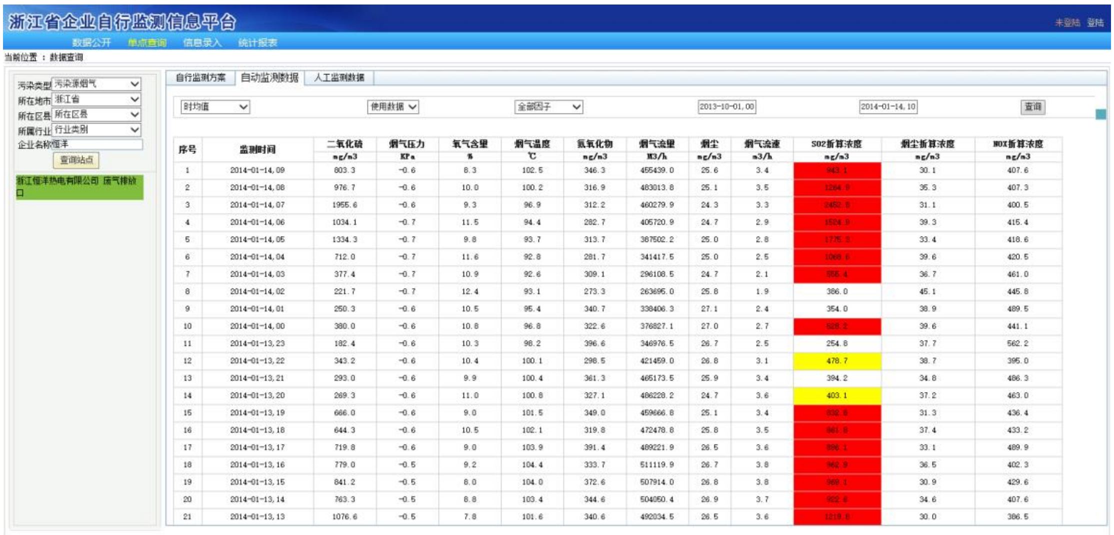

Figure 25 – Zhejiang Province disclosure platform showing exceedances at some thermal power plants

Inner Mongolia got the second highest score. Most notable was the fact that they plotted the locations of all key monitored enterprises on a digital map so the location of "big emitters" was obvious at a glance.

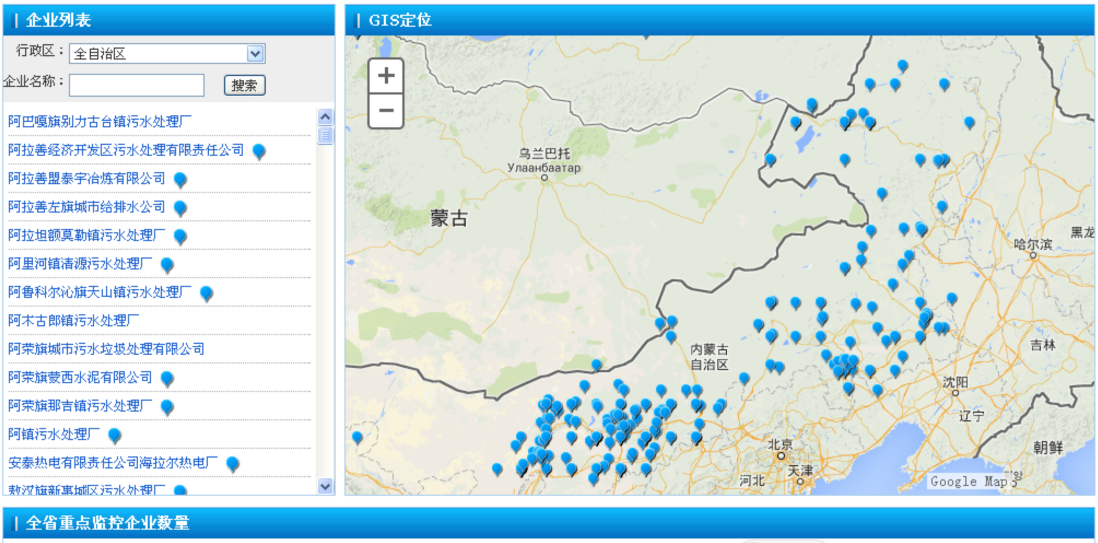

Figure 26 - Main page for the Inner Mongolia key monitored enterprise automatic monitoring disclosure platform

Some areas have finished building online disclosure platforms but the lack of data affects their evaluation scores. Taking Shougang Jingtang United Iron & Steel Co., Ltd. as an example, on August 31st 2013 the Hebei EPB handed down an administrative penalty notice to the company stating that, "The online monitoring facilities for their No. 1 sinter were operating abnormally and data was being displayed as a constant value, which contravenes article 12, section two of the 'Law of the People's Republic of China on the Prevention and Control of Atmospheric Pollution', so the company was handed a fine in accordance with article 46, section 3 of the 'Law of the People's Republic of China on the Prevention and Control of Atmospheric Pollution'".[31]

However, several months after they were handed the fine, there was still a lack of online monitoring discharge data for several of Shougang Jingtang United Iron & Steel Co., Ltd.'s discharge outlets. On January 13th, 2014, there was no data shown for any of their discharge outlets on the Hebei online monitoring disclosure platform.

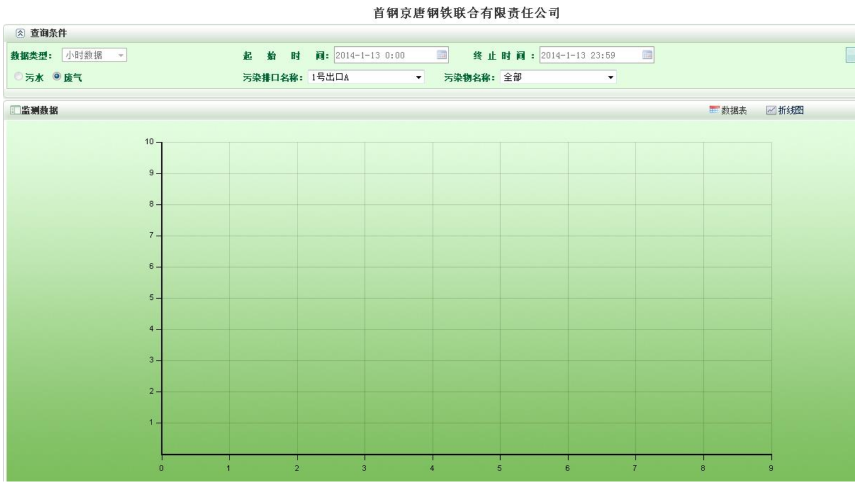

Figure 27 – Lack of data for Shougang Jingtang United Iron & Steel Co., Ltd.

[31] http://www.ipe.org.cn/pollution/com_detail.aspx?id=726130

2.1.4 Preliminary Analysis of Real-time Disclosure Results

We made an analysis of the online monitoring data from those provinces that have already started disclosure and came to four initial conclusions:

2.1.4.1 Discharge from some Enterprises Seriously Exceeds Discharge Standards

Shandong Case Study: Breaches of Discharge Standards by Key Enterprises are Widespread

Shandong's disclosure platform shows that there are a total of 1009 key monitored enterprises in the province. Although these enterprises only account for around 20% of the total number of emitters in the province they account for a very high proportion of total emissions from the province.

We analyzed the real-time data disclosed on the platform for the period October 1st, 2013, to November 15th, 2013 and calculated the frequency at which key state monitored enterprises listed for air emissions were breaching discharge standards. For a summary see below:

Table 12 - Frequencies of exceedance of monitoring sites of key monitored enterprises for emissions

Polluting Enterprises	Frequency of NO_x exceedance	Frequency of SO_2 exceedance
Liaocheng Enterprises	54.73%	28.68%
Dongying Enterprises	61.02%	5.60%
Dezhou Enterprises	44.83%	21.74%
Binzhou Enterprises	54.90%	5.02%
Yantai Enterprises	49.81%	9.48%
Jining Enterprises	44.61%	6.40%
Zibo Enterprises	42.04%	6.13%
Heze Enterprises	40.52%	7.41%
Qingdao Enterprises	26.47%	18.76%
Laiwu Enterprises	14.59%	23.80%
Rizhao Enterprises	33.62%	0.74%
Weihai Enterprises	29.62%	4.70%

Polluting Enterprises	Frequency of NO_x exceedance	Frequency of SO_2 exceedance
Zaozhuang Enterprises	24.40%	7.43%
Taian Enterprises	22.61%	5.89%
Linyi Enterprises	20.04%	6.29%
Weifang Enterprises	23.06%	2.39%
Ji'nan Enterprises	18.36%	5.56%

From the table it's possible to see that for the evaluation period, the frequency at which key monitored enterprises in Shandong breached discharge standards is quite high, especially for NO_x where some of the big emitters were breaching discharge standards more than 50% of the time.

Hebei Case Study: Steel Factories are Breaching New Discharge Standards on a Large Scale

From the Hebei online monitoring disclosure platform we can see that a group of large scale steel factories are seriously breaching discharge standards that came into force on November 30th, 2013. To make the following graphs clearer for the reader we added the company name as well as line indicating the current national discharge standard and the new Hebei provincial standard.

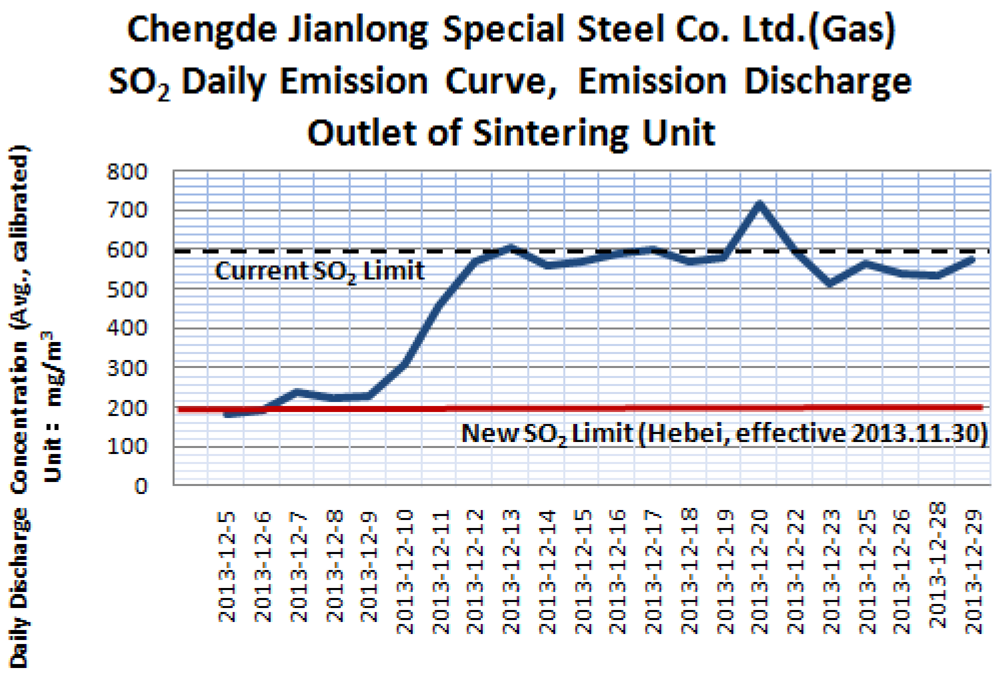

Figure 28 – December SO_2 emissions for Chengde Jianlong Steel Group compared with the new standard limit value

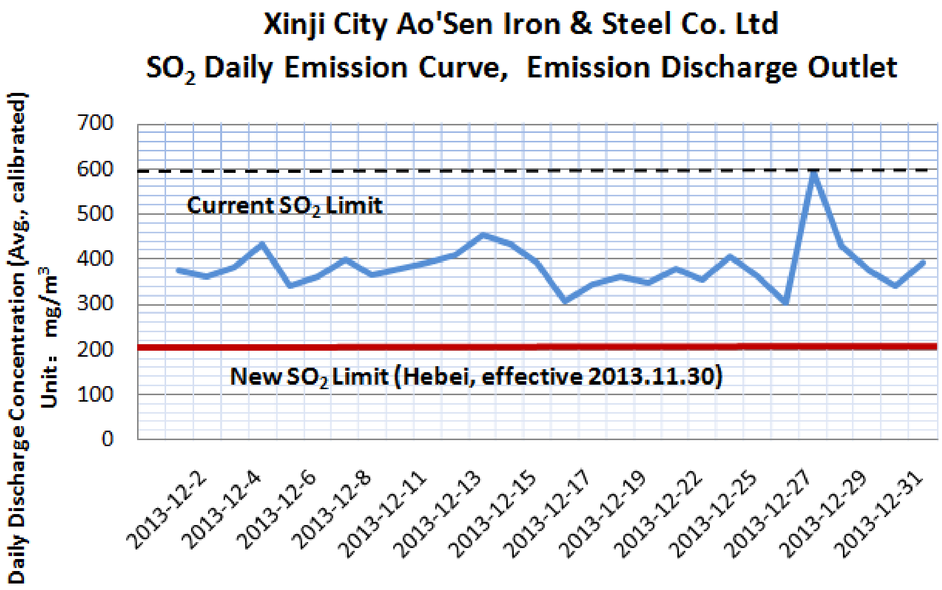

Figure 29 –December SO_2 emissions levels for Xinjin Aosen Steel compared with the new standard limit value

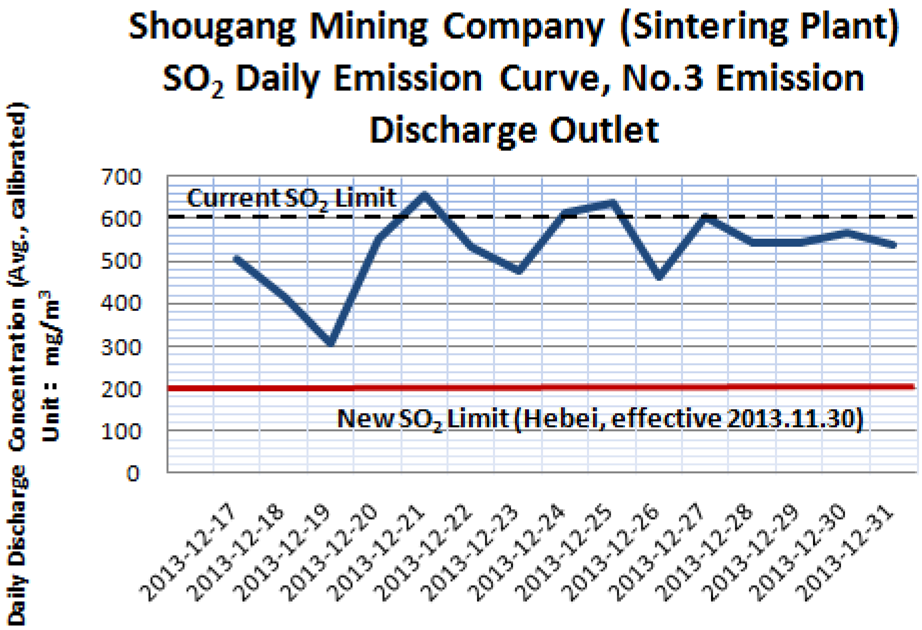

Figure 30 – SO_2 emissions levels from Shougang Mining (Sintering Plant) discharge outlet No.3 compared with the new standard limit value

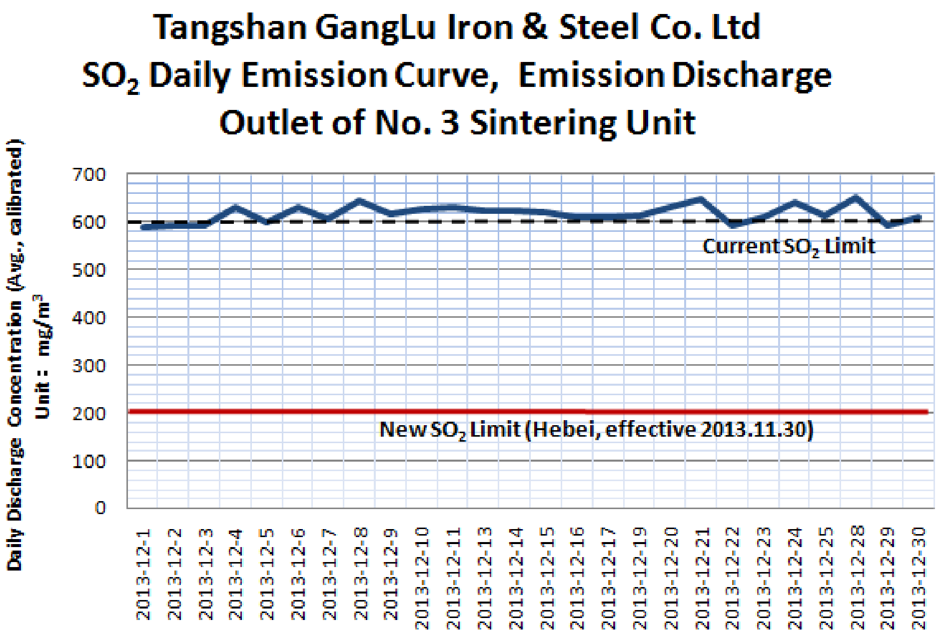

Figure 31 - SO_2 emissions levels from Tangshan Ganglu Iron & Steel Co., Ltd. compared with the new standard limit value

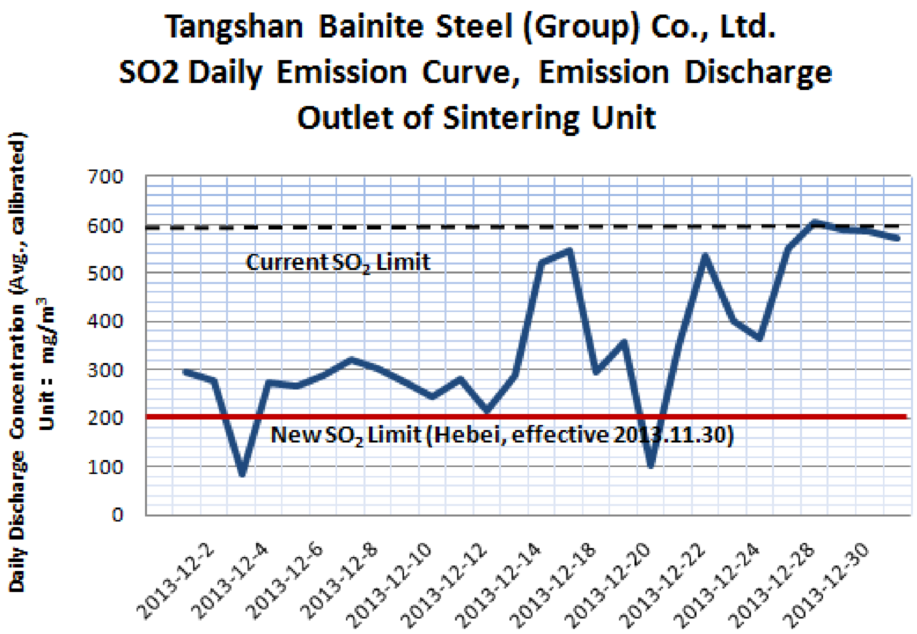

Figure 32 –December SO_2 emissions for Tangshan Bainite Steel Co., Ltd. compared with the new standard limit value

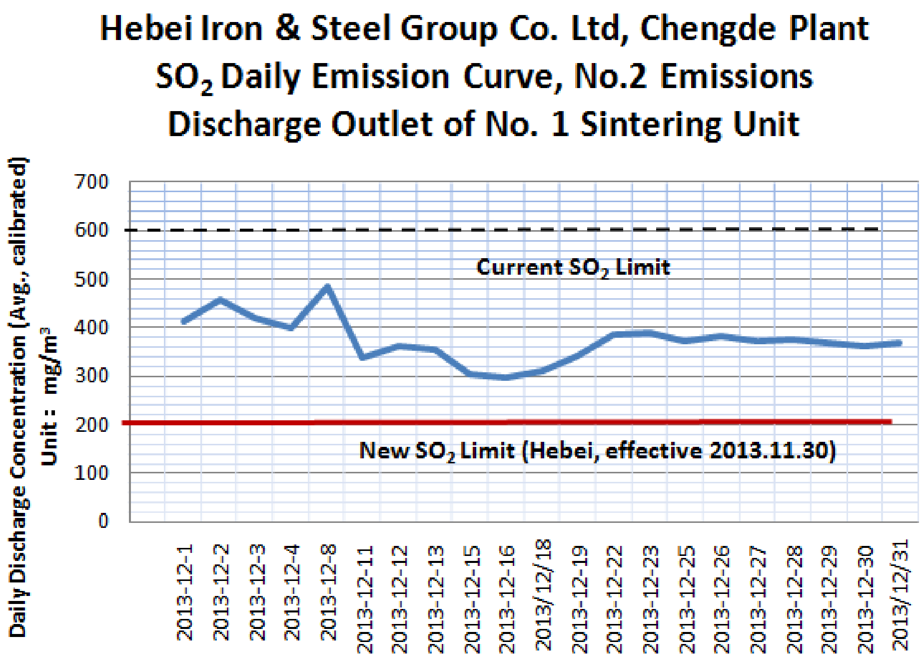

Figure 33 – December SO_2 emissions for Hebei Iron & Steel Group compared with the new standard limit value

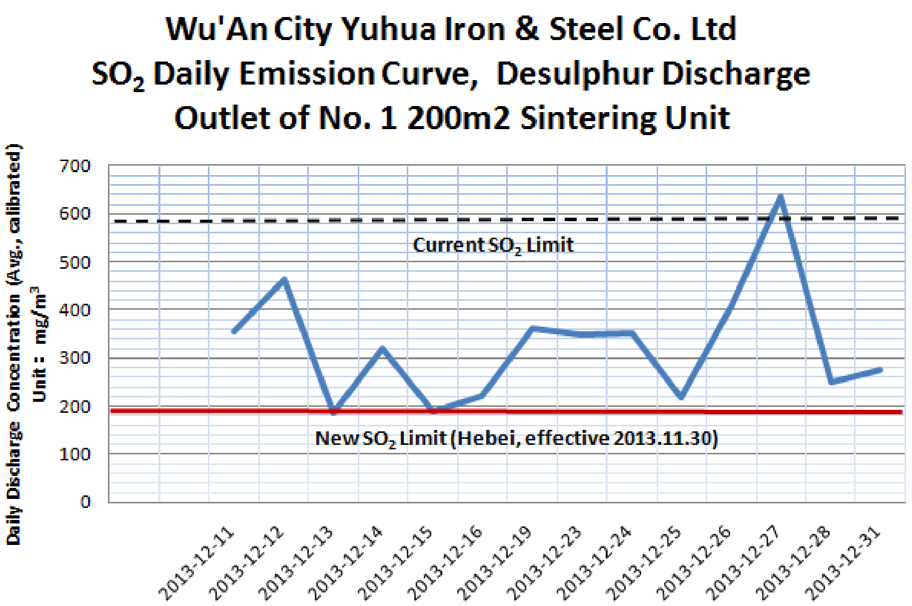

Figure 34 - December SO_2 emissions for Wuhan Yuhua Steel Co., Ltd. compared with the new standard limit value

Beijing Case Study: Average Daily Emissions shows that there are still Exceedances

The Beijing online monitoring disclosure platform[32] shows that from October to December, out of eight key monitored enterprises listed for air emissions, six had emissions in breach of the authorized emission standards. Both Huadian (Beijing) Thermal Power Co., Ltd.[33] and Beijing Taiyanggong Gas Thermal Power Co., Ltd. had multiple instances of breaching the discharge standards and some of these instances were serious breaches.

See appendix D for more information on the other key monitored enterprises in Beijing that breached discharge standards.

2.1.4.2 Discharge Levels Remains Very High Even During Periods of Heavy Pollution

Shandong Case Study: During Periods of Heavy Pollution Instances of Emission Standards Being Breached were Very High

In October 2013, during periods when the AQI for all cities in Shandong exceeded 200, the key monitored enterprises listed for air emissions in those cities were found to have exceeded discharge standards to varying degrees. Furthermore, the frequency at which key state monitored enterprises were breaching discharge standards on an hourly basis was very high.

Table 13 Exceedance of key monitored sites for emissions in cities of Shandong

City	Hours of AQI>200	Hours of SO_2 exceedance	Hours of NO_x exceedance
Zaozhuang	435	414	414
Heze	417	305	398
Jining	363	342	347
Liaocheng	299	285	285
Dezhou	290	273	273
Binzhou	284	220	268
Qingdao	225	213	213
Linyi	188	139	176
Laiwu	150	142	142
Ji'nan	139	118	130
Zibo	128	115	119
Taian	101	72	94

[32] Daily average concentration values in mg/m^3

[33] On January 15th, staff from Huadian (Beijing) Thermal Power Co., Ltd. (hereafter referred to as Beijing Huadian) called the IPE to express their doubt about the data showing exceedances at Beijing Huadian that were used in the report. IPE explained that the data that was used in the report came from the Beijing EPB automatic monitoring platform which was set-up according to the law to show automatic monitoring data from key state monitored enterprises. On the same day the IPE received another call from staff at Huadian Beijing stating that they had already contacted the Beijing EPB on the data discrepancy issue and were now waiting for official clarification from them.

City	Hours of AQI>200	Hours of SO_2 exceedance	Hours of NO_x exceedance
Dongying	67	60	62
Weifang	62	45	59
Weihai	6	6	6

From October 1st 2013 to November 15th 2013, the cities of Zibo, Zaozhuang, Weifang, Taian, Linyi, Liaocheng, Laiwu, Jining, Jinan, Binzhou, Dezhou, Dongying, and Heze in Shandong province all experienced an AQI with a 24 hour moving average of more than 200.

We chose the greatest 24 hour moving average for these 13 cities during the period October 1st, 2013 to November 15th, 2013 and found that one or discharge outlets for a number of companies were breaching discharge standards every hour for the period.

Liaocheng:

Time Period: October 28th, 2013 – October 29th, 2013

Air quality: Moving 24 hr. average – 390.86

Table 14 Exceedances of SO_2 at monitoring sites in Liaocheng

Monitoring site (SO_2)	Observation counts[34]	Exceedance counts	Lowest exceedance multiple	Highest exceedance multiple
Xinyuan Aluminum (4-5)	22	22	2	2.7
Xinyuan Aluminum (1-3)	22	22	1.8	2.6
Huaxin Aluminum (14-15)	22	22	0.7	2.8
Huaxin Aluminum (12-13)	22	22	1.2	1.5
Huaxin Aluminum (9-11)	22	22	1	1.5
Dongchang Coking Plant (3)	22	22	1.4	1.9
Dongchang Coking Plant (1-2)	22	22	1.5	2

Table 15 - NO_x Exceedances at monitoring sites in Liaocheng

Monitoring site (NO_x)	Observation counts	Exceedance counts	Lowest exceedance multiple	Highest exceedance multiple
Liaocheng Power Plant (3-4)	22	22	2.5	5.6
Liaocheng Power Plant (1)	22	22	3.3	5.4
Liaocheng Thermal Power Plant(7-8)	22	22	4.8	6.1

[34] There was no data showing for Liaocheng from 5pm on October 28th, to 5 pm on October 29th and from 8 pm on the 28th to midnight.

Monitoring site (NO_x)	Observation counts	Exceedance counts	Lowest exceedance multiple	Highest exceedance multiple
Xinyuan Aluminum (4-5)	22	22	3.7	4.4
Xinyuan Aluminum (1-3)	22	22	1.8	7.6
Huaxin Aluminum (14-15)	22	22	0.7	1.1
Huaxin Aluminum (12-13)	22	22	1	1.2
Huaxin Aluminum (9-11)	22	22	0.3	1.1
Quanlin Thermal Power Plant (1-3)	22	22	0.4	0.6
Deneng Power Plant (1-2)	22	22	0.1	0.4
Changrun Thermal Power Plant (1-3)	22	22	3	6.5
Qilu Heating Company (1-4)	22	22	0.6	1.1
Liaocheng Thermal Power Plant (7-8) (5-6)	22	22	3.3	4.9
Yunhe Thermal Power Plant (7-8) (1-4)	22	22	0.1	0.6

Bingzhou:

Time Period: 4am on October 29th, 2013 – 4am on October 30th

Air Quality: Moving 24 hr. Average AQI – 382.78

Table 16 - NO_x Exceedances at monitoring sites in Binzhou

Monitoring site (NO_x)	Observation counts[35]	Exceedance counts	Lowest exceedance multiple	Highest exceedance multiple
Lubei Power Plant(1)	23	23	0.7	2
Lubei Power Plant(2)	23	23	0.6	1.4
Zhanhua Thermal Power Plant 3(临时)	23	23	4.1	5.5
Zhanhua Thermal Power Plant 4(临时)	23	23	3.7	5.1
Zouwei Thermal Power Plant (3-4)	23	23	3.4	3.7
Weiqiao Pioneering (Thermal Power Plant7-8)	23	23	3.1	4.1
Weiqiao Pioneering (Thermal Power Plant 5-6)	23	23	3.4	4.2

[35] For all cities in Shandong between October 1st and November 15th there was no data for midnight so the number of daily readings was 23 at the most.

Monitoring site (NO_x)	Observation counts[35]	Exceedance counts	Lowest exceedance multiple	Highest exceedance multiple
Weiqiao Textile (Thermal Power Plant 5-6)	23	23	3.1	3.9
Weiqiao Pioneering (Thermal Power Plant 1-2)	23	23	2.2	4.3
Zouwei Thermal Power Plant (1-2)	23	23	3.5	4.2
Weiqiao Aluminum & Elelctricity(1-2)	23	23	3.2	3.9
Weiqiao Aluminum & Elelctricity (7-8)	23	23	3.2	3.9
Weiqiao Aluminum & Electricity (5-6)	23	23	3.1	3.9
Dingfeng Thermal Power Plant (1-3)	23	23	3.2	5.8
Dingfeng Thermal Power Plant (4-5)	23	23	2.5	5
Weiqiao Textile (Thermal Power Plant 1-2)	23	23	3.2	3.8
Weiye Thermal Power Plant (4-5)	23	23	3.8	7.6
Binbei Thermal Power Plant (1-4)	23	23	2.4	3.1
Jinan Thermal Power Plant	23	23	0.4	0.6
Weiye Thermal Power Plant (1-3)	23	23	0.1	2.4

Jining:

Time Period: 2am on October 29th, 2013 – 2am on October 30th

Air Quality: Moving 24 hr. Average AQI – 352.24

Table - 17 NO_x Exceedances at monitoring sites in Jining

Monitoring site (NO_x)	Observation counts	Exceedance counts	Lowest exceedance multiple	Highest exceedance multiple
Zouxian Power Plant(7)	23	23	1.5	1.9
Zouxian Power Plant (8)	23	23	1.3	1.7
Jiaxiang Power Plant (2)	23	23	3.5	5.4
Zouxian Power Plant (1-2)	23	23	0.1	0.3
Sun Paper (Third Phase 4-5)	23	23	2.3	3.1
Zouxian Power Plant(4)	23	23	1.7	2.9

Monitoring site (NO_x)	Observation counts	Exceedance counts	Lowest exceedance multiple	Highest exceedance multiple
Zouxian Power Plant (1)	23	23	1.7	2.7
Yunhe Power Plant (5)	23	23	2.6	4.6
Yunhe Power Plant (1-2)	23	23	4.7	6
Jining Power Plant (2)	23	23	0.3	1.4
Lineng Power Plant(5-6)	23	23	0.6	1
Jining Power Plant (6)	23	23	0.6	1.7
Yunhe Power Plant (3-4)	23	23	0.9	1.4
Shencheng Thermal Power Plant (2)	23	23	5.5	6.4
Nantun Power Plant(4-6)	23	23	0.4	1.2
Sun Paper (Second Phase1-3)	23	23	0.1	0.4
Huajin Corp.(5-9)	23	23	0.1	0.3
Jining Power Plant(5)	23	23	0.5	1.2
Gaoxin Thermal Power Plant (1-2)	23	23	0.7	1.2
Daizhuang Power Plant(1-2)	23	23	2	2.6
Yishan Chemical(1)	23	23	1.3	1.5
Huajin Corp.(1-4)	23	23	0.1	0.5
Hongkuang Corp.(1-3)	23	23	1.8	2.4

Heze:

Time Period: 11pm on October 28th, 2013 – 11pm on October 29th

AQI——348.11 Air Quality: 24hr Moving Average AQI – 348.11

Table 18 - NO_x exceedances at monitoring sites in Heze

Monitoring site (NO_x)	Observation counts	Exceedance counts	Lowest exceedance multiple	Highest exceedance multiple
CR Power (2)	23	23	4.5	5.6
Heze Power Plant (6)	23	23	1.5	3.3
Heze Power Plant (5)	23	23	3.4	5.3
Heze Power Plant (1-2)	23	23	9.9	11.3
Heze Power Plant (4)	23	23	3.4	5.5
Dongming Petrochem(3-5)	23	23	0.3	1.8

Dezhou:

Time Period: 3pm on October 28th, 2013 to 3pm on October 29th

Air Quality: Moving 24 hr. Average AQI – 344.41

Table 19 - NOx exceedances at monitoring sites in Dezhou

Monitoring site (NO_x)	Observation counts	Exceedance counts	Minimal exceedance multiple	Highest exceedance multiple
Dezhou Power Plant(5)	22	22	7.2	10.3
Dezhou Power Plant(3)	22	22	6.7	8.9
Dezhou Power Plant(1)	22	22	6.6	9.6
Petrochem Plant(4-8)	22	22	0.6	0.9
Leyuan Thermal Power Plant(1-2)	22	22	0.9	1.4
Hengli Thermal Power Plant (1-3)	22	22	2.4	4.4
Yangmei Chemical(1-3)	22	22	0.4	0.6

For more details on key monitored enterprises breaching discharge standards during periods of heavy pollution please see appendix C.

Zhejiang Case Study: During Periods of Heavy Pollution in the Yangtze River Delta there are still serious Levels of Emission Discharge

The Zhejiang automatic monitoring disclosure platform shows that most key state monitored thermal power plants are using the relatively lax national discharge standard (GB13223-2003). Even though this is the case there are still some state monitored thermal power plants whose emissions breach discharge standards.

At the start of December 2013, the eastern part of China experienced the most severe smog for the last ten years. Even though these unfavorable conditions existed, the discharge concentrations from many of Zhejiang Province's big emitters were still high, and were way above the limits set in the new national standard for thermal power plants which will become effective in the near future.

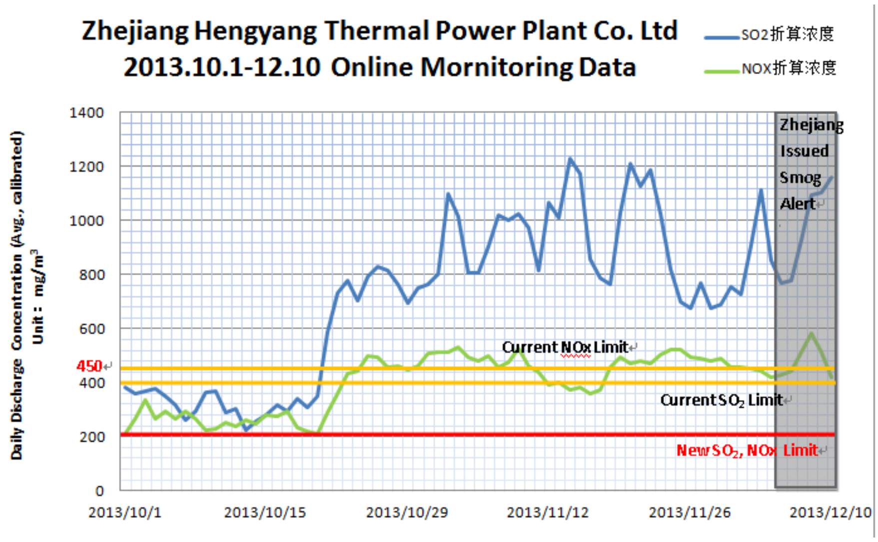

Figure 35 – Online monitoring data for Zhejiang Hengyang Thermal Power Co., Ltd. for the period October 1st to December 10th 2013

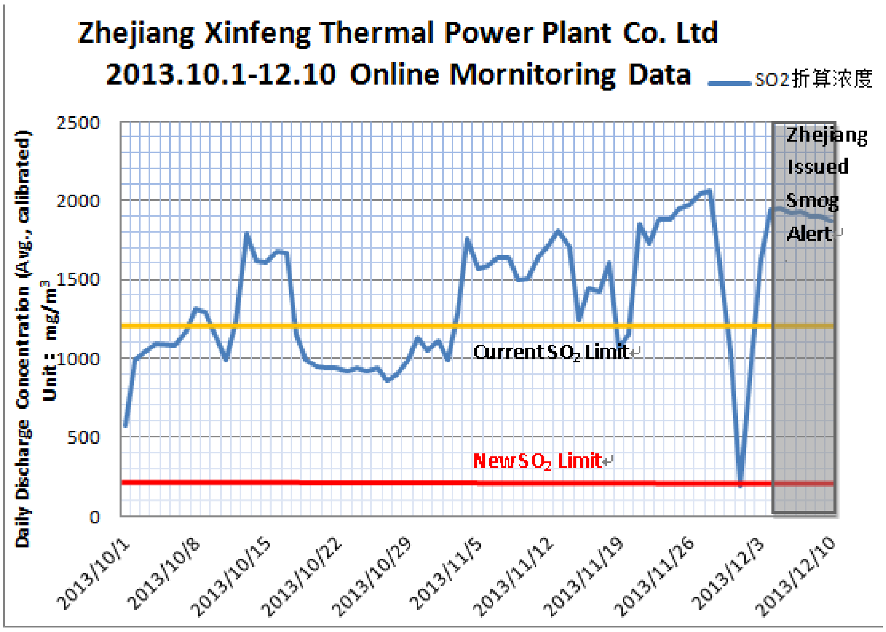

Figure 36 – Online monitoring data for Zhejiang Xinfeng Thermal Power Co., Ltd. for the period October 1st to December 10th 2013

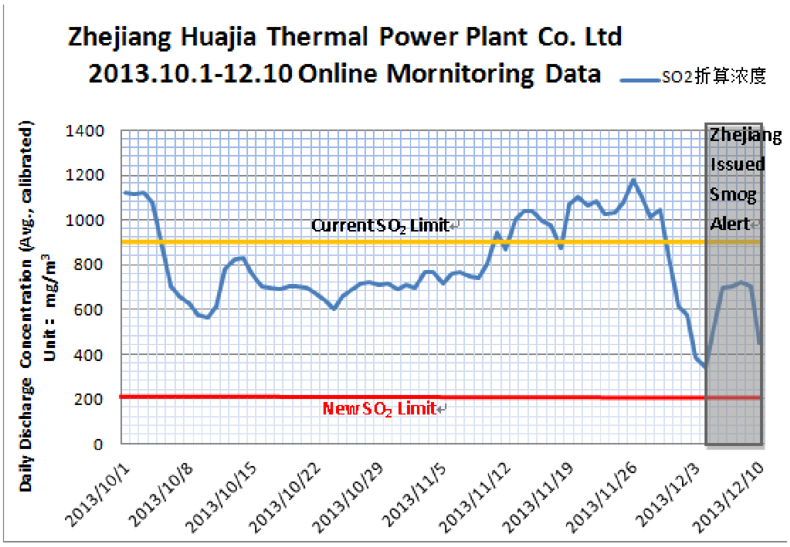

Figure 37 - Online monitoring data for Zhejiang Huajia Thermal Power Co., Ltd. for the period October 1st to December 10th 2013

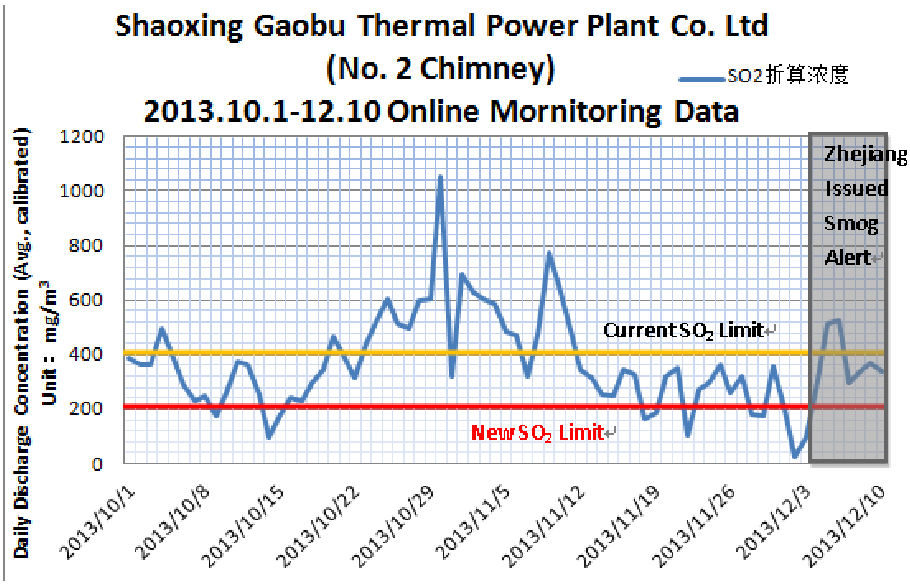

Figure 38 - Online monitoring data for Shaoxing Gaobu Thermal Power Co., Ltd. for the period October 1st to December 10th 2013

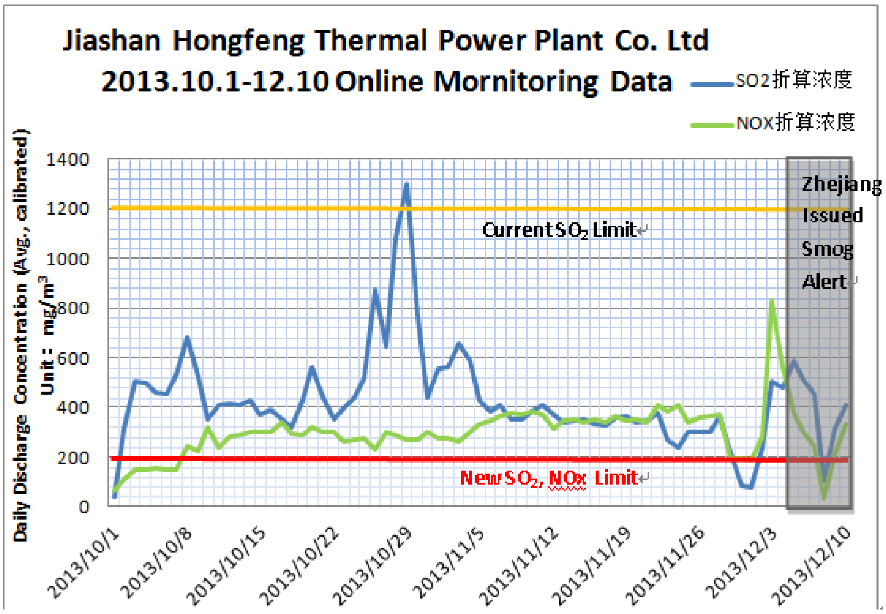

Figure 39 - Online monitoring data for Jiashan County Hongfeng Thermal Power Co., Ltd. for the period October 1st to December 10th 2013

Hebei Case Study: During Periods of Heavy Pollution Steel Factories have Particulate Matter Discharge well in Excess of the Authorized Discharge Standards

The online monitoring disclosure platform shows that during periods of heavy pollution a group of steel factories have been discharging fume (particulate matter) in breach of discharge standards.

Take Tangshan City for example: Tangshan's air quality information for December shows that on at least four occasions the city experienced periods of smog classified as severe, or worse than severe. During this very smoggy month, the concentration of fumes (particulate matter) discharged from many of Tangshan's steel companies breached discharge standard levels for extended periods of time.

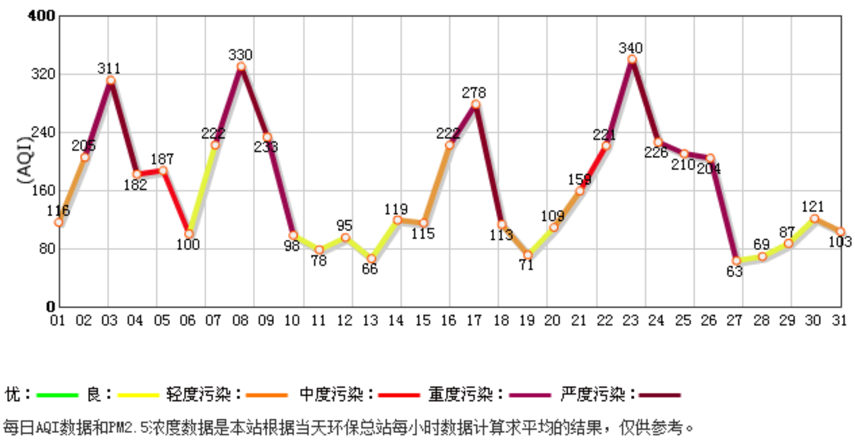

Figure 40 –December 2013 Air quality trends in Tangshan[36]

[36] http://www.tianqihoubao.com/aqi/tangshan-201312.html

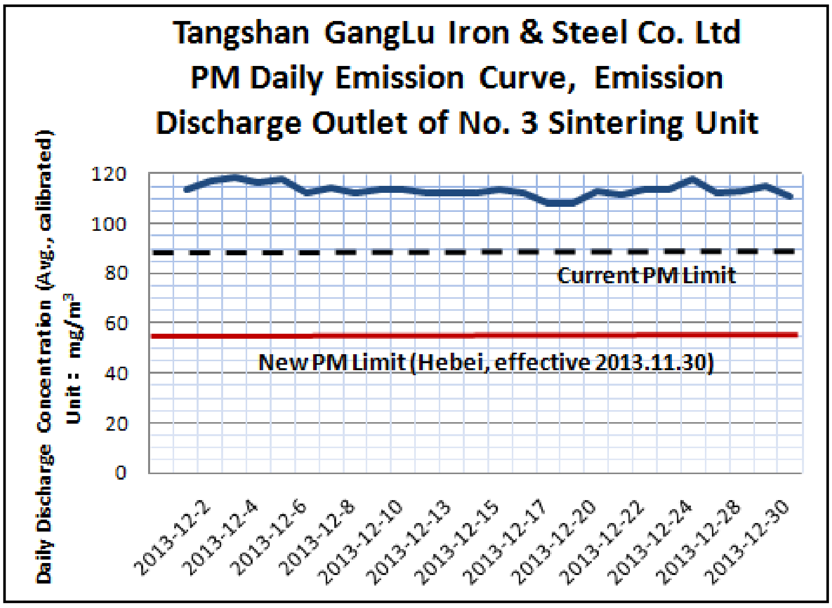

Figure 41 – Comparison of Tangshan Ganglu Iron & Steel Co., Ltd.'s December particulate matter discharge and the discharge standard level

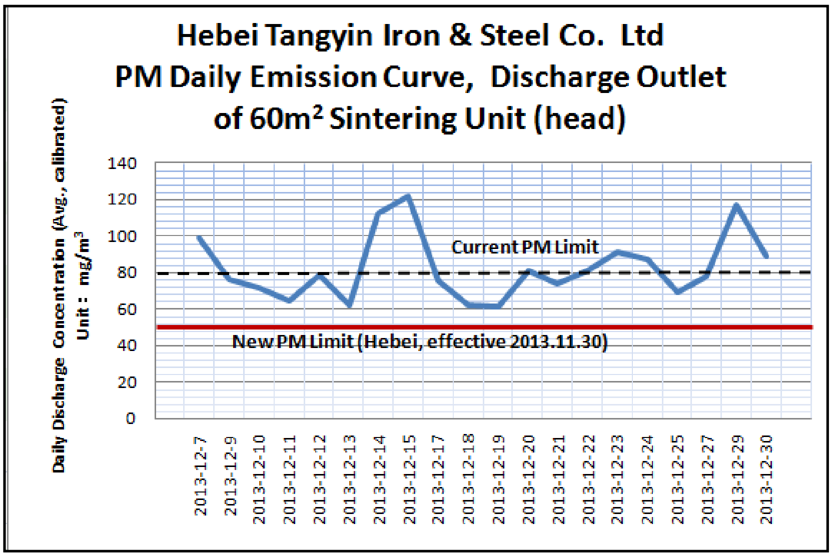

Figure 42 - Comparison of Hebei Tangyin Iron & Steel Co., Ltd.'s December particulate matter discharge and the discharge standard level

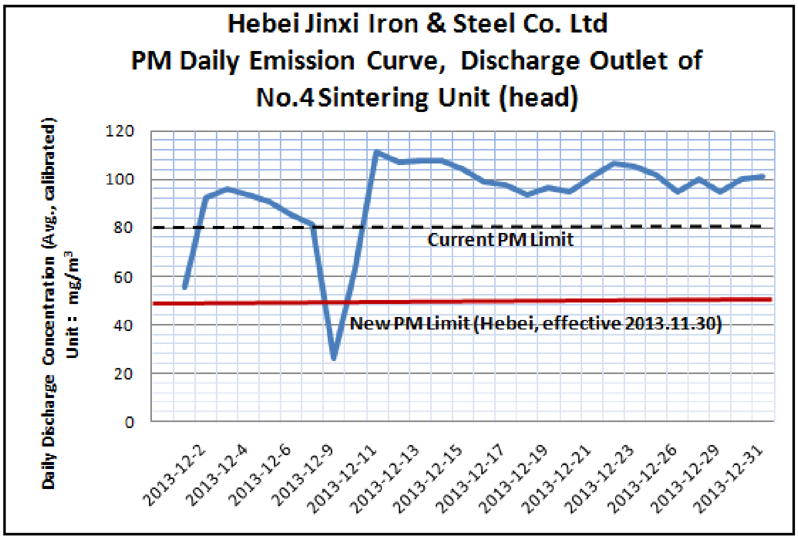

Figure 43 - Comparison of Hebei Jinxi Iron & Steel Co., Ltd.'s December particulate matter discharge and the discharge standard level

In December 2013 many cities in Hebei experienced periods of very severe smog. We chose the cities of Tangshan, Handan and Shijiazhuang as typical examples and took their daily average air pollutant concentration level graphs and superimposed the graphs showing the pollution discharge from some of the high intensity emitters in that city. Please see below for the results:

Enterprise in Tangshan: Shougang Mining Co., Ltd. (Sintering Plant) No. 4 Discharge Outlet
Pollutant: SO_2 Average Daily Discharge Concentration (mg/m^3)
Time Period: December 17th – December 31st 2013

Figure 44 - Shougang Mining (sintering plant) daily SO_2 emission average concentration and Tangshan daily SO_2 concentration in December[37]

[37] Trends in Air Quality for Tangshan in December, www.tianqihoubao.com

Handan Enterprise: Wuan Yuhua Iron & Steel Co., Ltd. No. 1 200m^2 sintering machine post-desulfurization outlet
Pollutant: SO_2 average daily concentrations (mg/m^3)
Time Period: December 11th – December 31st 2013

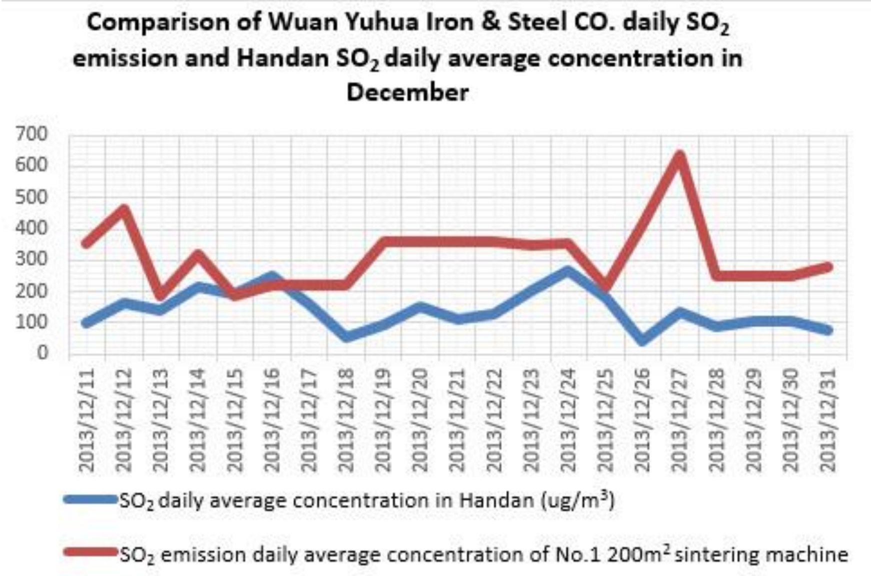

Figure 45 - Wuan Yuhua Iron & Steel daily SO_2 emission average concentration and Handan daily SO_2 concentration in December[38]

Shijiazhuang Enterprise: Hebei Xibaipo Power Co., Ltd. No.1 Discharge Outlet
Pollutant: Fumes Average Daily Concentration (mg/m^3)
Time Period: December 1st – December 31st 2013

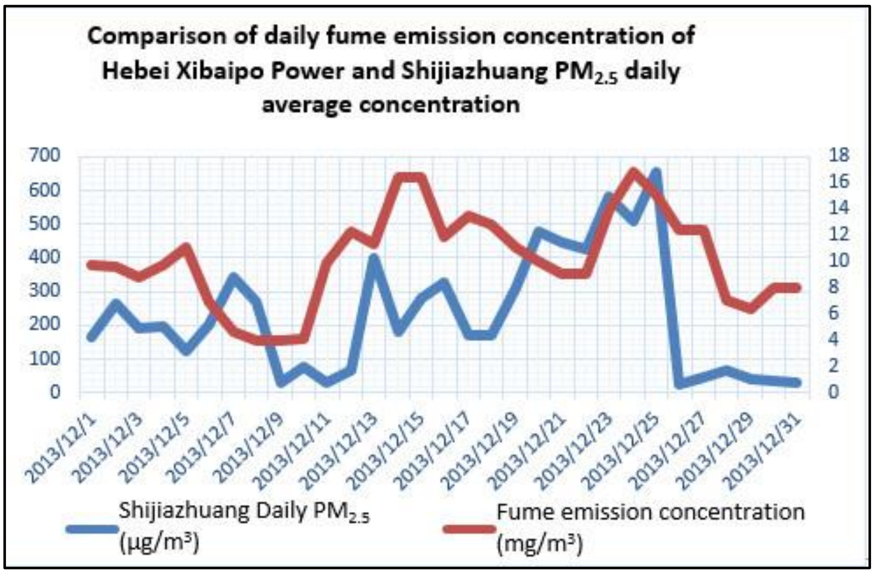

Figure 46 - Hebei Xibaipo Power daily fume emission average concentration and Shijiazhuang daily$PM_{2.5}$ concentration in December[39]

[38] December AQI trends in Handan, www.tianqihoubao.com

[39] Shijiazhuang December AQI Trends,www.tianqihoubao.com

We believe that whether the changes in emissions volume from these major pollution sources has a direct impact on local air quality is worth investigating further.

Shandong Case Study: Levels of Emissions from some Enterprises are Extremely High

Using the real-time data on the pollution source monitoring data disclosure platform for provincially and state controlled enterprises in Shandong, we calculated the emissions volume for each enterprise for the period October to December. Three months of emissions discharge for big emitting enterprises with 200 tons or more of emissions per month are shown below:

Table 20 - SO_2 emissions of polluting enterprises with monthly emissions of more than 200 tons for three consecutive months
(13 in total, unit: ton)

City	Enterprise	October Emissions	November Emissions	December Emissions	Total Emission
Liaocheng	Liaocheng Power Plant	1534.76	1022.97	736.04	3293.78
Yantai	Yantai Power Plant	545.60	946.64	465.61	1957.86
Jining	Zouxian Power Plant	599.64	551.23	531.11	1681.98
Dezhou	Dezhou Power Plant	573.67	485.32	587.56	1646.54
Liaocheng	Huaxin Aluminum	507.13	515.51	546.19	1568.83
Liaocheng	Xinyuan Aluminum	581.71	424.12	342.70	1348.53
Qingdao	Qingdao Power Plant	624.19	437.21	286.66	1348.06
Taian	Shiheng Power Plant	397.38	409.99	387.13	1194.50
Heze	Heze Power Plant	360.59	325.10	397.28	1082.97
Weifang	Weifang Power Plant	279.61	279.40	341.35	900.36
Laiwu	Laigang Iron Works	263.68	400.77	221.07	885.53
Rizhao	Rizhao Steel	236.13	284.17	318.81	839.11
Heze	CR Power	222.77	266.23	279.87	768.87

Note: Many points had a monitoring or emissions discharge value of 0. In these cases it was not possible to calculate a discharge volume for those times as it would lower the calculated monthly values compared to the actual emissions volumes. In October the Yunhe Power Plant was missing data for SO_2 24.2% of the time and the Yantai Power Plant was missing data for SO_2 for 28.2% of the time. In November SO_2 data for the Heze Power Plant was missing 20.1% of the time and in December So2 data for the Jining Power Plant was missing 17.1% of the time.

Table 21 - NO_x emissions of polluting enterprises with emissions > 200 ton for three months
(36 in total, unit: ton)

City	Enterprise	October Emissions	November Emissions	December Emissions	Total Emission
Liaocheng	Liaocheng Power Plant	3451.03	2708.79	1985.56	8145.38
Dezhou	Dezhou Power Plant	2274.12	2054.11	2224.79	6553.01
Jining	Zouxian Power Plant	2040.93	2035.93	1626.93	5703.79
Heze	Heze Power Plant	1617.94	1232.65	1569.31	4419.90
Jining	Yunhe Power Plant	779.60	861.80	1214.28	2855.68

City	Enterprise	October Emissions	November Emissions	December Emissions	Total Emission
Zibo	Qilu Petrochem	835.20	886.88	1053.80	2775.87
Heze	CR Power	825.56	945.26	795.39	2566.21
Rizhao	Rizhao Power Plant	746.22	791.09	773.14	2310.44
Yantai	Bainian Electricity	775.30	690.89	763.11	2229.30
Weifang	Weifang Power Plant	708.65	720.50	791.75	2220.90
Weihai	Huaneng Weihai	616.86	625.99	575.56	1818.40
Taian	Shiheng Power Plant	754.88	686.07	355.77	1796.72
Liaocheng	Liaocheng thermal power	736.22	606.19	431.71	1774.12
Zaozhuang	Xinyuan thermal power	348.59	643.29	734.66	1726.54
Liaocheng	Xinyuan Aluminum	653.77	518.37	470.75	1642.89
Zaozhuang	Shenfeng Cement	240.31	648.65	705.52	1594.48
Linyi	Feixian Power Plant	420.61	615.00	540.09	1575.69
Jining	Sun Paper	526.74	441.60	551.62	1519.96
Rizhao	Rizhao Steel	439.44	482.13	483.23	1404.80
Laiwu	Laicheng Power Plant	518.40	402.40	457.64	1378.44
Liaocheng	Huaxin Aluminum	407.43	411.36	509.94	1328.73
Jining	Jiaxiang Power Plant	430.28	364.85	482.39	1277.52
Qingdao	Qingdao Power Plant	320.92	260.78	631.17	1212.87
Jining	Lineng Power Plant	302.40	446.86	453.78	1203.04
Zaozhuang	Quanxing Cement	374.77	402.16	333.37	1110.30
Jining	Jining Power Plant	274.93	349.03	478.80	1102.75
Jinan	Zhangqiu Power Plant	381.22	243.96	420.38	1045.56
Zibo	Baiyanghe Electricity	347.97	318.09	344.24	1010.30
Dongying	Shengli Power Plant	249.75	285.90	462.82	998.46
Qingdao	Huangdao Power Plant	360.06	305.80	327.68	993.53
Yantai	Penglai Power Plant	280.05	334.88	305.43	920.36
Laiwu	Laiwu Power Plant	213.37	350.53	352.85	916.75
Jining	Shengcheng Thermal Power	300.79	253.48	330.45	884.71
Zaozhuang	Yicheng Pucheng	360.10	255.48	212.15	827.73
Ji'nan	Jinan Steel	261.72	210.96	224.95	697.63
Yantai	Longkou Donghai	236.97	221.02	228.20	686.18

Note: Many points had a monitoring or emissions discharge value of 0. In these cases it was not possible to calculate a discharge volume for those times as it would incorrectly reduce the monthly calculated values and not properly reflect the actual emissions volumes.

In October Yunhe Power Plant was missing data for NO_X 24.1% of the time and Jiayang Power Plant was missing 26.3% of data, Xinyuan Power Plant was missing 20.6%, Qingdao was missing 26%, Penglai Power plant 36.4% and Jining Power Plant was missing 26.4% of its data.

In November the Yunhe Power Plant was missing 27.3% of its NO_X data, Xinyuan Power Plant was missing 20.6%, Qingdao Power Plant was missing 26%, Penglai Power Plant 36.4% and Jining Power Plant was missing 26.4%.

In December Dezhou Power Plant was missing 10.3% of its NO_X data.

2.1.4.3 Some Key Areas have not Tightened Emission Standards

Good Practice Case Study 1 - Shandong Province the first to Implement more Stringent Air Emission Standards

It is worth mentioning that the Shandong online disclosure platform uses new local emission standards, which are more stringent than the current national ones, for reporting major air polluting industries and companies (such as thermal power plants, iron and steel factories, building materials factories etc.). According to an announcement[40] by the Shandong EPB in August 2013, the following six local environmental standards (hereafter referred to as "Atmospheric Series Standards") were officially implemented on September 1st, 2013.

- "Shandong Province - Integrated Regional Emission Standard for Air Pollutants" DB37/2376-2013
- "Shandong Province –Emission standard of Air Pollutants for Thermal Power Plants" DB37/664-2013
- "Shandong Province –Emission Standard of Air Pollutants for the Iron and Steel Industry"DB37/990-2013
- "Shandong Province –Emission Standard of Air Pollutants for the Building Materials Industry" DB37/2373-2013
- "Shandong Province –Emission Standard of Air Pollutants for Boilers" DB37/2374-2013
- "Shandong Province –Emission Standard of Air Pollutants for Industrial Kilns and Furnaces" DB37/2375-2013

We looked into the thermal power plant, iron and steel, and cement industries, to compare the major differences between the local Shandong "Atmospheric Series Standards" and the corresponding national standards.[41]

Table 22 - Comparison of thermal power industry standards[42]

Type	Pollutant	Current Shandong Standards	Current National Standards [43]	New National Standards from 2014.7.1 [44]	New Shandong Standards from 2017.1.1
Coal-fired boiler	Fume	30	50/200	30	20
	SO_2	200	400/800	200	100
	NO_x	100/200	450/650/1100	100/200	100/200

[40] 'Notice on the six regional atmospheric environmental standards in the Implementation of the "Shandong Province - Integrated Regional Emission Standards for Atmospheric Pollutants"', Shandong EPB Notice (2013) No. 108.

[41] The comparison of discharge standard and limits in this report all refer to a unit of "mg/m3" except when otherwise mentioned.

[42] Compared only the SO2, NOx and fume emission limits for coal-fired boilers applied to existing thermal power plants.

[43] Atmospheric Pollutant Discharge Standards for Thermal Power Plants (GB 13223 -2003), thermal power plant's coal-fired boiler built in the phase 3 period.

[44] Atmospheric Pollutant Discharge Standards for Thermal Power Plants (GB 13223 -2011).

Table 23 - Comparison of steel industry standards[45]

Steel Production Procedure	Manufacturing Process	Pollutant	Current Shandong Standards	Current National Standards [46]	New National Standards from 2015.1.1[47]	New Shandong Standards from 2015.1.1
Sintering	Equipment for sintering and pelleting	PM	50	80	50	30
		SO_2	200	600	200	100
		NO_x	300	500	300	300
Iron making	hot-blast stove	PM	20	50	20	20
		SO_2	100	100	100	80
		NO_x	300	300	300	300
Steel rolling	heat treatment furnace	PM	20	30	20	20
		SO_2	150	250	150	100
		NO_x	200	350	300	150

Table 24 - Comparison of construction material (cement) industry standards[48]

Industry/Process/Equipment	Pollutant	Current Shandong Standards	Current National Standards [49]	New Shandong Standards from 2015.1.1	New National Standards from 2015.7.1[50]
Manufacture of cement: cement kilns and cement mills	PM	30	100	30	30
	SO_2	200	200	100	200
	NO_x	800	800	400	400

The SO_2 and NO_x emission limit values for thermal power plants, and iron and steel plants, are significantly stricter in Shandong's local standards than in current national standards.

- The implementation of the new Shandong thermal power plant standard, corresponding to the new national standard (GB13223-2011), has been brought forward by 10 months in Shandong, from July 1st, 2014 to September 1st,2013;
- The implementation of the new Shandong iron and steel industry standard

[45] Compared only the SO_2, NO_x and PM emission limits of a few manufacturing processes applied to existing iron and steel mills.
[46] Including: " Emission standard of air pollutants for sintering and pelletizing of iron and steel industry" (GB28663-2012), "Emission standard of air pollutants for steel rolling industry," (GB 28665-2012), Emission standard of air pollutants for iron smelt industry, (GB 28663-2012), Emission standard of air pollutants for steel smelt industry" (GB 28664-2012), Emission standard of pollutants for ferroalloy smelt industry, (GB 28666-2012).
[47] See footnote 21.
[48] To compare only the SO_2, NO_x and PM emission limit of major manufacturing processes applied to existing cement mills.
[49] Emission standard of air pollutants for cement industry (GB 4915 -2004)
[50] Emission standard of air pollutants for cement industry (GB 4915—2013)

corresponding to the new national standard (6 related emission standards for the steel industry, namely GB 28662-2012 to GB 28666-2012) has been brought forward by 16 months in Shandong, from January 1st, 2015 to September 1st, 2013;

- The Shandong emission standards for the cement industry has kept the same discharge limits for the pollutants SO_2 and NO_x as the national standards, but has significantly tightened the limit value for PM. Shandong will start to implement a new cement industry discharge standard from January 2015, which is six months earlier than the corresponding new national standard. The new Shandong standard will apply a tighter emission control on SO_2 compared to the new national standard.

Shandong has taken the lead in implementing stricter control standards for large emitters within the province, which has proved an important factor in pushing for a reduction in emissions. As a major industrial province which ranks first on total amount of pollutants discharged, Shandong faces a pressing need to tackle its air pollution. According to the 2012 State of the Environment in Shandong Report, the electricity and heat generation & supply industry has discharged the most SO_2 and NO_x among all the industries, accounting for 52% and 62.8% respectively. Therefore, implementing stricter standards for key emission industries is crucial.

The good practice shown by Shandong has put forward a clear legal requirement for industries to achieve a step by step emission reduction, which has also enabled the public to participate in monitoring those enterprises that have not put much effort into reducing emissions. Even though this stricter requirement has contributed to a higher frequency of discharge exceedances, as shown on the real-time online monitoring platform, in the long run, it is helpful for these key state-monitored companies to get prepared for the new national standards that are upcoming.

Good Practice Case Study 2: Beijing Adopting the Most Stringent Special Emission Limits for Air Pollutants

As of December 31st, 2013, 8 out of the 10 key state-monitored companies (listed for air emissions) in Beijing had made public their daily emission data (average) on the Beijing online disclosure platform. However, two companies[51] have still failed to disclose.

国家重点监控企业自动监控情况公示

选择行政区： 北京市 选择日期： 2013-12-30 ○ 水国控 ● 气国控 查 询 备注

行政区	序号	企业名称	企业地址	监控点名称	监测日期	日累积流量(立方米)	烟气流速(米/秒)	监测项目	浓度折算日均值(毫克/立方米)	排放标准(毫克/立方米)	有效性审核 最近一次审核日期	有效性审核 合格情况
朝阳区	1	华能北京热电有限责任公司	北京市朝阳区王四营乡观音堂村	1号烟囱	2013-12-30	32299100	13.187	二氧化硫	16.746	50	2013-12-31	合格
								氮氧化物	69.476	100	2013-12-31	合格
				2号烟囱	2013-12-30	31874854	13.036	二氧化硫	19.188	50	2013-12-31	合格
								氮氧化物	75.744	100	2013-12-31	合格
				3号烟囱	2013-12-30	32795968	12.202	二氧化硫	0.872	50	2013-12-31	合格
								氮氧化物	20.492	100	2013-12-31	合格
				4号烟囱	2013-12-30	32674746	12.291	二氧化硫	0.736	50	2013-12-31	合格
								氮氧化物	20.656	100	2013-12-31	合格
	2	神华国华国际电力股份有限公司北京热电分公司	北京市朝阳区建国路75号	1号烟囱	2013-12-30	15829176	8.221	二氧化硫	20.27	50	2013-12-31	合格
								氮氧化物	86.96	100	2013-12-31	合格
				2号烟囱	2013-12-30	20723418	13.087	二氧化硫	10.613	50	2013-12-31	合格
								氮氧化物	87.974	100	2013-12-31	合格
	3	北京太阳宫燃气热电有限公司	北京市朝阳区西坝河路6号	2号烟囱	2013-12-30	30212462	12.3	二氧化硫	0.17	20	-	-
								氮氧化物	13.286	30	-	-
				1号烟囱	2013-12-30	32360474.625	13.25	二氧化硫	2.46	20	-	-
								氮氧化物	21.185	30	-	-
丰台区	4	北京京丰燃气发电有限责任公司	北京市丰台云岗西路15号	燃机烟囱	2013-12-30	-	-	二氧化硫	-	20	2013-12-25	合格
								氮氧化物	-	80	2013-12-25	合格
	5	华电（北京）热电有限公司	北京市丰台区西四环中路82号	二号炉	2013-12-30	38518016	22.34	二氧化硫	2.767	20	2013-12-31	合格
								氮氧化物	27.045	30	2013-12-31	合格
				一号炉	2013-12-30	40176456	22.668	二氧化硫	0.866	20	2013-12-31	合格
								氮氧化物	27.461	30	2013-12-31	合格
石景山区	6	大唐国际发电股份有限公司北京高井热电厂	北京市石景山区高井路	1号烟筒	2013-12-30	1050.54	5.154	二氧化硫	32.801	50	2013-12-31	合格
								氮氧化物	65.471	100	2013-12-31	合格
				2号烟囱	2013-12-30	2161.865	0	二氧化硫	32.485	50	2013-12-31	合格
								氮氧化物	68.603	100	2013-12-31	合格
				3号烟囱	2013-12-30	2266.518	39.12	二氧化硫	32.025	50	2013-12-31	合格
								氮氧化物	84.073	100	2013-12-31	合格
	7	北京京能热电股份有限公司	北京市石景山区广宁路10号	1号烟囱	2013-12-30	24918197.438	8.54	二氧化硫	28.06	50	2013-12-31	合格
								氮氧化物	61.091	100	2013-12-31	合格
				2烟囱	2013-12-30	17033918.438	14.43	二氧化硫	19.07	50	2013-12-31	合格
								氮氧化物	46.039	100	2013-12-31	合格
房山区	8	中国石化集团北京燕山石油化工有限公司（热力厂）	北京市房山区燕山岗南路1号	三热力车间一部3	2013-12-30	0	0	二氧化硫	0	50	2013-12-31	合格
								氮氧化物	0	200	2013-12-31	合格
				一热力车间一部1	2013-12-30	-	-	二氧化硫	-	50	2013-12-31	合格
								氮氧化物	-	200	2013-12-31	合格
				一热力厂一部2	2013-12-30	-	-	二氧化硫	-	50	2013-12-31	合格
								氮氧化物	-	200	2013-12-31	合格

Figure 47 – Beijing key state-monitored enterprises automatic monitoring disclosure platform

Beijing key state-monitored enterprises (listed for air emissions) are using the stricter Beijing local emission standard, namely the “Emission standard of air pollutants for boilers” (DB 11/139-2007). The discharge limit value in this standard is the same as the “Air pollutants Special Emission Limit” in Table 2 of the 2011 standard, the “Emission standard of air pollutants for thermal power plants” (GB 13223 -2011), which is one of the most stringent emission standards in China’s history.

According to the No. 14 Notice issued by the MEP in 2013,[52] in the 47 main cities categorized as key control zones, existing thermal power plants, iron and steel, and petrochemical industry enterprises, need to meet the requirements of the “Air pollutants Special Emission Limit” before the end of the 12th “Five Year Plan” period. Furthermore, coal-fired thermal power plants are required to meet the special emission limit for fumes from July 1st, 2014.

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[51] SinoPec Corp. (Beijing Yanshan Branch), Beijing Shougang Cold-Rolled Sheet Steel Co., Ltd.

[52] Notice of implementing the Special Emission limit of air pollutants, MEP Notice, No. 14, 2013

As the MEP notice only mentions that the implementation time for this "special emission limit" should be within the 12th "Five Year Plan" period, most of the cities in key control zones have not implemented this stricter limit. However, Beijing started to implement this special stricter local standard from July 1st, 2008.

In Tianjin, a city also located in the key control zone of Beijing, Tianjin and Hebei, the currently implemented local emission standard for boilers has a less stringent limit for NO_x.

Table 25 - Pollutant emission standards for boilers in Beijing and Tianjin

Type	Pollutant	Current Beijing Standard[53]	Current Tianjin Standard[54]	Special emission limit for air pollutants
Coal-fired boilers	Fume	20	30	20
	SO_2	50	100	50
	NO_x	100	450	100

The Beijing online automatic monitoring platform shows that[55] based on their daily emission data during the period Oct-Dec 2013, six out of the eight key state-monitored enterprises (listed for air emissions) have exceeded emission limits. Among these, two companies, Huadian (Beijing) Thermal Power Co., Ltd[56] and Beijing Taiyanggong Gas-fired Thermal Power Company, have shown multiple exceedances. For more details, please refer to Appendix D.

Further analysis on discharge volume data for a 3-months period showed that major thermal power plants in Beijing have seen an increase in volumes of pollutants released since the start of the winter heating season in mid-November. For more detailed analysis please refer to Appendix E.

Overall, due to the fact that Beijing has implemented the most stringent emission standards in the region, and most of the key state-monitored enterprises in Beijing can meet the discharge limits, the total discharge volume from Beijing's key state-monitored enterprises is far less than those in other cities in the same region.

[53] Emission standard of air pollutants for boilers (DB 11/139-2007) Table 2, Phase II boilers in thermal power plants.
[54] Emission standard of air pollutants for boilers (DB 12/151-2003) Table 2, Phase II coal-fired boilers.
[55] The pollutant discharge concentration is the average daily value (unit: mg/m^3)
[56] On January 15th, staff from Huadian (Beijing) Thermal Power Co., Ltd. (hereafter referred to as Beijing Huadian) called the IPE to express their doubt about the data showing exceedances at Beijing Huadian that were used in the report. IPE explained that the data that was used in the report came from the Beijing EPB automatic monitoring platform which was set-up according to the law to show automatic monitoring data from key state monitored enterprises. On the same day the IPE received another call from staff at Huadian Beijing stating that they had already contacted the Beijing EPB on the data discrepancy issue and were now waiting for official clarification from them.

Good Practice Case Study 3: Hebei Province implemented a more Stringent Emission Standard for its Iron and Steel Industry

75 key state-monitored iron and steel plants are listed on the Hebei pollution source automatic monitoring platform. The "2013 Q3 Supervision Monitoring Results for Hebei Key State-monitored Enterprises," shows that most of these enterprises use the national iron and steel industry emission standards (6 relevant emission standards for the steel industry, namely GB 28662-2012 to GB 28666-2012) made effective on 1 October 2012.

Hebei issued a local standard, "Emission standard of air pollutants in iron and steel industry" (DB13/ 1461—2011) on November 30th, 2011, which requires that existing iron and steel plants implement a more stringent emission limit two years after the date the standard became effective. A detailed comparison of the local and national standard is shown in the following table:

Table 26 - Hebei local standards and national standards for steel industry comparison[57]

Production unit or facility in steel making process		Pollutant	Hebei standard from 2011.11.30	Current Hebei standard from 2013.11.30	Current National standard from 2012.10.1	National standard from 2015.1.1
Sintering	sintering machine head, pellet firing equipment, drying machine (pelleting)	PM	80	50	80	50
		SO_2	650	200	600	200
		NOx	500	400	500	300
Blast furnace iron making	hot-blast stove	PM	20	20	50	20
		SO_2	100	80	100	100
		NOx	300	300	300	300
Steel making	lime-calcination reactor	PM	50	30	50	30
		SO_2	850 (coal-fired) 80 (gas-fired)	400 (coal-fired) 80 (gas-fired)	-	-
		NOx	800	800	-	-
Steel rolling	heat treatment furnace	PM	20	20	30	20
		SO_2	150	150	250	150
		NOx	240	150	350	300

We found that from November 30th, 2013, existing iron and steel plants in Hebei province had to implement a stricter emission standard than the current national one. Take the Sintering process as an example, the new Hebei standard sets the SO_2 discharge limit at 200mg/m^3, far stricter than

[57] Only compared SO_2, NO_x and PM discharge limit values at existing steel plants for some production processes.

the current national standard of 600mg/m^3.

Guangdong Province also has a more stringent local emission standard in place; however, regrettably until now the provincial online monitoring disclosure portal of Guangdong province has not yet been made public. For more details please refer to Appendix F.

Many Heavily Polluted Provinces and Regions have still not tightened their Emission Standards

Whether or not thermal power plants can meet new national standard remains a big question.

In less than six months, by July 1st, 2014, all existing thermal power plants will have to implement the new national emission standard. The discharge limits for main atmospheric pollutants, namely SO_2 and NO_x, will be greatly reduced.

However our research has found that most of the major power supplying provinces, such as Hebei, Zhejiang, Inner Mongolia, Jiangsu and Henan, are still using the current national standard.

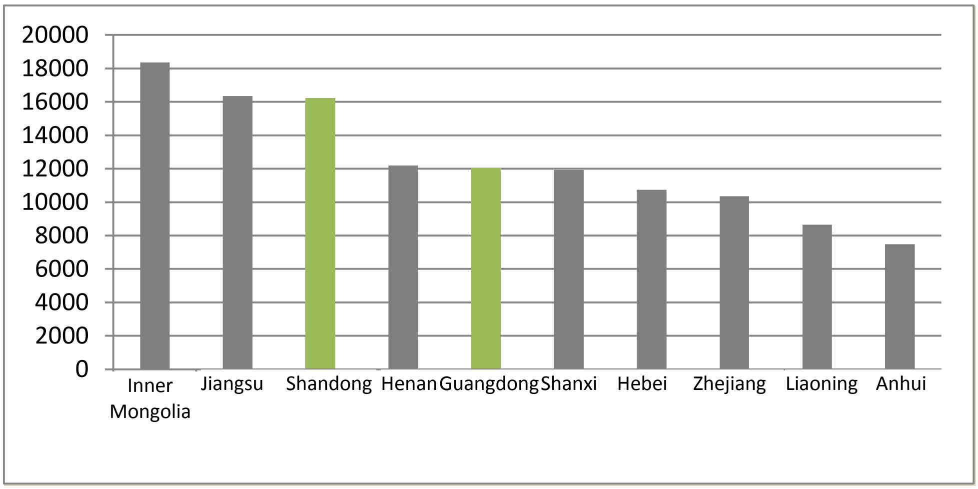

Figure 48 - 2011 TOP 10 provinces for coal consumption in the thermal power industry[58]

Note: Green colored provinces have implemented tighter emission control while gray colored ones have not.

Based on the analysis of online emission data from Hebei and Zhejiang provinces, thermal power plants are constantly discharging at relatively high levels (particularly for the air pollutant NO_x), far higher than the upcoming new national standard. Whether or not these plants have prepared for the implementation of the new requirements in half a year’s time and are able to significantly improve their pollutant treatment capability remains a worrisome question.

58 Based on the China Environmental Statistics Report 2011 (page 203)

Hebei Case Study: The emissions standards for thermal power plants is far less strict than in Shandong, and the level of emissions is far higher than the levels stipulated in the new upcoming standard

36 key state-monitored thermal power plants are listed on the Hebei Pollution source online monitoring platform. The “2013 Q3 Supervision Monitoring Results for Hebei Key State-monitored Enterprises,” shows that most of these power plants use the current national standards (GB13223-2003), which were implemented in 2004, and have been used since.

Data shown on the Hebei automatic monitoring platform shows that for the period October – December 2013, pollutant emissions from some of the key monitored thermal power plants either exceeded the standard limit values or was at a high concentration level. The following charts show a clear gap between the current emission patterns and the new emission standard that will be implemented in the future.

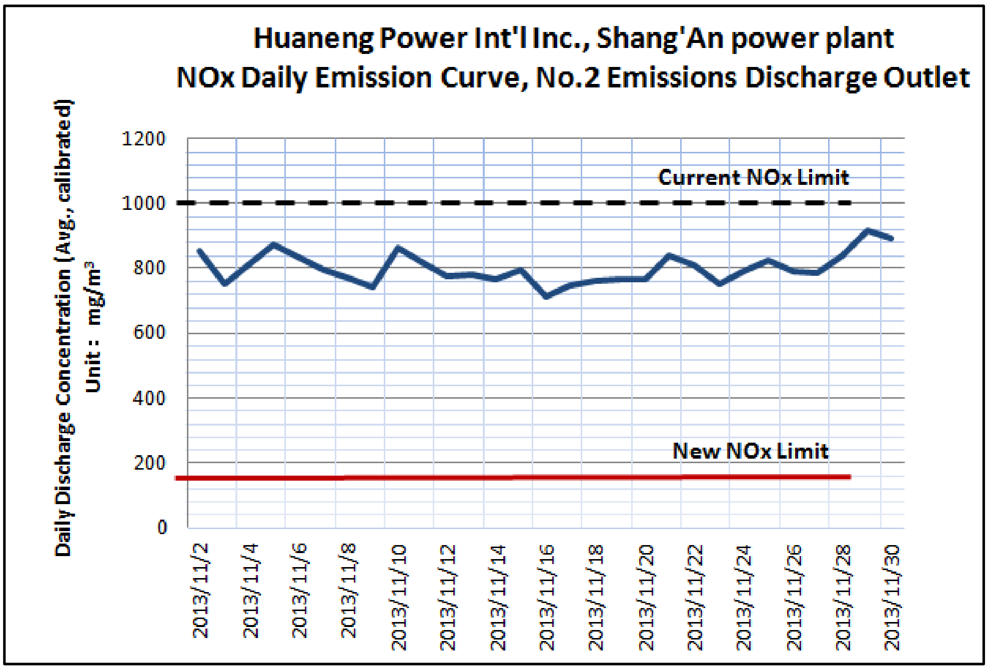

Figure 49 - NO_x daily emission curve of Huaneng Power Int’l Inc., Shang’an Power Plant (Nov. 2013)

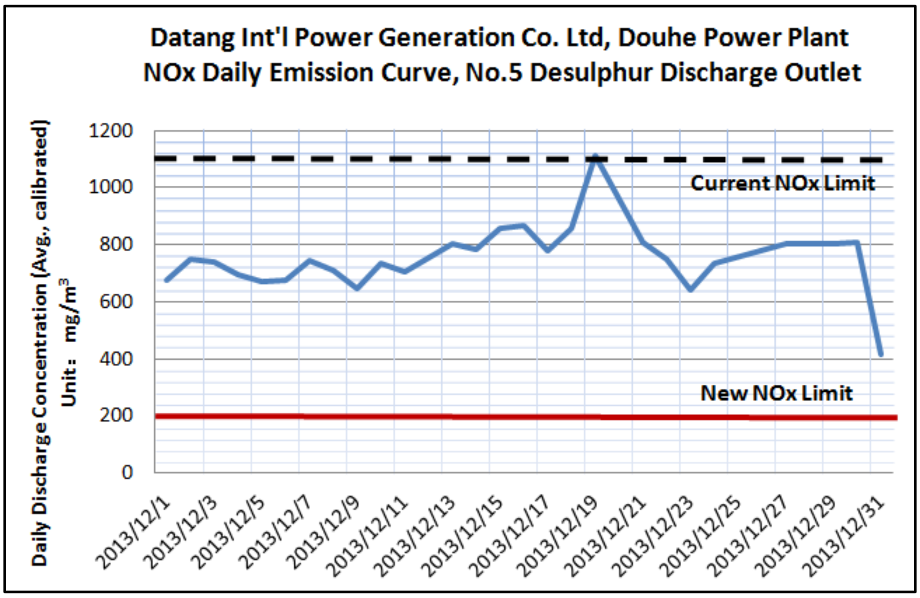

Figure 50 - NO_x daily emission curve of Datang Int'l Power Generation Co. Ltd, Douhe Power Plant (Dec. 2013)

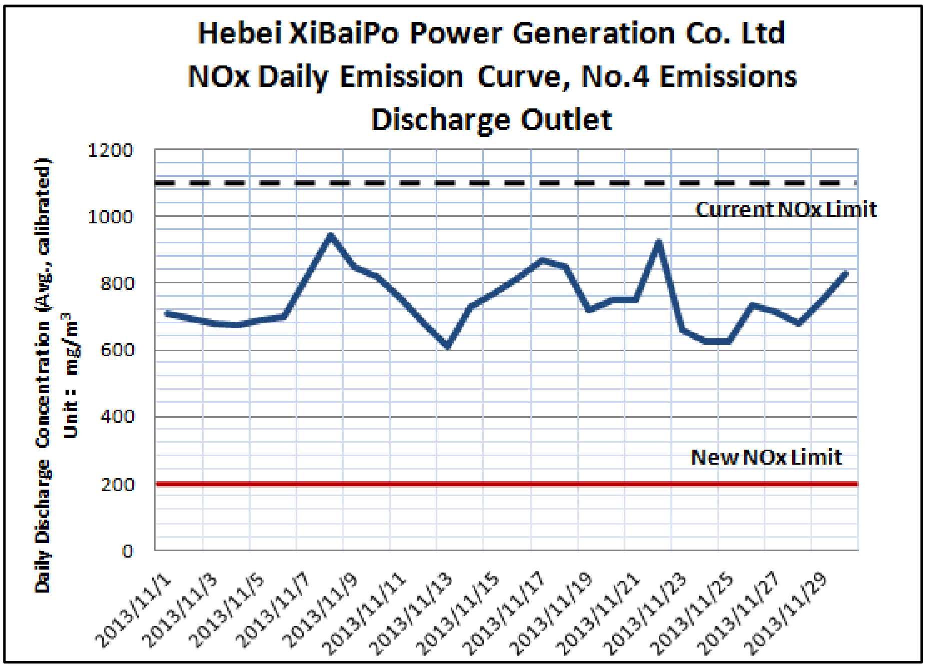

Figure 51 - NO_x daily emission curve of Hebei Xibaipo Power Generation Co. Ltd (Nov. 2013)

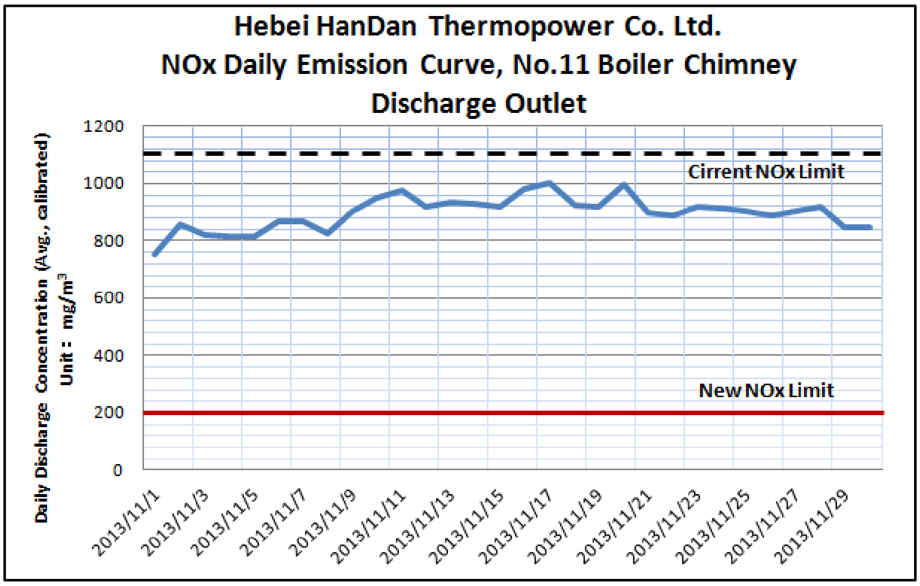

Figure 52 - NO_x daily emission curve of Hebei Handan Thermal Power Co. Ltd (Nov. 2013)

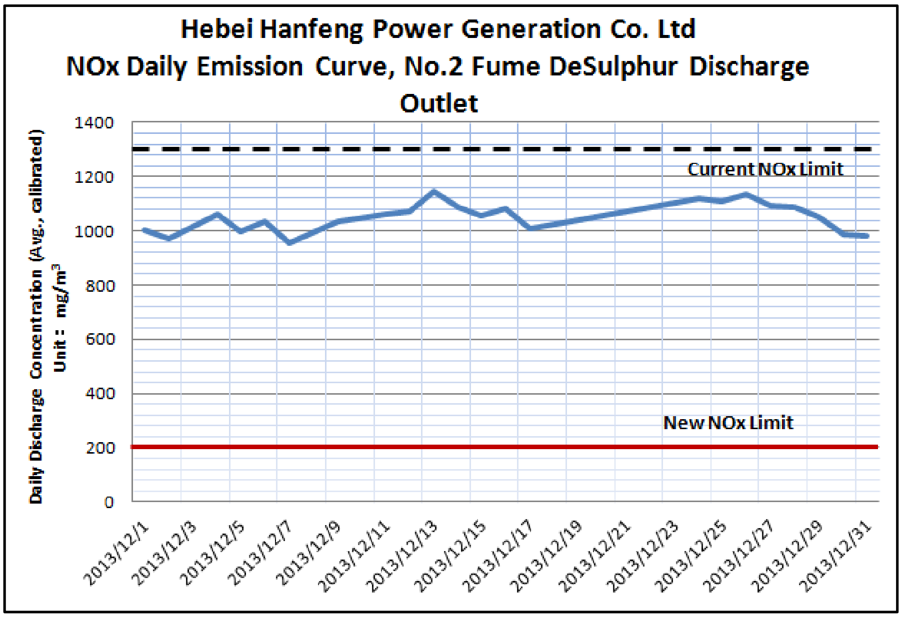

Figure 53 - NO_x daily emission curve of Hebei Hanfeng Power Generation Co. Ltd (Nov. 2013)

Zhejiang Case Study: Still a large gap to meet the new emission standards

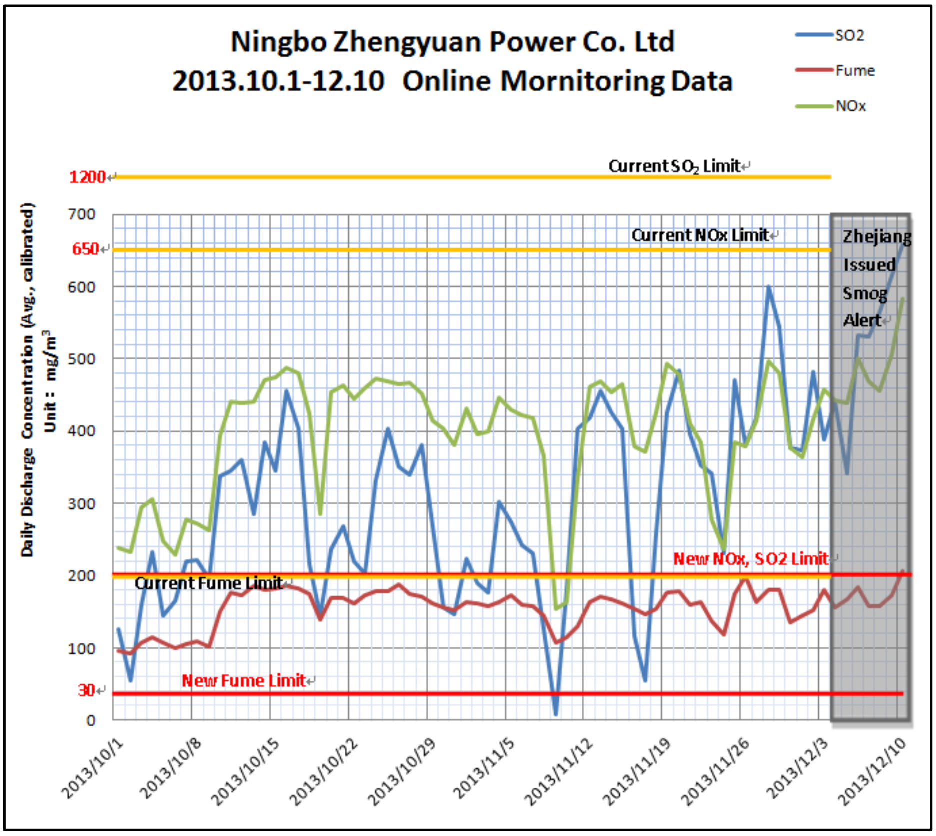

Figure 54 - Online monitoring data curve of Ningbo Zhengyuan Power Co. Ltd (Oct.1-Dec.10 2013)

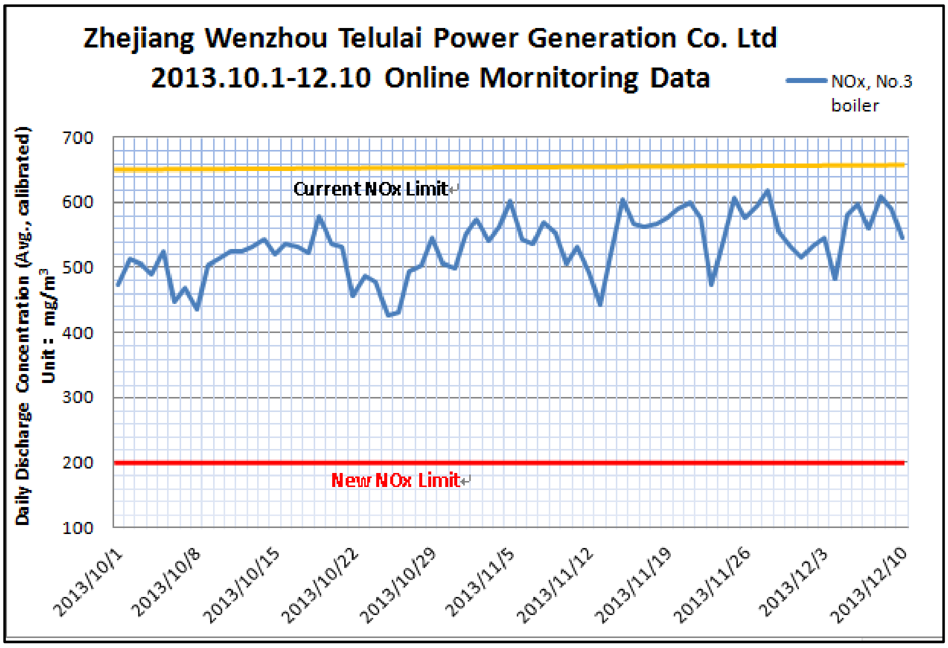

Figure 55 - Online monitoring data curve of Zhejiang Wenzhou Telulai Power Generation Co. Ltd (Oct.1-Dec.10 2013)

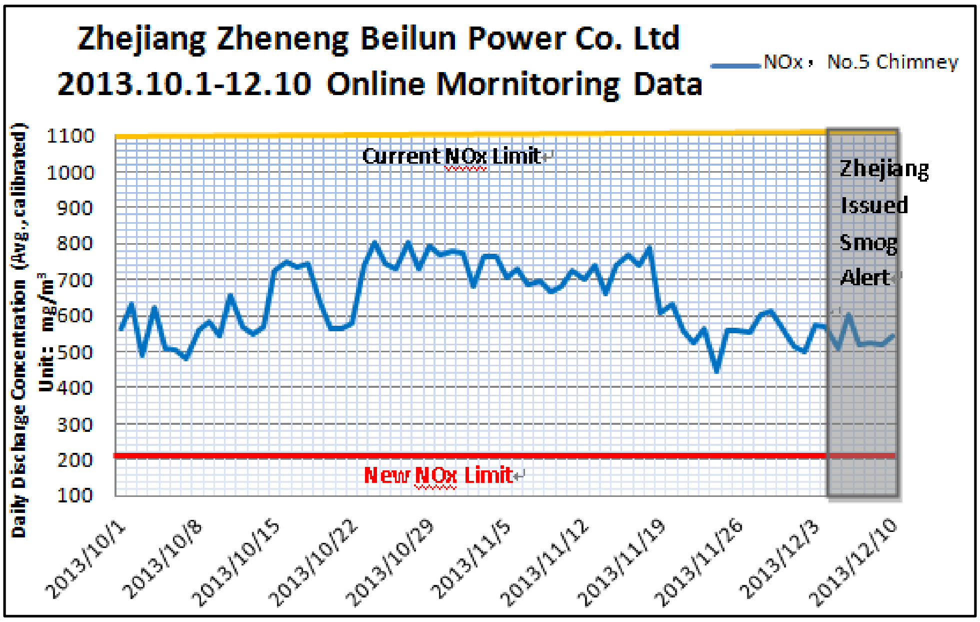

Figure 56 - Online monitoring data curve of Zhejiang Zheneng Beilun Power Generation Co. Ltd (Oct.1-Dec.10 2013)

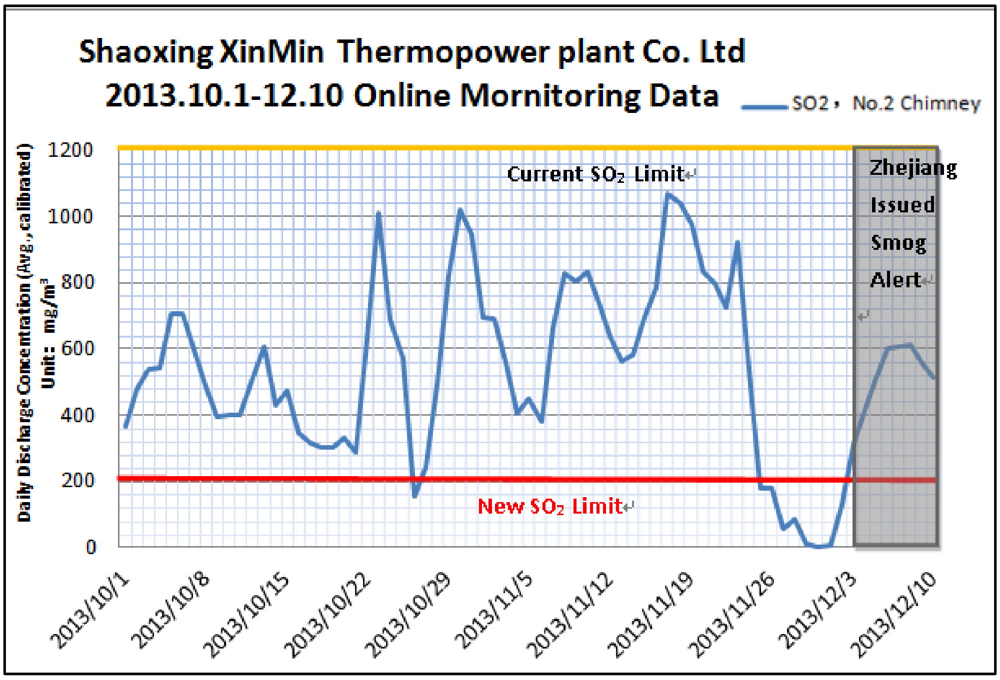

Figure 57 - Online monitoring data curve of Shaoxing Xinmin Thermal Power Co. Ltd. (Oct.1-Dec.10 2013)

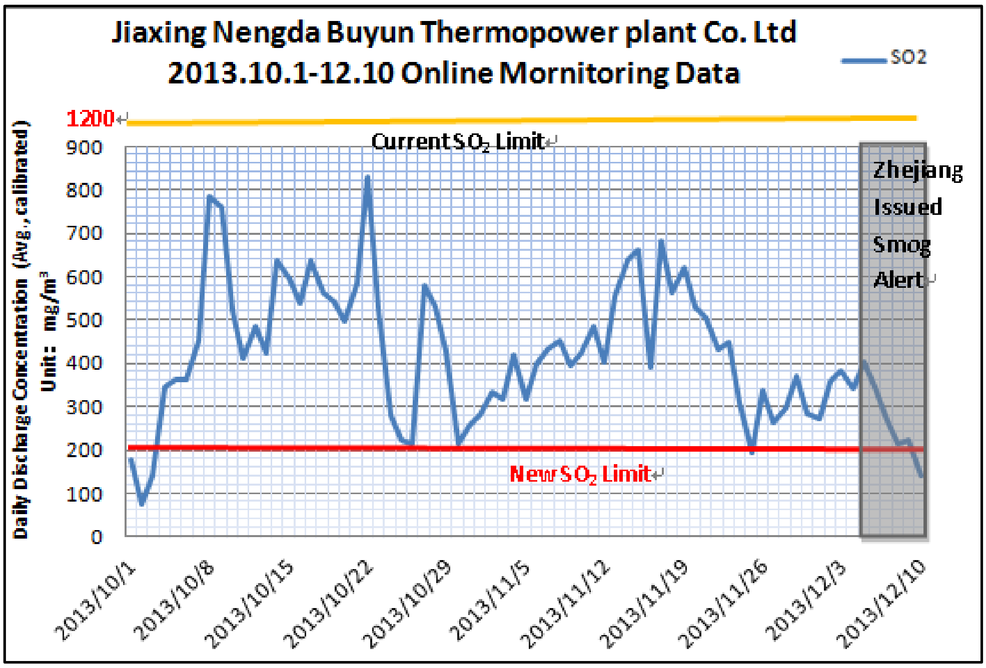

Figure 58 - Online monitoring data curve of Jiaxing Nengda Buyun Thermal Power Co. Ltd. (Oct.1-Dec.10 2013)

2.1.4.4 Online Monitoring Data has Shed Light on Key Regional Polluters

Using the real-time online emission data published by Beijing, Hebei and Shandong provinces, we were able to compare the total pollutant emission volume released by the eight biggest key state-monitored enterprises (listed for air emissions) in each area.[59] The analysis reveals a striking difference in the scale of emissions at different industrial pollution sources in each area.

By calculating the total emissions volumes for the period October to December 2013, Shandong and Hebei province's NO_x emissions were 37 times and 30 times greater than that of Beijing.

[59] Please see appendix G for more details of these key state monitored enterprises pollution discharge volumes.

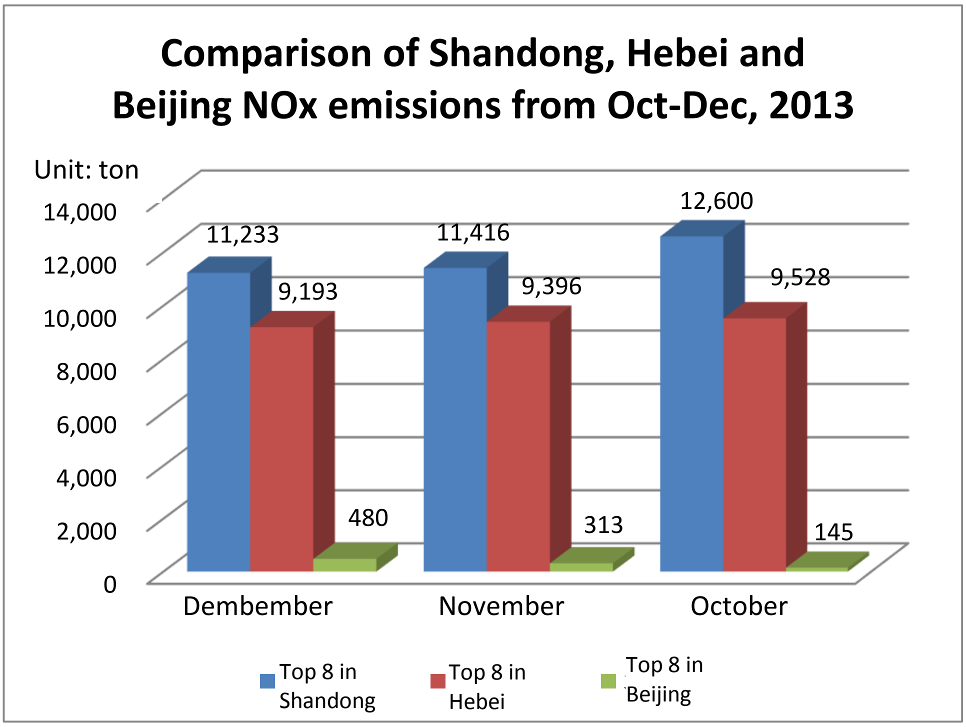

Figure 59 - Comparison of Shandong, Hebei and Beijing NO_x emissions from Oct-Dec 2013

By calculating the total emissions volumes for the period October to December 2013, Shandong and Hebei province's SO_2 emissions were respectively 77 times and 67 times greater than that of Beijing.

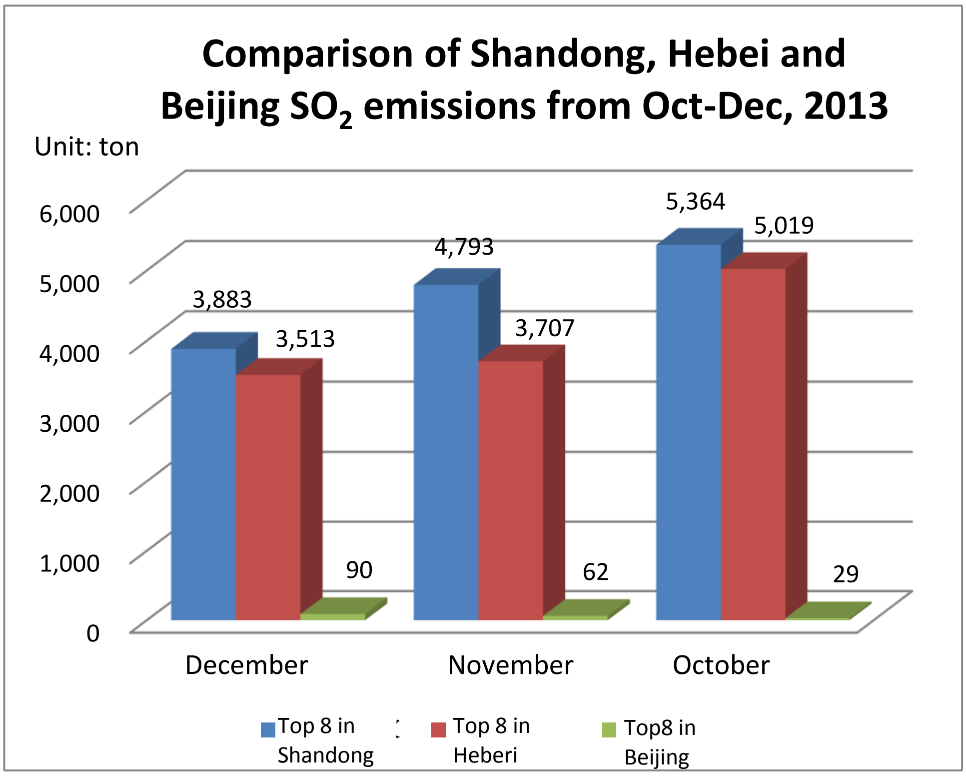

Figure 60 - Comparison of SO_2 emissions in Shandong, Hebei and Beijing for Oct-Dec 2013

Based on the December data for Shandong, Hebei and Beijing, as published on their online monitoring platforms, an illustrative graphic was made to show the distribution of some of the key regional pollution sources and the scale of their daily emissions.

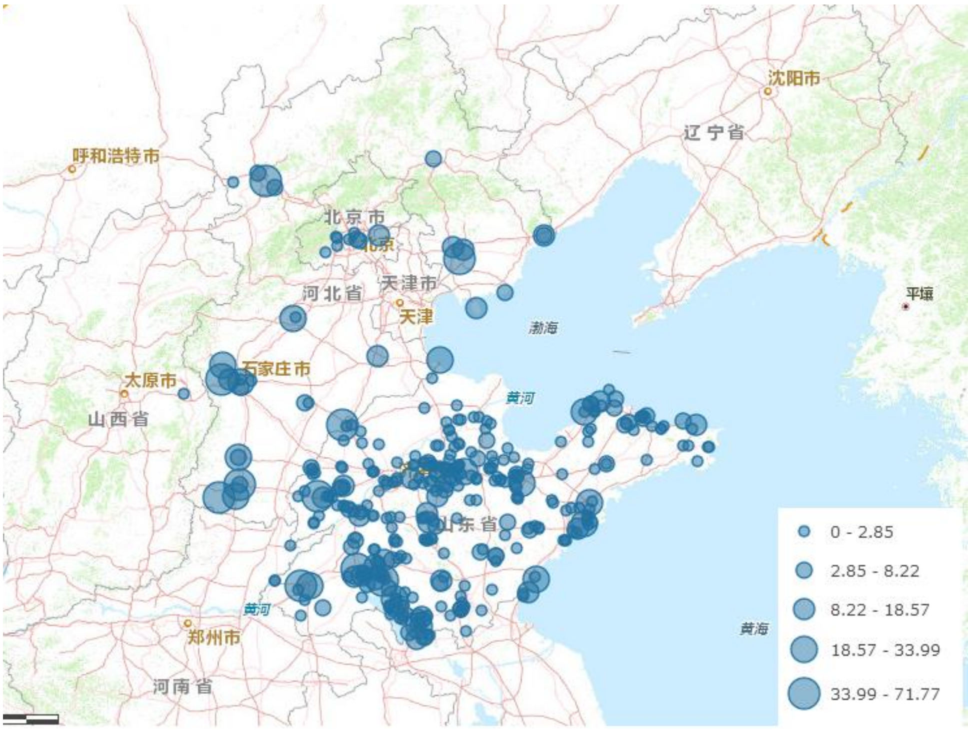

Figure 61 - Distribution and scale of emissions from key regional polluters in Beijing, Shandong and Hebei

It should be noted that despite several reminders sent to the Tianjin EPB by environmental groups, there is still no online disclosure platform for Tianjin. This means that the region is lacking a significant portion of its data, so we suggest that Tianjin immediately follow-up on this.

Showing a comparison of discharge volumes and main pollution sources on a map helps to clearly show pollution discharge sources within a geographical region. The huge disparity between emissions volumes in Beijing, Hebei and Shandong shows how necessary it is to adopt a regionally integrated approach to pollution control in the area.

2.2 A Key Breakthrough is needed to Promote Step by Step Emissions Reductions

The widespread smog in 2013 gave rise to social concern and resulted in an aggressive action plan being implemented.

On September 10th, 2013, the State Council issued the “Air Pollution Reduction Action Plan” that proposed a sharp reduction of heavily polluted days by 2017 for the Beijing-Tianjin-Hebei Area, the Pearl River Delta and the Yangtze Delta. It also aimed to eliminate heavy pollution days over the following five years and beyond.

The plan sets out step by step actions to improve air quality in key regions. By 2017, the Beijing-Tianjin-Hebei Area, the Yangtze Delta, and the Pearl River Delta are to reduce the concentration of $PM_{2.5}$ fine particulate matter by around 25%, 20%, and 15%, and Beijing should control its average annual $PM_{2.5}$ concentration to 60 ug/m^3.

This also marks a transformation of pollution control targets from emission volume targets to air quality targets. To achieve this target, wide-scale emissions reductions need to be realized, thus, amongst the Ten National Measures, the plan offers directions and incentives to aid the process.

Table 27. Summary of the Ten National Measures

1.	Coordinated governance for reduced pollution emissions
2.	Adjust and optimize industrial structures
3.	Speed up enterpises' technological transformation
4.	Speed up the adjustment of the energy sector
5.	Stricter energy conservation and environmental protection
6.	Increase use of market mechanisms
7.	Improve the legal and administrtive system
8.	Establish regional cooperation mechanisms
9.	Establish monitoring and early warning systems
10.	Mobilize public participation

Among these Ten National Measures, the first five concern the reduction of pollutant emissions, adjustments to the makeup of industry, cleaner production, adjustments to the structure of energy consumption, and stricter energy saving and environmental protection measures. All of these measures can directly reduce pollution emissions. The first article covers the reduction of major pollutant emissions, including industry and coal burning, dust and cooking fumes, and motor vehicles exhaust and other sources.

However, the most important breakthrough in the Ten National Measures lies in the recognition that to control air pollution there must be a reduction in emissions, and this reduction must involve the control of total coal consumption. Structural adjustments to the energy sector is also contingent on adjustments to industrial structure.

The Action Plan requires for the first time that by 2017, China's most economically developed areas, including Beijing-Tianjin-Hebei, the Yangtze Delta and the Pearl River Delta, should implement a more ambitious reduction in the growth rate of total coal consumption. Controlling the total coal consumption level, means effectively controlling the growth in energy demand. Because industrial production is the main source of China's energy consumption, controlling the growth of energy demand thus requires adjustment of the structure of industry, and solving the problem of having a high proportion of energy intensive industries. For this reason, the Action Plan proposes reining in energy intensive and highly polluting industries like steel, cement, electrolytic aluminum, and the plate glass industries, while at the same time increasing the elimination of backwards forms of production.

In addition to coal combustion, industrial emissions are also a major source of air pollution. The Action Plan proposes to increase desulfurization, denitrification and dust controls in the thermal power, steel, petrochemicals, non-ferrous metals, and cement industries. Cleaner production technologies should be implemented, and the emission intensity should be reduced by more than 30% compared to 2012 levels for the industries mentioned above. Simultaneously, a remediation system is to be implemented for volatile organic compounds from the petroleum and petrochemical, organic chemical, coating, packaging and printing industries.

Around the same time as the introduction of the Ten National Measures, provincial and city governments, and environmental protection departments, also issued a series of action plans directed at air pollution.

- The Beijing Municipal Government issued the "Clean Air Action Plan 2013-2017," which proposed a reduction of coal consumption by 13 million tons over five years, and by 2017 the city's share of coal as energy consumption should be reduced by 10%.
- The government of Tianjin issued the "Clean Air Action Program," which proposed a reduction of coal consumption by 10 million tons in five years, and the elimination of backward production capacity of 1.4 million tons of steel and 2.29 million tons of cement by the end of 2013.
- Hebei released the "Air pollution elimination action plan program," which aims that by 2017 the province's coal consumption will be reduced by a net reduction of 40 million tons from 2012 levels, steel production capacity will be cut by 60 million tons, and the backward production capacity of more than 61 million tons of cement and 36 million boxes of plate glass will be eliminated.
- In 2013 Shandong issued the "2013-2020 Air Pollution Prevention Plan," which set out three phases to reach the final targets. For the planning phase of 2013-2015, the target was to control air pollution with an improvement of air quality of more than 20% compared to 2010 levels. By the end of 2015, the province should phase out iron-smelting capacity by 21.11 million tons, steel production capacity by 22.57 million tons, and 13.1 million tons of coke production capacity, and strive to contain coal consumption growth. By the end of 2017, total net coal consumption, based on 2012 levels, should be reduced by 20 million tons.
- In the Yangtze Delta area, the Shanghai and Zhejiang governments have introduced a special air pollution action plan which proposes coal consumption reduction targets. It has been reported that Jiangsu's air pollution prevention and control action plan program is forthcoming.

If we are to achieve large-scale emissions reductions from industrial and coal-fired sources then priorities must be identified

Faced with such a huge number of pollution sources, we must determine which to focus on. Much of the emissions mentioned above come from a group of state and provincially monitored pollution sources. Analysis of online monitoring data has shown that a group of these enterprises discharge pollutants in breach of the regulations, and furthermore, their emissions volumes are extremely large. We tried to calculate that if the enterprises were able to meet all the discharge standards, including those new discharge standards that are going to be implemented over the next six months to a year, on what kind of scale, and by how much, could they reduce their emissions.

Table 28 - NO_X emission reduction potentials of some key monitored enterprises in Shandong

City	Monitoring site	October			November			December		
		Emission (tons)	Emission Reduction (tons)	Reduction Ratio	Emission (tons)	Emission Reduction (tons)	Reduction Ratio	Emission (tons)	Emission Reduction (tons)	Reduction Ratio
Liaocheng	Liaocheng Power Plant	3451	2760	80.0%	2709	2138	78.9%	1986	1561	78.6%
Dezhou	Dezhou Power Plant	2274	1921	84.5%	2054	1723	83.9%	2225	1815	81.6%
Jining	Zouxian Power Plant	2041	1425	69.8%	2036	1417	69.6%	1627	1044	64.2%
Heze	Heze Power Plant	1618	1381	85.3%	1233	1038	84.2%	1569	1341	85.5%
Zibo	Petrochem Assets	835	697	83.4%	887	733	82.6%	1054	872	82.8%
Heze	CR Power	826	690	83.5%	945	769	81.3%	795	563	70.8%
Jining	Yunhe Power	780	594	76.1%	862	681	79.0%	1214	970	79.9%
Yantai	Bainian Power	775	631	81.4%	691	565	81.7%	763	602	78.9%
Taian	Shiheng Power Plant	755	223	29.6%	686	167	24.4%	356	23	6.5%
Rizhao	Rizhao Power Plant	746	553	74.1%	791	592	74.9%	773	578	74.7%
Liaocheng	Liaocheng Thermal Power	736	633	86.0%	606	525	86.6%	432	378	87.6%
Weifang	Weifang Power Plant	709	420	59.3%	720	435	60.4%	792	443	55.9%
Liaocheng	Xinyuan Aluminum	654	472	72.2%	518	376	72.6%	471	349	74.1%
Weihai	Huaneng Weihai	617	354	57.4%	626	375	60.0%	576	304	52.9%
Jining	Sun Paper manufacturing	527	343	65.1%	442	288	65.2%	552	363	65.8%
Laiwu	Laicheng Power Plant	518	350	67.6%	402	268	66.7%	458	301	65.8%
Rizhao	Rizhao Steel Co.	439	0	0.0%	482	0	0.0%	483	0	0.0%
Jining	Jiaxiang Power Plant	430	331	76.9%	365	297	81.4%	482	377	78.1%
Linyi	Feixian Power Plant	421	255	60.6%	615	410	66.6%	540	321	59.4%
Liaocheng	Huaxin Aluminum	407	235	57.7%	411	213	51.8%	510	301	59.0%
Jinan	Zhangqiu Power Plant	381	229	60.0%	244	136	55.8%	420	279	66.3%
Zaozhuang	Quanxing Cement	375	0	0.0%	402	0	0.0%	333	0	0.0%
Zaozhuang	Yicheng Pucheng	360	29	7.9%	255	4	1.6%	212	3	1.4%

City	Monitoring site	October			November			December		
		Emission (tons)	Emission Reduction (tons)	Reduction Ratio	Emission (tons)	Emission Reduction (tons)	Reduction Ratio	Emission (tons)	Emission Reduction (tons)	Reduction Ratio
Qingdao	Huangdao Power Plant	360	130	36.1%	306	82	26.8%	328	80	24.4%
Zaozhuang	Xinyuan Thermal Power	349	249	71.3%	643	490	76.2%	735	554	75.5%
Zibo	Baiyanghe Power	348	204	58.6%	318	145	45.5%	344	166	48.2%
Qingdao	Qingdao Power Plant	321	85	26.5%	261	77	29.4%	631	392	62.1%
Jining	Lineng Power Plant	302	192	63.4%	447	317	70.9%	454	326	71.9%
Jining	Shengcheng Thermal Power	301	255	84.9%	253	211	83.4%	330	270	81.7%
Yantai	Penglai Power Plant	280	184	65.7%	335	198	59.0%	305	168	55.1%
Jining	Jining Power Plant	275	112	40.7%	349	166	47.6%	479	256	53.5%
Jinan	Ji'nan steel Co.	262	0	0.0%	211	0	0.0%	225	0	0.0%
Dongying	Shengli Power Plant	250	130	51.9%	286	154	54.0%	463	275	59.5%
Zaozhuang	Shenfeng Cement	240	0	0.0%	649	36	5.6%	706	96	13.6%
Yantai	Longkou Donghai	237	185	78.2%	221	172	77.8%	228	178	77.8%
Laiwu	Laiwu Power Plant	213	146	68.5%	351	247	70.5%	353	239	67.7%
Total		24413	16395	67.2%	23613	15444	65.4%	24203	15789	65.2%

Note: NOx emissions data for Shandong enterprises for the period October-December had a validity rate of 85.78%, so 14.22% of the data was invalid.

Table 29 - SO_2 emission reduction potentials of some key monitored enterprises in Shandong

City	Monitoring site	October			November			December		
		Emission (tons)	Emission Reduction (tons)	Reduction Ratio	Emission (tons)	Emission Reduction (tons)	Reduction Ratio	Emission (tons)	Emission Reduction (tons)	Reduction Ratio
Liaocheng	Liaocheng Power Plant	1535	613	40.0%	1023	381	37.3%	736	257	34.9%
Qingdao	Qingdao Power Plant	624	228	36.6%	437	78	17.9%	287	1	0.3%
Jining	Zouxian Power Plant	600	0	0.0%	551	317	57.6%	531	0	0.0%
Liaocheng	Xinyuan Aluminum	582	400	68.7%	424	282	66.5%	343	221	64.4%
Dezhou	Dezhou Power Plant	574	0	0.0%	485	0	0.0%	588	0	0.0%
Yantai	Yantai Power Plant	546	379	69.5%	947	816	86.2%	466	389	83.6%
Liaocheng	Huaxin Aluminum	507	334	65.9%	516	0	0.0%	546	337	61.7%
Taian	Shiheng Power Plant	397	0	0.0%	410	4	0.9%	387	4	1.1%
Heze	Heze Power Plant	361	0	0.0%	325	3	0.9%	397	16	4.1%
Weifang	Weifang Power Plant	280	0	0.0%	279	0	0.0%	341	0	0.0%
Laiwu	Laigang Iron Works	264	63	23.8%	401	180	44.9%	221	30	13.7%
Rizhao	Rizhao Steel Co.	236	0	0.0%	284	0	0.0%	319	0	0.0%
Heze	CR Power	223	0	0.0%	266	0	0.0%	280	0	0.0%
Total		6727	2018	30.0%	6349	2061	32.5%	5441	1255	23.1%

Note: The SO_2 emissions data for Shandong's enterprises for the period October-December, had a validity rate of 81.61%, so 18.39% of the data was invalid.

Table 1 - Emission NO_X reduction potentials of some key monitored enterprises in Hebei

City	Enterprise	October			November			December		
		Emission[60] (Tons)	Reduction[61] (Tons)	Reduction ratio	Emission (Tons)	Reduction (Tons)	Reduction ratio	Emission (Tons)	Reduction (Tons)	Reduction ratio
Shijiazhuang	Huaneng Power Co., Ltd Shangan Power Plant	2,778	1,999	71.9%	1,763	1,228	69.6%	1,683	1,081	64.2%
Handan	Hebei Handan Power Plant Co., Ltd	1,116	880	78.8%	1,809	1,477	81.7%	1,747	1,347	77.1%
Shijiazhuang	Hebei Xibaipo Power Plant Co., Ltd	1,529	1,045	68.3%	1,643	1,153	70.2%	904	563	62.3%
Tangshan	Hebei Datang Tangshang Thermal Power Co., Ltd	889	402	45.2%	1,242	565	45.5%	1,430	522	36.5%
Handan	Datang Hebei Power Co., Ltd, Matou Thermal Power branch	490	292	59.6%	822	534	65.0%	781	499	63.8%
Xingtai	Xingtai Guotai Power Co., Ltd	473	300	63.4%	640	414	64.7%	798	513	64.3%
Zhangjiakou	Datang Co. Power Co., Ltd Zhangjiakou Power Plant	1,404	671	47.8%	969	554	57.2%	1,211	770	63.5%
Cangzhou	Hebei Guohua Cangdong Power Co., Ltd	848	329	38.9%	480	131	27.4%	637	221	34.7%
Cangzhou	Cangzhou CR Thermal Power Co., Ltd	341	36	10.5%	615	65	10.6%	540	35	6.5%
Shijiazhuang	Hebei Huadian Shijiazhuang Thermal Power Co., Ltd	22	-	0.0%	74	-	0.0%	90	-	0.0%

If the 35 thermal power plants listed above were to adhere to the new discharge standards then they could achieve NO_x reductions of 7948 tons, or 48.7% (based on data for December 2013). Those 21 power plants with emissions greater than 200 tons/month have a total emissions volume of 14,740.96 tons, and account for 90.3% of total emissions. If these 21 companies effectively implemented the new standards, they could achieve an emissions reduction of 7666.4 tons, or

[60] Emissions calculation method: Used the daily average concentration of pollutants released and the average flow rate (m^3/s) as released on Hebei's online monitoring platform. Depending on the quality of the data, some adjustments were made to reflect the correct unit of measurement (m^3/s to m^3/h). Some of the flow rates showed negative figures so were not included. Same for below.

[61] Method used to calculate reduction potential: Using the emissions volume data for each enterprise, the calculation assumes that the enterprises can satisfy the July 1st new national discharge standards for thermal power plants, namely NO_x emission max upper limit: 200mg/m^3; SO_2 emissions max upper limit: 200mg/m^3. Same for below.

52.0%. This shows that the potential for reducing NO_x emissions is substantial.

Table 31 - Emission SO_2 reduction potentials of some key monitored enterprises in Hebei

City	Enterprise	October			November			December		
		Emission (tons)	Reduction (tons)	Reduction ratio	Emission (tons)	Reduction (tons)	Reduction ratio	Emission (tons)	Reduction	Reduction ratio
Shijiazhuang	Huaneng Power Co., Ltd Shangan Power Plant	1,628	684	42.0%	1,175	496	42.2%	956	78	8.1%
Cangzhou	Cangzhou CR Thermal Power Co., Ltd	1,818	1,506	82.8%	518	114	22.0%	398	23	5.7%
Cangzhou	Hebei Guohua Cangdong Power Co., Ltd	146	7	4.5%	349	142	40.7%	200	29	14.6%
Handan	Hebei Handan Power Co., Ltd	280	50	17.9%	570	246	43.3%	485	101	20.9%
Handan	Datang Hebei Power Co., Ltd Matou Thermal Power Branch	270	66	24.3%	337	56	16.8%	303	39	12.9%
Xingtai	Xingtai Guotai Power Co., Ltd	223	50	22.3%	269	43	15.9%	288	17	5.8%
Zhangjiakou	Datang Power Co., Ltd Zhangjiakou Power Plant	556	4	0.7%	340	2	0.5%	470	43	9.2%
Shijiazhuang	Hebei Xibaipo Power Co., Ltd	262	0	0.0%	329	1	0.4%	245	-	0.0%
Tangshan	Hebei Datang Co. Tangshan Thermal Power Co., Ltd	207	-	0.0%	289	-	0.0%	344	-	0.0%
Shijiazhuang	Hebei Huadian Shijiazhuang Thermal Power Co., Ltd	37	1	2.6%	163	12	7.1%	269	30	11.2%

If the 35 thermal power companies listed above were to implement the new standards, SO_2 emissions would be reduced by 750.85 tons, or 9.8% (based on data for December 2013). 18 enterpises with emissions greater than 200 tons/month had total emissions of 5782.97 tons, and accounted for 75.2% of the emissions total. For these 18 companies, the implementation of new standards would reduce their emissions by 519.24 tons, or 9.0%.

This result shows that stricter emissions standards based on environmental capacity and key pollution sources adhering to emission standards, can achieve large-scale reductions of regional pollution emissions. This can be the breakthrough towards effective coal combustion and industrial pollution control.

Controlling Motor Vehicle Exhaust and Dust Pollution is also Key

Besides emissions from industry and coal combustion, motor vehicle exhaust and dust are also important sources of pollution.

The problem of construction and road dust pollution is clear, methods of abatement are low-tech, only limited investment is needed, and public oversight is easy to develop. For these reasons the control of dust pollution should be implemented along with industrial and coal combustion pollution control.

By contrast, motor vehicle pollution covers a wide range of complex pollution problems, so vehicles, fuel, roads etc. all need to be controlled. According to a study on Beijing’s motor vehicle exhaust emissions, diesel trucks, which account for just 5% of total vehicles, create 50% of total NO_x emissions from motor vehicles. Clearly, for motor vehicle pollution reduction efforts, trucks should be the focus and national diesel standards should be raised as soon as possible.

Structural Adjustments to Industry to Overcome Resistance

Weak enforcement of pollution control measures is a longstanding issue, the costs of violation remain extremely low, and local protectionism exists. The Ten National Measures and other regional emissions reduction measures will touch on huge vested interests so their implementation will require great determination.

By controlling coal consumption in the Beijing-Tianjin-Hebei area over the next four years, the total amount used will be reduced by 63 million tons, which is nearly one-fifth of the region's total coal consumption for 2012.[62] Hebei province is China's number one steel producer, crude steel production in 2012 was about 220 million tons, accounting for 13.9% of the province's GDP, and 11.6% of the total tax revenues paid.[63] According to the plan, by the end of 2017, Hebei will cut steel production capacity by a total of 60 million tons, which means that nearly thirty percent of steel production capacity will be phased out, those iron and steel enterprises that do not phase out production will face the challenge of higher costs brought about by stricter environmental regulations.

Following the commencement of local action on pollution control, there will be direct impacts to local GDP in the short term, which may even affect public finances and employment in the area, and thus there will no doubt be resistance. Recognizing the difficulty of implementation, the last five of the ten national provisions propose using legal measures, an assessment system, market mechanisms, regional cooperation, and public participation to provide impetus for the implementation of emissions reduction.

[62] Daily Economic News, According to expert explanation in the Beijing-Tianjin-Hebei area the total amount of coal consumed in each area was: Beijing 22 million tons, Tianjin, 50-60 million tons and 300 million tons in Hebei.
[63] China Economic Weekly, December 9th, 2013, “Hebei Cuts Steel Production to Control Smog,” http://finance.sina.com.cn/china/dfjj/20131209/172617577148.shtml

3. Conclusions and Recommendations

- China's real-time disclosure of online monitoring data is a world first
  - There is no other country in the world that carries out this kind of large scale real-time disclosure of monitoring data to substantially increase the knowledge that the general public have about the environment
  - Both Shandong and Zhejiang Provinces have already started real-time disclosure and it is fairly reliable, which is extremely significant
  - Real-time disclosure in some provinces and areas is far from perfect. In Tianjin, Guangdong and Henan for instance they have not yet started disclosure and so should immediately remedy this
  - The quality of data must be strictly controlled

- The real-time disclosure of monitoring data is of strategic importance
  - Is good for public participation and can help overcome problems related to weak enforcement
  - Can place local pollution sources under regional supervision and promote regional cooperation
  - Highlights the big emitters and helps to clarify regional pollution sources

- Real-time disclosure highlights how serious emission problems are
  - Enterprises in large parts of Shandong and Hebei are breaching stricter local emissions standards
  - A large number of enterprises are still breaching emissions standards even during times of severe pollution

- A large group of key enterprises have yet to make proper preparations for the introduction of new stricter national standards which will come into force over the next year
  - Beijing and Shandong have brought forward the implementation of new emissions standards for key power plant enterprises, and Hebei has already implemented stricter emission standards for the steel industry
  - Emission standards in Jiangsu, Zhejiang, Henan, Tianjin (as well as the thermal power standard in Hebei) need to urgently be made stricter
  - Emissions from a large group of key enterprises are well above the level stipulated in the new national standards for the power and steel industries, which will be implemented over the next year

- A breakthrough with prioritized targets is needed to achieve emissions reduction
  - Air emissions from around 4000 enterprises account for 65% of China's total industrial air emissions
  - Ensuring key industrial and coal-fired pollution sources adhere to emissions standards will bring about large scale reduction in emissions within a geographical region

- A joint effort is needed to push for enterprise emission reductions
  - Everybody should pay close attention to the air pollution sources in their area that have been identified through real-time disclosure
    - The environmental authorities should strictly enforce regulations and penalize those enterprises that violate them
    - The media should expose those enterprises that breach emissions regulations and the general public should use social media to spread this information to make these large emitters feel massive public pressure and supervision by public opinion
    - Environmental groups and lawyers should work together to provide assistance to those residents that have been affected and launch environmental lawsuits against those big emitters that continuously breach discharge standards
    - The China Banking Regulatory Commission and the banks should restrict credit for those enterprises that persistently discharge emissions in breach of the law
    - The China Securities and Regulatory Commission should prevent those enterprises that persistently discharge emissions in breach of the law from obtaining finance through the capital markets
    - Large scale enterprises, like real estate developers and automobile manufacturers that use a lot of energy intensive products such as steel, cement, and building materials, should use green procurement to push polluting enterprises to implement corrective actions and make improvements

Appendix A - 2013 AQTI Evaluation Scores for 113 Chinese Cities

Table 32 – 2013 AQTI scores for 113 Chinese Cities

Rank	City	PM_{10}	$PM_{2.5}$	SO_2	NO_2	CO	O_3	VOC	Pb	Other	Total
1	Beijing	15	13.4	15	15	10	9	0	0	0	77.4
2	Dongguan	14.4	14.4	14.4	14.4	9.6	9.6	0	0	0	76.8
3	Nanjing	15	13.4	15	15	9	9	0	0	0	76.4
3	Suzhou	15	13.4	15	15	9	9	0	0	0	76.4
3	Chongqing	15	13.4	15	15	9	9	0	0	0	76.4
6	Ningbo	14.4	12.8	14.4	14.4	8.6	8.6	0	0	2.8	76
6	Dalian	14.4	14.4	14.4	14.4	8.6	8.6	0	0	0	74.8
6	Qingdao	14.4	14.4	14.4	14.4	8.6	8.6	0	0	0	74.8
6	Guangzhou	14.4	14.4	14.4	14.4	8.6	8.6	0	0	0	74.8
6	Jiaxing	14.4	12.8	14.4	14.4	8.6	8.6	1	0	0	74.2
11	Tianjin	14.4	12.8	14.4	14.4	8.6	8.6	0	0	0	73.2
11	Hangzhou	14.4	12.8	14.4	14.4	8.6	8.6	0	0	0	73.2
11	Wenzhou	14.4	12.8	14.4	14.4	8.6	8.6	0	0	0	73.2
11	Shaoxing	14.4	12.8	14.4	14.4	8.6	8.6	0	0	0	73.2
11	Fuzhou	14.4	12.8	14.4	14.4	8.6	8.6	0	0	0	73.2
11	Yantai	14.4	12.8	14.4	14.4	8.6	8.6	0	0	0	73.2
11	Wuhan	14.4	12.8	14.4	14.4	8.6	8.6	0	0	0	73.2
11	Chengdu	14.4	12.8	14.4	14.4	8.6	8.6	0	0	0	73.2
11	Kunming	14.4	12.8	14.4	14.4	8.6	8.6	0	0	0	73.2
20	Xiamen	13.8	13.8	13.8	13.8	8.2	8.2	0	0	0	71.6
20	Ji'nan	13.4	13.4	13.4	13.4	9	9	0	0	0	71.6
22	Shanghai	12	15	12	12	10	10	0	0	0	71
23	Taizhou	13.4	12.8	13.4	13.4	8.6	8.6	0	0	0	70.2
24	Changzhou	13.8	12.2	13.8	13.8	8.2	8.2	0	0	0	70
24	Nantong	13.8	12.2	13.8	13.8	8.2	8.2	0	0	0	70
24	Lianyungang	13.8	12.2	13.8	13.8	8.2	8.2	0	0	0	70
24	Yichang	13.8	12.2	13.8	13.8	8.2	8.2	0	0	0	70
28	Huzhou	12.8	12.8	12.8	12.8	8.6	8.6	0	0	0	68.4
28	Zibo	12.8	12.8	12.8	12.8	8.6	8.6	0	0	0	68.4
28	Zaozhuang	12.8	12.8	12.8	12.8	8.6	8.6	0	0	0	68.4
28	Weifang	12.8	12.8	12.8	12.8	8.6	8.6	0	0	0	68.4
28	Jining	12.8	12.8	12.8	12.8	8.6	8.6	0	0	0	68.4
28	Taian	12.8	12.8	12.8	12.8	8.6	8.6	0	0	0	68.4
28	Weihai	12.8	12.8	12.8	12.8	8.6	8.6	0	0	0	68.4
28	Rizhao	12.8	12.8	12.8	12.8	8.6	8.6	0	0	0	68.4
36	Xi'an	12	13.8	12	12	9.2	9.2	0	0	0	68.2
37	Foshan	12	14.4	12	12	8.6	8.6	0	0	0	67.6

Rank	City	PM_{10}	$PM_{2.5}$	SO_2	NO_2	CO	O_3	VOC	Pb	Other	Total
38	Shenzhen	12	13.4	12	12	9	9	0	0	0	67.4
39	Zhuhai	12	12.8	12	12	8.6	8.6	0	0	0	66
39	Zhongshan	12	12.8	12	12	8.6	8.6	0	0	0	66
41	Taiyuan	12.2	12.2	12.2	12.2	8.2	8.2	0	0	0	65.2
41	Zhengzhou	12.2	12.2	12.2	12.2	8.2	8.2	0	0	0	65.2
41	Kaifeng	12.2	12.2	12.2	12.2	8.2	8.2	0	0	0	65.2
44	Shijiazhuang	12	12.2	12	12	8.2	8.2	0	0	0	64.6
44	Tangshan	12	12.2	12	12	8.2	8.2	0	0	0	64.6
44	Qinhuangdao	12	12.2	12	12	8.2	8.2	0	0	0	64.6
44	Handan	12	12.2	12	12	8.2	8.2	0	0	0	64.6
44	Baoding	12	12.2	12	12	8.2	8.2	0	0	0	64.6
44	Harbin	12	12.2	12	12	8.2	8.2	0	0	0	64.6
44	Wuxi	12	12.2	12	12	8.2	8.2	0	0	0	64.6
44	Xuzhou	12	12.2	12	12	8.2	8.2	0	0	0	64.6
44	Yangzhou	12	12.2	12	12	8.2	8.2	0	0	0	64.6
44	Hefei	12	12.2	12	12	8.2	8.2	0	0	0	64.6
44	Zhuzhou	12	12.2	12	12	8.2	8.2	0	0	0	64.6
44	Nanning	12	12.2	12	12	8.2	8.2	0	0	0	64.6
44	Guiyang	12	12.2	12	12	8.2	8.2	0	0	0	64.6
44	Lanzhou	12	12.2	12	12	8.2	8.2	0	0	0	64.6
44	Xining	12	12.2	12	12	8.2	8.2	0	0	0	64.6
59	Yinchuan	10.8	12.8	10.8	10.8	8.6	8.6	0	0	0	62.4
60	Changzhi	12	10.8	12	12	7.2	7.2	0	0	0	61.2
60	Shantou	12	10.8	12	12	7.2	7.2	0	0	0	61.2
62	Hohhot	10.8	12.2	10.8	10.8	8.2	8.2	0	0	0	61
62	Shenyang	10.8	12.2	10.8	10.8	8.2	8.2	0	0	0	61
62	Changchun	10.8	12.2	10.8	10.8	8.2	8.2	0	0	0	61
62	Yancheng	10.8	12.2	10.8	10.8	8.2	8.2	0	0	0	61
62	Nanchang	10.8	12.2	10.8	10.8	8.2	8.2	0	0	0	61
62	Changsha	10.8	12.2	10.8	10.8	8.2	8.2	0	0	0	61
62	Xiangtan	10.8	12.2	10.8	10.8	8.2	8.2	0	0	0	61
62	Urumchi	10.8	12.2	10.8	10.8	8.2	8.2	0	0	0	61
70	Datong	10.8	10.8	10.8	10.8	7.2	7.2	0	0	0	57.6
70	Yangquan	10.8	10.8	10.8	10.8	7.2	7.2	0	0	0	57.6
70	Linfen	10.8	10.8	10.8	10.8	7.2	7.2	0	0	0	57.6
73	Beihai	9	10.8	9	9	8	8	0	0	0	53.8
74	Baotou	9	10.8	9	9	7.2	7.2	0	0	0	52.2
74	Maanshan	9	10.8	9	9	7.2	7.2	0	0	0	52.2
74	Quanzhou	9	10.8	9	9	7.2	7.2	0	0	0	52.2
74	Shaoguan	9	10.8	9	9	7.2	7.2	0	0	0	52.2

Rank	City	PM_{10}	$PM_{2.5}$	SO_2	NO_2	CO	O_3	VOC	Pb	Other	Total
74	Liuzhou	9	10.8	9	9	7.2	7.2	0	0	0	52.2
74	Guilin	9	10.8	9	9	7.2	7.2	0	0	0	52.2
74	Mianyang	9	10.8	9	9	7.2	7.2	0	0	0	52.2
74	Yibin	9	10.8	9	9	7.2	7.2	0	0	0	52.2
74	Baoji	9	10.8	9	9	7.2	7.2	0	0	0	52.2
74	Xianyang	9	10.8	9	9	7.2	7.2	0	0	0	52.2
84	Ordos	8.4	10.8	8.4	8.4	7.2	7.2	0	0	0	50.4
84	Anshan	8.4	10.8	8.4	8.4	7.2	7.2	0	0	0	50.4
84	Tongchuan	8.4	10.8	8.4	8.4	7.2	7.2	0	0	0	50.4
84	Yan'an	8.4	10.8	8.4	8.4	7.2	7.2	0	0	0	50.4
88	Wuhu	9	8.4	9	9	5.6	5.6	0	0	0	46.6
88	Jingzhou	9	8.4	9	9	5.6	5.6	0	0	0	46.6
90	Jinzhou	6	8.4	6	6	5.6	6	0	0	0	38
91	Chifeng	6	8.4	6	6	5.6	5.6	0	0	0	37.6
91	Fushun	6	8.4	6	6	5.6	5.6	0	0	0	37.6
91	Benxi	6	8.4	6	6	5.6	5.6	0	0	0	37.6
91	Jilin	6	8.4	6	6	5.6	5.6	0	0	0	37.6
91	Qiqihaer	6	8.4	6	6	5.6	5.6	0	0	0	37.6
91	Daqing	6	8.4	6	6	5.6	5.6	0	0	0	37.6
91	Mudanjiang	6	8.4	6	6	5.6	5.6	0	0	0	37.6
91	Jiujiang	6	8.4	6	6	5.6	5.6	0	0	0	37.6
91	Luoyang	6	8.4	6	6	5.6	5.6	0	0	0	37.6
91	Pingdingshan	6	8.4	6	6	5.6	5.6	0	0	0	37.6
91	Anyang	6	8.4	6	6	5.6	5.6	0	0	0	37.6
91	Jiaozuo	6	8.4	6	6	5.6	5.6	0	0	0	37.6
91	Yueyang	6	8.4	6	6	5.6	5.6	0	0	0	37.6
91	Changde	6	8.4	6	6	5.6	5.6	0	0	0	37.6
91	Zhangjiajie	6	8.4	6	6	5.6	5.6	0	0	0	37.6
91	Zhanjiang	6	8.4	6	6	5.6	5.6	0	0	0	37.6
91	Panzhihua	6	8.4	6	6	5.6	5.6	0	0	0	37.6
91	Luzhou	6	8.4	6	6	5.6	5.6	0	0	0	37.6
91	Zunyi	6	8.4	6	6	5.6	5.6	0	0	0	37.6
91	Qujing	6	8.4	6	6	5.6	5.6	0	0	0	37.6
91	Jinchang	6	8.4	6	6	5.6	5.6	0	0	0	37.6
91	Shizuishan	6	8.4	6	6	5.6	5.6	0	0	0	37.6
91	Karamay	6	8.4	6	6	5.6	5.6	0	0	0	37.6

Appendix B – List of NGOs who have helped with Positioning of Pollution Sources

Table 33 - NGOs participating in positioning work (in no particular order)

NGO
Lv Se Jiang Nan Public Environmental Concerned Centre
Green Han River
Wuhan Green Canaan
Green Hunan
Green Stone
Chongqing Liangjiang Volunteering Development Center
Friends of Nature: Shanghai Team
Tianjin Luling
Zhaolu Environmental Protection Welfare Service Center
Green Qilu
Friends of Nature: Zhengzhou Team
Friends of Nature: Guangzhou Team
Huangyan Environmental Protection Volunteer Association
The Fujian Green Home Environment-Friendly Center
Wenzhou Green Water

Appendix C – Enterprises Breaching Discharge Standards during Periods of Heavy Pollution in Shandong Province

Zibo:

Time Period: 5 am on November 2nd – 5 am on November 3rd, 2013

Air Quality: Moving 24 hr. average - 263

Table 34 - SO_2 Exceedances at monitoring sites in Zibo

Monitoring Sites (SO_2)	Observation Counts	Exceedance Counts	Lowest Exceedance Multiple	Highest Exceedance Multiple
Xingang Gas	22	22	1.2	1.7
China Aluminum Thermal Power(1-2)	22	22	1.3	3.9
Wanjie Thermal Power	22	22	0.8	5.3

Table 35 NO_x Exceedances at monitoring sites in Zibo

Monitoring Sites (NO_x)	Observation Counts	Exceedance Counts	Lowest Exceedance Multiple	Highest Exceedance Multiple
Tangshan Thermal Power (2-3)	22	22	3.8	6.1
Tianyuan Thermal Power (East Factory 3-5)	22	22	0.4	0.8
Baiyanghe Electricity(7)	22	22	1.4	1.9
Baiyanghe Electricity(6)	22	22	1.4	2.3
Hongda Thermal Power (3-4)	22	22	0.8	1.5
Petrochem Assets(7-8)	22	22	5.6	6.6
Petrochem Assets(1-2)	22	22	4	4.7
Petrochem Assets(3-4)	22	22	3	4.9
Qilu Petrochem(No.2 Fertilizer Plant)	22	22	1	1.5
Petrochem Assets(5)	22	22	2.3	4.7
Xinsheng Thermal Power(1-5)	22	22	0.5	0.8
Fushan Thermal Power (6-7)	22	22	4.4	5.8
Xinsheng Thermal Power (6-7)	22	22	0.8	1.2
Qilinguihe	22	22	0.2	0.6
Longsheng Steel(Thermal Power)	22	22	0.5	0.9
Chenguang Thermal Power (1-2)	22	22	1.9	2.2
Zhoubei Thermal Power (1-3)	22	22	0.2	1
Licun Thermal Power (1-4)	22	22	0.4	0.7
Kaitai Power Plant(1-7)	22	22	1.5	1.9
Xuanzesong Electricity	22	22	1.3	1.7
Hongqiao Thermal Power	22	22	1.5	1.6

Wanjie Thermal Power	22	22	2.9	5.5
China Aluminum Thermal Power (3)	22	22	4.6	5.8

Dongying:

Time Period: 3 pm on November 2nd to 3pm on November 3rd 2013

Air Quality: Moving 24 hr. average AQI – 231.7

Table 36 - NO_x Exceedances at monitoring sites in Dongying

Monitoring Sites (NO_x)	Observation Counts	Exceedance Counts	Lowest Exceedance Multiple	Highest Exceedance Multiple
Jintai Paper (West)	22	22	2.5	3.3
Jinlin Chemical (6-9)	22	22	2	2.6
Huatai Chemical	22	22	1.3	2.2
Lihuayi Electricity (1-2)	22	22	0.9	1.4
Zhenghe Thermal Power(1-2)	22	22	0.4	3.3
Lihuayi Electricity (3)	22	22	2.6	4.2
Yongtai Thermal Power	22	22	2.3	3.6
Wanda Thermal Power (1-4)	22	22	2.3	4.1
Xishui Thermal Power (Third Phase)	22	22	1.4	4.5
Huataiqinghe	22	22	1.4	3.9
Jinmao Power Plant (1-2)	22	22	3.7	4.1

Jinan:

Time Period: 4 am on October 29th to 4pm on October 30th 2013

Air quality: Moving 24hr average AQI – 282.43

Table 37 - NO_x Exceedances at monitoring sites in Ji'nan

Monitoring Sites (NO_x)	Observation Counts	Exceedance Counts	Lowest Exceedance Multiple	Highest Exceedance Multiple
Zhangqiu Power Plant (3)	23	23	1.7	2.5
Zhangqiu Power Plant (1)	23	23	4.3	5.7
Riyue Chemical	23	23	0.4	0.6
Minghu Thermal Power(1-5)	23	23	0.4	0.8

Laiwu:

Time Period: 7pm on October 28th – 7pm on October 29th 2013

Air Quality: 24hr Moving Average AQI – 233.72

Table 38 - SO_2 Exceedances at monitoring sites in Laiwu

Monitoring Sites (SO_2)	Observation Counts	Exceedance Counts	Lowest Exceedance Multiple	Highest Exceedance Multiple
Laigang Iron Works (No.4 Sintering)	22	22	0.1	1.2
Jiuyang Corporation (Coking 2)	22	22	1.1	2.1
Jiuyang Corporation (Coking 1)	22	22	0.8	1.3

Table 39 - NO_x Exceedances at monitoring sites in Laiwu

Monitoring Sites (NO_x)	Observation Counts	Exceedance Counts	Minimum Exceedance Multiple	Highest Exceedance Multiple
Laiwu Power Plant (5)	22	22	1.6	2.4
Laiwu Power Plant (4)	22	22	0.6	5.9
Laicheng Power Plant (4)	22	22	2	4.2
Laicheng Power Plant (1)	22	22	1.1	2.2

Linyi:

Time Period: 3pm on October 28th – 3pm on October 29th 2013

Air Quality: Moving 24 hr. Average AQI – 296.29

Table 40 - NO_x Exceedances at monitoring sites in Linyi

Monitoring Sites (NO_x)	Observation Counts	Exceedance Counts	Minimum Exceedance Multiple	Highest Exceedance Multiple
Feixian Power Plant (2)	22	22	0.8	2.5
Huaneng Linyi NO.5	22	22	4.3	7.1
Huaneng Linyi NO.6	22	22	1.3	2
Huaneng Linyi NO.3	22	22	2.7	3.6
Xinchengjinluo (5-7)	22	22	0.9	1.2
Xinchengjinluo (1-4)	22	22	0.7	3

Tai'an:

Time Period: 11pm on October 28th – 11pm on October 29th 2013

Air Quality: Moving 24hr average AQI – 259.91

Table 41 - NOx Exceedances at monitoring sites in Taian

Monitoring Sites (NO_x)	Observation Counts	Exceedance Counts	Smallest Exceedance Multiple	Largest Exceedance Multiple
Shiheng Power Plant (1)	23	23	0.3	1.4
Ruixing Chemical (3-4)	23	23	0.5	0.9
Aside Electricity	23	23	0.5	0.9

Zaozhuang:

Time Period: 11pm on October 28th – 11pm on October 29th 2013

Air Quality: Moving 24hr Average AQI – 306.96

Table 42 - SO_2 Exceedances at monitoring sites in Zaozhuang

Monitoring Sites (SO_2)	Observation Counts	Exceedance Counts	Lowest Exceedance Multiple	Highest Exceedance Multiple
Shenglong Coking (1)	23	23	0.5	5.5
Shenghuo Coking	23	23	2.2	5.5

Table 43 - NO_x Exceedances at monitoring sites in Zaozhuang

Monitoring Sites (NO_x)	Observation Counts	Exceedance Counts	Lowest Exceedance Multiple	Highest Exceedance Multiple
Xinyuan Thermal Power (4)	23	23	3.4	7.3
Xinyuan Thermal Power (2)	23	23	5.2	6.6
Guotai Chemical	23	23	1.2	1.7
Huarun Paper (1-3)	23	23	0.3	1.1
Tuliquan Electricity (5)	23	23	6.1	7.1
Jinhui Paper	23	23	2.5	4.1
Jinjing Glass (2)	23	23	0.3	3.8

Weifang:

Time Period: 11pm on November 2nd to 11pm on November 3rd 2013

Air Quality: Moving 24hr Average AQI – 277.2

Table 44 - NO_x Exceedances at monitoring sites in Zaozhuang

Monitoring Sites (NO_x)	Observation Counts	Exceedance Counts	Lowest Exceedance Multiple	Highest Exceedance Multiple
Weifang Power Plant (3)	22	22	2.3	3.1
Weifang Power Plant (2)	22	22	1.9	3.8
Yingxuan Industrial	12	12	0.1	0.2
Huawei Thermal Power (1-3)	12	12	0.3	0.7
Yineng Thermal Power (1-4)	12	12	0.5	0.7
The second Thermal Power (2-3)	12	12	1.4	1.8
Shengshi Thermal Power (1-5)	12	12	0.1	0.3
Haihua Group (Thermal Power 9-10)	12	12	1.1	1.4
Xinxing Starch (1-3)	12	12	1.7	1.9
Hailong Share(10-12)	12	12	4.2	4.9
Taisheng Chemical (1-2)	12	12	0.3	0.4

Note: The observation counts was 12 because during this 24 hour period only monitoring results for 12 hours were released. There was no publication of data for the other times.

Appendix D – Average Daily Emissions Concentrations showing Exceedances for some Key State Monitored Enterprises in Beijing

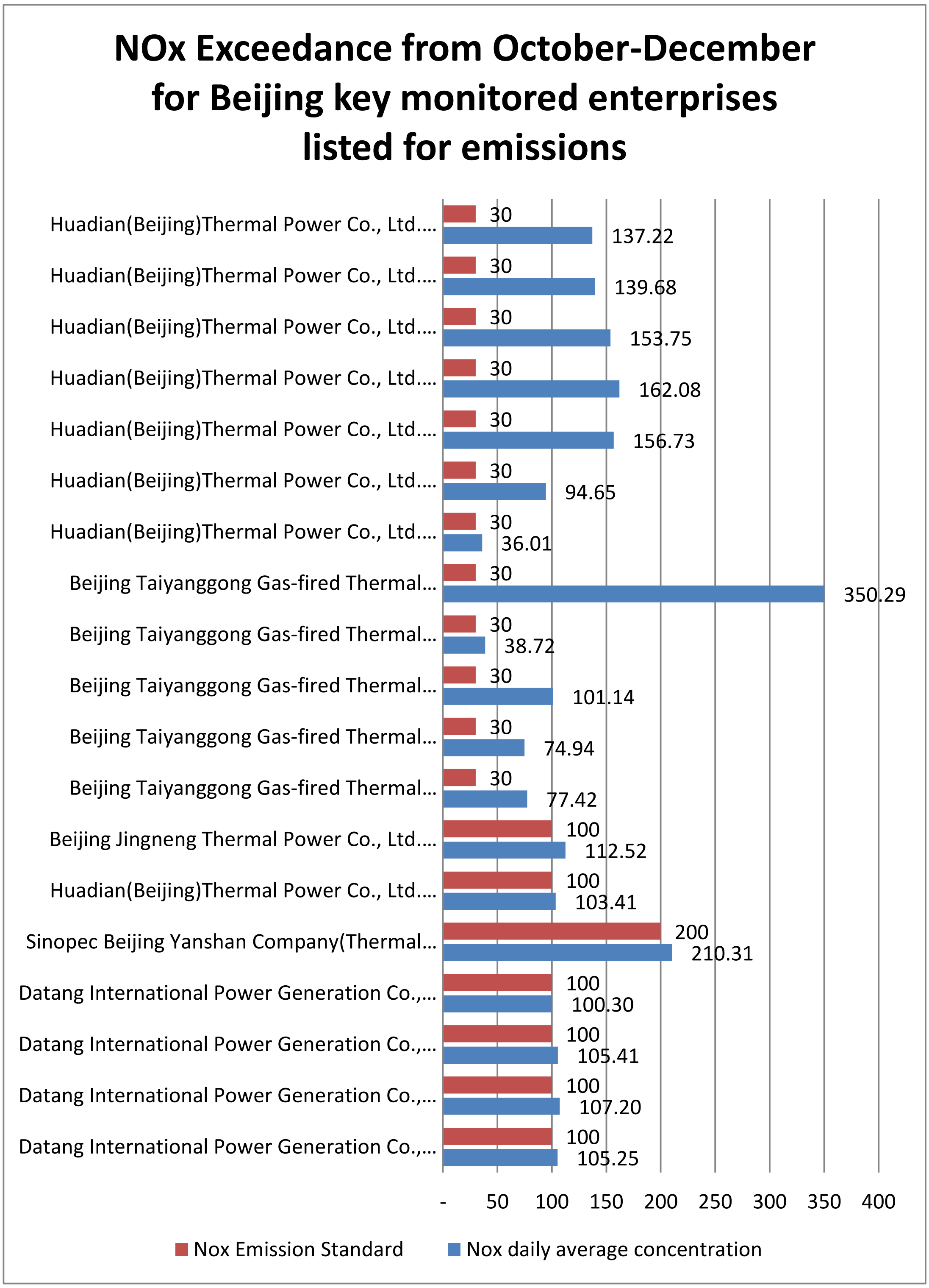

Figure 62 - NO_x exceedance of Beijing key enterprises for emissions in October-December[64]

[64] On January 15th, staff from Huadian (Beijing) Thermal Power Co., Ltd. (hereafter referred to as Beijing Huadian)

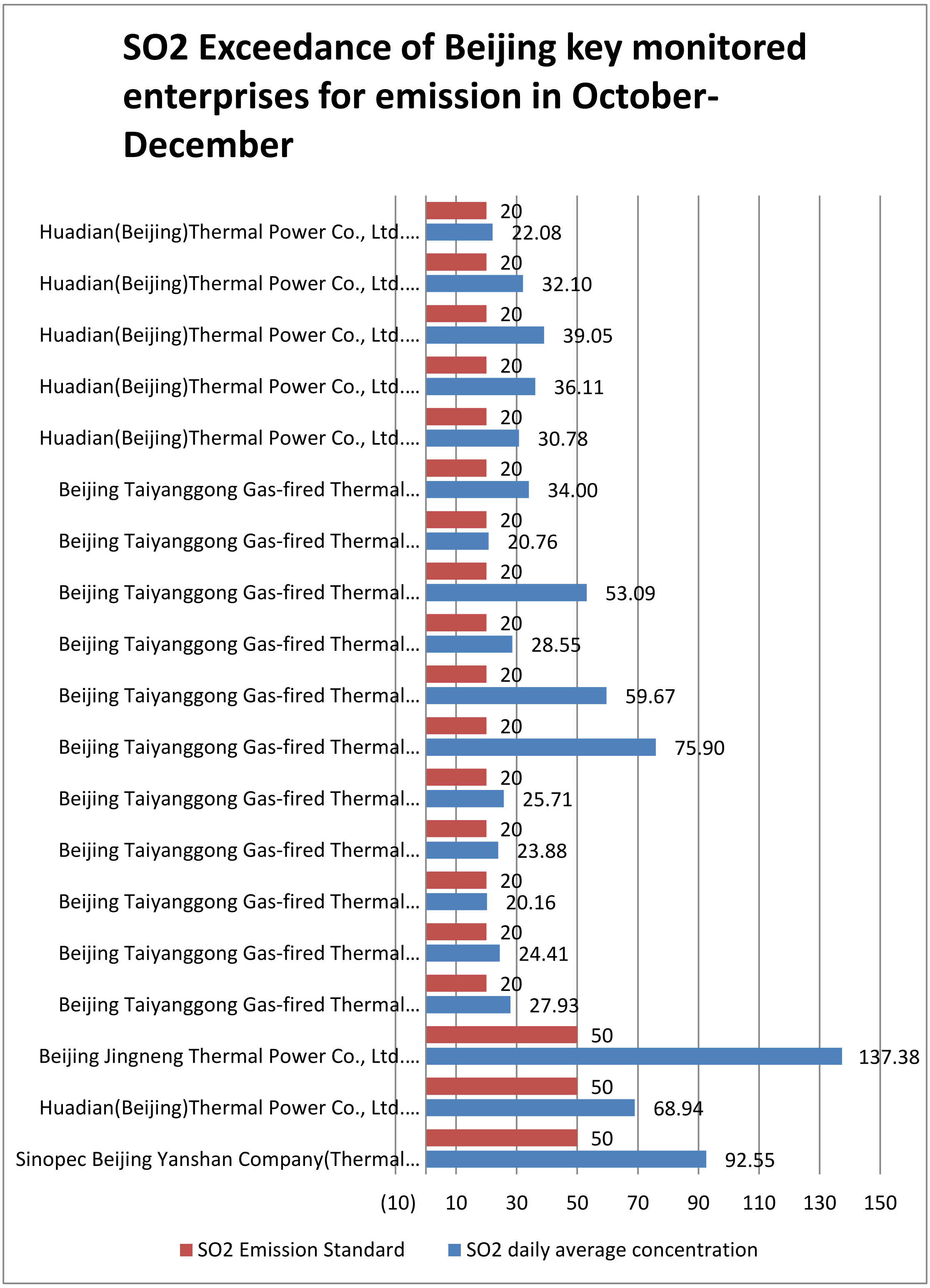

Figure 63 SO_2 exceedance of Beijing key enterprises for emissions in October-December[65]

called the IPE to express their doubt about the data showing exceedances at Beijing Huadian that were used in the report. IPE explained that the data that was used in the report came from the Beijing EPB automatic monitoring platform which was set-up according to the law to show automatic monitoring data from key state monitored enterprises. On the same day the IPE received another call from staff at Huadian Beijing stating that they had already contacted the Beijing EPB on the data discrepancy issue and were now waiting for official clarification from them.

[65] On January 15th, staff from Huadian (Beijing) Thermal Power Co., Ltd. (hereafter referred to as Beijing Huadian)

Appendix E – Changes in Discharge Volumes over the period October-December from some Key Monitored Enterprises in Beijing

Discharge volume data from this three month period shows that from the middle of November, Beijing entered the winter heating season, which caused the pollutant discharge from thermal power plants to increase. Winter is also the time of year when smoggy weather occurs most in the northern regions of China, so controlling the pollutant discharge from large scale thermal power plants is especially important.

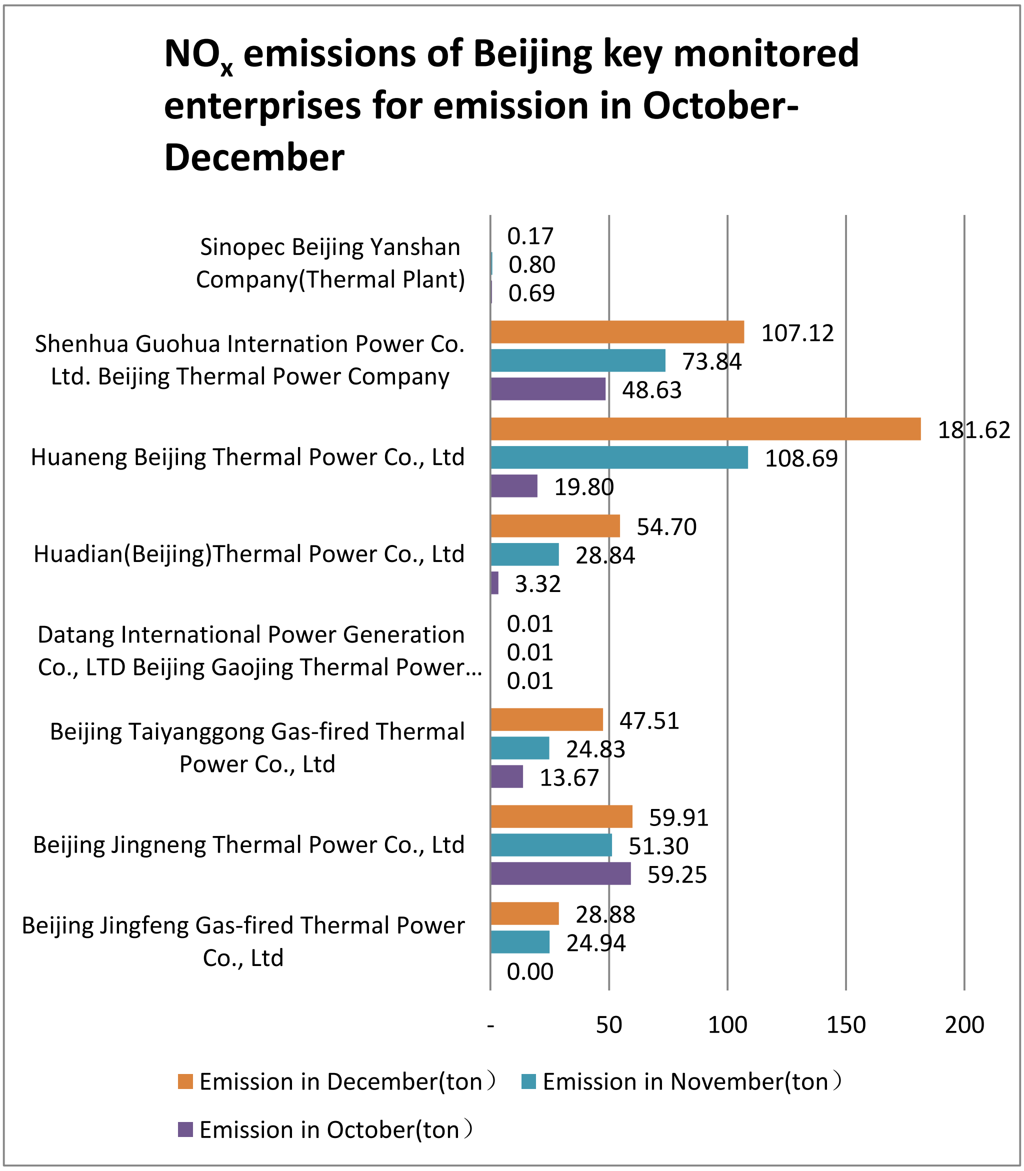

Figure 64 - NO_x emissions of Beijing key monitored enterprises for emission in October-December

called the IPE to express their doubt about the data showing exceedances at Beijing Huadian that were used in the report. IPE explained that the data that was used in the report came from the Beijing EPB automatic monitoring platform which was set-up according to the law to show automatic monitoring data from key state monitored enterprises. On the same day the IPE received another call from staff at Huadian Beijing stating that they had already contacted the Beijing EPB on the data discrepancy issue and were now waiting for official clarification from them.

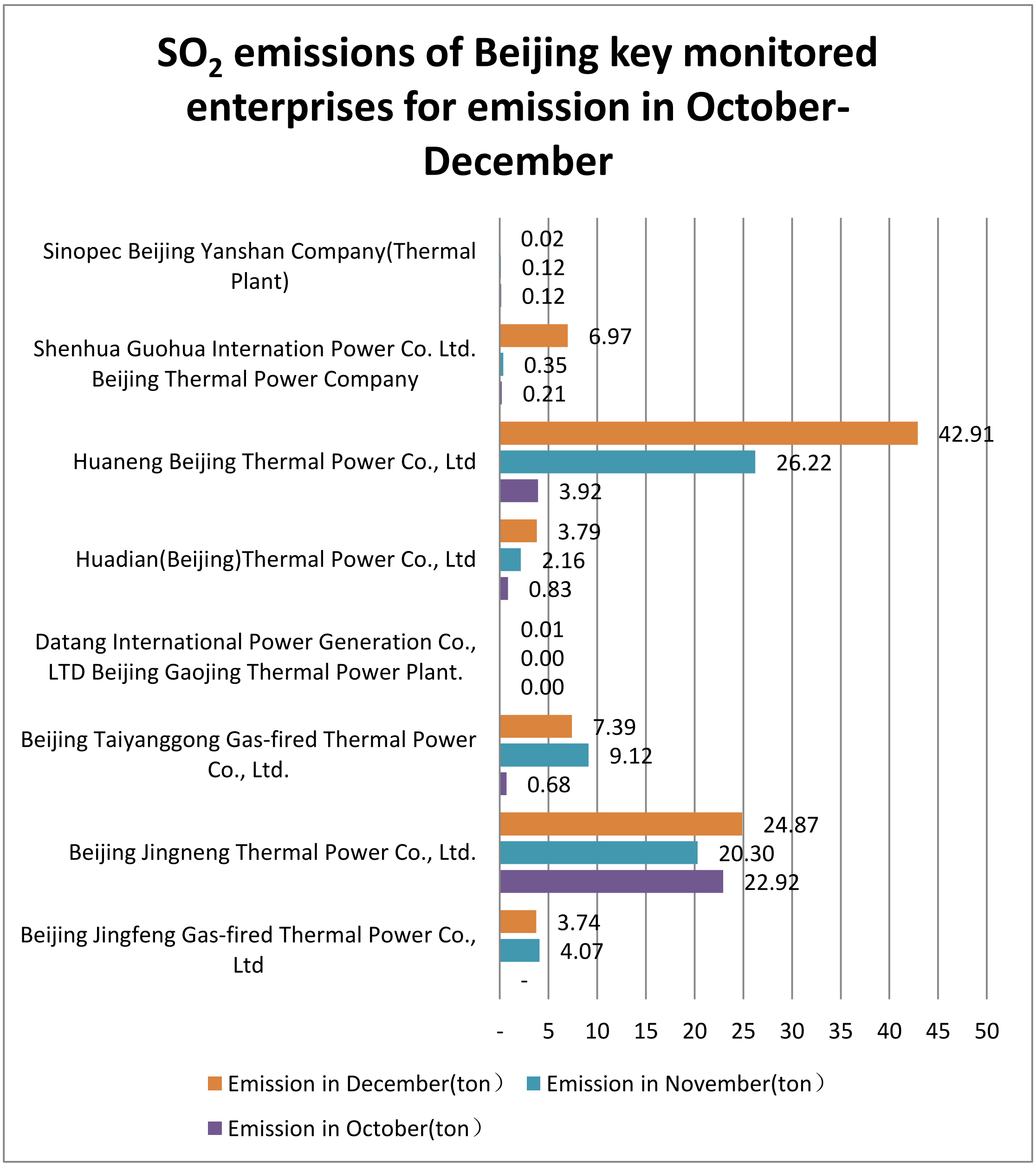

Figure 65 - SO_2 emissions of Beijing key monitored enterprises for emission in October-December

Appendix F – Guangdong Case Study

Guangdong Case Study: Local Standards made more Stringent but Real-time Disclosure of Monitoring Data still Lacking

As a high electricity consuming province, SO_2 and NO_x discharge volumes from Guangdong's thermal power plants are higher than for any other industry. Because some of the standard limit values in the "Thermal Power Plant Atmospheric Pollutant Discharge Standard (GB3223-2003)" are quite lax and are based on the national standard requirements, even if all the power plants were to discharge within the standard limit values then they would still be unable to satisfy Guangdong Province's environmental management requirements. Therefore, on August 1st 2009, the Guangdong Department of Environmental Protection, under their own initiative, formulated and implemented stricter discharge standards, namely the "Thermal Power Plant Atmospheric Pollution Discharge Standard (DB44/612-2009)". This local standard is compared with the national standard in the table below:

Table 45 Thermal power industry standards Comparison[66]

Type	Pollutant	Current Guangdong Standard[67]	Current National Standard[68]	National Standards from 2014.7.1 [69]
Coal-fired Boiler	Fume	30/100	50/200	30
	SO_2	200	400/800	200
	NO_x	200	450/650/1100	100/200

With regards to the disclosure of real-time pollution source discharge data we were very surprised to see that Guangdong has yet to establish a disclosure platform with information showing discharge standard compliance rates for key air emissions enterprises.

[66] Only compared the existing limit values for coal fired thermal power plants for SO2, NOx and Fumes
[67] Thermal Power Plant Atmospheric Pollution Discharge Standard (DB44/612-2009), Phase 3 Thermal Power Plant Coal-fired Boilers
[68] Thermal Power Plant Atmospheric Pollution Discharge Standard (DB44/612-2009), Phase 3 Thermal Power Plant Coal-fired Boilers
[69] Thermal Power Plant Atmospheric Pollutant Discharge Standard (GB3223-2003)

Appendix G – List of Key Monitored Enterprises in Beijing, Hebei, Shandong by Discharge Volume

Beijing key monitored enterprises for emission
Beijing Jingfeng Gas-fired Thermal Power Co., Ltd
Beijing Jingneng Thermal Power Co., Ltd
Beijing Taiyanggong Gas-fired Thermal Power Co., Ltd
Datang International Power Generation Co., LTD Beijing Gaojing Thermal Power Plant
Huadian (Beijing) Thermal Power Co., Ltd
Huaneng Beijing Thermal Power Co., Ltd
Shenhua Guohua Internation Power Co. Ltd. Beijing Thermal Power Company
Sinopec Beijing Yanshan Company (Thermal Plant)

Hebei key monitored enterprises for emission	
Thermal Power Plants with Top 8 SO_2 emission	Thermal Power Plants with Top 8 NO_x emission
Huaneng International Thermal Power Co., Ltd Shang'an Power Plant	Hebei Danfeng Power Generation Co., Ltd
Hebei Danfeng Power Generation Co., Ltd	Huaneng International Thermal Power Co., Ltd Shang'an Power Plant
Datang International Power Generation Co., LTD. Zhangjiangkou Power Plant	Hebei Datang International Thermal Power Co., Ltd
Cangzhou Huarun Thermal Power Co., Ltd	Datang International Power Generation Co., LTD. Zhangjiangkou Power Plant
Hebei Datang International Thermal Power Co., Ltd	Hebei Xibaipo Power Generation Co., Ltd
Datang Hebei Power Generation Co. Ltd. Matou Thermal Power Company	Xingtai Guotai Power Generation Co., Ltd
Xingtai Guotai Power Generation Co., Ltd	Datang Hebei Power Generation Co. Ltd. Matou Thermal Power Company
Hebei Huadian Shijiazhuang Thermal Power Co., Ltd	Hebei Guohua Cangdong Power Generation Co., Ltd

Shandong key monitored enterprises for emission	
Thermal Power Plants with Top 8 SO_2 emission	**Thermal Power Plants with Top 8 NO_x emission**
Liaocheng Power Plant	Liaocheng Power Plant
Qingdao Power Plant	Dezhou Power Plant
Zouxian Power Plant	Zouxian Power Plant
Xinyuan Aluminum	Heze Power Plant
Dezhou Power Plant	Petrochem Asset
Yantai Power Plant	Huarun Power
Huaxin Aluminum	Yunhe Power Plant
Shiheng Power Plant	Bainian Power