



## CHINA'S POLLUTION ISSUES:- *Economic miracle - Environmental disaster?* 1. AIR POLLUTION

### Background

International attention has increasingly become focused on environmental degradation within China. Pollution plays a major role in the challenges produced; the result of unchecked rapid socio-economic changes in what is now 'factory to the world'. Within the country most people are affected in some way by pollution, from air, water and land sources, especially the poorer most vulnerable groups. Despite grandiose national strategies, China lacks effective management policies and control at regional and local scales. Air pollution in particular has been highlighted as a result of the problems with air quality standards in Beijing during the 2008 Olympics and also current discussions over the successor to the Kyoto protocol, since China is near to being the greatest contributor of greenhouse gases.

What sets China aside from the pollution problems experienced by countries which have already undergone manufacturing revolutions such as the UK, is the sheer scale and rapid growth of the pollution produced. In 1997 the World Bank published a groundbreaking report in conjunction with China's State Environmental Protection Administration (SEPA) called 'China 2020-Clear Water Blue Skies'. Economic implications from air and water pollution were estimated as costing between 3.5 to 8 % of the country's Gross Domestic Product (GDP). Increased efforts were made to create an environmental cost model called the Green GDP.

### Fig. 1 Green GDP.

- GDP or Gross Domestic Product, is a commonly used measure of the economic activity in an area, especially at national scale, but it fails to take into account the cost to the environment of resource use and pollution.
- The UN and the World Bank developed an alternative composite indicator including resource consumption in the 1990s, which China followed in an effort to raise awareness of the negative impacts of the production of goods and services. Awards ceremonies rewarding regions/municipalities reducing their environmental footprint were held on TV.
- However, by 2004 environmental degradation including pollution was estimated at 511.8 billion yuan (US\$ 67.7 billion) or 3.05 % of GDP. Some Chinese regions, especially in the poorer west with less investment and manufacturing revenue, found environmental losses cancelled out all GDP growth, and efforts to calculate growth proved so controversial that the government stopped publicising its Green GDP in 2007!

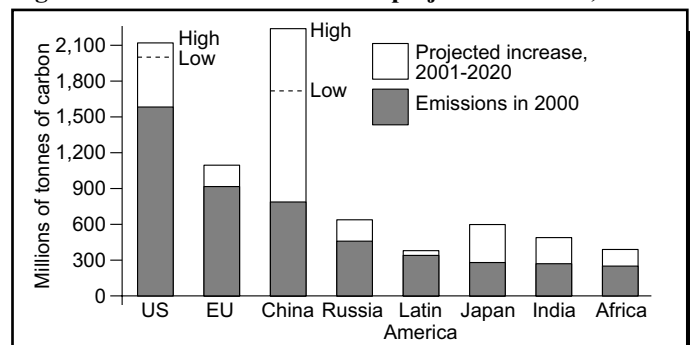
In 2007 'The Cost of Pollution in China' was published by SEPA and the World Bank, but SEPA and the Health Ministry removed about a third of the report for fear of causing "social instability". The missing figures included some of the following facts:

- 750,000 Chinese die prematurely annually from air pollution-related respiratory diseases. 350,000-400,000 of these are from outdoor air pollution, and 300,000 from indoor air pollution from the coal-burning stoves and boilers that are the main source of heat in the country.
- China has 16 of the world's 20 most polluted cities, with 75 % of urban residents breathing polluted air.
- China now emits more SO<sub>2</sub> than any other country, resulting in acid rain falling on more than a third of the nation.
- Other pollutants, in particular emissions of fine particles known as PM10s, are rapidly increasing. Dust storms regularly cover an eighth of the country, generated by soil erosion from degraded and desertified land.
- 60,000 died from diseases ranging from cancer to diarrhoea connected with water pollution, the focus of *Geo Factsheet 239 China's Pollution Issues - 2. Water Pollution*.

### Causes of air pollution

By 2005 China became the greatest source of SO<sub>2</sub> emissions globally, and in 2008 the International Energy Agency announced that China will almost certainly overtake the United States as the leading contributor of the greenhouse gas CO<sub>2</sub> by 2009, more than a decade earlier than anticipated (*see Fig. 2*). Gases originate from power plants, factories, domestic homes and motor vehicles. Every 7-10 days, another coal-fired power plant is being opened, big enough to serve a city the size of Birmingham. These are to power an urban population which increased by 103m to 400m between 2001-5.

Fig. 2 Carbon emissions in 2000 and projected increases, 2001-2020.



**Table 1 Causes and sources of pollution.**

| Causes of pollution  | Direct sources of pollution  |
|--|--|
| <p>The remarkable economic, industrial and urban growth of China recently has:</p> <ul style="list-style-type: none"> <li>led to annual increases of GDP of 8 to 9%.</li> <li>decreased those in absolute poverty by about 400m (i.e. more consumption).</li> <li>produced a booming middle class, demanding cars, air conditioners, refrigerators and second homes, plus carbon-intensive leisure activities such as car clubs and golfing. Urban residents consume 350% more energy than rural Chinese.</li> </ul> | <p>China has few oil and natural gas reserves, and over 70% of its energy comes from its highly sulphurous coalfields.</p> <p>Energy use has increased threefold since 1980, accounting for 10% of the world's total energy consumption.</p> <p>Total energy consumption in China increased 70% between 2000 and 2005, and the most polluting fossil fuel, coal, increased by 75%, despite efforts to increase energy efficiency and control pollution</p> |

Source: National Bureau of Statistics of China.

Consumption patterns and consumerist demands are following those of the Western world in the 20<sup>th</sup> C. It will be interesting to see whether China follows the model shown by more developed economies such as the USA and UK in its pollution trends (Fig. 3), ideally so sustainable development prevails pollution amounts will fall, but the reality is they do not because of consumer demands.

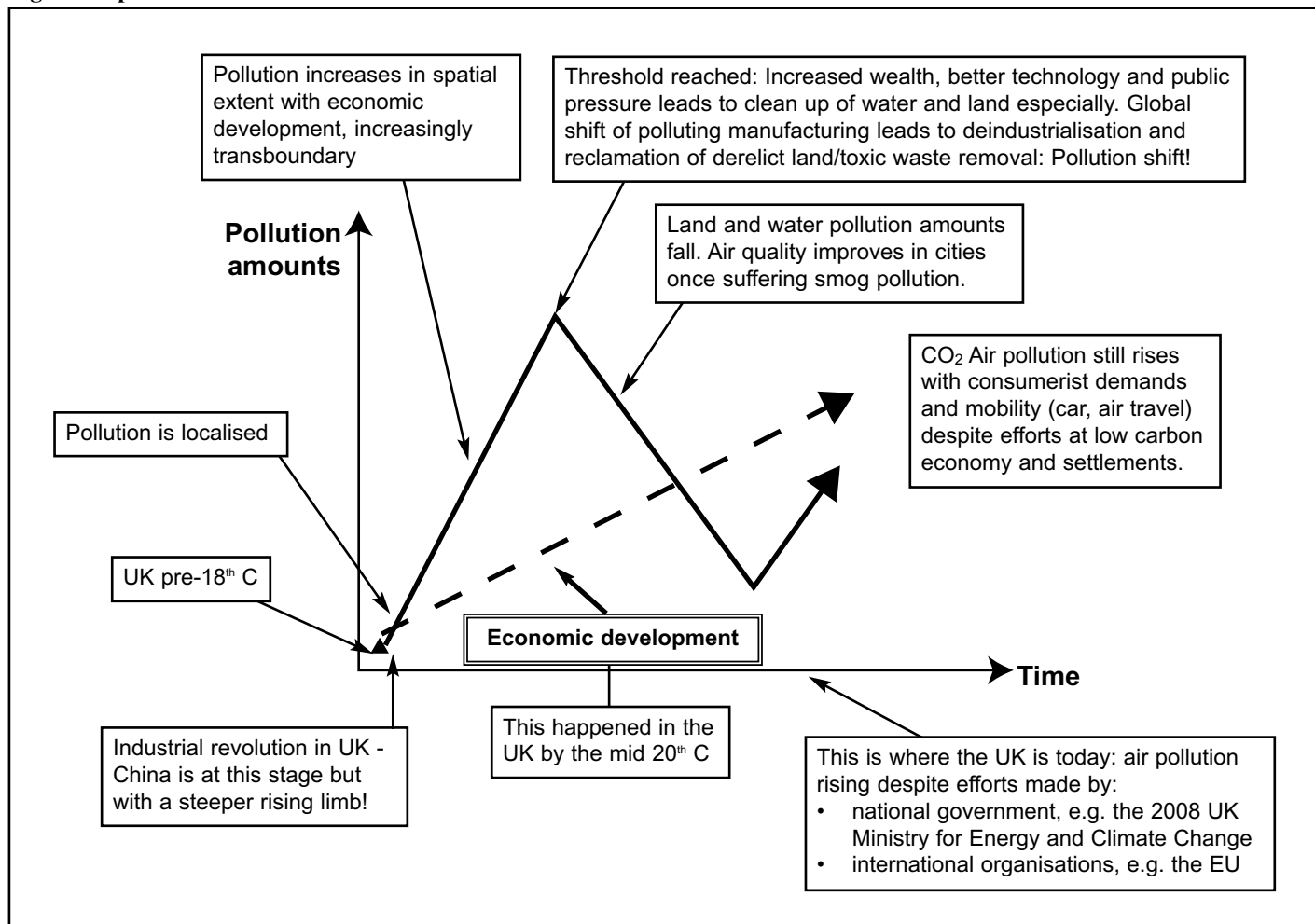
**Case Study: One of the world's dirtiest cities? The role of physical factors in Lanzhou's pollution hotspot.**

LAN Zhou (pronounced 'Lan-Joe', population 2 million, similar to Merseyside, is rapidly growing, but has a poor public transport system and no strict vehicle emission limits. By 1998 the average level of air particulate pollution was 20 times higher than in a British city, and 10 times the health limit set by the World Health Organization. It is a major oil-refining centre, has numerous textile mills, petrochemical, rubber, and fertiliser plants and is the centre of China's nuclear energy industry. Most importantly, coal is locally abundant and is the major fuel used by industry, domestic heating and cooking.

Its physical geography, like that of Mexico City or Los Angeles contributes to its pollution hotspot: being in a narrow valley, surrounded by hills 1500m above sea level at the foot of the Tibetan plateau with a continental location creating large temperature extremes. The combination of heat island and temperature inversions means little dispersion of pollutants especially in winter.

The local government has already attempted closing some heavy industries and restricting traffic, but in 2008 started a more stringent plan of restricting emissions based on air quality warnings with yellow and red level alerts to reduce/stop factory production.

**Fig. 3 Adapted environmental Kuznet Curve.**



**Health risks from air pollution**

People are exposed to air pollution by breathing in pollutants and exposing eyes and skin when outdoors. Living and working near power plants, local industries and road networks is obviously going to increase exposure. Infants, children and the elderly are most affected, plus those with pre-existing health conditions. Health effects depend on many factors: type of pollutant, concentration, temperature and humidity and exposure period. There is no doubt that China presents one of the largest challenges to combat pollution and reduce health risks today! The vast productive work force which helped drive China's meteoric economic growth needs good health to be sustained, but like many other transition economies, China now has to tackle the **double burden** of :

- preventable **infectious diseases**, which water pollution often increases (see *Geo Factsheet 239*)
- **chronic, degenerative related diseases**, often linked to air pollution.

Both are compounded by the trend of an ageing population.

Levels of **persistent organic pollutants (POPs)** and **volatile organic compounds (VOCs)** like benzene and toluene are also much higher than in most developed countries. By 2006, 32.8 million people in China had COPD (chronic obstructive pulmonary disease) an umbrella term used to describe lung diseases such as bronchitis. 39 million also had asthma. 50% of all respiratory disease cases are now caused by air pollution, with 5 to 8 times as many people dying from lung cancer in cities as in non-polluted rural areas. If present trends continue, the World Bank estimates that by 2020 China will be paying \$390 billion to treat diseases indirectly caused by burning coal, or 13 % of its predicted GDP!

China has put more emphasis on health since 2000, taking on the **MDG goals**. By 2020 it aims to have delivered a more sustainable approach to development, where good health care is part of its 'Scientific Concept of Development and Five Balances of Development'. It is following the ideals of '**xiaokang**' (meaning well off in an all round way).

**Spatial patterns of pollution**

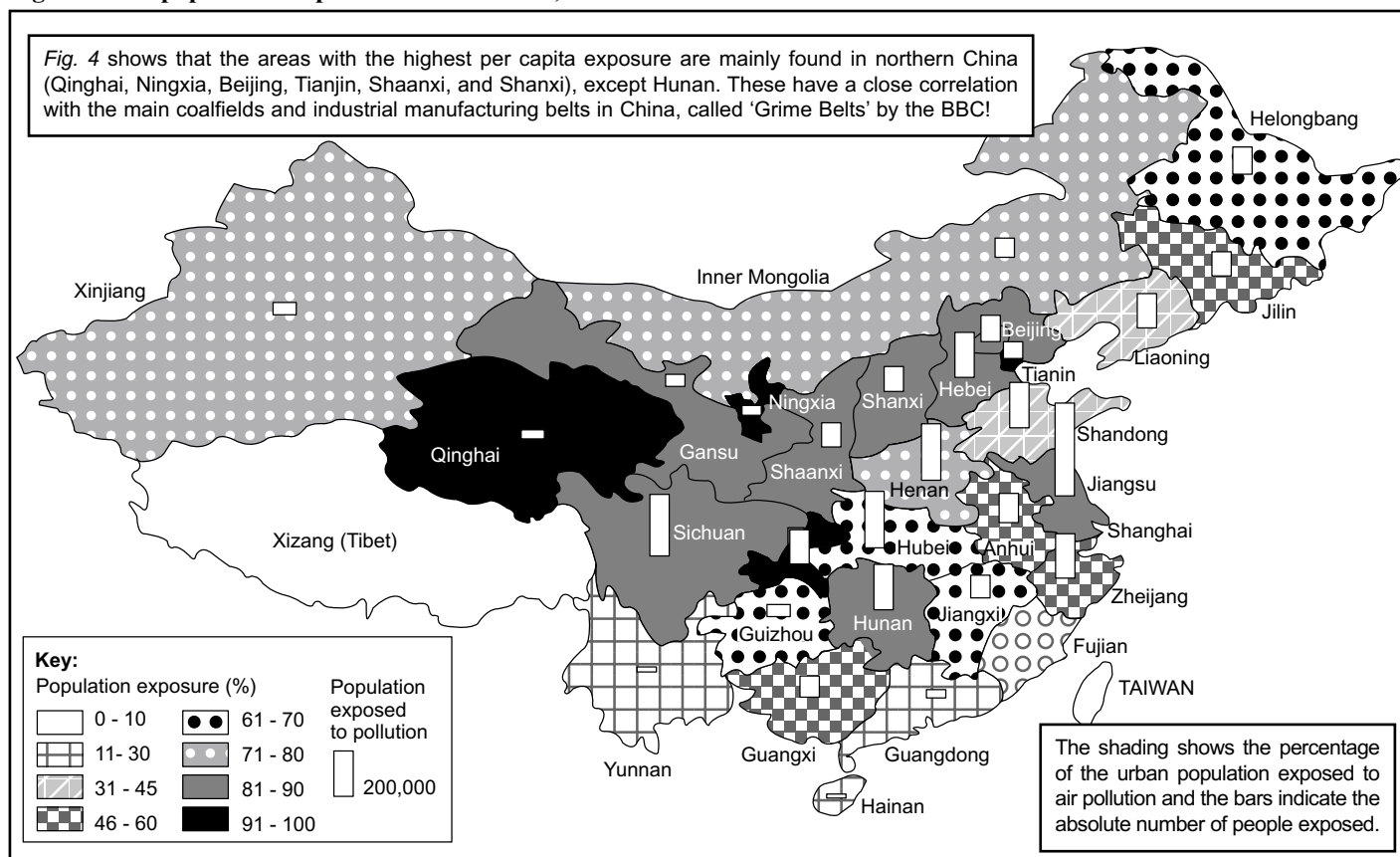
Airborne pollutants can be categorised into:

- **Primary pollutants:** from fossil fuel combustion from power plants, vehicle engines and industrial production, by burning biomass, and by natural processes e.g. windblown dust.
- **Secondary pollutants:** when primary pollutants react with sunlight, oxygen, water and other chemicals present in the air.

Both may consist of chemical compounds in solid, liquid or vapour phases:

- Outdoor air pollution in the context of public health is characterised by several major airborne pollutants. Particulate Matter (PM), Tropospheric Ozone (O<sub>3</sub>), Nitrogen dioxide (NO<sub>2</sub>), and Sulfur dioxide (SO<sub>2</sub>) are some of the most commonly monitored pollutants.
- Particulate matter in the atmosphere is mainly attributed to the combustion of fossil fuels, especially coal and diesel fuel, and is composed of tiny particles of solids and liquids including ash, carbon soot, mineral salts and oxides, heavy metals such as lead, and other organic compounds<sup>1</sup>. Particulate Matter is typically measured and characterised by particle size, as either PM<sub>10</sub> (particle diameter ≤ 10 microns) or as PM<sub>2.5</sub> (particle diameter ≤ 2.5 microns). The smaller particles are able to penetrate deeper into the lungs, disrupting the exchange of oxygen into the blood and causing inflammation.
- NO<sub>2</sub> and SO<sub>2</sub> are chemicals produced by the combustion of fossil fuels and play a major role in generating photochemical smog, as well as creating acid rain.
- Ozone is a major component of photochemical smog, formed when primary pollutants like NO<sub>2</sub> and Carbon monoxide (CO) react with sunlight to form a variety of secondary pollutants.
- Lead (Pb) from leaded petrol was finally banned in China from 2000.

**Fig. 4 Urban population exposed to PM10 levels, 2003.**



### Pollution management

Management requires baseline data to assess improvements, and ambient standards to aim for. By 2001 47 cities in China regularly measured air pollution levels of SO<sub>2</sub>, NO<sub>2</sub> and PM10 and forecasted an Air Pollution Index. The two dominant principles underlying most modern pollution management are:

- The **polluter pays principle**, where pollution is managed after it is produced, or at its sink.
- The **precautionary principle** is when action is taken to reduce pollution at its source even if the negative effects are unproven or unknown.

Evidence of the polluter paying was well exemplified in the highly publicised clean up to reduce polluting sources and reduce health risks for visiting athletes and supporters, before the 2008 Olympics, in Beijing's Blue Skies Policy.

**Table 2 Beijing.**

| Beijing: Pressure to create a suitable environment for both athletes and spectators forced the Chinese government to enforce probably the world's biggest pollution control experiment, but it was only for the summer of 2008!  | Effectiveness                                   |
|--|---|
| <b>Short term:</b> <ul style="list-style-type: none"> <li>• Removal of over 1m of the city's 3.3 m vehicles from the roads for 3 months. Car ownership nationally is under 4% (USA is 85%!) but rising: over 1000 new cars a day in Beijing!</li> <li>• Factories and construction bans within the city</li> </ul> | The clearest skies Beijing has seen in 10 years |
| <b>Longer term:</b> <ul style="list-style-type: none"> <li>• Expansion of public transport subway system</li> <li>• Possible expansion of permanent restriction policies on number of license plates as in Shanghai</li> <li>• Improved bike ways</li> </ul>   | Raised vehicle speeds 10% to 43 kph.            |

### Solutions

- China's current 50-year energy plan seeks to **reduce coal use** from 67% to 27% in 2050 by a large increase in natural gas and renewable energy (especially HEP and solar power).
- **SO<sub>2</sub>**: In 2006 China's SO<sub>2</sub> emissions were 27% higher than in 2000, despite government goals of reducing them by 10%. Efforts to date:
  - Closure of many small coal-fired power plants
  - Low-sulphur coal burnt
  - Cleaning coal before burning to remove sulphur
  - Scrubbing it out from gas flue emissions

However, increasing motor vehicle emissions will mean more NO<sub>x</sub> gases, and acid rain will contain nitric acid as well as sulphuric acid.

- **Dust pollution** is being tackled by planting a controversial giant windbreak to slow winds and stabilise the environment: a "green great wall" of trees across more than 35 million hectares of land by 2050, especially in the west. However, trees may remove water supply to the soil and not reduce erosion.
- **CO<sub>2</sub>**: China is seen as a 'developing country' by the United Nations and as such is not required to reduce its emissions under the original Kyoto protocol. However at the 2007 UN climate summit in Indonesia, China responded to international pressure, pledging to consider cutting its emissions in the "son of Kyoto" from 2012. In November 2008 the Chinese government called on world leaders to spend 1% of their GDP on helping poorer nations cut their greenhouse emissions, for example by green technology transfer, such as more efficient coal burners.

### Public involvement in pollution

Cost benefit analysis will show, in the long term, that preventing pollution at source is the best option. However, societies, businesses and individuals usually operate on a shorter time scale, and it needs great commitment by governments often influenced by an increasing mobilised public who sponsor pressure groups who in turn manipulate media to galvanise change in poor practices. Pollution prevention in China is hindered by the lack of:

- The rule of law, i.e. the principle that no one is above the law, is a relatively new concept in China.
- Publicly available data and involvement, since it is a one party state.
- Official accountability in its authoritarian political system
- Few incentives for local officials to act on pollution, especially in resource-deficient and poorer regions of west China.

However, over the last decade there have been increasing public protests and an attempt by journalists to report on pollution incidents and problems, aided by global media especially the internet. A few even dare take legal action such as Beijing lawyer Zhang Jingjing, working for the Centre for Legal Assistance to Pollution Victims. The Chinese leadership is now concerned that environmental degradation is leading to social unrest, with 50,000 environmental protests reported in 2005 alone. Such protests are usually small in scale, but some have involved 40,000 people, and often been violent.

International pressure is also building, from financial institutions like the World Bank to pressure groups like Greenpeace which aims to increase grassroots support for environmental protection. A number of multinational corporations have even adopted environmental protection as an important and integral part of their business ethic in China.

### Conclusion

According to other experiences in older industrialised countries, greater public involvement in environmental protection - through a free media, unregulated non-governmental organisations or an independent judiciary was linked to a reduction in pollution by greater governmental control. Without some type of change on attitude it may well be that China's miracle could lead to environmental collapse. This has been acknowledged by central government, but unfortunately provincial governments may still sacrifice the environment to attract investors in a competitive globalised world fighting for investment. China certainly has a long way to go to meet the WHO's latest target of reducing levels of fine particulates from traffic, industry and burning of fossil fuels be cut to a third of what they were in 2006.

Another major challenge is the fact that pollution is increasingly trans-boundary: The black cloud and smog from China is contributing to bad air quality and possibly even affecting the climate in parts of the western United States, according to Journal of Geophysical Research. Huge clouds 300 miles wide and six miles deep of dusty, industrial smog, including carbon, sulfates and nitrates track every few days across the Pacific Ocean to cities like Los Angeles and San Francisco.

### Questions

1. Summarise the local and global impacts of air pollution in China using the following categories: social, economic and environmental. You may need to research the global implications of air pollution.
2. Use the Blacksmith Institute and BBC websites to research into other air pollution hotspots in China.

### Further Research

- Cost of Pollution in China by World Bank and SEPA 2007 [http://siteresources.worldbank.org/INTEAPREGTOPENVIRON-MENT/Resources/China\\_Cost\\_of\\_Pollution.pdf](http://siteresources.worldbank.org/INTEAPREGTOPENVIRON-MENT/Resources/China_Cost_of_Pollution.pdf)
- NGO watchdog: Blacksmith Institute [www.blacksmithinstitute.org](http://www.blacksmithinstitute.org)
- Slideshow of environmental pollution by photographer Stephen Voss [www.cnn.com/2008/TECH/science/10/27/what.matters.huai/index.html?iref=mpstoryview#cnSTCText](http://www.cnn.com/2008/TECH/science/10/27/what.matters.huai/index.html?iref=mpstoryview#cnSTCText)
- Worldwatch Institute, an environmental pressure group website [www.worldwatch.org/node/4622](http://www.worldwatch.org/node/4622)
- Youtube Pollution in China e.g. BBC on China's 'Grime Belt' [www.youtube.com/watch?v=-1DNjJd2YfA&feature=related](http://www.youtube.com/watch?v=-1DNjJd2YfA&feature=related)
- World Health Organization on PM10 - lots of health-pollution links on this site! [www.who.int/mediacentre/news/releases/2006/pr52/en/index.html](http://www.who.int/mediacentre/news/releases/2006/pr52/en/index.html)
- China online information network on pollution laws and rule of law [www.china.org.cn/government/news/200802/28/content\\_11025486\\_6.htm](http://www.china.org.cn/government/news/200802/28/content_11025486_6.htm)

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