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

A ROAD MAP TO BLUE SKIES

CHINA'S ATMOSPHERIC POLLUTION SOURCE POSITIONING REPORT (DRAFT)

December 2011 | Beijing, China

IPE (The Institute of Public & Environmental Affairs)

The Institute of Public & Environmental Affairs (IPE) is a registered non-profit organization based in Beijing. Since its establishment in May 2006, IPE has developed two pollution databases to monitor corporate environmental performance and to facilitate public participation in environmental affairs. Its aim is to expand environmental information disclosure to allow communities to fully understand the hazards and risks in the surrounding environment, thus promoting widespread public participation in environmental governance. (http://www.ipe.org.cn/En/index.aspx)

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With haze in Beijing, Shanghai and Guangzhou, large cities are increasingly suffering from the rapidly expanding and serious problem of air pollution.

At present, no fundamental change to China's coal-based energy infrastructure has taken place. The problem of sulfur dioxide (SO_2) and total suspended particles (TSP) in the atmospheric environment of cities has not been completely resolved and pollution from coal burning has long been the main type of pollution present. At the same time, motor vehicle ownership is increasing, causing ever more serious exhaust fume pollution and haze, as well as leading to complex atmospheric pollutant problems such as photochemical smog and acid rain to become increasingly prominent.

The most direct perception the public have of this is that a blue sky is often considered a luxury. In 2009, China's Environmental Protection Departments carried out a pilot monitoring for haze in many cities and discovered the number of annual hazy days ranged between 51 and 211. From these monitored cities, Tianjin had 51 hazy days, Shenzhen 115 days, Chongqing 133, Shanghai 134, Suzhou 169 and Nanjing had 211 hazy days.[1]

Air Pollution creates a huge environmental cost. In 2004, the actual cost of managing the country's emissions was RMB 47.82 billion or 0.29% of China's industrial GDP for that year. The theoretical cost of managing the country's emissions was RMB 92.29 billion or 0.55% of GDP. The cost of the environmental degradation caused by atmospheric pollution was RMB 219.8 billion, making up 42.9% of the total cost of environmental degradation and making up 1.31% of that year's GDP. [2] While a huge cost like this is hard to completely cover, this pollution also creates an impact on the quality of life of hundreds of millions of urban citizens, not to mention seriously harming their health.

To resolve the problem of atmospheric pollution, pollutant discharge must be controlled. In order to control the discharge of pollutants, the first step is to start with the identification of pollutant sources. Owing to the complexity of atmospheric pollution sourcing and in view of China's lax environmental supervision and the low cost associated with violating, the public must be allowed to understand the sources of pollutants so that they can then take part in the supervision and management of atmospheric pollution.

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[1] *"Ambient Air Quality Standard,"* (Draft Soliciting Comments) Establishing Instructions, *"Ambient Air Quality Standard,"* Establishing Group, November 18th, 2010.

[2] 'STUDY REPORT 2004 for GREEN NATIONAL Economic ACCOUNTING,' *MINISTRY OF ENVIRONMENTAL PROTECTION OF THE PEOPLE'S REPUBLIC OF CHINA, SEPTEMBER 7TH, 2006.*

During the course of this investigation more than 4400 companies came into our sights, for being confirmed by environmental bureaus as being China's biggest sources of emissions pollution. The discharge volume from these companies occupies a very large proportion of the national emissions discharge volume. These companies not only discharge large volumes but also many of them cannot even reach stable discharge standards.

By carrying out analysis of key state monitored enterprises, confirming their geographical location, clarifying whether they have any environmental violations, as well as determining their discharge volumes this will assist in carrying out information disclosure. This will also lead to public supervision of these key emissions polluting sources, which will be invaluable to China's efforts for atmospheric pollution control.

1. WHY THE PUBLIC NEED TO KNOW THE SOURCES OF INDUSTRIAL POLLUTION

1.1. IMPORTANT STEPS ON THE ROAD MAP TO BLUE SKY DAYS

Twenty years ago, during the process of rapid industrialization and urbanization, many cities unconsciously lost blue sky days. While easily lost, these blue sky days are difficult to recover. This is due to the complexity of atmospheric pollution sources and pollutant control, which often involves large financial investment and inconvenience to those stakeholders involved. This then requires for difficult policy choices to be made.

Understanding that this is not a task that a "quick-fix" can solve, we need to formulate a long road map, ensuring that we can find a way to move forward, step-by-step, towards the goal of recovering these lost blue sky days.

Blue Sky Day Road Map Includes the following Steps:

Step I: Carry out monitoring of pollutants in order to get to grips with the state of pollution. At the same time, the public's right to know must be satisfied by publishing pollutant monitoring data.

Step II: Point out the appropriate health guidance to the public, while effectively controlling pollutants to reach the largest degree of impact mitigation. At the same time, it must be advocated to the public that a reduction in polluted days can be caused by a change in discharge behavior.

Step III: Start to investigate and identify sources of pollution discharge.

Step IV: Focus on different discharge sources and formulate a plan and time schedule for reducing the discharge of each source, followed by implementing pollution source discharge reduction plans according to a sequence from easy to difficult.

At present, the Ministry of Environmental Protection is in the process of making amendments to the "Ambient Air Quality Standard" and is soliciting comments. Draft two of the manuscript has already added PM2.5 and ozone, which were previously not included, to the indicators that will be routinely monitored and published. It is planned that this will be implemented nationally by 2016. As a result, the monitoring and publishing problems that have long plagued China's atmospheric pollution control are expected to be resolved. Environmental Protection Departments have also stated that after the new standards have been implemented they will make clearer health tips.

The next step is that we need to ensure that monitoring publications and health warnings are able to be successfully carried out as scheduled, but on the other hand, we also need to start to identify those atmospheric pollutant discharge sources

1.2INDUSTRIAL POLLUTION SOURCES ARE THE PRINCIPLE PART OF ATMOSPHERIC POLLUTANT DISCHARGE

The air quality at any given place and at any given time is affected by many different factors, including those factors which are natural. However, the volume of pollutant discharge from human activities and production are the main factors impacting air quality. Atmospheric pollutant sources can firstly be divided into natural and human sources. The main sources we lend our attention to are mainly those from human activity. From human activity sourced pollution we can again divide these into fixed and moving sources.

According to the pollutant occurrence category, atmospheric pollutants come from four main sources: industrial pollution, domestic pollution, transportation pollution and agricultural pollution.

At present, sulfur dioxide (SO_2), nitrogen dioxide (NO_2), particulate matter (TSP, PM_{10}, $PM_{2.5}$), carbon monoxide (CO), ozone (O_3), lead (Pb) and benzo [a] pyrene (B[a]P) are the main pollutants that are having a notable impact on the health of China's citizens.

As China is in the process of large scale industrialization and urbanization, the sources of many of the aforementioned atmospheric pollutants are discharge from electricity production and industry.

Figures 1, 2 and 3 all show that during the period of the "*11TH FIVE YEAR PLAN,*" industrial sulfur dioxide emissions accounted for 85.7% of total sulfur dioxide emissions and industrial fumes emissions occupied 75.5%[3] of total fumes emissions. Between the years 2006 and 2009, industrial nitrogen oxide occupied 76.1%[4] of total nitrogen oxide emissions.

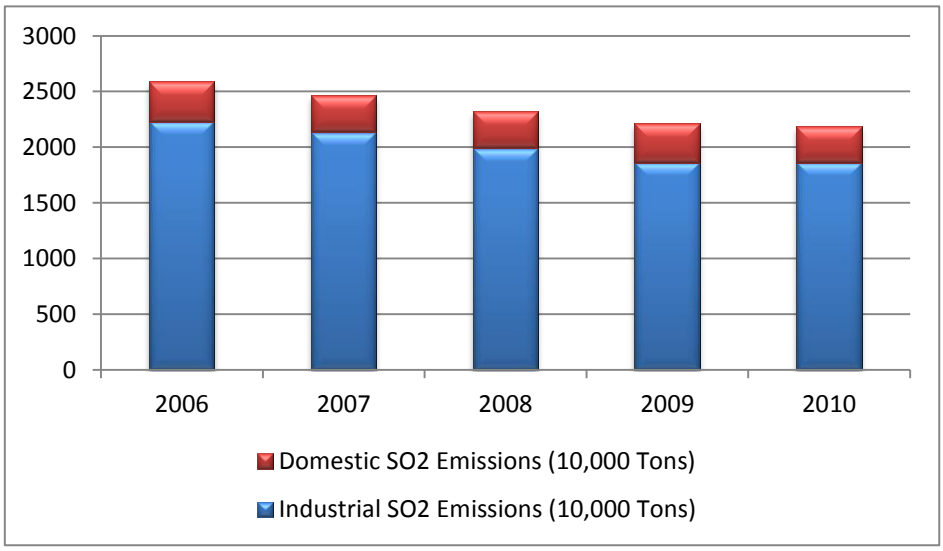

Figure 1: 2006-2010 Nationwide Industrial Sulfur Dioxide Emissions and Domestic Sulfur Dioxide Emissions[5]

[3] According to data calculated from: *'2010 Report on the State of the Environment in China.'*

[4] According to data calculated from: *'2009 Report on the State of the Environment in China.'*

[5] *'2010 Report on the State of the Environment in China,'* Ministry of Environmental Protection, June, 2011.

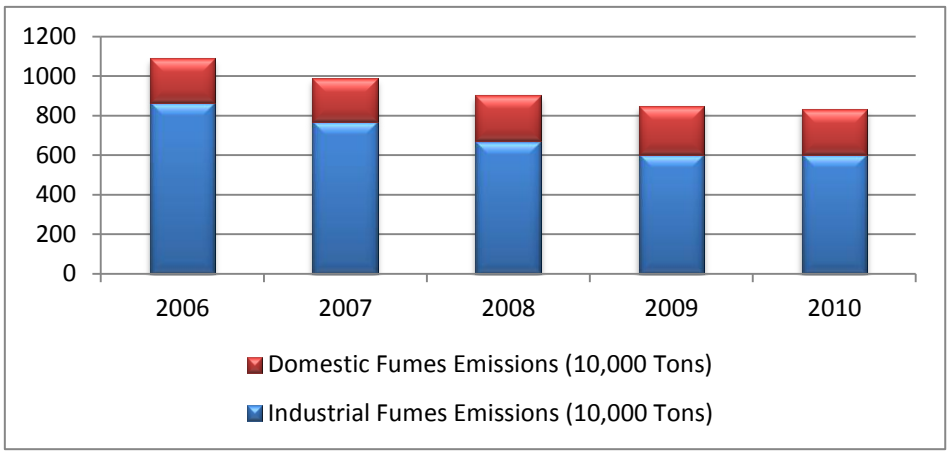

Figure 2: 2006-2010 Nationwide Industrial Fumes Emissions and Domestic Fumes Emissions[6]

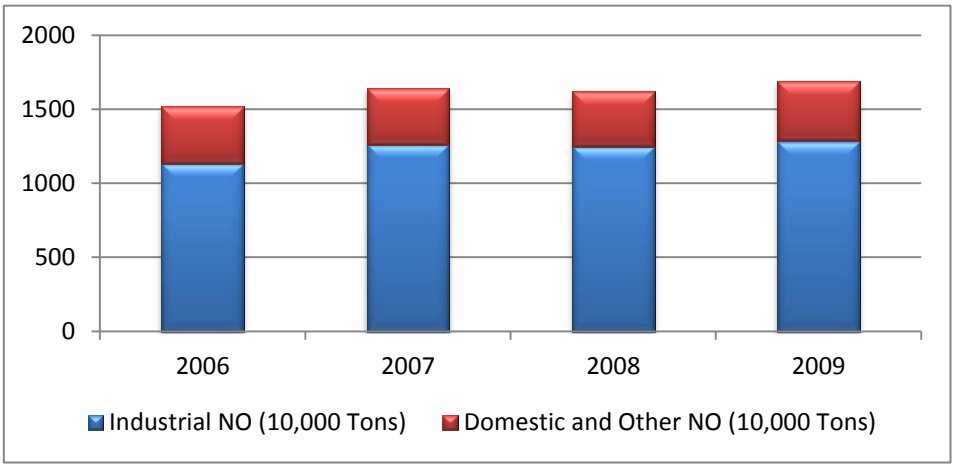

Figure 3: 2006-2009 Nationwide Industrial NO Emissions and Domestic and other NO Emissions[7]

Another recent example of how $PM_{2.5}$ has aroused widespread public concern is when, according to research[8] by Cao Guoliang, in 2007, the $PM_{2.5}$ for industrial emissions reached as high as nine million fifty-nine thousand tons, much higher than the $PM_{2.5}$ emissions volume from domestic, transportation and biomass burning sources.

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[6] *'2010 Report on the State of the Environment in China,'* Ministry of Environmental Protection, June, 2011.

[7] *'2009 China Environmental Statistical Yearbook,'* Compiled by the Ministry of Environmental Protection, China Environmental Science Press, December, 2010.

[8] *"Emission Inventories of Primary Particles and Pollutant Gases for China,"* CAO GuoLiang, ZHANG Xiaoye, GONG Sunling, AN Xinqin, WANG Yaqiang, March 2011 ,Vol.56 No.3

Pollutant	Biomass Burning	Electricity Generation	Transportation Sources	Industrial Sources	Domestic Sources	Total	
PM2.5	66.7	18.6	59.9	905.9	270.1	1321.2	
BC	10.4	1.3	10.3	52.9	65.1	139.9	
OC	43.3	1.7	14.5	80.5	154.6	294.6	
SO2	1.4	961.6	41.1	1995.2	159.1	3158.4	
NOx	50.5	939.3	256.7	886	192.5	2324.8	
CO	1227	2905.4	1405.1	5532.8	5415.3	16485.6	
NH3	Waste Disposal	Agricultural Processes	Industrial Processes	Fertilizer Production			
	957.6	362.3	248	33.8	1601.7		
VOCs	Transport Sources	Solvent Use	Industrial Sources	Domestic Sources	Petrochemical, Chemical Production	Waste Disposal	
	409.9	865.3	266.8	575.3	443.7	985.4	3546.4

Table 1: 2007 Emission Inventories for Pollutants Sub-Category (Unit: 10,000Tons)[9]

[9] *"Emission Inventories of Primary Particles and Pollutant Gases for China,"* CAO GuoLiang, ZHANG XiaoYe, GONG SunLing, AN XinQin, WANG YaQiang, March 2011 ,Vol.56 No.3

In addition, almost all of the heavy metal particles and fluoride that cause atmospheric pollution come from industrial sources. The formation of the secondary pollutant ozone is also related to the discharge of nitrogen oxide and hydrocarbons from industrial sources. There are many positive correlations between the concentration of principle atmospheric pollutants and industrial pollutant discharge volume.

Large amounts of pollutants discharged from industrial sources will inevitably have an effect on an area's ambient air quality. Figures 4 and 5 compare the industrial fumes, industrial sulfur dioxide and industrial nitrogen dioxide emissions volume in ambient air nationally and the local sulfur dioxide and nitrogen dioxide annual average daily concentrations for 113 key state cities in 2009. These charts show that in many cities in China there is an obvious correlation between sulfur dioxide and nitrogen dioxide concentrations in ambient air and the amount of industrial sulfur dioxide and industrial nitrogen dioxide emissions.

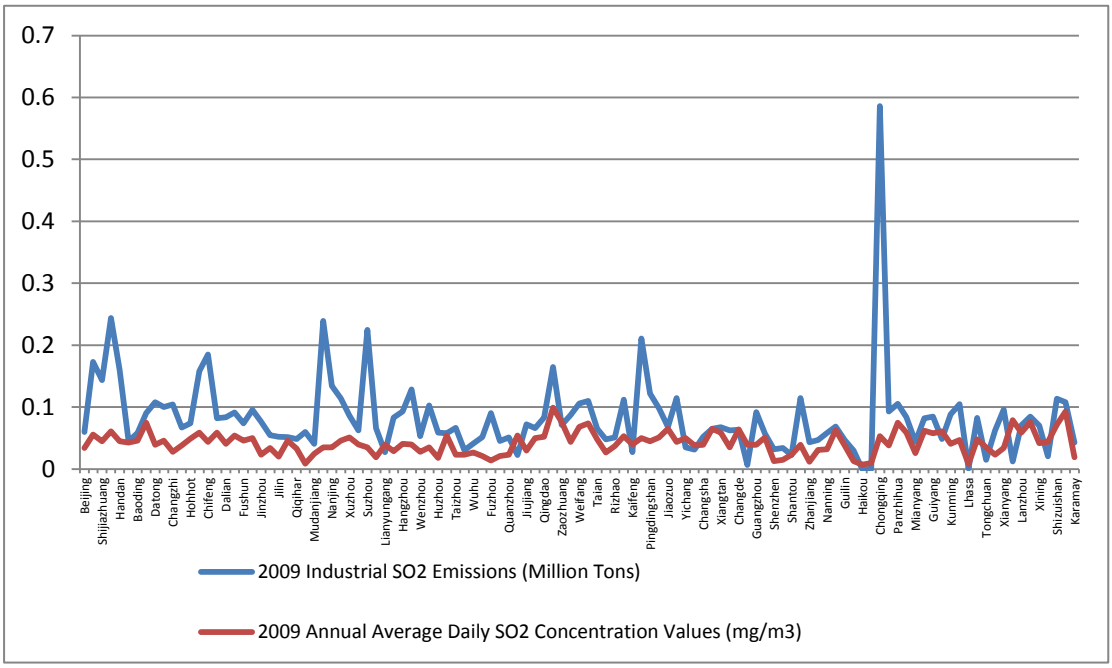

Figure 4: 2009 Comparison of Key State Cities' Industrial Sulfur Dioxide Emissions Volumes[10] and Annual Average Daily Concentrations of Sulfur Dioxide in Ambient Air[11]

[10] *'2009 China Environmental Statistical Yearbook,'* Compiled by the Ministry of Environmental Protection, China Environmental Science Press, December, 2010.

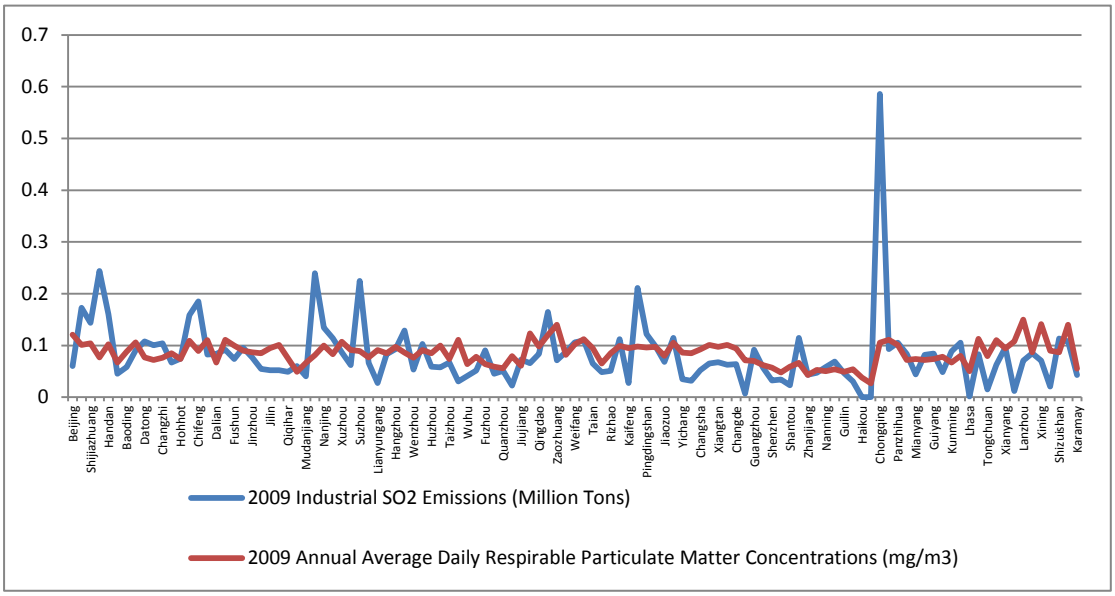

Figure 5: 2009 Comparison of Key State Cities' Industrial Nitrogen Oxide Emissions Volumes[12] and Annual Average Daily Concentrations of Nitrogen Oxide in Ambient Air[13]

1.3 ACTIONS TAKEN AT MAJOR EVENTS TO SAFEGUARD THE ATMOSPHERE VERIFY THAT THE POTENTIAL TO LIMIT INDUSTRIAL POLLUTION SOURCES IS HUGE

The Beijing Olympics, Shanghai World Expo and the Guangzhou Asian Games became significant events in the efforts to safeguard air quality. These cities and the surrounding areas all adopted measures to reduce emissions, amongst these were measures to control local vehicle exhaust fumes and dust pollution, whilst also taking measures to reduce the emissions of many industrial pollution sources.

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[11] *'2009 China Environmental Statistical Yearbook,'* Compiled by the Ministry of Environmental Protection, China Environmental Science Press, December, 2010.

[12] *'2009 China Environmental Statistical Yearbook,'* Compiled by the Ministry of Environmental Protection, China Environmental Science Press, December, 2010.

[13] *'2009 China Environmental Statistical Yearbook,'* Compiled by the Ministry of Environmental Protection, China Environmental Science Press, December, 2010.

For instance, during the 2008 Beijing Olympic and Paralympic games, Beijing Dongfang Petrochemicals Co. Ltd.'s Dongfang Chemicals Factory temporarily halted production and Yanshan Petrochemical Company halted a part of their production. At the same time, key polluting enterprises like Beijing Shougang *HONGYE* Steel Plant and Beijing Flat Glass Group Corporation either halted or limited their production. Beijing Jingneng Thermal Power Co., Ltd., Datang Beijing Gaojing Thermal Power Plant, Huaneng Beijing Thermal Power Corporation and Guohua Beijing Co-generation Branch Company, took measures to use high quality low sulfur coal and increased their operational management of pollution control facilities so as to reduce pollutant discharge by 30% to ensure emissions standards were met. In addition to this, all the cement companies throughout Beijing temporarily halted production.[14]

At the same time, the Ministry of Environmental Protection coordinated with the areas surrounding Beijing, such as Tianjin Municipality and the provinces of Hebei, Shanxi, Inner Mongolia and Shandong, to collectively control the regions' thermal power, construction, cement, chemical and steel companies. Amongst these areas, parts of Tianjin and Hebei took restrictive measures and implemented halts at some enterprises. Based on Beijing's municipal air quality status, Shanxi, Inner Mongolia and Shandong, carried out the appropriate restrictions on pollution from coal burning. Together these six areas came together to improve the air quality in Beijing.

Limiting automobiles and reducing industrial pollution sources has had a significant effect. Data shows that in the first 20 days of August, the average level of pollutant concentrations had dropped 40%. Sulfur dioxide, respirable particulate matter, carbon monoxide and nitrogen dioxide had decreased 27%, 40%, 50% and 61% respectively, compared to the same period in 2007. In August 2008, Beijing gained 13 'Grade One' days, exceeding the city's monthly record for the first time in 10 years.[15] The Deputy Director of the Beijing Municipal *ENVIRONMENTAL PROTECTION* Bureau, Mr. *DU SHAOZHONG*, commented saying that even if there was the situation whereby there were many bad air quality days, Beijing would still be capable of reaching standards. Going on to say that this is the result of implementing safeguard measures for the Olympic Games, especially the measures for temporary discharge reduction.

In addition to this, in the period before the 2010 Shanghai World Expo, the Shanghai Municipal Environmental Protection Bureau, in conjunction with the Provincial Environmental Protection Departments in Jiangsu and Zhejiang, formulated the Yangtze River Delta region atmospheric

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[14] Notice From the People's Government of Beijing Municipality Regarding the Publication of Measures taken to Safeguard the Municipal Air Quality During the 2008 Beijing Olympic & Paralympic Games, April 2008

[15] August 2008 *"Beijing Air Quality Record Commitment to Honor the Success of the Green Olympics,"* China.org.cn, September 2nd, 2008. http://www.china.com.cn/sport/zhuanti/2008ay/2008-09/02/content_16371389.htm

pollution union prevention and control program. Focusing on atmospheric pollution sources, such as the steel, chemical, construction and shipping industries within a 300km radius of the Expo venues. They hoped to implement a comprehensive remediation on coal-fired boilers and carry out a comprehensive inventory of furnaces. These measures basically assured air quality during the period of the World Expo event.

In order to safeguard air quality for the Asian Games in Guangzhou, according to research conducted by a group composed of leading experts in their fields of atmospheric chemistry, pollution control, environmental medicine and meteorology, the results showed that the discharge from: power plants, motor vehicles, industrial sources and dust sources, including sources of volatile organic products, were the five key pollutant sources that affect the ambient air quality of the Pearl River Delta region. To improve the ambient air quality of the Pearl River Delta region and to safeguard the efforts made during the Asian Games, Guangzhou and the surrounding cities must manage the problems together.

During the Asian Games, one of the most important temporary measures taken by Guangzhou to reduce emissions was the halting or restricting of production at 72 key industrial enterprises. A spokesperson at Guangzhou Environmental Protection Bureau revealed, "It is estimated that the direct loss to industrial production output is within ten billion RMB."[16] According to statistics, during the Asian Games, Guangzhou's air quality was good 100% of the time. The daily monitor results from 18 main monitoring sites were in line with national ambient air quality Level Two Standards.[17]

1.4 EMISSIONS POLLUTION FROM POWER PRODUCTION AND INDUSTRIAL ENTERPRISES CAN LEAD TO MANY HAZARDS FOR THE ENVIRONMENT AND PUBLIC HEALTH

1.4.1. THE HARM CAUSED TO PUBLIC HEALTH

From looking at different types of pollutants the main airborne pollutants that affect people's health are sulfur dioxide, nitrogen dioxide, carbon monoxide and volatile organic compounds. These mainly come from industrial emission sources. Respirable particulate matter, PM_{10}, and fine particulate matter, $PM_{2.5}$, also come from industrial pollution sources. The formation of ozone and

[16]Guangzhou Province Environmental Department: *"Asian Games Guangzhou Restrictions on Production Loss is Close to One Billion,"* Nanfang Dushi Bao, October 26th, 2010.

[17] *"Guangzhou Publishes Data Commending the 100% Good Air During the Asian Games,"* Guangzhou Daily, May 8th, 2011.

nitrogen oxide from industrial sources and hydrocarbons are related. Airborne heavy metals and fluoride practically all come from industrial sources

Industrial emissions pollution harms the human body in both acute and chronic ways. Acute harm occurs in industrial areas or those areas nearby. The chronic harm is from atmospheric pollutants directly or indirectly acting on the functions of the human body. This kind of harm is not obviously manifested in the short term and so is difficult to perceive.

Research carried out both domestically and abroad has shown that industrial pollution has an obvious effect on the health of residents. Early research focused more on a number of industrial cities. The research method used was usually to compare the situation of people falling sick in relatively polluted industrial areas in comparison to cleaner residential areas in the suburbs.

For example, in 1995, Zhang Liyun and Liu Fengzhen had already carried out an epidemiological study into the health effects of pollution in Tianjin's industrial area.[18] The main industries in the industrial area were thermal power production, steel smelting, dyeing chemicals, textiles and locomotive rolling stock production. The other area studied for comparison was a clean suburban residential area upwind that contained basically no industry.

From table 2 we can see that for the polluted area, the illness rate was 36.57% and for the clean area, used for comparison, the illness rate was 8.06%. The illness rate for the polluted area was 4.54 times the rate for the clean area. Many respiratory system ailments occurred in the order of colds, pharyngitis, bronchitis, tonsillitis, asthma and allergies, showing an obvious difference with the comparison area. Children in the polluted area had respiratory system ailments and allergies in a one month period, that were, with the exception of tonsillitis, obviously much higher than those of the children in the comparison area.

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[18] Zhang Liyun, Liu Fengzhen, Jin Lingdeng, *"Research on the Health Effects on Children of Atmospheric Pollution in Tianjin City's Industrial Zones."* 1999, 16(2):93-95.

Illness	Pollutant Area (n=902)		Control Area (n=918)		Polluted/Clean
	People	**%**	**People**	**%**	
Cold	93	10.3	15	1.63	6.32
Bronchitis	57	6.32	1	0.11	57.45
Asthma	40	4.43	0	0	
Pharyngitis	58	6.43	5	0.55	11.69
Tonsillitis	51	5.65	52	5.66	0.1
Allergies	31	3.44	1	0.11	31.27
Total	330	36.57	74	8.06	4.54

Table 2: Investigation Results of Research into Child Respiratory and Allergic Illness[19]

Another example is the investigation carried out by the Taiyuan municipal health authority between 1999 and 2001, that compared the respiratory system symptoms and ailments of 6292 adults living in polluted (Area A) and clean (Area B) areas of Taiyuan.[20] The ages of all those that had taken part in the study from the two areas became a standard and standardization was then carried out on the rate of adult respiratory symptoms and ailments in the two areas. This research showed that following the increase in TSP and SO_2 pollution levels there was also an upward trend in the frequency at which adult respiratory symptoms and ailments occurred. The risk of adult respiratory system symptoms, ailments and chronic illness was 1.5 times higher in Area A than in Area B.

Research Area	Coughing	Sputum Mucus	Wheezing	Asthmatic Symptoms	Breathing Difficulties (Short of Breath)
A	22.53	25.28	30.88	8.77	35.52
B	10.52**	12.81**	12.47**	3.73**	19.31**
Note: ** *P*< 0.01					

Table 3: Two Research Areas of Incidence Ratio of Standard Symptoms Adult Respiratory System[21]

[19] Zhang Liyun, Liu Fengzhen, Jin Lingdeng, *"Research on the Health Effects on Children of Atmospheric Pollution in Tianjin City's Industrial Zones."* 1999, 16(2):93-95

[20] Du Yijiao, JinXuelong, *"Coal-burning Atmospheric Pollution Influences Symptoms & Illnesses in the Respiratory System,"* Chinese Health Education, 2004, 20(6):543-544.

[21] Du Yijiao, JinXuelong, *"Coal-burning Atmospheric Pollution Influences Symptoms & Illnesses in the Respiratory System, Chinese Health Education*," 2004,20(6):543-544.

Research Area	Bronchitis	Pneumonia	Chronic Bronchitis	Emphysema	Asthma
A	15.01	8.23	8.56	0.72	2.86
B	5.41**	2.99**	3.01**	0.49	1.25**
Note: ** *P*< 0.01					

Table 4: Two Research Areas of Incidence Ratio of Standard Symptoms Adult Respiratory System[22]

It is not easy to be optimistic when researching the health impacts of atmospheric pollution in the industrial zones of the northern city of Tangshan. In a study, Gao Hongxia and Feng Fumin[23] took 452 children between the ages of 7 and 15 as research subjects. These children had come separately to Tangshan's industrial polluted areas and the relatively clean areas to study. The investigation showed a higher detection ratio, averaging over 50%, for pharyngitis (inflammation of the pharynx), rhinitis (sore throat) and hyposmia (diminished sense of smell), in the polluted areas as opposed to those in the clean "control" area (as shown in Table 4). When compared with the children in the control area, the lung function and immune function of those in the polluted areas declined at varying degrees.

Group	Sample No.	Pharyngitis		Rhinitis		Hyposmia	
		People	**Detection Ratio**	**People**	**Detection Ratio**	**People**	**Detection Ratio**
Pollution	214	195	91.12	87	40.65	72	33.64
Control	238	114	47.92)	632)	26.47 1)	42	17.652)

Table 5: Comparison of Detection Ratio for Upper Respiratory Illnesses[24]

[22] Du Yijiao, JinXuelong, *"Coal-burning Atmospheric Pollution Influences Symptoms & Illnesses in the Respiratory System",* Chinese Health Education, 2004,20(6):543-544.

[23] Gao Hongxia, Feng Fumin, Zhang Zhikun, *"Research on the Health Impacts on Children of Atmospheric Pollution in Tangshan City's Industrial Zones [J]."* Journal Of Environment And Health, 2000,17(6):349-354

[24] Gao Hongxia, Feng Fumin, Zhang Zhikun, *"Research on the Health Impacts on Children of Atmospheric Pollution in Tangshan City's Industrial Zones [J]."* Journal Of Environment And Health, 2000,17(6):349-354.

Research from southern China also shows that industrial area air pollution has an obvious effect on public health. For example, research[25] by Wu Hengsheng, Huang Wenshan, from 1991-2002, showed that the industrial area in Nanning Municipality, Guangxi Province, had a lung cancer mortality rate that was between 2.2 and 1.65 times that of the urban area, while the urban area had a rate that was 1.7-2.1 times the suburban area. The respiratory system illness mortality rates in the industrial area were 1.4 – 2.4 times the rate in the urban area.

Following the functional change of many cities, a large number of industrial enterprises have started to move to the outer suburbs and even rural areas, with the impact of industrial pollution emissions also being extended to these areas. For example, according to an investigation by Chen Yan into the difference in prevalence of asthma and allergies in the Conghua rural area, the investigation survey of 5841 children, aged between 13-14 years old, showed that the prevalence of a history of asthma and recent breathing problems were 4.4% and 2.1% in industrial areas, showing this to be higher than the non-industrial area figures of 2.3% and 1.1% ($P<0.01$).[26] Recent symptoms of allergic rhinitis and the prevalence of eczema in industrial areas was 31.5% and 2.7% respectively, showing that it was higher than the figures of 21.4% and 1.5% for the non-industrial areas ($P<0.01$). The conclusion from this is that the prevalence of asthma and allergies in the rural Conghua area was fairly low and the prevalence of symptoms in the industrial area was obviously higher than the non-industrial areas

1.4.2. DESTRUCTION OF NATURAL RESOURCES

Industrial pollution emissions, in the form of wet deposition or dry deposition, can be transferred from the atmosphere to the ground, thereby impacting humanity and natural eco-systems. Therefore, the hazards brought about by acid deposition (acid rain) in pollutant emissions are not easy to ignore. Acid rain landing on the ground causes acidification in the soil, lakes and rivers, and when the pH value of this water drops below five it can very seriously impact the breeding and development of aquatic life and can destroy aquatic ecosystems. Acid rain can inhibit the decomposition of organic matter and the fixing of nitrogen in soil, it can also cause a large amount of inorganic minerals run-off

[25] Wu Hengsheng, Huang Wenshan, Zhang Xinying, *"Countermeasures by Nanning Municipal Policy to Control the Hazards of Atmospheric Pollutants on the Human Body [J]."* China Population, Resources & Environment, 2003, 13(6):86-90.

[26] Chen Yan, Li Jing, Zhong Nanshan, "Study into the Difference in Prevalence of Asthma and Allergies in the Conghua Rural Area." Henan Medicine, 2011, 22(20):135-136.

which can then decrease soil fertility and can even lead to soil hardening. Following rainfall some toxic metal elements that have accumulated in the soil, then flow into rivers causing secondary pollution in water bodies.

Acidification of soil can cause an accumulation of aluminum ions which can be a fatal hazard for the root systems of plants. Acid rain is also hazardous to forest vegetation and can directly damage the epidermal tissue and membrane structure of leaves, disrupting normal metabolic processes and affecting the plant's reproductive processes. The main distribution of acid rain in China is in seven southern provinces (as shown in Figure 6). The estimated forested area damaged by acid deposition is 1.2821*106hm^2. Since the 1980s, at Chongqing's 1800hm^2, Nanshan mountain, 46% of mason pine (Pinus Massoniana) have died; at the summit of Mount Emei, 40% of fir trees (Abies Fabri) have died; in Sichuan's Fengjie County's Caoba Forest 96% of pine (P. armandii) trees in the 6000hm^2 forest have died. Initial verification has shown that this decline (in forests) is related to acid rain.[27]

Research from the China Research Academy of Environmental Sciences and Tsinghua University show that pollution from acid rain causes an annual economic loss in excess of RMB110 billion, as just one ton of sulfur dioxide causes a loss in excess of RMB 5000. The annual economic loss due to atmospheric pollution is estimated to be between 2-3% of China's annual GDP.[28]

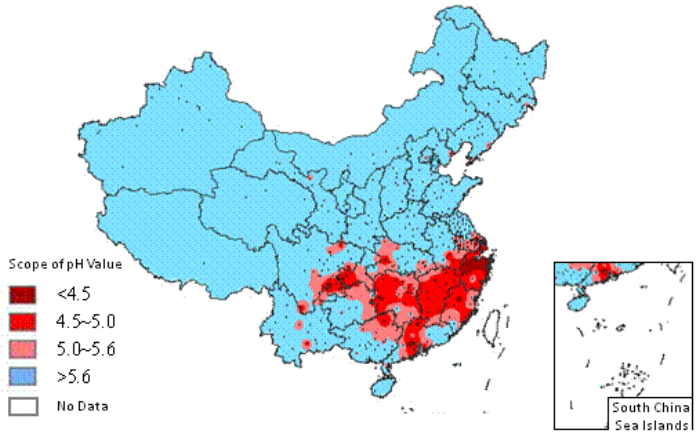

Figure 6: 2010 Annual National Precipitation pH Value Chart[29]

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[27] Wang Honglin, "Harm of Acid Rain on Forests and Counter Measures Taken," Anhui Forestry, 2004, 4:42-43.

[28] "Thermal Power Production Pollutant Discharge Standards" "Upgrade," Press Release No. 26, March 2nd, 2004.

[29] *'2010 Report on the State of the Environment in China,'* Ministry of Environmental Protection, June 5th, 2011.

1.5. CLEAR MEASURES FOR INDUSTRIAL SOURCE RESPONSIBILITY & MANAGEMENT

China has established legislation and standards for controlling the pollutant discharge from industrial enterprises; which involves wastewater, emissions, noise, solid waste and radiation.

Amongst these are standards related to industrial atmospheric pollutant discharge; which are listed below:

Atmospheric Pollutant Discharge Standards:

Standard Name	Standard Serial No.	Publication Date	Implement--ation Date
Emission Standard of Air Pollutants for Thermal Power Plants	GB 13223-2011	2011-7-29	2012-1-1
Emission Standards of Pollutants from Rare Earths Industry	GB 26451-2011	2011-1-24	2011-10-1
Emission Standard of Pollutants for Vanadium Industry	GB 26452-2011	2011-4-2	2011-10-1
Emission Standard of Air Pollutants for Flat Glass Industry	GB 26453-2011	2011-4-2	2011-10-1
Emission Standard of Pollutants for Rubber Products Industry	GB 27632-2011	2011-10-27	2012-1-1
Emission Standard of Pollutants for Ceramics Industry	GB 25464-2010	2010-9-27	2010-10-1
Emission Standard of Pollutants for Aluminum Industry	GB 25465-2010	2010-9-27	2010-10-1
Emission Standard of Pollutants for Lead and Zinc Industry	GB 25466-2010	2010-9-27	2010-10-1
Emission Standard of Pollutants from Copper, Nickel, Cobalt Industry	GB 25467-2010	2010-9-27	2010-10-1
Emission Standard of Pollutants from Magnesium and Titanium Industry	GB 25468-2010	2010-9-27	2010-10-1
Emission Standard of Pollutants for Nitric Acid Industry	GB 26131-2010	2010-12-30	2011-3-1
Emission Standard of Pollutants for Sulfuric Acid Industry	GB 26132-2010	2010-12-30	2011-3-1
Limits and Measurement Methods for Exhaust Pollutants from Small Spark Ignition Engines of Non-road Mobile Machinery (Phase I, II)	GB 26133-2010	2010-12-30	2011-3-1
Emission Standard of Coal Bed Methane/Coal Mine Gas (Trial)	GB 21522-2008	2008-4-2	2008-7-1
Emission Standard of Pollutants for Electroplating	GB 21900-2008	2008-6-25	2008-8-1
Emission Standard of Pollutants for Synthetic and Artificial Leather Industry	GB 21902-2008	2008-6-25	2008-8-1
Emission Standard of Air Pollutant for Bulk Gasoline Terminals	GB 20950-2007	2007-6-22	2007-8-1
Emission Standard of Air Pollutant for Gasoline Filling Stations	GB 20952-2007	2007-6-22	2007-8-1

Emission Standard for Pollutants from Coal Industry	GB 20426-2006	2006-9-1	2006-10-1
Emission Standard of Air Pollutants for Cement Industry	GB 4915-2004	2004-12-29	2005-1-1
Emission Standard of Air Pollutants for Thermal Power Plants	GB 13223-2003	2003-12-30	2004-1-1
Emission Standard of Air Pollutants for Coal-burning, Oil-burning, Gas-fired Boilers	GB 13271-2001	2001-11-12	2002-1-1
Emission Standard of Cooking Fume (Trial)	GB 18483-2001	2001-11-12	2002-1-1
Emission Standard of Air Pollutants for Industrial Kiln and Furnace	GB 9078-1996	1996-3-7	1997-1-1
Emission Standard of Air Pollutants for Coke Oven	GB 16171-1996	1996-3-7	1997-1-1
Integrated Emission Standard of Air Pollutants	GB 16297-1996	1996-4-12	1997-1-1
Emission Standards for Odor Pollutants.	GB 14554-93	1993-8-6	1994-1-15

Clear regulations and standards mean that the responsibility for industrial source pollution controls is clearer than for other sources. Furthermore, they are also bound by law.

At the same time, besides transportation and commercial vehicle discharge, industrial sources generally have clear and fixed discharge outlets. Compared to hundreds of thousands, even millions of municipal transport sources and rural non-point sources, the development of clear targets, government monitoring and public supervision is comparatively easy to develop.

In light of these considerations, we have decided to firstly focus on the atmospheric pollution created by industrial sources.

2. DETERMINING KEY POINTS FOR THE PUBLIC INVESTIGATION INTO INDUSTRIAL POLLUTION SOURCES

The number of industrial pollution sources in China is enormous. Where should the public focus its attention? When answering this question, we should first determine the sources of industrial atmospheric pollution.

2.1. INDUSTRIAL ATMOSPHERIC POLLUTANT SOURCES

Industrial atmospheric pollutants primarily come from the following two sources: fuel combustion and industrial production processes.

- **Fuel Combustion**

Fuel Combustion primarily involves the thermal power, steel and coking industries. Owing to China's energy infrastructure being based on coal, the main pollutants discharged from fuel combustion processes are particulates, sulfur oxides and nitrogen oxides.

- **Industrial Production Processes**

Industrial production processes primarily involve the chemical, petrochemical, steel and cement industries. All pollutants from raw materials and production operations, crushing, as well as all kinds of raw material manufacturing and finishing processes are emitted into the atmosphere. Amongst these processes the main pollutants are dust, sulfur compounds, volatile organic compounds (VOCs), nitrogen compounds and halogen compounds.

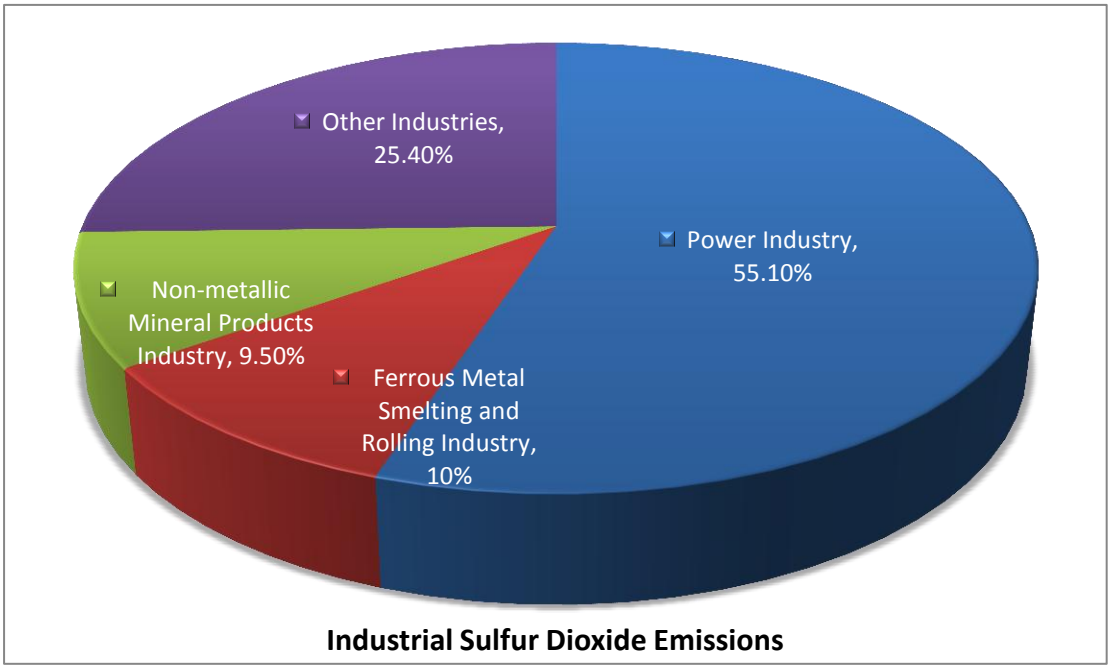

Figure 7: 2009 Industrial Sulfur Dioxide Emissions[30]

[30] *'2009 China Environmental Statistical Yearbook,'* Compiled by the Ministry of Environmental Protection, China Environmental Science Press, December, 2010.

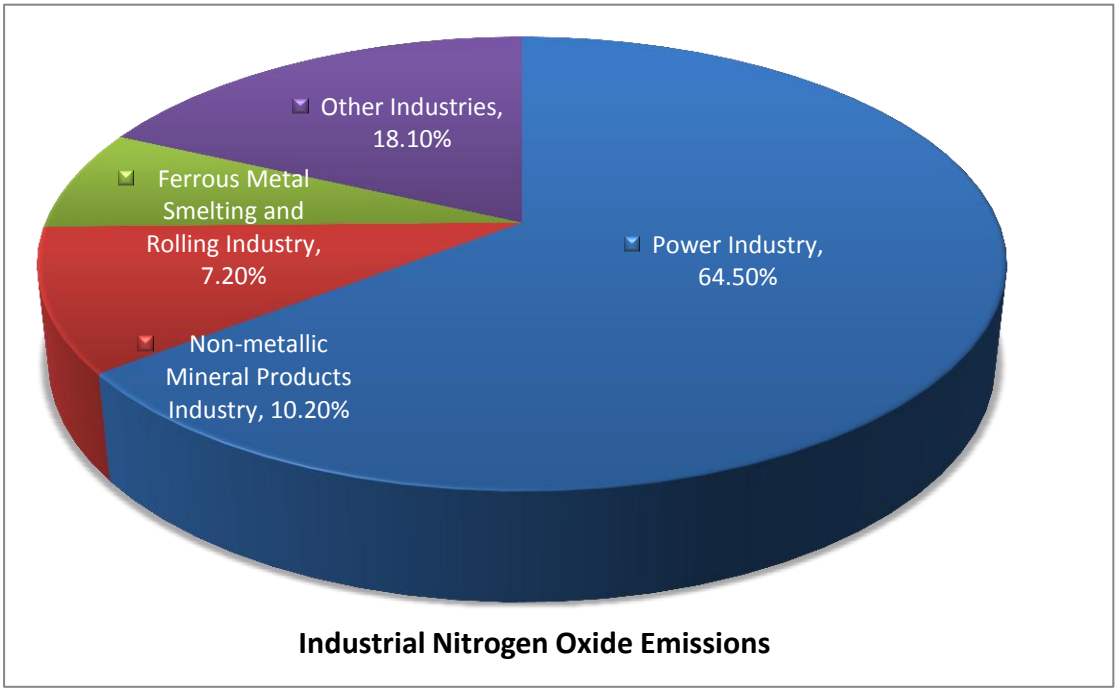

Figure 8: 2009 Industrial Nitrogen Oxide Emissions[31]

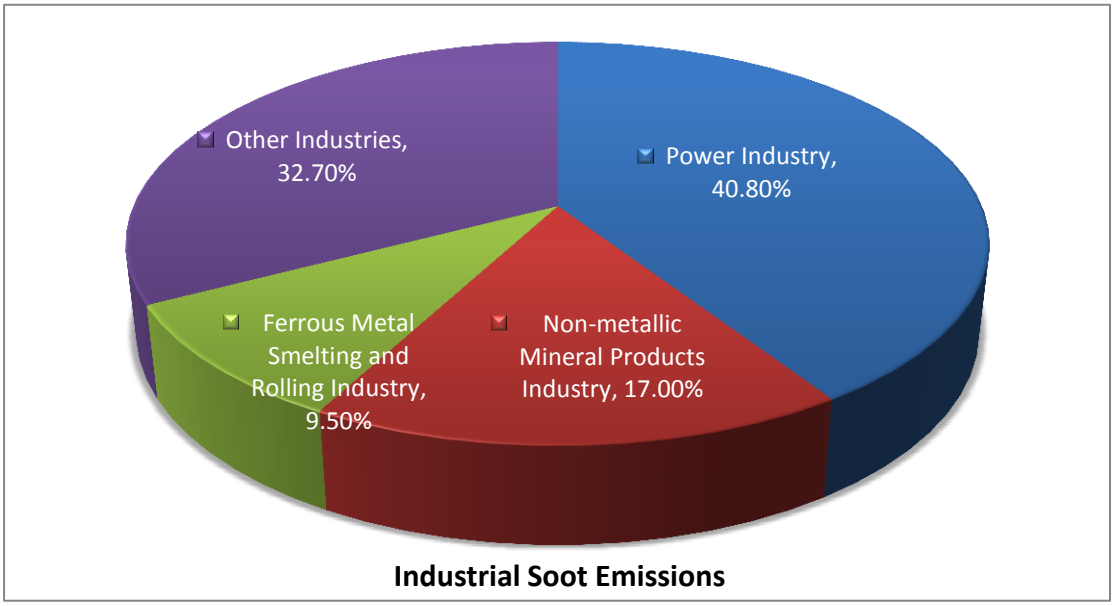

Figure 9: 2009 Industrial Soot Emissions[32]

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[31] *'2009 China Environmental Statistical Yearbook,'* Compiled by the Ministry of Environmental Protection, China Environmental Science Press, December, 2010.

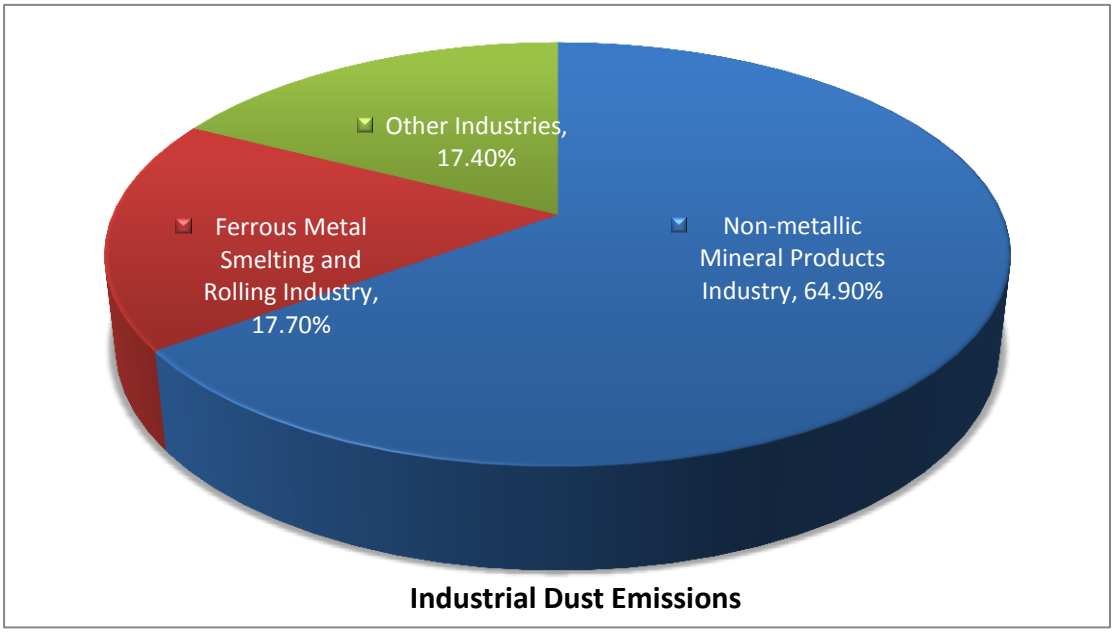

Figure 10: 2009 Industrial Dust Emissions[33]

An industry insider recently told the media that the domestic steel industry now has more than 1200 sintering machines, but has only 170 sets of desulfurization equipment in operation or currently under construction meaning coverage of less than 15%.[34]

Clearly, including the steel industry in the key industry large emitters is a must for the public's attention and supervision.

2.2. KEY MONITORED ENTERPRISES FOR EMISSIONS

When developing the 'China Air Pollution Map Database' we paid attention to the official names on the 'List of Key State Monitored Enterprises.'

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[32] *'2009 China Environmental Statistical Yearbook,'* Compiled by the Ministry of Environmental Protection, China Environmental Science Press, December, 2010.

[33] *'2009 China Environmental Statistical Yearbook,'* Compiled by the Ministry of Environmental Protection, China Environmental Science Press, December, 2010.

[34] The Iron and Steel Industry is Facing "Green" Regulatory Pressure, China Securities News, June 3rd, 2011.

The 'List of Key State Monitored Enterprises' is set according to the selection principles and methods of the Ministry of Environmental Protection. Comments are sought from all localities and relevant departments in the final formation of the list. Since 2007, the list has been confirmed and published annually.

According to the "Notice Regarding the Publication of the '2011 List of Key State Monitored Enterprises,' published by the Environmental Protection Bureau on March 25th, 2011, the specific selection criteria for enterprises listed for emissions was as follows:[35]

- According to selection principles and using the 2009 environmental statistical database as a foundation, industrial enterprises were separated according to sulfur dioxide and nitrogen dioxide discharge volumes. These companies were then ranked in order from greatest to lowest discharge volumes and those companies occupying the greatest 65% of the industrial discharge volume were selected. These results took the form of the preliminary list of companies listed for emissions.

- The power industries, the large-scale petroleum processing and refining industries, the iron and steel industries, non-ferrous metal smelting industries, cement industries, glass products industries, as well as tile production enterprises, are all listed and managed as key state monitored enterprises.

- Key controlled enterprises listed for heavy metals, all thermal power stations with an operating capacity over 6000 kilowatts, iron and steel sintering processing enterprises, oil refining enterprises and those with the potential for a large environmental impact were also added to the list.

By analyzing the standards above we can deduce the following:

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[35] Key State Monitored Enterprises for the Year are 65% of the National Baseline for Industrial Emissions Discharge Volumes. For 2011 Screening and Filtering Methods Please See: http://www.mep.gov.cn/gkml/hbb/bgt/201103/t20110331_208210.htm

- Owing to this list being published by the national environmental authorities, and the fact that it covers the largest emitters nationally, as well as covering all of the key industries, all of the companies included on this list are worth the attention of the public.

- Through positioning, the public will be able to visualize the geographical distribution of the largest emitters nationally. This will assist the public in understanding the pollution sources in their locality, protecting both the environment and the health of the public.

- The discharge volume for these companies, selected as large emitters, occupies 65% of all industrial discharge. Through interaction with the China Pollution Map Database the relation between the company's spatial location and the violation record will emerge allowing the public to better understand the actual environmental performance of these large emitters.

- Clearly these large emitters 'hold the tap' on these emissions, through information disclosure, the formulation of social pressure and through pushing these companies to disclose their pollutant discharge information; this will strongly promote a reduction in emissions.

Based on the above findings, we decided to carry out investigations into and positioning of large wastewater dischargers and emitters, based on the '2011 List of Key State Monitored Enterprises.' This report mainly relates to those waste gas emitting companies in our investigation

3. THE INVESTIGATION AND FINDINGS OF ATMOSPHERIC INDUSTRIAL POLLUTION SOURCES

3.1 THE COLLECTION OF ATMOSPHERIC POLLUTION SOURCE SUPERVISION & DISCHARGE RECORDS

In December 2007, the Institute of Public & Environmental Affairs (IPE) established the 'China Air Pollution Map Database' and from then on have continued to collect and sort the air quality information, pollution discharge data and environmental supervision records for 31 provinces and 300 prefecture level cities nationwide.

When visiting the 'Pollution Map Database' the content related to pollution emissions sources can be found under the 'Corporate Supervision Records' column and the 'Discharge Data' column.

Corporate Supervision Records: As of December 8th, 2011, the IPE had collected 23,038 official air quality environmental supervision records, published by environmental protection departments at all levels and dating back as far as 2004.

- The supervision records are sourced from officially disclosed routine monitoring data and on information related to confirmed complaints from the public.
- The supervision records cover company records for exceeding discharge standards and the total discharge volume standards, records on deadlines for companies to make rectifications and to reduce discharge, as well as the phasing out of seriously polluting outdated production techniques and equipment.
- Related to heavy polluting industries such as the thermal energy, casting, cement, metallurgy, steel and chemical industries.
- The public can search this information according to year, location and violation type.

Discharge Data: As of December 8th, 2011, the IPE had collected more than 9,800 enterprise discharge data sets, including emissions data. This column has the following functions and features:

- The indicators related to emissions include, but are not limited to, the total emitted volume, dust, sulfur dioxide and nitrogen oxides.
- The client "buyer" companies of enterprises that have many years of discharge data recorded can click to see the trends in annual pollutant discharge.

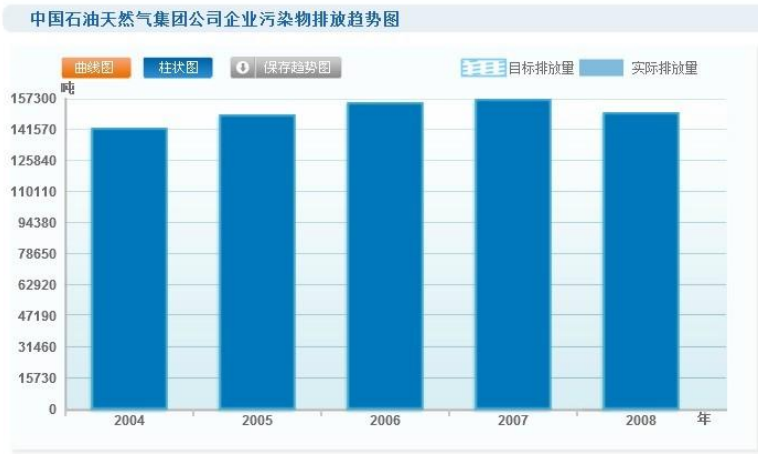

Figure 11: Pollutant (SO_2) Discharge Trend for China National Petroleum Corporation - Weinan Company[36]

[36] http://www.ipe.org.cn/pollution/fdetail.aspx?cid=1&industry=42075

3.2. LAUNCHING ATMOSPHERIC POLLUTION SOURCE POSITIONING

Pollution source positioning can be done using two methods, **online positioning** and **on-site positioning.**

Online Positioning

- Online positioning can be done using statistical resources. This method is highly efficient and economical on both human and material resources. It is for this reason that we must strive for each pollution source to be positioned using various online mapping tools, combined with telephone inquiries and any other forms of positioning available.
- When there is a large number of enterprises with whom their specific locations cannot be positioned on an electronic map, or if there are conflicts concerning the enterprise address; only on-site positioning will be capable of confirming the exact location of the pollution source. On-site positioning should be carried out based on the general location found during online positioning. At the same time, efforts must be made to map out and plan the most reasonable and coordinated route in order to improve the efficiency of the positioning tasks.

On-site Positioning

- Although for on-site, compared to online positioning, more manpower and resources need to be invested, there are advantages to this type of positioning:
- On-site positioning acts as a supplement to and an extension of online positioning. At the same time, this can lead to the launch of an on-site investigation of the operating circumstances and pollutant discharge of the enterprises involved. Further to this, knowledge can be gained on the surrounding environmental quality of the enterprise location, as well as the relationships between the enterprise and the residents in the surrounding communities.

After the completion of both on-line and on-site positioning, the relevant data will be uploaded to the database. By accessing the electronic map on the website, the public will be able to understand the distribution status of pollution sources.

3.3. KEY POLLUTION SOURCE INVESTIGATION & FINDINGS

Through investigating and positioning we discovered the following:

- The distribution of pollution sources on a macro scale.
- Which industries are the main emission sources.
- Whether or not those companies, with very large pollution discharge, have environmental violation records and whether or not they have disclosed their discharge data in the past.
- That many large emitters are clustered around water sources.
- By obtaining satellite imagery of the companies it is possible to give the public a better understanding of the situation.

- In some areas the emissions discharge of companies were enormous and they were situated quite close to each other. This should be a top priority for environmental regulation and energy conservation.
- Enterprise atmospheric pollution is already having an adverse effect on the life of communities, public health and the eco-system.

3.3.1. DISCOVERING POLLUTION SOURCE DISTRIBUTION PATTERNS

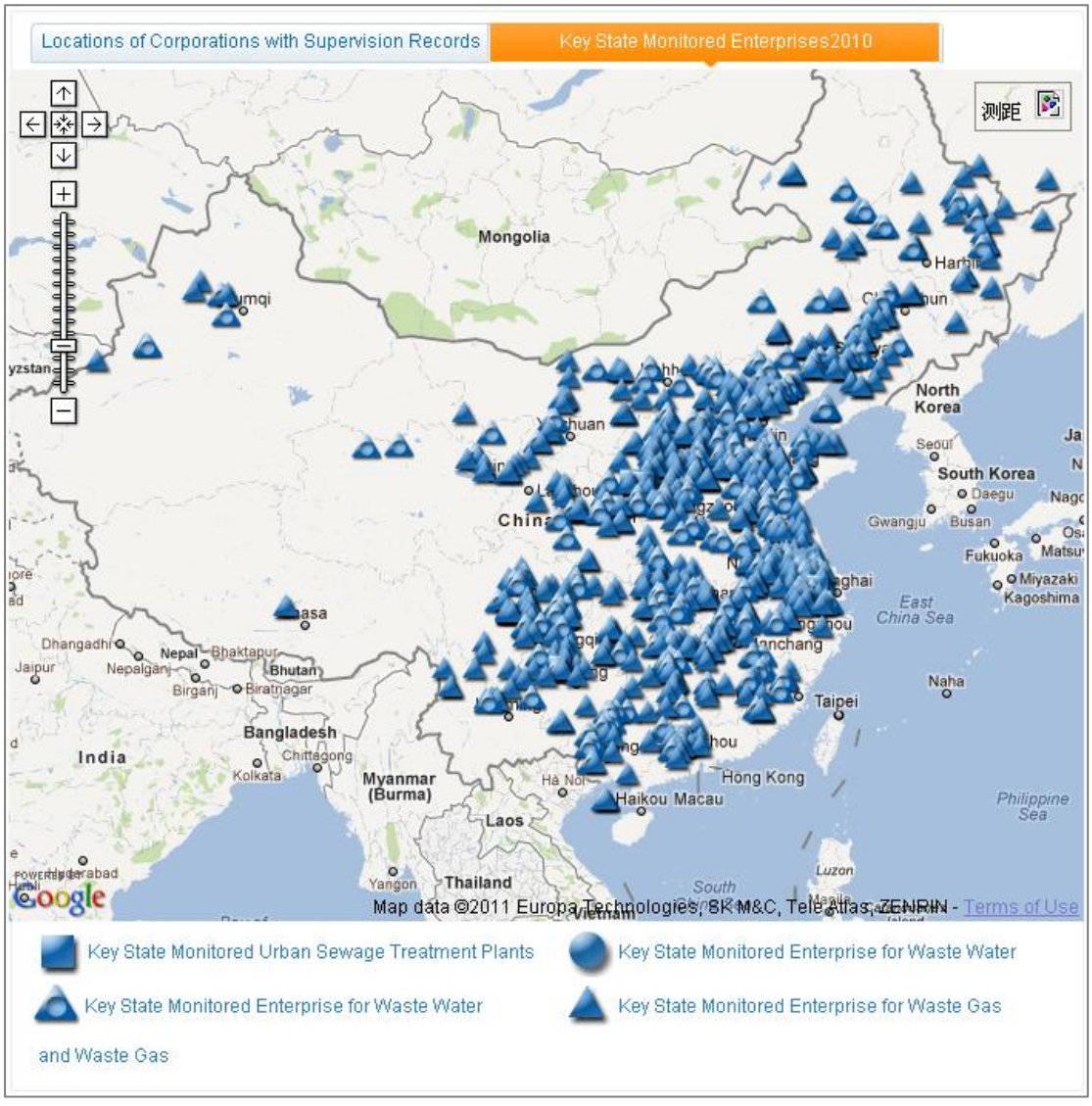

Figure 12: 2010 Distribution of Key State monitored Enterprises Listed for Emissions as shown on the IPE Website.

When we focus on key monitored enterprises listed for emissions we can see that their distribution has its own characteristics.

- The more developed eastern areas have the highest concentration but some central areas also have concentrated distributions. The Chengdu and Chongqing economic areas in the west, Ningxia and Inner Mongolia on the upper reaches of the Yellow River, as well as the Wei River basin in Shanxi also have fairly concentrated distributions.
- Originally, due to the large production scale of the energy and raw materials industries, large emitters were concentrated in the northern areas, but have now started to extend south to the Yangtze River and the Pearl River basin. The Yangtze River Delta now has a large number of big chemical industry emitters.

3.3.2. POLLUTION SOURCES DISTRIBUTED IN KEY AREAS

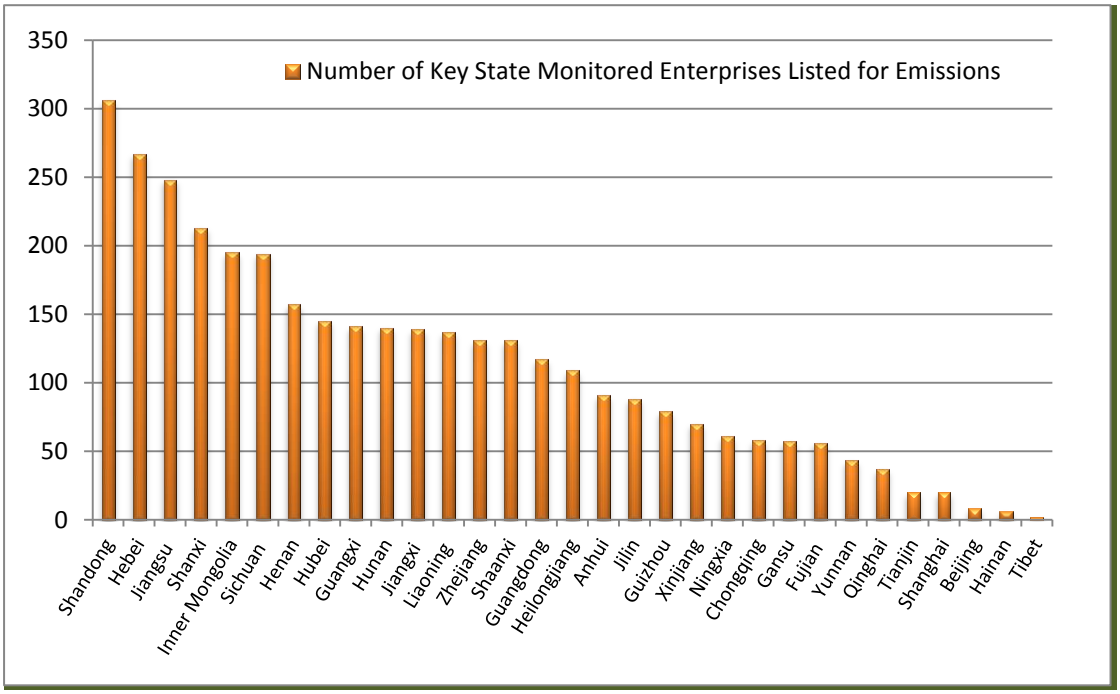

Figure 13: 2010 Number of Provincial, Autonomous Region and Municipalities' Key State Monitored Enterprises Listed for Emissions

The figure above shows that Shandong, Hebei, Jiangsu, Shanxi and Inner Mongolia are the provinces with the densest concentration of large scale emitters. The eastern coastal provinces

account for three from the top ten and if Guangxi is included that makes four. The central regions have five in the top ten and for the west there is just Sichuan placed at number six.

It is not difficult to see that the regions on the eastern coast are still the areas with the greatest concentration of large emitters. However, the central regions are developing strongly and will subsequently follow this trend.

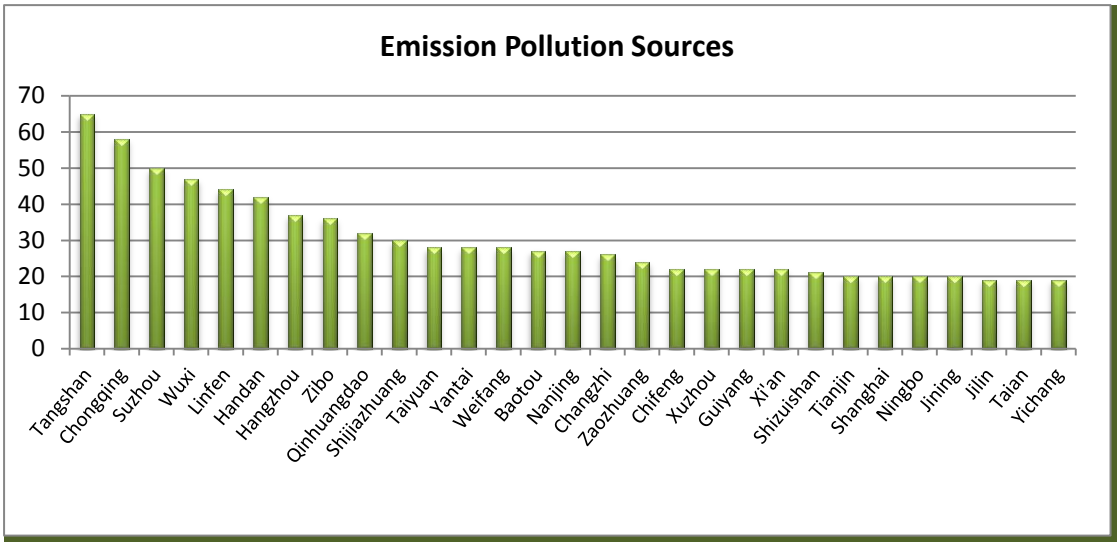

Figure 14: 2010 Number of Key State Monitored Enterprises Listed for Emissions in 29 Key Environmental Protection Cities

The above figure shows how many key state monitored enterprises listed for emissions there are in the top 25% of the 113 environmental protection cities. In other words, the large emitters are relatively more densely packed in these cities.

- Looking at the eastern, central and western regions:

  - There are 17 cities from the east which shows that the eastern coastal cities still have the highest concentrations of big emitters.
  - There are seven cities from the central regions, Shanxi province has three and Inner Mongolia has one, showing that central cities with coal based resources are paying an environmental price.
  - The western regions also have four cities, Chongqing, Guiyang, Xi'an and Shizuishan, which shows that with the backdrop of the 'develop the west,' large emitting enterprises are clustered in several western cities.

The following image reflects the situation of emissions pollution sources distribution on the banks of the Yellow River, Shizuishan, and Ningxia Hui Autonomous Region.

Figure 15: The Red Box Contains a Key Monitored Enterprise Listed for Emissions

- Looking at the Northern and Southern Regions:
  - There are 19 cities from the north meaning that they are in the majority. The main reason for this is that a large number of northern cities rely on the energy, steel and cement industries which are all large emitters.
  - The South's large emitters are mainly concentrated in the Yangtze River basin and Qiantang River basin. These basins include the cities Suzhou, Wuxi and Hangzhou, cities that traditionally have relied on light-industry. This shows that southern cities' pollution intensity is following the increase in industry.

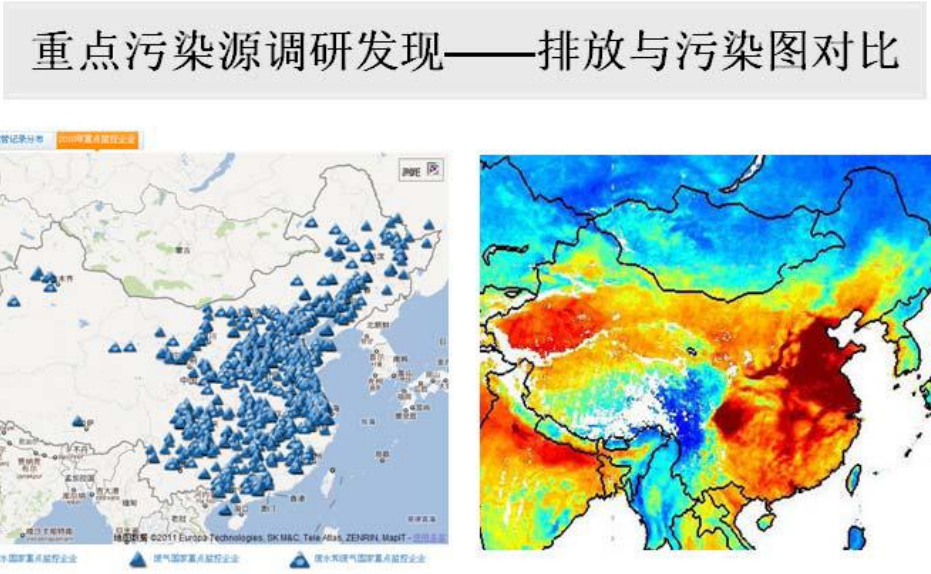

Figure 16

3.3.3. CLEARLY KEY EMISSIONS SOURCES ARE LINKED TO KEY INDUSTRIES

The 2010 key monitored enterprises listed for emissions by industry:

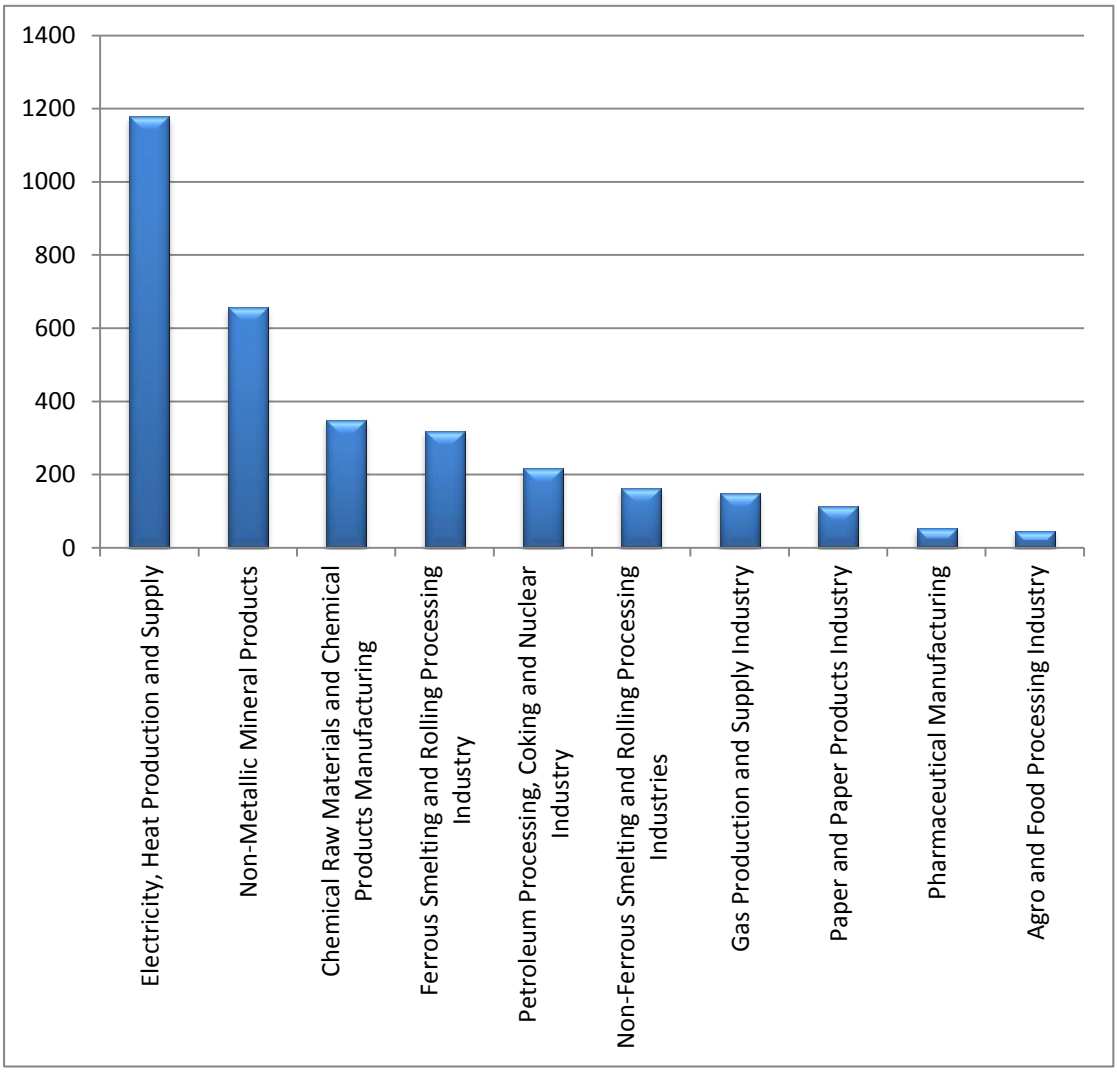

Figure 17: 2010 Key State Monitored Enterprises Listed for Emissions by Industry (Top 10) [37]

[37] Classified according to the company categorization standards of the National Bureau of Statistics of China.

The above figure shows that power, cement, chemicals, steel and coking make up most of the heavily emitting industries nationally. Amongst these, the power industry is far ahead with 1178 companies, accounting for 34% of all key monitored enterprises listed for emissions.

From looking at the situation in all parts of the country, by province, area and city, most of the large emitters are in the heavy chemical industries. However, the industries are distributed differently. With this in mind, we have carried out analysis on the first six provinces ranked for their amounts of key monitored enterprises for emissions.

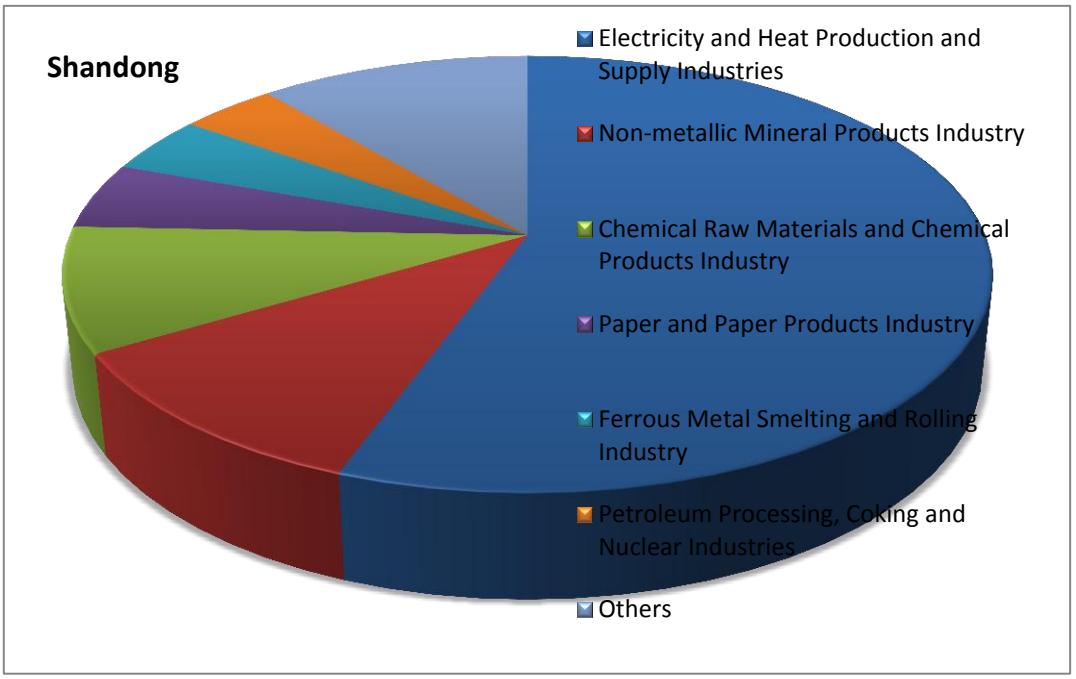

Figure 18: 2010 Shandong Province Key State Monitored Enterprises Listed for Emissions by Industry Type

The above figure shows that for Shandong, the province with the highest concentration of key monitored enterprises listed for emissions, more than half the key emission pollution sources are power plants. This reflects the high energy consumption model of economic development and a model of high discharge. The construction materials and chemical industries also contribute to atmospheric pollution.

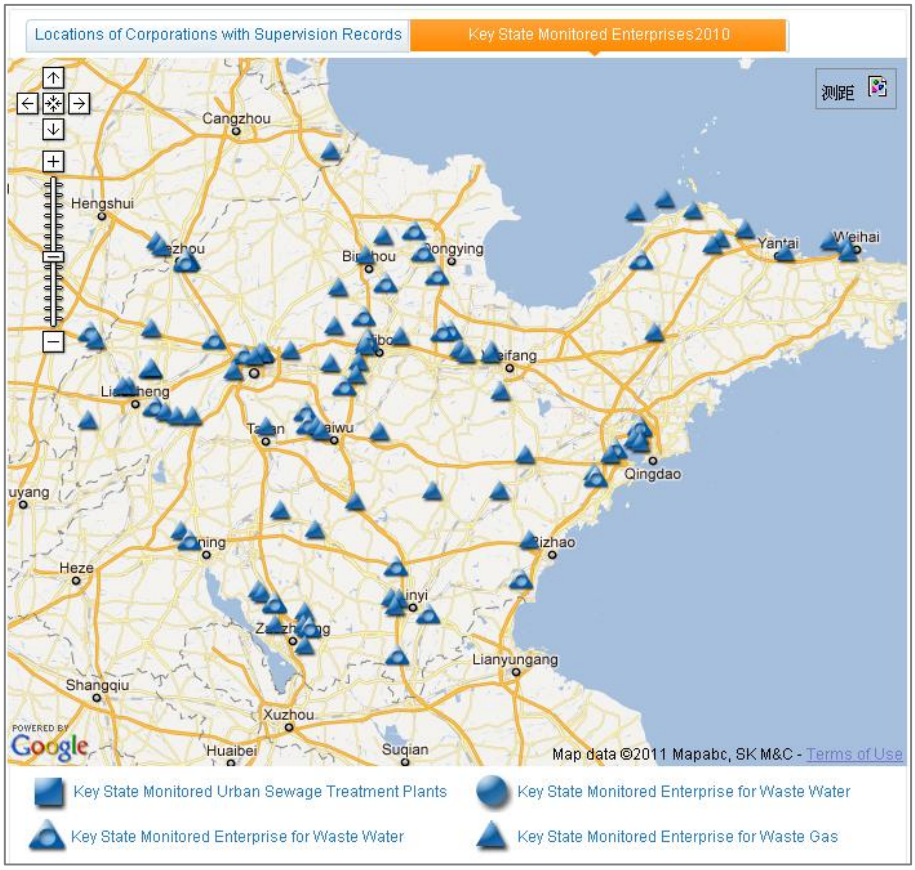

Figure 19: Distribution of Key State Monitored Enterprises for Emissions in Shandong Province as Shown on the IPE Website.

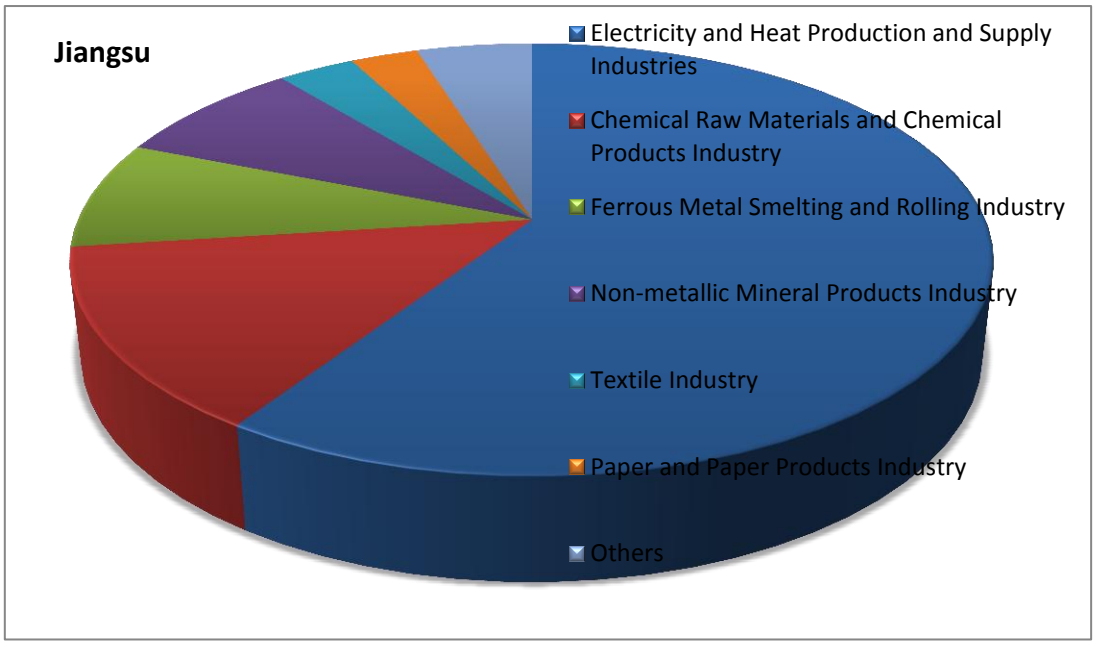

Figure 19: 2010 Jiangsu Province Key State Monitored Enterprises Listed for Emissions by Industry Type

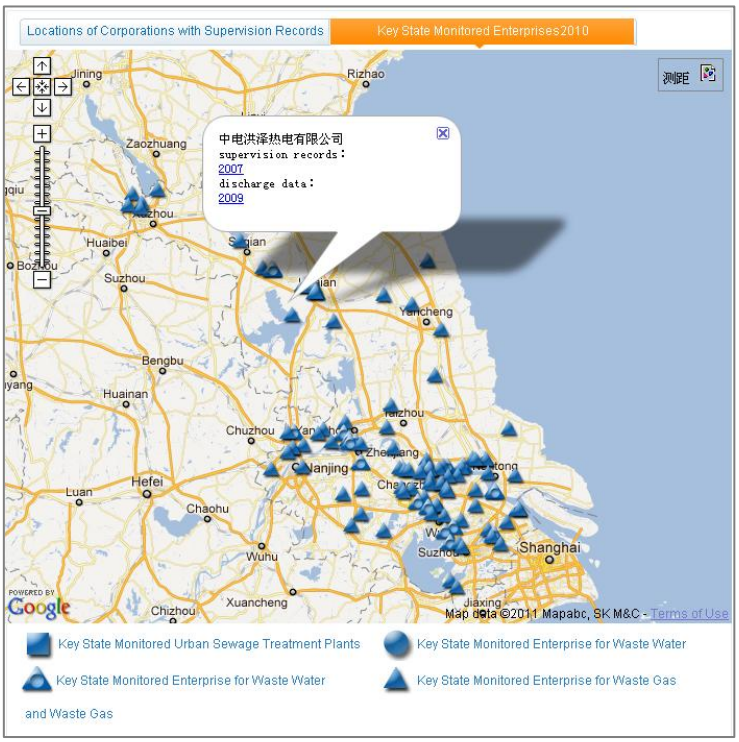

Figure 21: Distribution of Key State Monitored Enterprises for Emissions in Jiangsu Province as shown on the IPE website

The province in the south with the highest concentration of key emission enterprises, Jiangsu, is similar to Shandong province, but with even more power plants. The remaining industries are mainly heavy industries such as chemical, steel and cement, far outnumbering the traditional light industries of textiles and paper manufacturing.

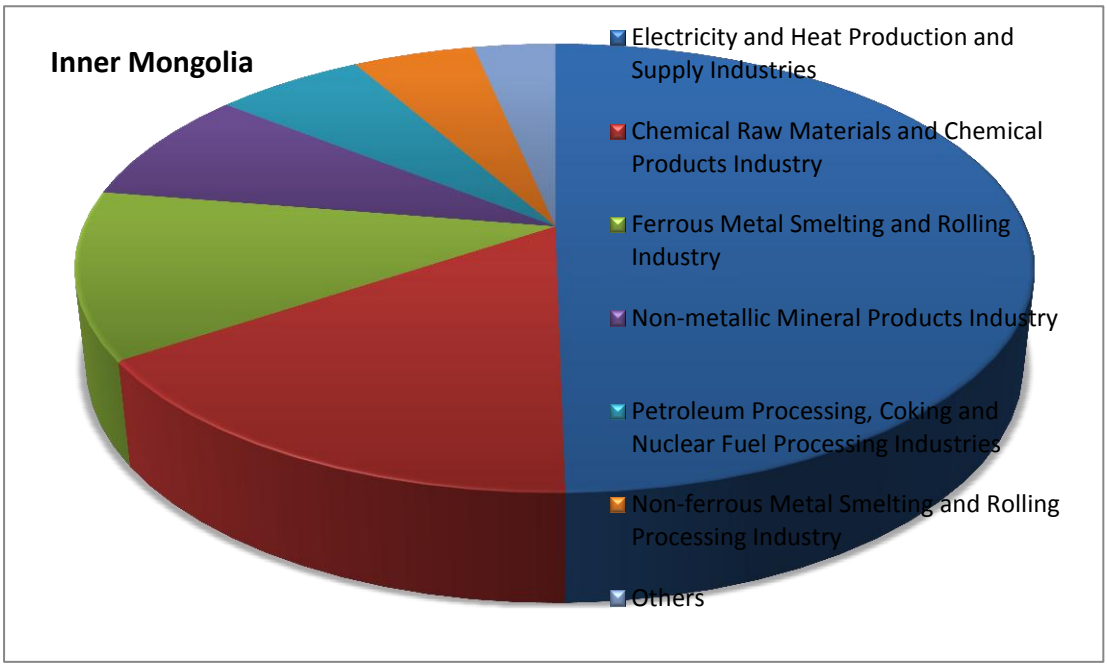

Figure 22: 2010 Inner Mongolia Autonomous Region Key State Monitored Enterprises Listed for Emissions by Industry Type

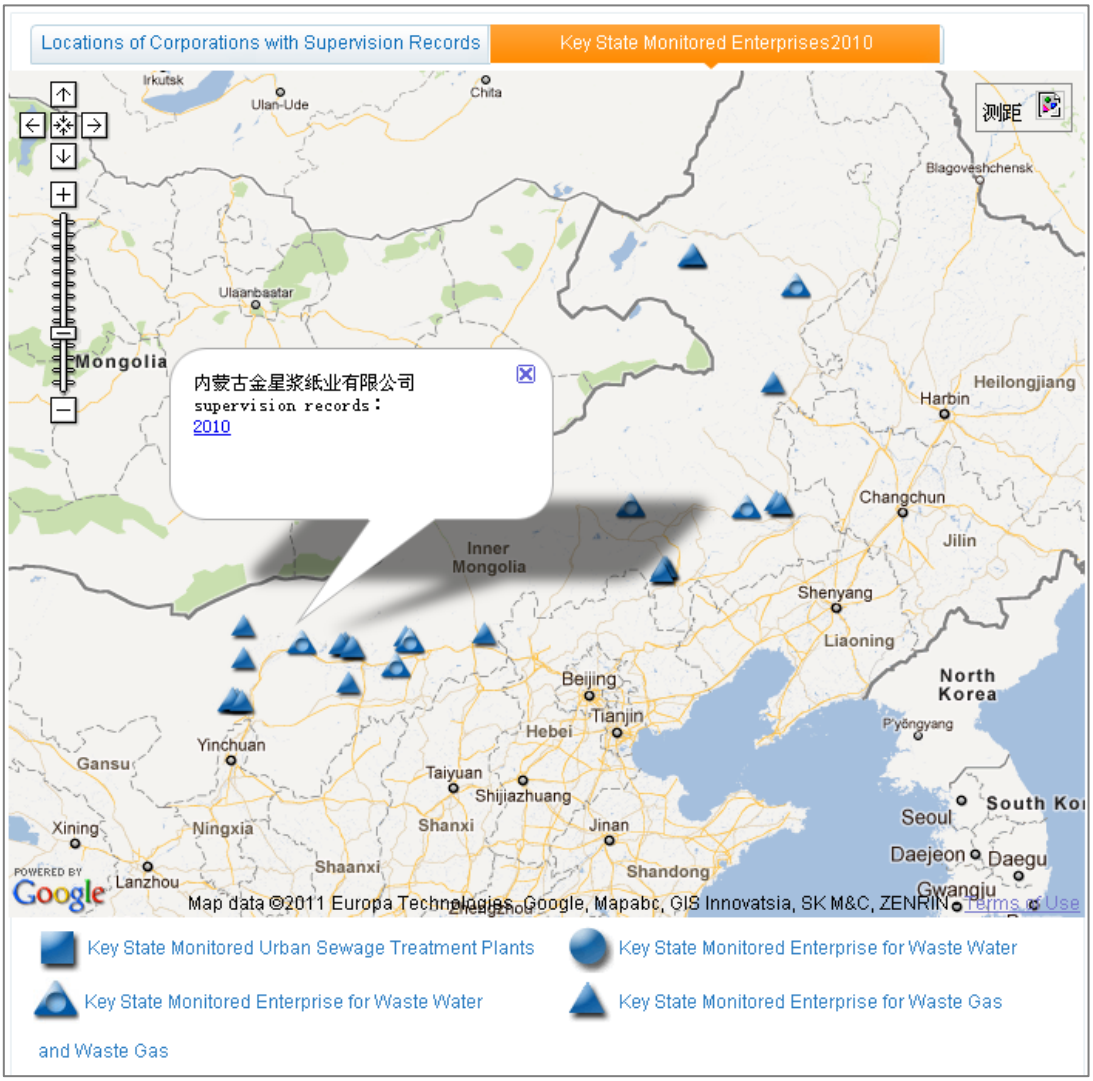

Figure 23: Distribution of Key State Monitored Enterprises for Emissions in Inner Mongolia as Shown on the IPE Website

The situation in Inner Mongolia seems similar to that of Shandong and Jiangsu but actually has some differences. Although power plants make up half of the big emitters, a lot of the electricity is sent to the north and the north east regions of China. In the first half of 2011, the region's 6000 kW and over power plants generated a total of 150.805 billion kWh. Thermal power plants generated 137.787[38] billion kWh, making up 91.4% of total power generated. The amount of electricity sent out

[38] Electricity Production for the First Half of the Year, Inner Mongolia Autonomous Region Industry and Information Committee, July 19th, 2011. http://www.nmgjxw.gov.cn/cms/dlyx/20110719/5558.html

of the region was 61.752 billion kWh making up 40.9% of the total for the first half of the year. 40.489 billion KWh was sent to the North China Power Grid whilst 20.77 billion kWh were sent to the North East Power Grid. [39] Of course Inner Mongolia's own high energy consuming chemical, steel, construction materials, petrochemicals, non-ferrous metals smelting and coal industries have also seen a rapid expansion. According to statistics the six industries of energy, metallurgy, chemical, equipment manufacturing, agricultural and livestock processing industries as well as high-tech industries increased to make up 80% of the region's value added industry in 2006[40], and by 2010, this proportion had increased to around 90% making them the main force in driving Inner Mongolia's fast growing industrial production.[41]

In contrast, Hebei, Shanxi and Sichuan's big emitters are not power plants.

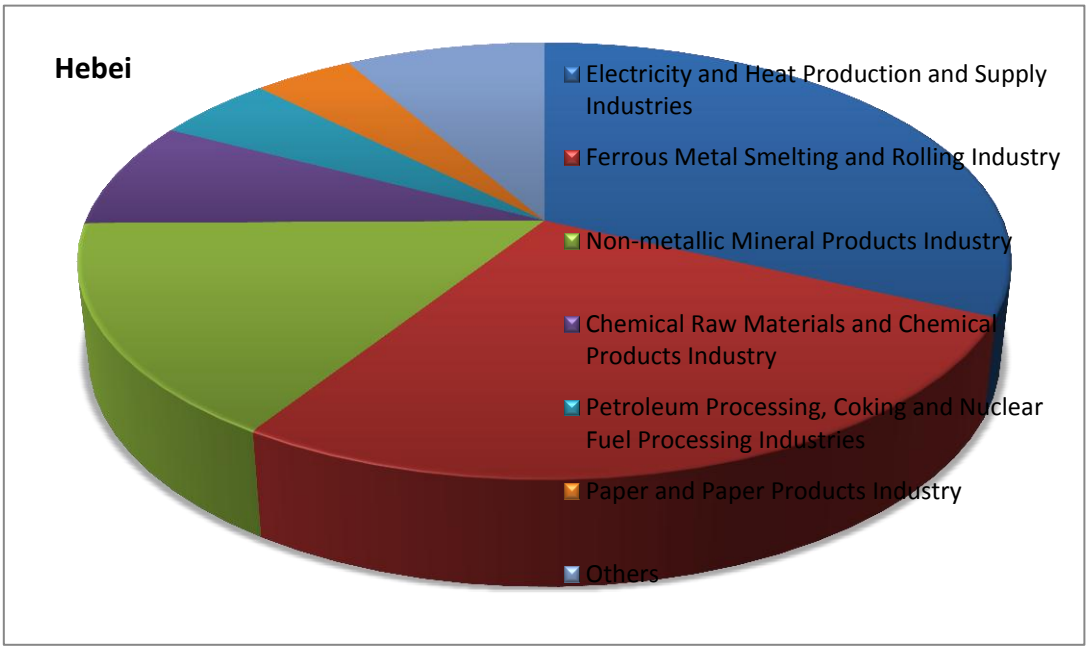

Figure 28: 2010 Hebei Province Key State Monitored Enterprises Listed for Emissions by Industry Type

[39] Electricity Production for the First Half of the Year, Inner Mongolia Autonomous Region Industry and Information Committee, July 19th, 2011. http://www.nmgjxw.gov.cn/cms/dlyx/20110719/5558.html

[40] Inner Mongolia Autonomous Region 2006 Economic and Social Development Statistics Bulletin, Inner Mongolia Autonomous Region Bureau of Statistics, June 15th, 2007.

[41] Inner Mongolia Autonomous Region 2006 Economic and Social Development Statistics Bulletin, Inner Mongolia Autonomous Region Bureau of Statistics, March 21st, 2011.

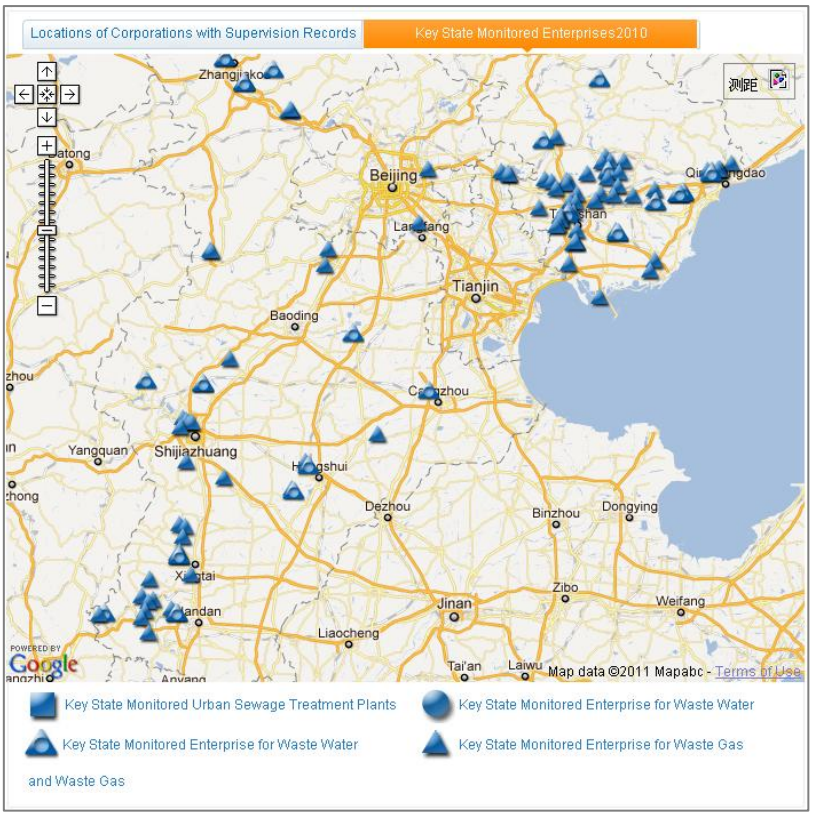

Figure 25: Distribution of Key State Monitored Enterprises Listed for Emissions in Hebei Province as Shown on the IPE Website

In Hebei province, which is ranked second, power and steel enterprises only make up one third. In our follow-up investigation we found that pollution emissions from the rapidly expanding steel industry had a serious effect on the local environment and residents.

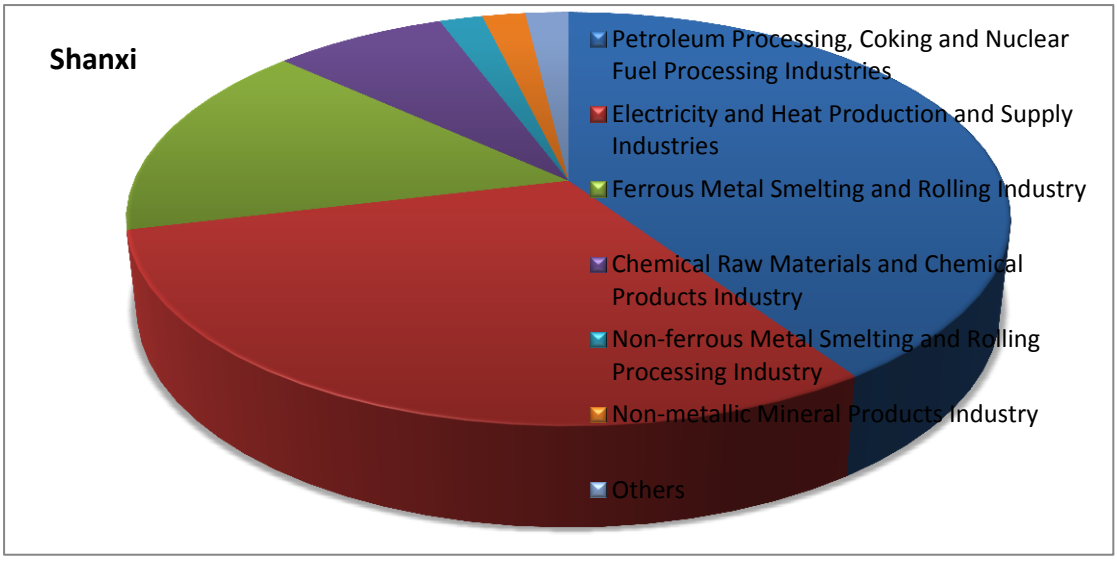

Figure 26: 2010 Shanxi Province Key State Monitored Enterprises Listed for Emissions by Industry Type

In Shanxi the coking industries that use coal as a base make up the largest portion of the big emitters. The pollutants discharged by the coking plants not only include sulfur dioxide and nitrogen dioxide but also hydrogen sulfide, phenol, benzene, naphthalene and hydrocarbons. These pollutants are having a serious impact on the public's health. The large emissions from the power industry mean it ranks in second whilst the high energy consuming steel and chemical industries also make a considerable contribution.

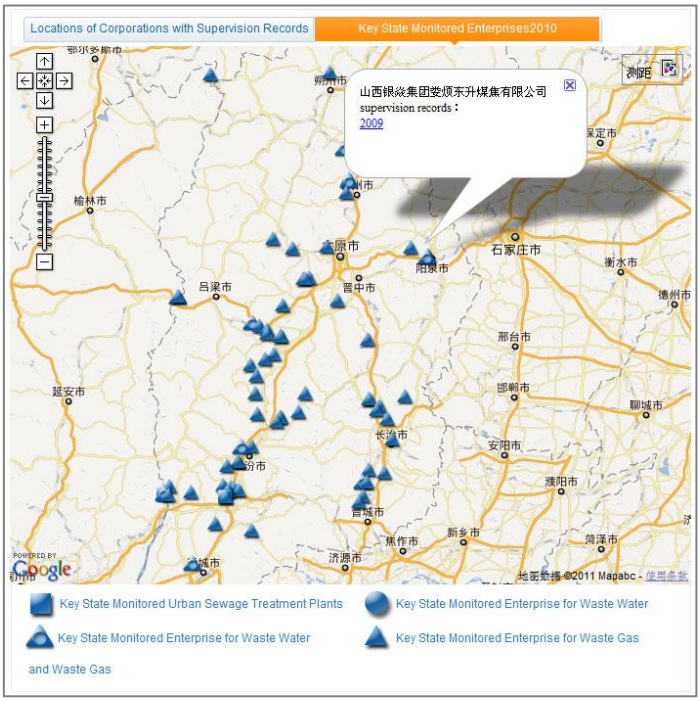

Figure 27: Distribution of Key State Monitored Enterprises Listed for Emissions in Shanxi Province as Shown on the IPE Website

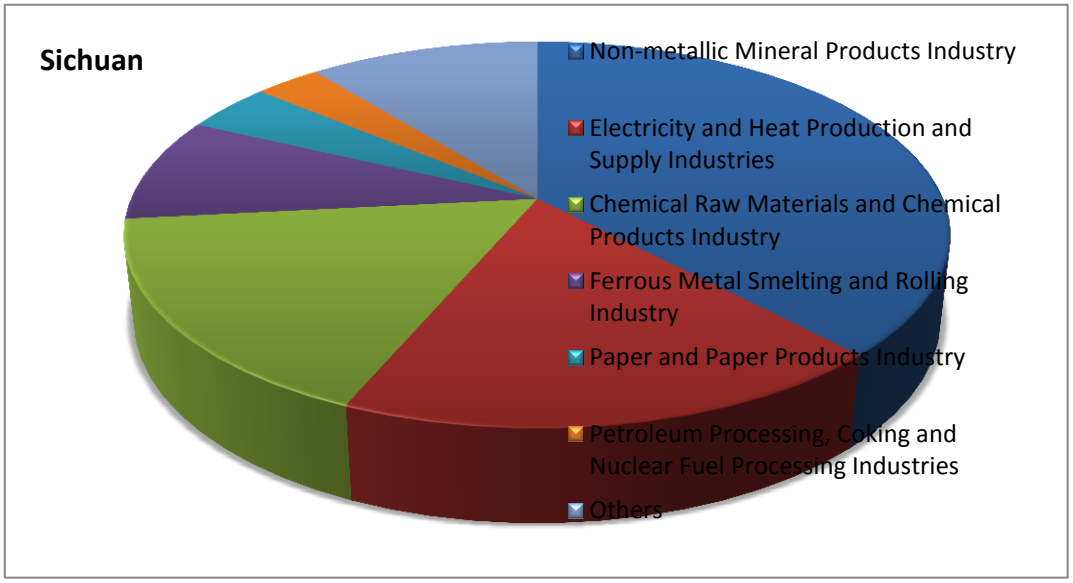

Figure 28: 2010 Sichuan Province Key State Monitored Enterprises Listed for Emissions by Industry Type

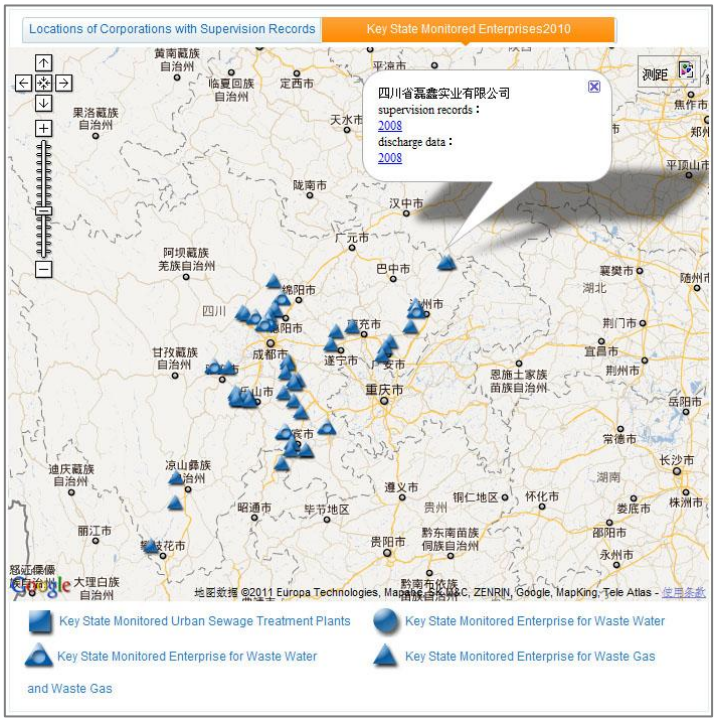

Figure 29: Distribution of Key State Monitored Enterprises for Emissions in Sichuan Province as Shown on the IPE Website

The situation in the province in western China with the greatest number of large emitters, Sichuan, is again not the same. Construction materials industries are the most numerous large emitters accounting for 37.9% of the total, with just cement factories accounting for 72 companies and glass and ceramics making up the remainder. The other large emitters are power, chemical and steel heavy industries as well as paper manufacturing and food processing.

3.3.4. UNDERSTANDING THE ENVIRONMENTAL COMPLIANCE STATUS OF KEY POLLUTION SOURCES

Key state monitored enterprises listed for emissions are the focus of environmental compliance and environmental monitoring. Government reports show that the frequency of key state monitored enterprises meeting emissions standards is not satisfactory. According to the *'2009 Bulletin on Key State Monitored Enterprises and Wastewater Treatment Plants' Main Pollutants Breaching the Authorized Annual Discharge Standards,'* [42]published in March 2010, in 2009, out of 3557 nationally

[42] http://www.zhb.gov.cn/gkml/hbb/bgt/201003/t20100326_187445.htm

monitored state monitored enterprises listed for emissions, the average rate for discharge reaching the authorized standards was 73%. Amongst these only 59% of enterprises met the standards for all sulfur dioxide monitoring and 26% breached the standards for some monitoring whilst 15% of those breached standards. When state controlled enterprises for emissions were monitored, 57 companies were found to have breached the standards for annual sulfur dioxide discharge totaling 89 discharge outlets.

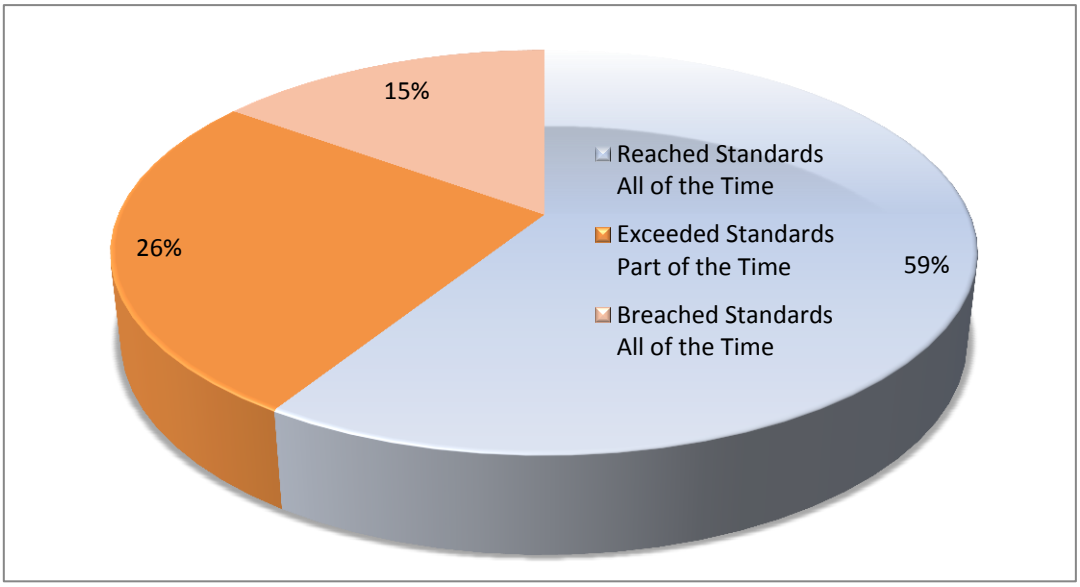

Figure 34: 2009 Annual Comparison Primary Pollutants Discharge for National Key State Monitored Enterprises for Emissions

It should be noted that the above statistics only look at sulfur dioxide and do not take into consideration other pollutants and also do not include other environmental violations held by a particular company. If the fact that in some areas the 2009 state controlled pollution source automatic monitoring project was in place, then the degree of progress is still lagging, a standard has not been established and there is a deficiency of complete and stable data. [43] This all means that the actual environmental violation situation of large emitter's nationwide is much more serious.

[43] Huan Fa [2010] No. 38 Notice Regarding the Strengthening of Key Pollution Source Automatic Monitoring Capabilities Project Verification Network and Operating Management Work, Ministry of Environmental Protection, April, 16th, 2010.

The "China Air Pollution Map," can be used as a channel to assess the status of corporate compliance. Our database is a collection of government disclosed company environmental supervision information, including information on enterprises with emissions concentrations in breach of the standards, total emissions volume in breach of the standards, improper use of emissions treatment equipment, production that has not been approved and plants that do not have the appropriate emissions treatment equipment. As of August 19th, 2011, the database had 86,500 records collected together from information disclosed by government departments between 2004 and 2011, among them 18,600 new records had been added since the end of September 2010, when the new website came on-line. During the database design process we strived to strengthen the interaction between associated data. Therefore, at the same time as plotting the position of large emitters on the map, the user can also check whether or not the company has had an environmental violation since 2004.

Through analyzing the companies by their positioning, we discovered that many key monitored enterprises listed for emissions were not only large volume emitters but also had environmental violations.

Included in these companies are many large state enterprises. For example, Sinopec holds records within the 'China Pollution Map Database' spanning many years. These violations cover: exceeding the discharge standards for sulfur dioxide[44] and ozone,[45] the illegal transfer of hazardous waste,[46] unauthorized production,[47] repeated listings to make rectifications within a deadline[48] and listings for administrative supervision.[49] This company has also been listed as a "Red" Company for 'Key Pollution Sources' Environmental Protection Credit Management Monitoring'[50] and a "Yellow" company in the 'Key Pollution Source Environmental Protection Credit Assessment," both undertaken by the Guangzhou Environmental Protection Bureau.

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[44] http://www.ipe.org.cn/pollution/com_detail.aspx?id=580913

[45] http://www.ipe.org.cn/pollution/com_detail.aspx?id=664955

[46] http://www.ipe.org.cn/pollution/com_detail.aspx?id=584889

[47] http://www.ipe.org.cn/pollution/com_detail.aspx?id=642048

[48] http://www.ipe.org.cn/pollution/com_detail.aspx?id=629748

[49] http://www.ipe.org.cn/pollution/com_detail.aspx?id=591030

[50] http://www.ipe.org.cn/pollution/com_detail.aspx?id=594854

Figure 31: The Location of *CHINA* Petroleum & Chemical Corporation – Guangzhou Branch on the State Monitored Enterprises' Distribution Map.

A number of large emitters that have received foreign investment also have environmental violation problems. For example, Lafarge Chongqing holds many violation records in the 'China Pollution Map Database.' These include records for exceeding the final discharge volumes for sulfur dioxide and chemical oxygen demand (COD).[51]

[51] http://www.ipe.org.cn/pollution/com_detail.aspx?id=635920，
http://www.ipe.org.cn/pollution/com_detail.aspx?id=638926，
http://www.ipe.org.cn/pollution/com_detail.aspx?id=640634

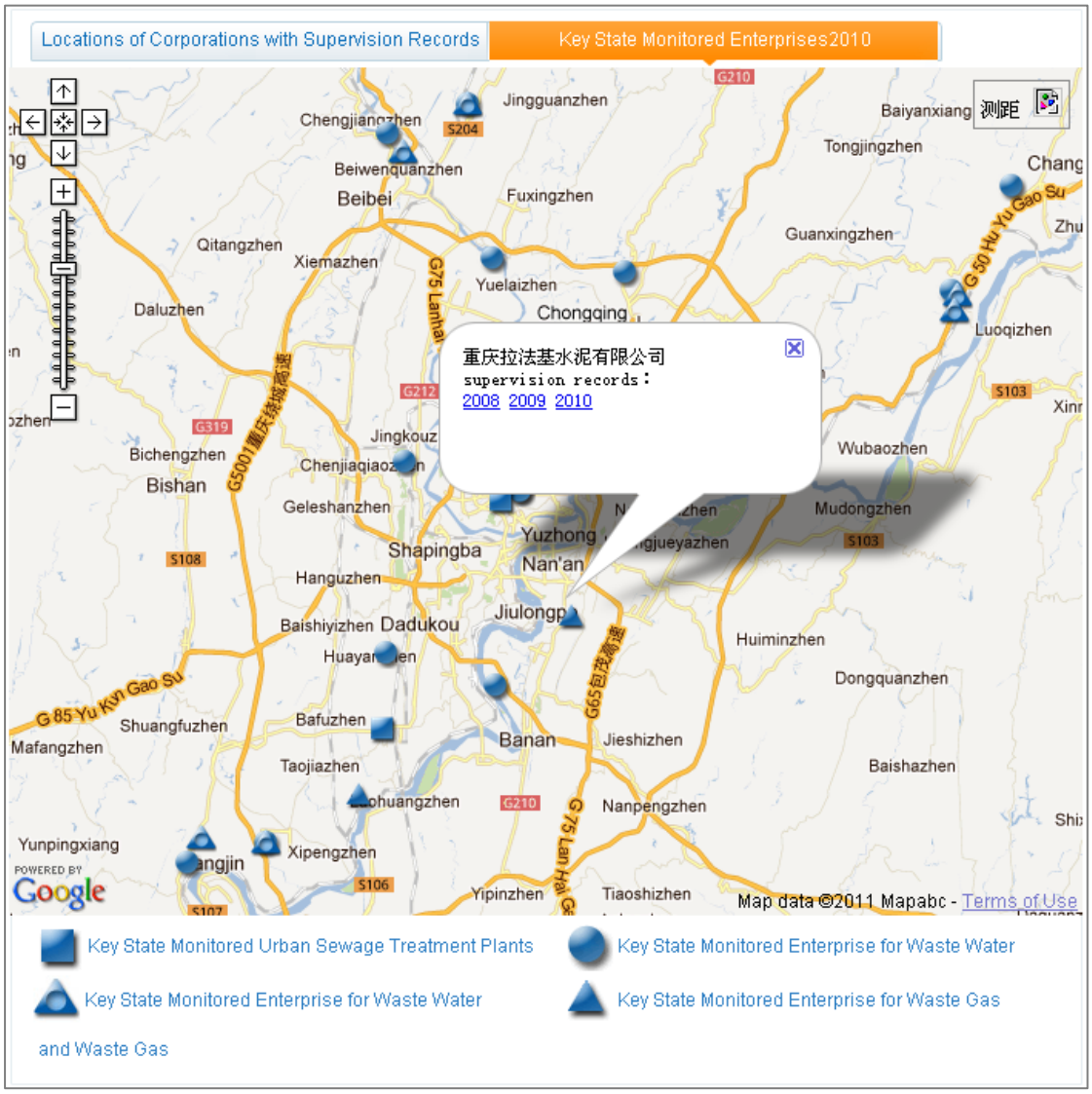

Figure 32: The Location of Lafarge Chongqing Cement Co., Ltd. on the 'Key State Monitored Enterprises' Distribution Map.

The charts below are estimates of the numbers of environmental supervision records for the 2010 key state monitored enterprises for emissions within the 'China Pollution Map Database.'

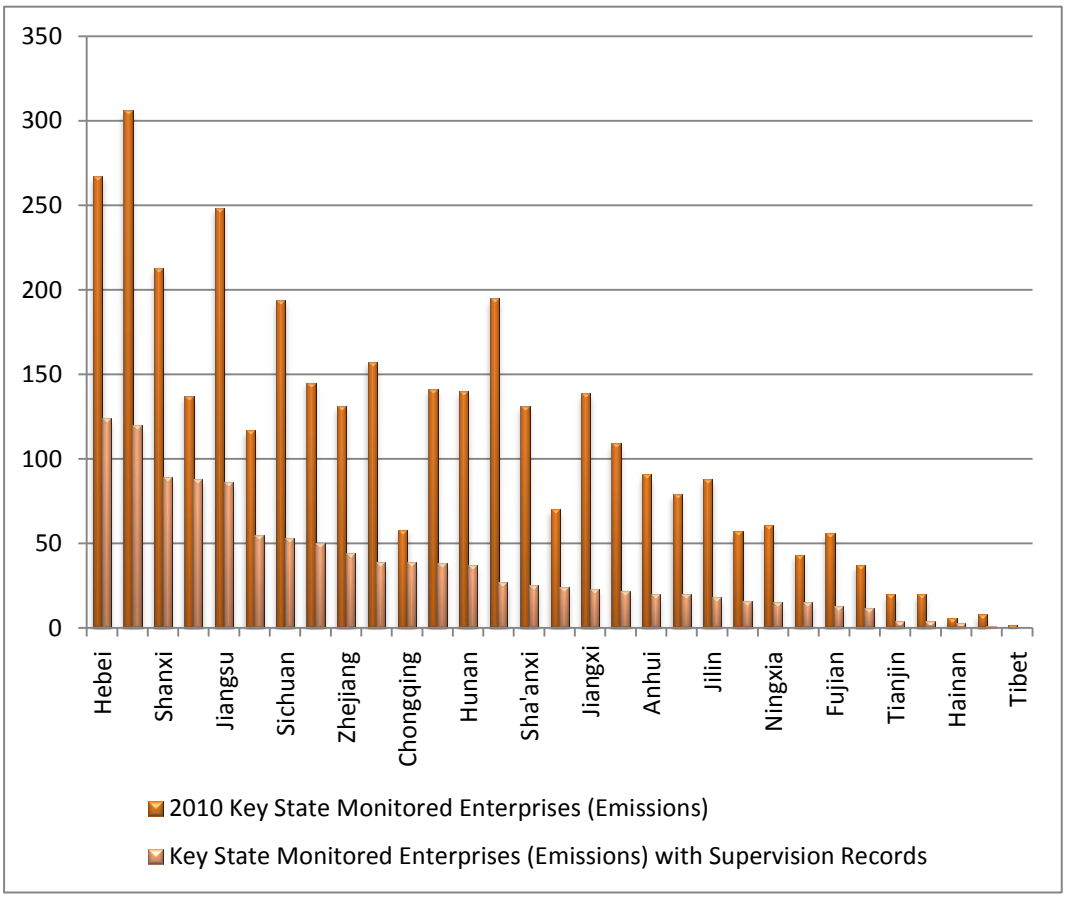

Figure 33: 2010 Number of Provincial, Autonomous Region and Municipalities' Key State Monitored Enterprises for Emissions

By looking at the whole country it is possible to see that for the 3464 key monitored enterprises listed for emissions in 2010, 1124 (32.4%), have an environmental supervision record or records between 2004 and 2011.[52] It should be noted that the reason these companies were included in the list of key state monitored enterprises was due to the fact they had extremely large emissions. At present, environmental regulations across the country, as well as monitoring and penalties, focus on pollutant discharge concentrations in breach of authorized standards. Whether it's very big total emissions volumes or concentrations in breach of the authorized standards, these can both harm the local atmospheric environment. Therefore, these companies that have very large emissions and concentrations that are in breach of the authorized standards should be the top priority for supervision from regulatory bodies and society.

[52] Statistics on Supervision Records are for up to April, 2011.

From the above figure it can be seen that Hebei is the province with the highest number of key monitored enterprises holding supervision records, with 124. The second is Shandong, with 120 records. By doing some comparisons it is possible to see that Chongqing is the city with the highest percentage of key monitored enterprises that also hold supervision records with 67.2% followed closely by Liaoning with 64.2%.

It should be noted that due to the state of environmental information disclosure in China, the violation records for large pollution emitters are not a complete set of data. Some regions publish more supervision records. The relatively large amount of records published can also be connected to the strength of information disclosure in a particular region.

For instance, although there are limits on overall information disclosure in Shandong, Weihai, a city in the province, has taken the lead nationally with real-time monitoring and the publishing of results on the internet.

所属区域	企业名称	超标时间	监测项目	监测指标	执行标准	超标倍数	超标程度
市直	威海博通热电股份有限公司(烟囱)	2009-12-27 19:00	SO_2(mg/m3)	2182	1200	0.82	一般超标
		2009-12-27 20:00	SO_2(mg/m3)	2185	1200	0.82	一般超标
		2009-12-27 21:00	SO_2(mg/m3)	2345	1200	0.95	一般超标
		2009-12-27 22:00	SO_2(mg/m3)	2549	1200	1.12	一般超标
		2009-12-27 23:00	SO_2(mg/m3)	2674	1200	1.23	一般超标
		2009-12-28 0:00	SO_2(mg/m3)	2530	1200	1.11	一般超标
		2009-12-28 1:00	SO_2(mg/m3)	2377	1200	0.98	一般超标
		2009-12-28 2:00	SO_2(mg/m3)	2374	1200	0.98	一般超标
		2009-12-28 3:00	SO_2(mg/m3)	2550	1200	1.13	一般超标
		2009-12-28 4:00	SO_2(mg/m3)	2426	1200	1.02	一般超标
		2009-12-28 5:00	SO_2(mg/m3)	2508	1200	1.09	一般超标
		2009-12-28 6:00	SO_2(mg/m3)	2577	1200	1.15	一般超标
		2009-12-28 7:00	SO_2(mg/m3)	2676	1200	1.23	一般超标
乳山	威海鑫山集团有限公司铁厂烧结机	2009-12-27 9:00	SO_2(mg/m3)	992	600	0.65	一般超标
		2009-12-27 11:00	SO_2(mg/m3)	1069	600	0.78	一般超标
		2009-12-27 13:00	SO_2(mg/m3)	1122	600	0.87	一般超标
		2009-12-27 23:00	SO_2(mg/m3)	817	600	0.36	一般超标
		2009-12-28 0:00	SO_2(mg/m3)	920	600	0.53	一般超标
		2009-12-28 2:00	SO_2(mg/m3)	1056	600	0.76	一般超标
		2009-12-28 4:00	SO_2(mg/m3)	793	600	0.32	一般超标

Figure 34: Weihai Municipal EPB Website Published the Key Monitored Enterprise Real-time Monitoring Results of Discharge in Breach of the Authorized Standards[53]

[53] http://www.whep.gov.cn/text.php?artid=1329, Screenshot taken on January 16th, 2010.

In some areas it seems that there is a very small percentage of non-compliance but in fact it is just a lack of information disclosure.

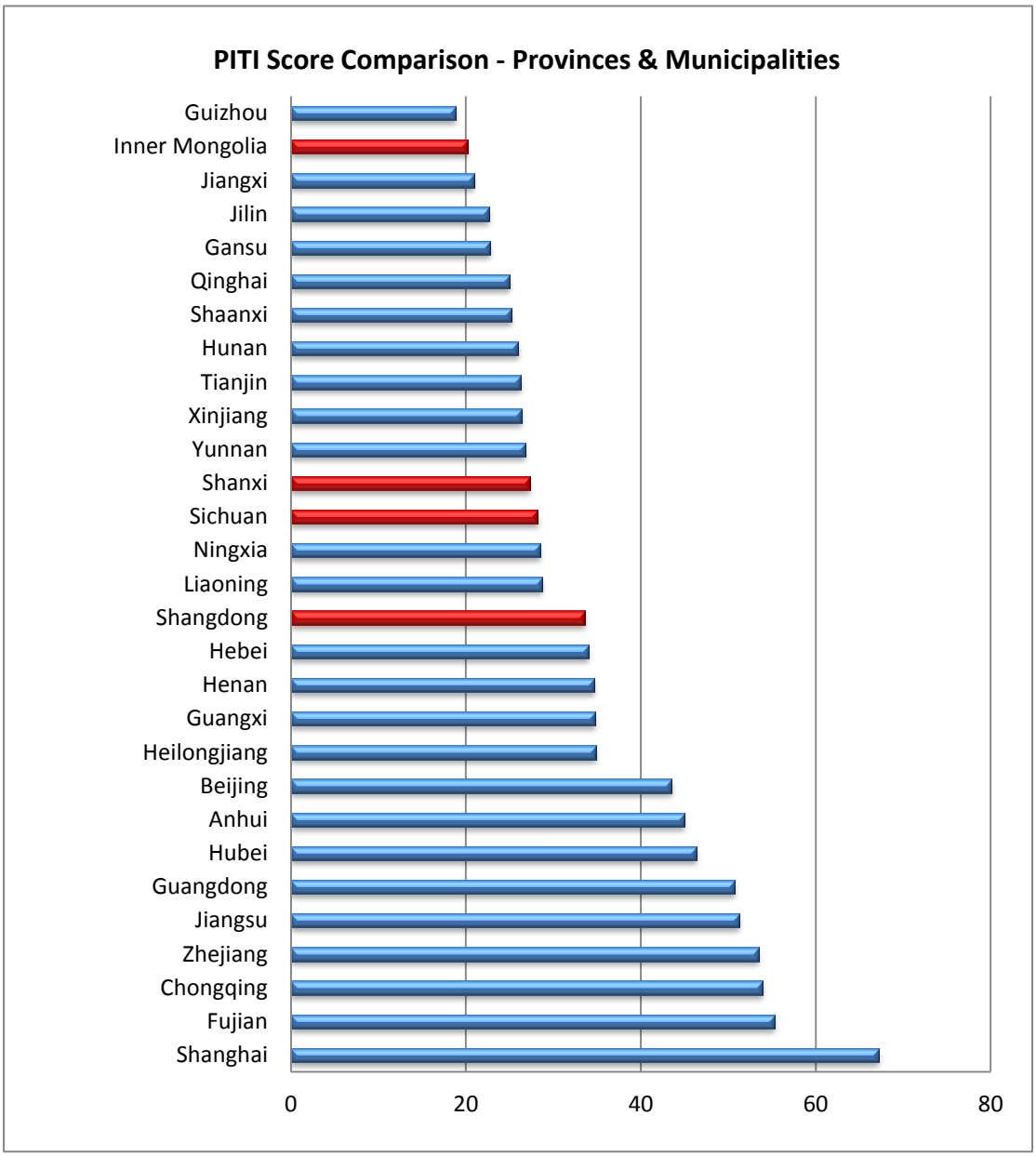

Figure 35: 2009 Provincial, Autonomous Region and Municipality Average PITI Scores[54]

[54] Environmental Open Information: Between Advance and Retreat – The 2009-2010 Pollution Information Transparency Index (PITI) 2009-2010 Second Annual Assessment of Environmental Transparency in 113 Chinese Cities, Institute of Public & Environmental Affairs, National Resources Defense Council (NRDC), December, 2012.

From the above figure it is not difficult to see that the provinces with high concentrations of large emitters such as Inner Mongolia, Sichuan, Shanxi and Shandong have lower than national average levels of pollution source supervision information disclosure.

3.3.5. THE MANY HAZARDOUS SUBSTANCES FROM LARGE EMITTERS

According to the principles for selecting key state monitored companies for emissions, in addition to adding industries where the amount of sulfur dioxide and nitrogen dioxide discharge amounts are taken into consideration, the energy industry, large scale petroleum processing, coking industry, steel industry and non-ferrous metal smelting industries should also be added to the list. At the same time, key enterprises under control for heavy metal have also been added.

The industries that have been added here are very important not only because the industrial discharge is not limited to the common pollutants, sulfur dioxide and nitrogen dioxide, but often their discharge can contain many types of hazardous substances.

For example, some large emitters in the coking industry not only discharge common pollutants, but also can produce a large amount of aromatic pollutants, in particular, the carcinogenic benzo [a] pyrene (B[a]P).

From the following image we can see that, to one's surprise, the coking industry discharges over three quarters of national benzo [a] pyrene (B[a]P). The discharge from these companies is a major threat to public health in the provinces of Shanxi, Hebei and Shandong, where coking is prominent.

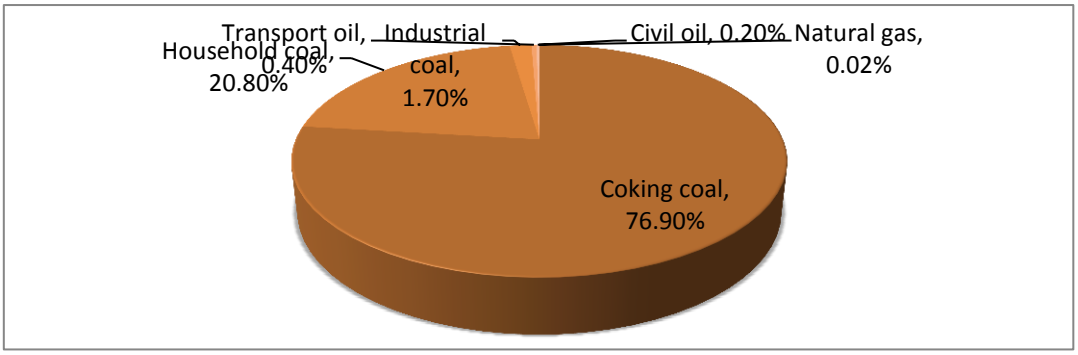

Figure 36: Benzo [a] pyrene (B[a]P) Contribution Ratio of Main Combustion Sources[55]

[55] *"Human Exposure to Polycyclic Aromatic Hydrocarbon Pollution & Health Risk Assessment Methods,"* Duan Xiaoli, China Environmental Science Press, October 2011.

Another strong type of carcinogen is dioxins, with the steel industry being a principle discharge source. A spokesperson at the Environmental Protection Department disclosed that the sources of dioxins discharge is a key concern in the 12th five year plan, with the steel industry accounting for half of this discharge and within the industry electric arc furnace steelmaking and Iron ore sintering being the main source. [56]

Even if the concentration of dioxins in the environment is very low, people can suffer pathogenic changes and many of these large scale enterprises are distributed around cities, amongst these are Bao Steel, Ma'anshan Iron & Steel and Tangshan Iron & Steel, which are located in urban areas. Understanding the surrounding large steel pollution discharge and the control for protecting local people's health has great significance.

Heavy metal pollution has recently attracted wide-spread attention and is closely related to the discharge of industrial emissions. According to research, hazardous substances such as heavy metal elements primarily enter soil through wastewater irrigation, atmospheric deposition and by the application of fertilizer. Around industrial cities and smelting enterprises, the amount of heavy metals entering the soil through atmospheric wet and dry deposition and irrigation water, can be ten to hundreds times the amount that enters from fertilizer. When controlling heavy metal pollution, apart from strengthening regulation, there must be a promotion of social supervision of the large heavy metals emitters, such as the mining and smelting industries.

3.3.6. LARGE EMITTERS ARE OFTEN ALSO LARGE DISCHARGERS OF WASTEWATER

Many large emitters are concentrated around sources of water because power, steel, chemical and refining industries are not only large waste gas emitters but also use and discharge large amounts of water.

[56] *"Iron and steel Industry is Facing "Green" Regulatory Pressure,"* China Securities Journal, June 3rd, 2011.

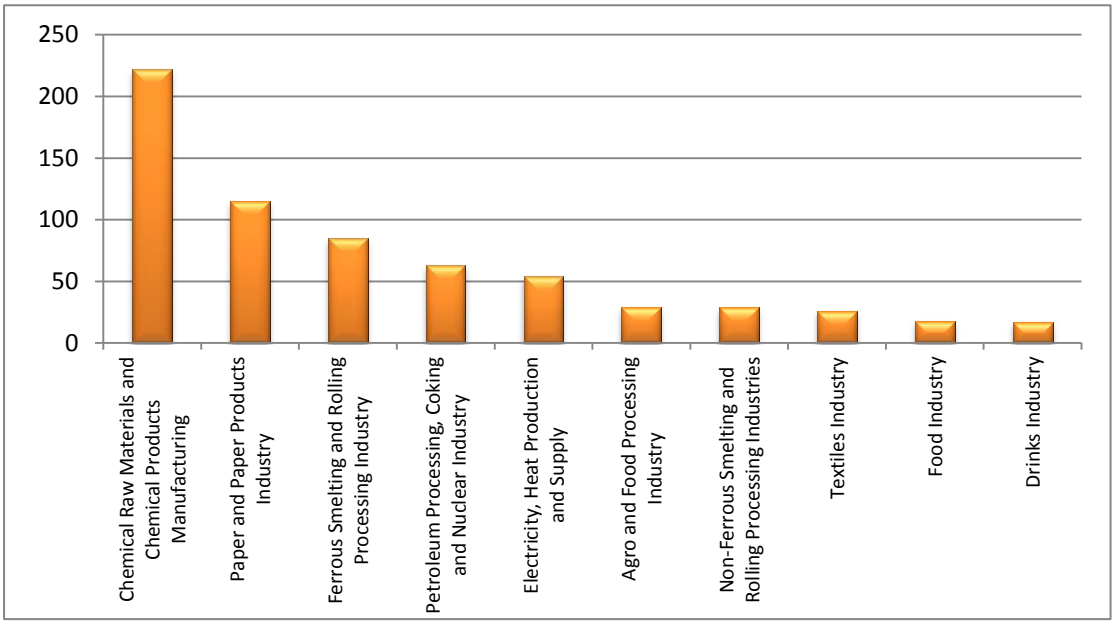

Figure 37: 2010 Distribution of Key State Monitored Enterprise Industries for Watsewater & Emissions by Industry (Top 10)

The number of big emitters that are both 2010 state controlled emission pollution sources as well as state controlled wastewater enterprises is 729. Most of them are in the chemical, paper, steel, coking and power industries.

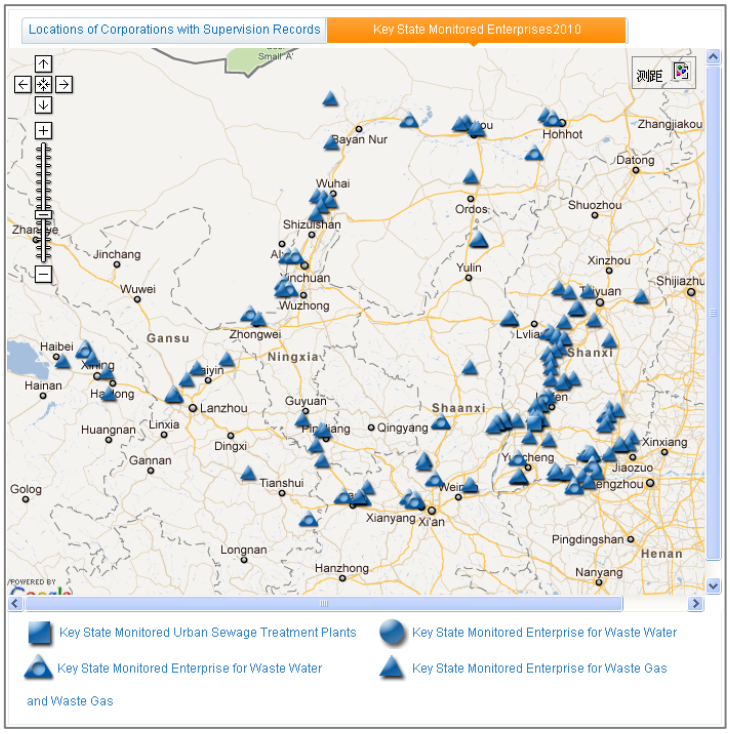

Figure 38: 2010 Distribution of State Key Monitoring Enterprises for Emissions in Yellow River Basin

Figure 39: Image of Yellow River Basin 2009 Water Quality Integrated Assessment[57]

From Figure 39 it is possible to see that the places where key state monitored enterprises are most concentrated (Taiyuan, Luliang, Linfen and Yuncheng) are amongst those same areas along the Yellow River basin tributary where the water quality is at its worst (Fen River and Sushui River). The same goes for the distribution of large emitters at the sections of the Wei River in Baoji, Xian, Weinan and the Huangshui River in Xining where the water quality is very bad, at level 5.

3.3.7. SATELLITE IMAGES HELP THE PUBLIC TO FORM AN INTUITIVE UNDERSTANDING

Whilst using the map tools it is possible to view a satellite image of an enterprise. From these images it is possible to clearly see a number of companies' exhaust emissions as well as ash deposits in a number of their factory areas. Some of the companies have seriously disorganized emissions discharge. These images can help the public to form an intuitive understanding of the environmental management at large local emitters.

[57] 2009 Yellow River Water Resources Report, Ministry of Water Resources Yellow River Resources Committee

- **Eastern Regions**

Figure 40: Wuxi City, Jiangsu Province

Figure 41: Zhenjiang City, Jiangsu Province

Figure 42: Shanghai

- **Central Regions**

Figure 43: Tongliao City, Inner Mongolia Autonomous Region

Figure 44: Linfen City, Quwo County, Shanxi Province

- **Western Regions**

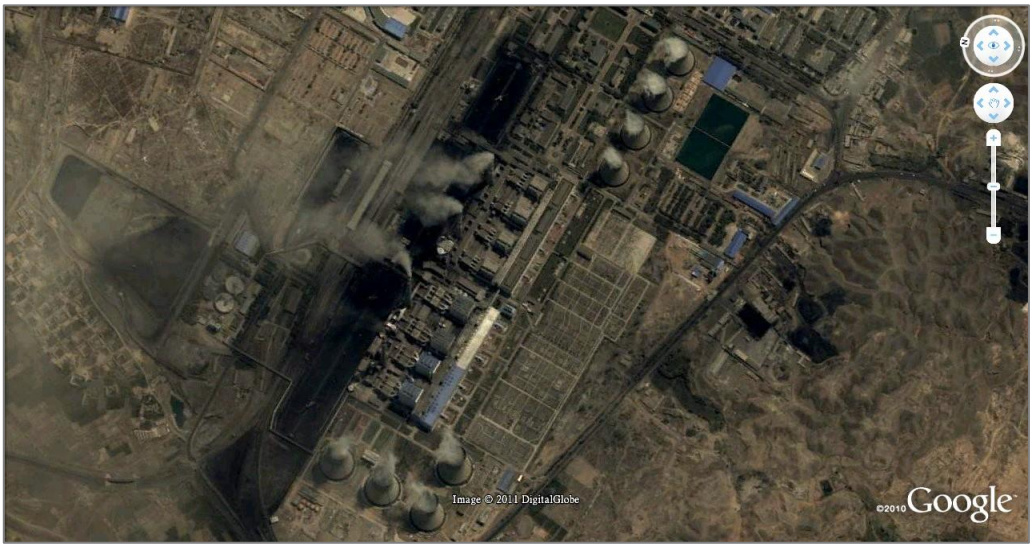

Figure 45: Jingyuan State Power Generation Co., Ltd., Baiyin City, Gansu Province

Figure 46: Guizhou Liupanshui Shuangpai Aluminium Co., Ltd.

Figure 47: Gaolan ARC Ferroalloy Co., Ltd.

3.3.8. ENTERPRISES WITH VERY LARGE EMISSIONS THAT ARE DISTRIBUTED CLOSE TOGETHER SHOULD BE THE FOCUS OF GOVERNMENTAL AND SOCIETAL SUPERVISION

Case Study 1: Caofeidian Industry Zone

Due to the relocation of Shougang Iron & Steel Company to the area, Tangshan's Caofeidian Industry Zone is well known. However, as of August 22nd 2011, the most recent online electronic maps, mentioned above, only display Caofeidian Industry Zone as a series of roads and an unclear geographical area. This gives us no indication of the exact position, longitude or latitude of the plant.

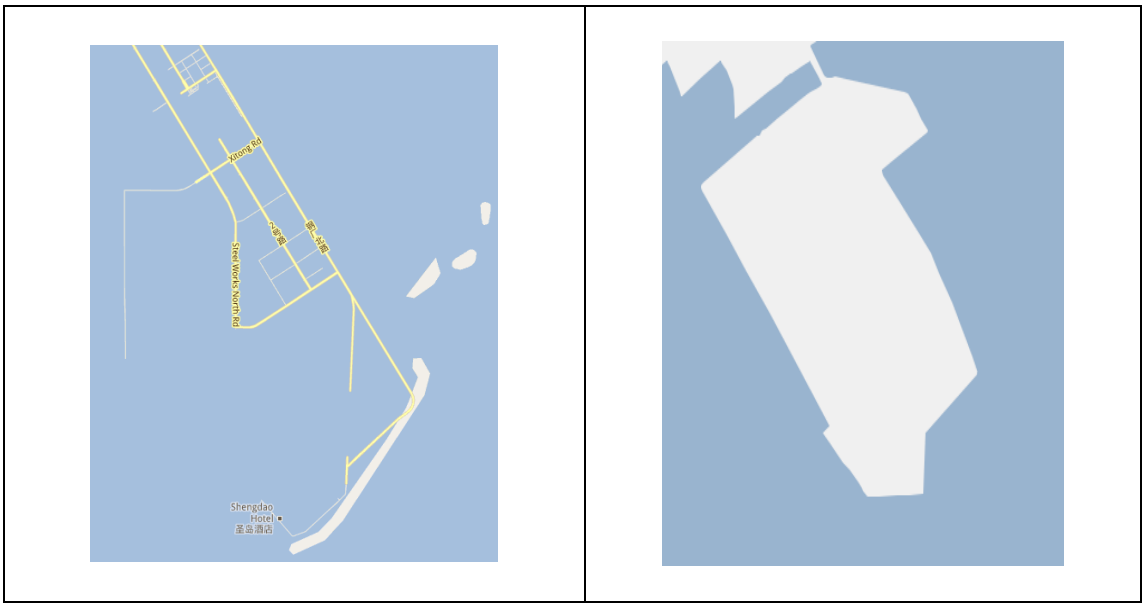

Figure 48: Google Maps Image (Left) and Baidu Maps Image (Right) for Caofeidian Industry Zone

Only through physical visits will we be able to know the true features of this location. Land reclamation caused by blowing sands has led to a vast expanse of flat land, while the vertical and horizontal crisscrossing of high quality public roads stretches to each block carrying large scale commercial vehicles and trucks that shuttle back and forth. While this plant has not yet laid its foundations, the electrical cables have already been laid to connect to the grid. This scale and speed of operations gives us an indication of the future rise of the Caofeidian area.

In the '2011 List of Key State Monitored Enterprises,' published by the Ministry of Environmental Protection, there are two companies listed in Caofeidian Industry Zone under emissions, these companies are, respectively China Resources Power (Tangshan Caofeidian) Co., Ltd. and Shougang Jingtang Company at China Resources Power (Tangshan Caofeidian) Co., Ltd.

Although we did not know the exact location of the China Resources Power (Tangshan Caofeidian) Co., Ltd. in advance, the tall smoke stacks were extremely prominent on the flat plains. Already in commercial use was a 2X30MW plant that occupies only a corner of the area, an even greater plot of land has been reserved for a 2X200MW ultra super critical (USC) power plant. although this large scale thermal power plant was in the preliminary stages of taking shape, even satellite images showed only a sandy area in the ocean.

Figure 49: China Resources Power (Tangshan Caofeidian) Co., Ltd.

In the view of the road ahead we could see a grey dizzily sky hanging over the Shougang Jingtang Company's plant. Separated by a bay, laid row after row, we could see buildings housing equipment used for the coking, sintering, iron making, hot rolling and cold rolling sections. Billowing smoke stealthily ascended into the gloomy sky after the rain had fallen.

A manager from Shougang stated: *"Modern steel plants need to still satisfy demand, yet they cannot emit. In order to ensure zero oxygen nitrogen emissions in gas, water and steam, we plan to invest a total of more than RMB 200 million in the construction of buildings and the purchasing of systems equipment. Currently we have already spent around one third of this amount."* [58] Looking at

[58] http://finance.ifeng.com/leadership/ppgl/20110128/3345154.shtml

the enormous plant and its continuously ascending white smoke, we feel this new Shougang plant still has a lot of hard work to undertake until it can effectively reduce its energy consumption.

Figure 50: Shougang Jingtang Company

Case Study 2: Dongmazhuang Industrial Park, Yincheng Puxiang, Fengrun District: A Street Filled with Dense Smoke

Prior to engaging in an on-site investigation we already knew that there were many steel and cement plants located in the Dongmazhuang Industrial Park. However, when we reached our destination we were truly taken back by the sheer number of chimneys, the intensity of their concentration and the extent of air pollution in the area. The industrial park's pot-holed main road holds four lanes of traffic on each side, along this two way traffic system cement plants and iron plants nestle close to each other: Tangshan Fengrun Jinshan Iron & Steel Co., Ltd., Tangshan Zhenwen Cement Co., Ltd., Tangshan Hongshun Building Material Co., Ltd., Tangshan Yidong Cement Additive Co., Ltd., Tangshan Yandong Group Huajun Steel Co., Ltd., Tangshan Yandong Cement Co., Ltd., Tangshan Xinyu Steel Factory, Tangshan Shengda Steel Co., Ltd., Hebei *JINXI* Iron & Steel Group Zhengda Iron & Steel Co., Ltd., *TANGSHAN* Fengrun *RONGTAI* Steel Co., Ltd., Tangshan Hangxin Steel Co., Ltd., Tangshan Baotai Steel Group Gancheng Steel Co., Ltd., Tangshan Xin Yiyuan Steel Co., Ltd., Tangshan Feilong Cement Co., Ltd . . .

Figure 51: A section of Dongmazhuang Industrial Park, Fengrun District, Tangshan City

As the evening approached, white, yellow and grey colored smoke pervaded the sky above the entire industrial park. As the grey, black dust, which had accumulated over time on the surfaces of homes, pipes, furnaces and chimneys, caught a gust of wind, passersby lowered their heads and sheilded their faces from harm. Visiting on a national holiday, it is hard to imagine what this industrial park would be like once production had been restarted, what color would the sky be then? How can the villagers of the nearby Dongmazhuang village endure such an odor?

Figure 52: Vicinity of the Dongmazhuang Industrial Park, Fengrun District, Tangshan City

Figure 53: Xin Yiyuan Steel Co., Ltd., Dongmazhuang Industrial Park, Fengrun District, Tangshan City

Figure 54: Vicinity of the Dongmazhuang Industrial Park, Fengrun District, Tangshan City

Figure 55: Vicinity of the Dongmazhuang Industrial Park, Fengrun District, Tangshan City

We discovered from on-site positioning that some of these large scale heavy emitters in industrial parks are located together and that many run the risk of serious spillage and have very lax levels of management.

Through allowing the public to be familiar with the location of these companies, we expect that this will lead to increased social supervision, a push for stronger local government regulation and the promotion of effective implementation of corporate responsibility, while in turn alleviating risk to public health and to the environment.

3.3.9. A NUMBER OF DISCHARGING ENTERPRISES HAVE ALREADY HAD A NEGATIVE EFFECT ON LIVES OF THOSE IN THE COMMUNITY

During our research we discovered that many large emitters have become the targets of complaints from the general public and have even led to mass incidents occurring.

Case Study 3: Ningxia Qiyuan Pharmaceuticals

The stench created during production processes at Ningxia Qiyuan Pharmaceuticals was seriously polluting the city's air. The people reacted strongly and lodged many complaints. In 2008, the government's "12345" complaint hotline received 185 complaints about atmospheric pollution, 116 of which concerned Qiyuan Pharmaceuticals. The "12369" environmental protection complaints hotline received 870 complaints about atmospheric pollution, 719 of which just concerned Qiyuan Pharmaceuticals.[59] In 2010, the "12369" number dealt with 3927 complaints about environmental pollution. The smell from Qiyuan Pharmaceuticals disturbing people was complained about 180 times by the public, making it the company with the highest number of and most focused complaints. In 2010 and 2011, Qiyuan Pharmaceuticals was handed repeated penalties from Yinchuan Environmental Protection Bureau for having odor emissions over the authorized standards.[60]

Case Study 4: Nanhai Number One Power Plant

Nanhai Number One Power Plant is located in Nanhai District, Foshan Municipality, Guangdong Province. It has been handed administrative penalties[61] on numerous occasions for not implementing the "Three Simultaneous System," going into operation without permission and discharging emissions in breach of the authorized standards. The plant's sulphur dioxide emissions target is 3309 tons/year.[62] However, in 2009, their actual discharge reached 4661.52 tons, breaching the authorized standards by a wide margin. Billowing black smoke caused a lot of problems for the residents of Gaoming district just across the river. On January 20th, 2009, a number of provincial, municipal and district representatives from the Chinese National People's Congress submitted, "An Appeal Regarding the Strengthening of the Requirements for Nanhai Number One Power Plant to Manage their Discharge in Accordance with the Law and to not Carry out the Phase III Expansion Project," to

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[59] Yinchuan Municipal People's Congress Standing Committee Pollution Enforcement Inspection, Yinchuan News, July 16th, 2009.

[60] Qiyuan Pharmaceuticals is the Number One for Complaints from Residents, Ningxia News, January 5th, 2011. http://www.nxnet.cn/newscenter/newsmqmy/201101/t20110105_950545.htm

[61] According to "Nanhai Number One Power Plant – A City's Nightmare," Wang Gu Zuoyou, Guangdong Provincial People's Government Administration Forum, http://bbs.gd.gov.cn/thread-488395-1-1.html

[62] Three Questions for Nanhai Number One Power Plant, Southern Daily, July 30th, 2009. http://epaper.nfdaily.cn/html/2009-07/30/content_6768712.htm

the National People's Congress Environmental and Resources Protection Committee.[63] Because they were worried that a number of power plants pollute Gaoming's environment, several hundred residents from Gaoming, on the afternoon of January 24th, 2010, wore face masks and walked down the street to voice their concerns. Approximately 300-400 people gathered in the entranceway to Nanhai Number One Power Plant and shouted anti-pollution slogans and sang the national anthem.[64]

Figure 56: Picture by Guo Jijiang, Nanfang Dushi Newspaper

During our on-site positioning we also discovered atmospheric pollution from enterprises had had a negative effect in some areas on communities and the ecological environment.

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[63] Forwarded from the General Office of the Ministry of Environmental Protection regarding the Seeking of Comments on "2011 Key State Monitored Enterprises List," "Draft Seeking Comments," Suggestions, Guangdong Provincial Environmental Protection Bureau, November 17th, 2010.

[64] Three Questions for Nanhai Number One Power Plant, Southern Daily, July 30th, 2009. http://epaper.nfdaily.cn/html/2009-07/30/content_6768712.htm

Case Study 5: Xiaojizhen Industrial Zone, Fengnan District

Gathered in Xiaojizhen area are a number of small and medium sized steel and cement enterprises: Ruifeng Iron & Steel (Corp) Co., Ltd., Donghua Steel Co., Ltd., Xinrisheng Steel Co., Ltd., *HONGYE STEEL* Pipe Factory, Hongli Group and Changsheng *CEMENT* Co., Ltd. When we visited, colored smoke streamed from an array of surrounding chimneys while the wind blew dust across an exposed coal field and up into the surrounding air. Being forced to wear masks we still had little option but to hold our breath as the smell of burnt smoke drifted through the air and swept through the wheat fields on its way to the nearby village.

Figure 57: Xiaojizhen Industrial Zone on a relatively sunny day, with good visibility. A misty smoke hangs over this steel plant

Figure 58: Ruifeng Iron & Steel (Corp) Co., Ltd., amongst the wheat fields

While speaking to a local villager he informed us that on one day in February this year, smoke made the entire sky black. Some villagers, unable to endure the emissions from these steel plants, attempted to block the road leading to Ruifeng Iron & Steel Corp in an effort to prevent vehicles from passing through. This local villager went on to inform us that as far as he was aware, no compensation for the surrounding crop fields had been given. In the past, people have reported the pollution problem to the local enterprises and also to the Government, however nothing has come of these attempts and from time to time the unpleasant odor continues to encroach.

3.4. ALLOWING THE PUBLIC TO UNDERSTAND SOURCES OF INDUSTRIAL POLLUTION IS BECOMING AN INTERNATIONAL TREND.

Internationally, disclosing information to the public such as discharge data from industrial pollution sources has been a convention for some time in industrialized countries. In China, there are no complete legal provisions for industrial pollution sources to disclose discharge data.

3.4.1. TRI SYSTEM: A SYSTEM FROM THE UNITED STATES, THE EARLIEST TO BE PUT INTO PRACTICE

In 1986 the United States passed the Emergency Planning and Community Right-to-Know Act (EPCRA) which proposed the establishment of the Toxic Release Inventory (TRI). At present, the regulations require that the release of over 600 toxic chemicals be reported. The amount of toxic chemicals released has been reduced by 58% since 1988. Environmental organizations think that it is one of the most direct, effective and efficient ways of promoting environmental awareness to the general public and enterprises. The TRI system has initiated the detailed marking of the positions of pollution sources, offering a means of public inspection at any given time.

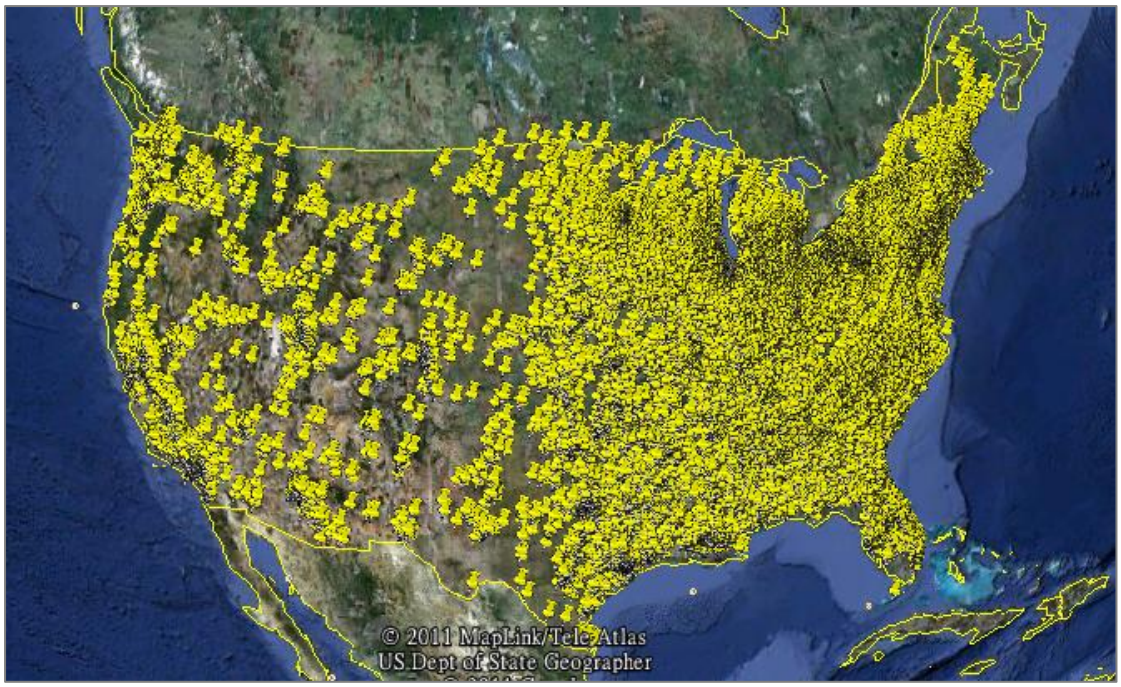


Figure 59: 2008 Distribution of United States' TRI[65] Pollution Sources

By clicking on any of the pollution sources shown on the map in figure 59 you will be taken to the TRI pollution source page section of the United States Environmental Protection Agency website. This page shows the name, detailed address and 2004-2008 annual discharge amounts for each registered pollutant. By clicking on the "Map this Facility" button the pollution source's longitude and latitude will be shown as well as 2D and 3D maps.

[65] http://www.prtr.net/en/gis/

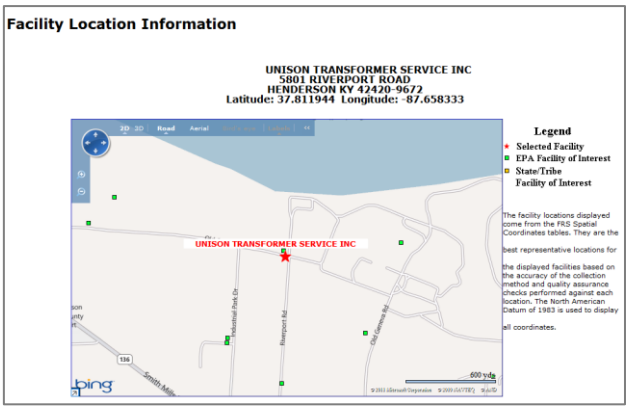
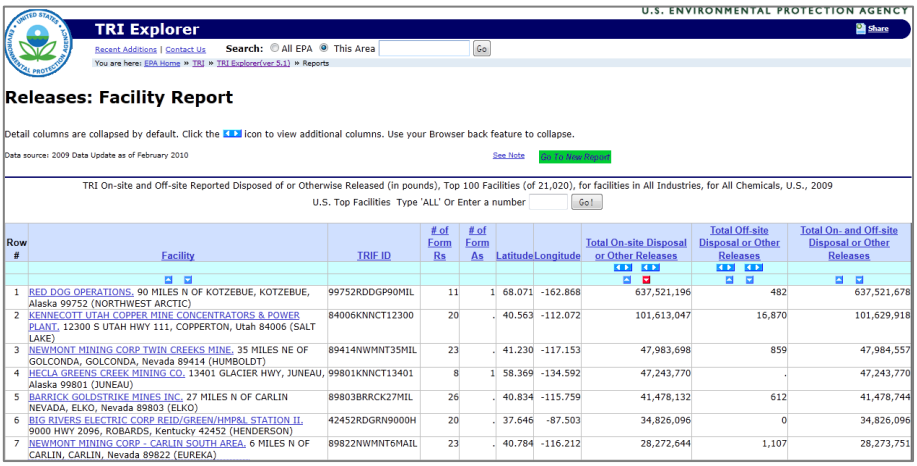


Figure 60: United States TRI Pollution Source Location Information[66]

If users want to get the name, longitude and latitude, annual discharge volumes and other detailed information for the entire United States or each individual state they can search in the TRI Explorer section of the EPA website,[67] (see the screenshot below) or download the information at the United States Government Data Website (data.gov). [68]



Row #	Facility	TRIF ID	# of Form Rs	# of Form As	Latitude	Longitude	Total On-site Disposal or Other Releases	Total Off-site Disposal or Other Releases	Total On- and Off-site Disposal or Other Releases
1	RED DOG OPERATIONS, 90 MILES N OF KOTZEBUE, KOTZEBUE, Alaska 99752 (NORTHWEST ARCTIC)	99752RDDGP90MIL	11	1	68.071	-162.868	637,521,196	482	637,521,678
2	KENNECOTT UTAH COPPER MINE CONCENTRATORS & POWER PLANT, 12300 S UTAH HWY 111, COPPERTON, Utah 84006 (SALT LAKE)	84006KNNCT12300	20	.	40.563	-112.072	101,613,047	16,870	101,629,918
3	NEWMONT MINING CORP TWIN CREEKS MINE, 35 MILES NE OF GOLCONDA, GOLCONDA, Nevada 89414 (HUMBOLDT)	89414NWMNT35MIL	23	.	41.230	-117.153	47,983,698	859	47,984,557
4	HECLA GREENS CREEK MINING CO, 13401 GLACIER HWY, JUNEAU, Alaska 99801 (JUNEAU)	99801KNNCT13401	8	1	58.369	-134.592	47,243,770	.	47,243,770
5	BARRICK GOLDSTRIKE MINES INC, 27 MILES N OF CARLIN NEVADA, ELKO, Nevada 89803 (ELKO)	89803BRRCK27MIL	26	.	40.834	-115.759	41,478,132	612	41,478,744
6	BIG RIVERS ELECTRIC CORP REID/GREEN/HMP&L STATION II, 9000 HWY 2096, ROBARDS, Kentucky 42452 (HENDERSON)	42452RDGRN9000H	20	.	37.646	-87.503	34,826,096	0	34,826,096
7	NEWMONT MINING CORP - CARLIN SOUTH AREA, 6 MILES N OF CARLIN, CARLIN, Nevada 89822 (EUREKA)	89822NWMNT6MAIL	23	.	40.784	-116.212	28,272,644	1,107	28,273,751

Figure 9: 2009 US Nationwide Industries and all TRI Registered Chemical Product On-Site, Off-Site and other Categories of Emission Sources[69]

[66] http://oaspub.epa.gov/enviro/lrt_viewer.map_page?sys_id=110000766449

[67] http://www.epa.gov/tri/stakeholders/communities/index.htm

[68] http://explore.data.gov/Geography-and-Environment/2010-Initial-Toxics-Release-Inventory-data-for-Fed/r8m7-nxkj

[69] http://www.epa.gov/cgi-bin/broker?VIEW=USFA&trilib=TRIQ1&TAB_RPT=1&_LINESPP=&sort=RELLBY&INDUSTRY=ALL&FLD=RELLBY&FLD=TSFDSP&FLD=RE_TOLBY&FLD=TRIID&FLD=NUMFR&FLD=NUMFA&FLD=LNGLAT&sort_fmt=2&TopN=100&STATE=ALL+STATES&COU

3.4.2. PRTR SYSTEM: THE EU PLAYS CATCH-UP

In May 2003, 36 European countries jointly signed the *'Protocol on Pollutant Release and Transfer Register'* that ruled that each country that signed the protocol should establish the Pollutant Release and Transfer Register (PRTR). The PRTR records details of any hazardous substance that is moved or emitted into the environment from places like chemical factories or transportation. In a number of European countries the general public can enter their post-code into the website and can find polluting factories near to their homes, as well as detailed information such as the types of pollutants, their concentrations and their volumes. Figure 10 shows the position of pollution sources in Europe as disclosed in the PRTR in 2009: European Union, Iceland, Liechtenstein, Serbia and Switzerland.

Figure 62: 2009 European PRTR: EU, Iceland, Liechtenstein, Serbia and Switzerland[70]

NTY=All+counties&CHEMICAL=ALL+CHEMICALS&YEAR=2009&BGCOLOR=%23D0E0FF&FOREGCOLOR=black&FONT_FACE=arial&FONT_SIZE=10+pt&FONT_WIDTH=normal&FONT_STYLE=roman&FONT_WEIGHT=bold&_SERVICE=oiaa&_PROGRAM=xp_tri.sasmacr.tristart.macro

[70] http://www.prtr.net/en/gis/

By clicking on one of the pollution sources the user will be taken to the pollution source page of the PRTR section of the European Environment Agency website which will show the position on a digital map as well as name, product, address, latitude and longitude, contact details, pollutant discharge volume and waste transport volume.

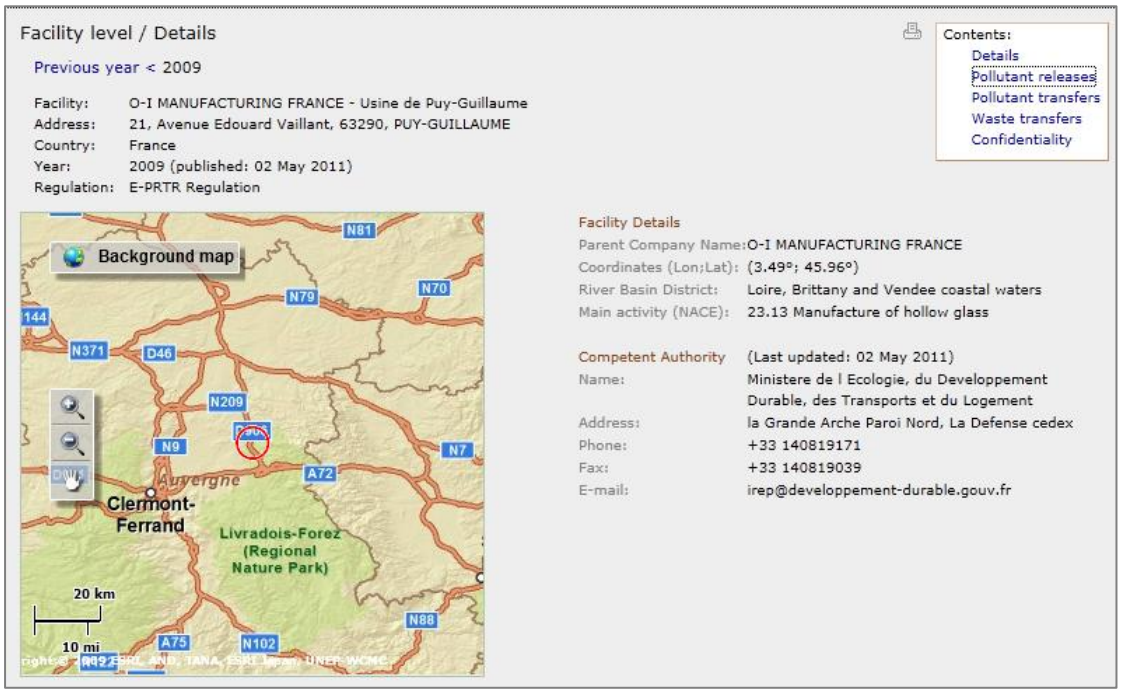


Figure 63: Detailed Information on EU PRTR Pollution Sources[71]

3.4.3. THERE IS A SIGNIFICANT GAP IN CHINA'S INDUSTRIAL POLLUTION SOURCE INFORMATION DISCLOSURE

The experience of PRTR and TRI shows that these systems can make the public understand nearby pollution sources and sources of risk. They can help the public distinguish environmental risk, arouse the public's sense of involvement, focus attention on pollution sources, supervise companies' environmental performance and actively participate in the formation of policy. Over the past 20 years western companies have actively reduced their emissions with the general public using information disclosure as a base to push the companies.

[71] http://prtr.ec.europa.eu/PopupFacilityDetails.aspx?FacilityReportId=186726

Unfortunately, even though China is one of the countries in the world that has the highest amount of emissions and the worst atmospheric pollution, disclosure of information about pollution sources is lacking. The disclosure of companies' environmental information by the government is still insufficient and the number of companies who publish their own emissions data is very few. [72] It is very hard for the public to get basic and detailed information about the location and level of risk of nearby pollution sources in a systematic and timely way. [73]

Based on these considerations, we decided to first focus on the sources of atmospheric pollution from industrial sources.

4. CONCLUSIONS AND RECOMMENDATIONS

4.1 MAIN CONCLUSIONS:

Through our research into major pollution sources nationwide we have drawn the following conclusions:

- Industrial emissions are the main source of many different kinds of atmospheric pollutants. They have a very big impact on the quality of the atmosphere and harm the health of the general public. There is a need for the public to understand industrial pollution sources so that they can take precautions against the risks and establish societal supervision.
- Nationwide, Power Generation, Cement, Chemicals, Steel and Coking industries are the industries with the highest concentration of big emitters. Among them, the power industry is way ahead with 1178 companies, making up 34% of key monitored enterprises listed for emissions.

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[72] State of Information Disclosure in Key Cities, please see the jointly authored report by the IPE and NRDC http://www.ipe.org.cn/Upload//2010-09/2029b0a7e3754216a111e578d7d3e066.pdf and http://www.ipe.org.cn/Upload/IPE%20report/PITI_2010_EN_NEW_0328.pdf

[73] Research on Key Cities Air Quality Information Disclosure, please see the joint report by the IPE and Renmin University of China School of Law: http://www.ipe.org.cn/Upload/Report-AQTI-EN.pdf

- In a number of locations, because large emitters are concentrated together and management is very loose, these emitters pose a huge environmental risk and potential threat to the health of the general public.

- Major developed countries have all already developed systems of registering pollutant release and transportation and regularly release this information to the public, thus pushing the reduction of pollutant discharge. China has yet to establish this kind of system.

- In Europe and the United States the specific distribution of major pollution sources is published on a digital map on the internet. The general public can then obtain information on the geographic location and discharge status of those sources. Chinese environmental protection organizations have started the initial positioning of 2700 key state monitored enterprises listed in 2010 and amongst these there were 1070 companies listed for emissions. At the same time, related monitoring records and discharge data was also added. However, the general public can still not effectively access nationwide pollution source information.

4.2. MAIN RECOMMENDATIONS:

In light of the above conclusions we recommend:

- All regions should begin to do detailed research as soon as possible and identify and publish main atmospheric pollution sources. After this they should, using the principles of information disclosure and public participation, formulate a detailed management plan according to a sequence of emissions reduction, tackling the easy things first then moving onto the more difficult.

- Because power productions, cement, chemicals, iron and steel and coking are the industries with the biggest concentration of large emitters, the strengthening of monitoring of the big emitters in these industries will result in the biggest emission reduction results. Because of lax enforcement and the cost of violation being very low, information disclosure needs to be expanded so that society as a whole can monitor those violating enterprises.

- Using information disclosure as a base and through environmental economic methods like greencredits, green stocks and bonds and green supply chains, large emitters can be pushed to reduce their emissions.

- Key state monitored enterprises listed for emissions mainly just determine two indexes, sulfur dioxide and nitrogen dioxide. However, during our research we have discovered that many large emitters not only discharge these pollutants but also discharge many other types of substances that are seriously harmful to human health. We recommend that in the interests of protecting the health of the public, monitoring and publication of different types of pollutants should be carried out.

- By using the international experience as a reference, we quickly concluded that through the enforcement of a system of registering enterprise pollutant discharge and transportation, and taking this information and the geographic location of the enterprise and showing their relationship, the public can better understand a company's discharge volume for each main pollutant and annual changes in discharge.

- By quickly completing the work of positioning key state monitored enterprises nationwide and forming a complete pollution source distribution map, society's ability to monitor these large national pollution emitters will be advanced. In the future, publication of on line monitoring data onto the internet could be considered. This would benefit society's ability to monitor large emitters in real time using information disclosure as a method.

[The End]