ISSUE BRIEF
United Nations Development Programme
ENVIRONMENT AND ENERGY
Empowered lives.
Resilient nations.

AIR POLLUTION IN CHINA

Air pollution in China has been making headlines around the world with hazardous haze blanketing Beijing for extended periods of time in 2013 and 2014, while a dust storm in March 2015 broke monitoring equipment in the nation's capital. In early 2015, Under the Dome, a video by journalist Chai Jing that effectively communicated the scope of China's air pollution problems to a popular audience went viral, wracking up over 200 million views, before being pulled from Chinese websites.

There is no question that the problem is serious; however, air quality has been slowly improving in China since the 1990s. Internationally, cities in South Asia and the Middle East now outdo Chinese cities in terms of poor air quality in the World Health Organization's Ambient Air Pollution in Cities Database.[i] The city that makes the most headlines, Beijing, has seen an average 3.3% year on year decrease in the 4 major air pollutants since 1998.[ii]

ADB notes that from 1999 to 2009 the number of cities in China categorised as having worse than Grade III air quality has decreased from about 40% of 340 cities surveyed in 1999 to less than 2% of 612 cities surveyed in 2009.[iii] The Ministry of Environmental Protection combined Grade II and III in 2012 (see chart). Annual national reports on air quality indicate a continuing steady decline of most major pollutants to 2013 (the last year for which a comprehensive State of the Environment Report is available).[iv]

Air Quality Standards

Pollutant (yearly average)	Concentration limits		Unit
	Grade I	Grade II	
SO_2	20	60	μg/m^3
NO_2	40	40	
CO (24 hourly average)	4	4	mg/m^3
O_3 (8 hourly average)	100	160	μg/m^3
PM_{10}	40	70	
$PM_{2.5}$	15	35	

Source: Ministry for Environmental Protection
2012 Ambient Air Quality Standards

The overall global picture of air quality, however, is not good. The Ambient Air Pollution in Cities Database surveys 1628 cities in 91 countries, and more than 90% have unhealthy air quality.[v] The impact on human health is significant with 350,000 to 1.2 million premature deaths linked to air pollution each year just in China (3.7 million worldwide).[vi] Moreover, out of the 10% drag on GDP due to environmental degradation in China, air pollution takes the greatest share at 6.5%.[vii] Monitoring for one component of air pollution, particulate matter, far exceeds hazardous (defined as 301-500 micrograms per cubic metre) levels in cities such as Beijing, some days reaching up to 800 or 900 μg/m³.[viii] WHO considers an annual mean of 20 μg/m for PM10 (or 50 μg/m for a 24-hour mean)and 10 μg/m for PM2.5 (24-hour mean :25 μg/m) to be acceptable, although no level of PM2.5 is really considered safe for human health.[ix]

Types and sources of air pollution

Air pollutants of major public health concern include particulate matter, carbon monoxide, ozone, volatile organic compounds, nitrogen dioxide and sulphur dioxide.

Particulate matter is made up of acids (such as nitrates and sulfates), organic chemicals, metals, and soil or dust particles. Particles with a diameter of 10 micrometers (PM 10) or smaller are of particular concern as they can collect in the lungs and pass directly into the bloodstream contributing to heart disease, respiratory illnesses and lung cancer. PM10 generally consists of dust from roadways and industry, while fine particulate matter (PM2.5) may have direct sources or result from sulphur dioxide (SO_2), nitrogen oxides (NO_X), and ammonia undergoing chemical reactions in the air to become sulfate and nitrate particles.

Coal used for heating and electricity generation is the single most significant source of emissions, followed by that used in industrial processes. China produces and consumes almost as much coal as the rest of the world combined.[x] It is the major

source of black carbon and heavy metals and can be a source of SO_2 and NO_2, among the major precursors for sulphate and nitrate PM2.5. Coal combustion also creates NO_x. Coal also contributes 15-30% of PM10 depending on time of year and location.[xi]

Soil and road dust are major sources of particulate matter in Northern and Western China and the arid climate results in dust becoming a 30-60% source of PM10 in these areas, compared to 5-30% in southern cities.

Industrial dust can contribute up to 20% of particulate matter in heavy industrial cities. Industrial processes also produce SO_2, NO_x and volatile organic compounds, which are precursors to PM2.5 and to ozone. Because of the length of time involved in precursors undergoing chemical reactions to become pollutants with impacts on human health, the secondary pollutant is often found tens to hundreds of kilometers from its source.

Vehicle emissions are now making a larger contribution to air pollution both in the form of direct particulate matter from incomplete combustion (soot, black carbon etc.) and from NO_x emissions, a precursor for PM2.5.[xii]

Biomass burning may contribute up to 10% of PM2.5 emissions, although more data is needed. Biomass burning produces smaller, and therefore more dangerous, particulate matter.

Responses to the crisis

A recognition of the health and economic impacts of pollution on human development has further encouraged the Chinese government to give greater emphasis to 'balanced development' that takes into account quality of life and not only economic growth. This is reflected in the priorities set out in the 12th Five-year Plan, the revised Environmental Law (which came into force on 1st January 2015), and the 2015 government work report, which not only lowered economic growth rate targets to 7% but also set a 3.1% target for reduction in carbon intensity, and 2-5% cuts for other pollutants. [xiii] Other plans, such as the new Urbanization Plan (2014-2020), with its call for significant investment in public transportation and environmental protection will also positively impact air quality.[xiv] The Energy Development Strategy Action Plan (2014-2020) sets an absolute cap on coal at 4.2 billion tons and a target of 15% renewables by 2020,[xv] even as coal consumption in 2014 dropped for the first time in 14 years.[xvi]

Monitoring

Pollutants such as PM 2.5 have only recently begun to be more comprehensively monitored, adding more complexity to the situation. For example, the Ministry of Envrionmental Protection released a report on 74 major cities in January 2015 that identified PM2.5 followed by PM10 as the major pollutant for cities experiencing poor air quality. Only one of the 47 cities in the three major urban conglomerations of Beijing-Tianjin-Hebei, the Yangtze River Delta and the Pearl River Delta reached national standards (which are not as strict as WHO standards) for low pollution days.[xvii]

In 2012, the Ministry of Environmental Protection introduced revised ambient air quality standards, including indicators of PM2.5 and ozone concentrations to take effect in 2016.

Several cities have already implemented these standards and 179 cities began releasing real-time air quality information as of January 2014.[xviii]

Vehicle Emission Trends 2010-2012

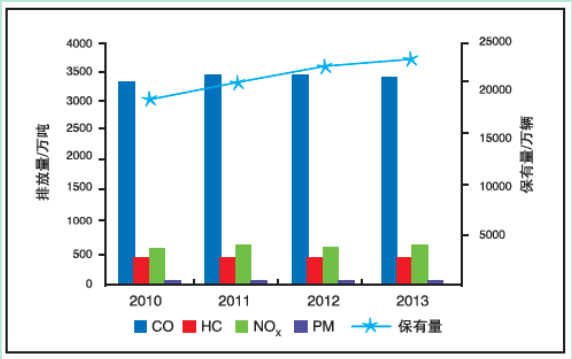

图22 全国机动车污染物排放量变化趋势

Source: adapted from China Vehicle Emission Control Annual Report 2013

Targets and investment

Hard targets for energy and emissions reductions, including for SO_2 and NOX, were set in the 12th Five-Year Plan (2011-2015).[xix] 3 trillion RMB has been earmarked for environmental protection, with approximately one third dedicated to control air pollution.[xx]

In July 2013, the government announced it would spend 1.7 trillion RMB (US$277 billion) over the next 5 years to improve air quality nationally. [xxi] The Airborne Pollution Prevention and Control Action Plan (2013-17) was issued by the State Council in September 2013, focuses on improving air quality in the Beijing-Tianjin-Hebei area, the Yangtze River Delta and the Pearl River Delta. Targets include reduction of PM10 by 10% compared to 2012 levels for all second-tiered cities, and reductions of PM2.5 by 25%, 20% and 15% for the 3 key regions respectively.[xxii] In March, 2015, the National Development and Reform Commission's circular on the environmental spending for the 2015 central budget included a 1.5 billion RMB (US242 million) allocation to suppport Beijing, Tianjin, Hebei, Shandong, Inner Mongolia and Shanxi to address atmospheric pollution.[xxiii]

The Action Plan has identified ten measures for reducing air pollution which include decreasing coal consumption to below 65% in the three target areas by 2017, increasing renewables, increasing public transportation and clean energy vehicles, eliminating old vehicles, small coal boilers and illegal industries and improving industrial processes.[xxiv]

Several regions and cities have subsequently released their own detailed plans and all 31 provinces and autonomous regions have signed on to emission reduction targets of between 10-25% reductions in PM2.5. Beijing has pledged 15 billion RMB (US $2.4 billion) to support its local efforts[xxv] and this March, Li Shixiang, executive vice-mayor of Beijing, announced that the city would reduce coal consumption by 4 million tonnes, shut down 300 factories and and use financial subsidies to retire 200,000 heavily polluting vehicles in 2015.[xxvi] Beijing shuttered 2 coal plants and the last will close in 2016, all to be replaced by natural gas.[xxvii]

Nine measures for reducing air pollution

- Promotion of industry upgrades and restructuring;
- Acceleration of companies' technology upgrading;
- Acceleration of energy restructuring;
- Enforcement of energy-saving and environmental protection in market entrance requirements;
- Application of market-oriented instruments and environmental economic policies;
- Improvement of the legal framework, implementation and enforcement;
- Establishment of regional collaboration mechanisms;
- Establishment of monitoring, alerting and emergency response systems for air pollution episodes; and
- Definition of responsibilities and engage with government, private sector and the public for environmental protection

Source: Adapted from Clean Air Asia

Conclusion

Air pollution is one of the most visable impacts of China's rapid industrialization and economic development with significant consequences for quality of life for China's city dwellers. Public outcry has helped bring about improved monitoring and research into the problem. While it is not well understood that air quality has improved over the past decade, there is nevertheless considerable work to be done in addressing current sources of air pollution such as coal and industrial processes while avoiding new ones such as motor vehicle exhaust. Current plans and budgets by the Government demonstrate strong committment to addressing the issue. If successfully implemented, China's air quality improvement measures will be a significant step in its quest for balanced development.

Contact Information:
Climate Change Team
United Nations Development Programme
No.2 Liangmahe Nanlu, Beijing China 100600
Pstcc.cn@undp.org

[i] http://www.who.int/phe/health_topics/outdoorair/databases/cities/en/ WHO notes that data is incomplete as many developing country cities do not or only partially monitor ambient air pollution.

[ii] http://www.bjepb.gov.cn/bjepb/413526/331443/331937/333896/418344/index.html

[iii] Towards an Environmentally Sustainable Future, ADB, 2012, p. 55. http://www.adb.org/sites/default/files/pub/2012/toward-environmentally-sustainable-future-prc.pdf. . The World Bank, limiting its analysis to particulate matter, classifies more cities below Level II, but nevertheless notes declining rates of all air pollutants from 2001-2009. See https://openknowledge.worldbank.org/handle/10986/11913

[iv] http://wfs.mep.gov.cn/dq/kqzl/201208/t20120827_235262.htm. See also http://www.mep.gov.cn/image20010518/5298.pdf for a definition of Grade I ,II and III air quality standards. China has standards for concentrations of major air pollutants NO2, NOx, lead(Pb), PM10, SO2, and TSP. Rural, urban and industrial areas have different sets of standards to be met, and there are separate standards for 24-hour and annual concentrations. Standards are generally not as strict as WHO or developed nation requirements. A city will be evaluated on the average of all the monitoring stations in a city and will be classified as Grade II if one pollutant drops to Grade II standards for the requisite number of days. The number of cities monitored has changed over time. See https://openknowledge.worldbank.org/handle/10986/11913 p. 5-6 for an explanation of air quality standards.

[v] http://www.who.int/phe/health_topics/outdoorair/databases/cities/en/

[vi] South China Morning Post reports on an article in the Lancet by former Health Minister Chen Zhu (350,000-500,000 deaths) and a 2012 study by Yang Gonghuan (1.2 million) http://www.scmp.com/news/china/article/1399671/ex-health-minister-endorses-finding-chinas-smog-kills-350000-year. 3.7 million a year figure from the World Health Organization. http://www.who.int/mediacentre/factsheets/fs313/en/

[vii] China 2030: Building a Modern, Harmonious, and Creative Society, World Bank, 2013.

[viii] See for example, historical U.S. Embassy air qulaity monitoring data at http://www.stateair.net/web/historical/1/1.html. The China Ministry of Environmental Protection also publishes its own PM data for more cities at http://datacenter.mep.gov.cn/

[ix] http://www.who.int/mediacentre/factsheets/fs313/en/

[x] U.S. Energy Information Administration http://www.eia.gov/todayinenergy/detail.cfm?id=16271

[xi] These and the following figures are based on Integrated Air Pollution Management, World Bank, 2012. https://openknowledge.worldbank.org/handle/10986/11913

[xii] Data on air pollution in China is complex and dynamic with new studies continuously emerging. In addition, air quality vaires from region to region. For example, a study by the Chinese Academy of Sciences released in December 2013, indicated that vehicle emissions accounted for only 4% of Beijing's PM2.5 (http://www.atmos-chem-phys.net/13/7053/2013/acp-13-7053-2013.html). However,previous studies had indicated that vehicle emissions may contribute 20-30% of PM2.5 and a recent report by the MEP indicates that car emissions are the major source of smog for Beijing, Hangzhou, Shenzhen and Guangzhou. http://english.sina.com/china/p/2015/0401/797284.html See here for a discussion of the controversy http://www.rsc.org/chemistryworld/2014/01/pollution-research-sparks-car-control-debate-china

[xiii] http://news.xinhuanet.com/english/china/2015-03/16/c_134071473_5.htm

[xiv] http://politics.people.com.cn/n/2014/0317/c1001-24649809.html

[xv] http://www.gov.cn/zhengce/content/2014-11/19/content_9222.htm

[xvi] http://www.cpnn.com.cn/zdzgtt/201501/t20150121_778878.html

[xvii] http://www.mep.gov.cn/gkml/hbb/qt/201502/t20150217_296054.htm

[xviii] Institute of Environmental and Public Affairs, 2014, Blue Sky Roadmap Report Phase II. http://www.ipe.org.cn/en/about/notice_de_1.aspx?id=11442

[xix] CNHDR ibid, p.119-126.

[xx] http://english.peopledaily.com.cn/90882/8343733.html

[xxi] http://europe.chinadaily.com.cn/china/2013-07/25/content_16826754.htm

[xxii] See the Clean Air Initiative for a summary of the Plan. http://cleanairinitiative.org/portal/node/12066

[xxiii] http://www.sdpc.gov.cn/gzdt/201503/t20150320_668108.html

[xxiv] See Clean Air Asia http://cleanairinitiative.org/portal/node/12066 and the Ministry of Environmental Protection http://english.mep.gov.cn/News_service/infocus/201309/t20130924_260707.htm

[xxv] http://www.reuters.com/article/2014/01/16/us-china-pollution-idUSBREA0E0RD20140116

[xxvi] http://news.xinhuanet.com/english/2015-03/06/c_134045395.htm

[xxvii] http://www.bloomberg.com/news/articles/2015-03-24/beijing-to-close-all-major-coal-power-plants-to-curb-pollution