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The Red Zone: Why Beijing's Air Pollution Crisis is More Complicated than You Think

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The air pollution crisis in Beijing is an immediately pressing issue, as particulate concentrations have reached unprecedented levels and photographs of a smog-filled city with masked citizens fill international news. As the world's biggest source of carbon emissions, China is under domestic pressure from its populace to counter air pollution as it poses not only health risks to its citizens, but also grave long-term environmental threats. But the issue of air pollution in Beijing is much more complicated than media often portrays. Beijing is particularly susceptible to adverse atmospheric conditions both due to its rapid urbanization and the geography of the area. The national and municipal government have enacted policies in order to combat air pollution, including restrictions on vehicle and industrial emissions and carbon trading. But there are many challenges to address given the multi-faceted nature of the crisis. In light of the recent policies and scientific contributions, Beijing could go one step further in attempting to decrease pollution through implementing driver taxes, expanding and diversifying urban forests, and investing in alternative energy, particularly wind power. However, even such advanced preventative measures are met with their own obstacles given the constraints of urban infrastructure.

Beijing's air pollution poses a health risk to the people who live there. Such particulate air pollution combines liquid droplets in the atmosphere with a number of components, including acids like nitrates and sulfates, organic chemicals, metals, and soil or dust particles, which can be harmful to those who inhale it. There is a significant exposure-response relationship between maternal exposures to sulfur dioxide and total suspended particles during the third trimester of pregnancy and infant birth weight. The data suggests that total suspended particles and sulfur dioxide, or a more complex pollution mixture associated with these pollutants, contribute to an excess risk of low birth weight in the Beijing population (Wang et al., 1997) There are also negative health effects regarding respiratory and cardiovascular issues, amongst others, as the annual numbers of mortality and morbidity increase significantly in the presence of PM10 pollution in the urban areas. Moreover, the chronic effects of long-term exposure could take years to develop cannot be fully quantified in such studies (Zhang, 2007). Health complications are also accompanied by economic costs as well as productivity decreases and hospitalization increases; thus it is in the interest of the city to invest in finding solutions to air pollution problems.

Beijing's rapid urbanization causes many of its air pollution problems. Factories in neighboring provinces circle the city of more than 20 million, as the number of cars on Beijing's streets multiplies at an astounding rate. Since 1990, the population in Beijing has been growing at a rate of about 2% annually. In 2011, Beijing had a population of about 20.7 million, and the number continues to grow (Beijing Statistical Yearbook, 2011). The increase in the population has stimulated real-estate development and accelerated urbanization. In the last decade, many new high-rise buildings have been constructed, hindering the dispersion of air pollutants (Liu H. et al., 2005). Furthermore, the growth of the population and GDP has increased the demand for vehicular transport. The number of vehicles has increased from 1.39 million in 1999 to 2.65 million in 2005 alone.

Beijing's geological conditions also make it highly susceptible to air pollution. Beijing sits on a plain flanked by hills and escarpments that can trap pollution on days with little wind (Wong, 2013). Conversely, strong northwestern winds carry dust from the Gobi desert to Beijing in the spring and lead to low visibility and high concentrations of PM10, particulate matter with diameter of 10 micrometers that are considered highly harmful to human health (Zhang R. et al., 2005). Domestic heating in this heavily populated city usually starts in mid-November and ends in the following March, and it is the major source of pollutant sulfur dioxide in the winter season (He et al., 2001). High temperature and relative conditions in Beijing summers favor the transformation of air pollutants, resulting in some episodes with high concentrations of secondary pollutants (He et al., 2001). The above-average rate of foggy conditions indicates atmospheric chemical reactions, as hydrophilic aerosols can serve cloud condensation nuclei, leading to the formation of the dramatic fogs in the photographs circulating around the worldwide Web (Seinfeld and Pandis, 1998).

The result of the vicious combination between rapid urbanization and unfavorable geological conditions has caused Beijing to have air pollution dangerously above the international average. The density of fine particulate matter, PM2.5, used as an indicator of air quality, was well above 600 micrograms per cubic meter – safe level under WHO guidelines is 25 micrograms per cubic meter (Watt, 2013). In 2011, an air quality-monitoring device atop the United States Embassy in Beijing recorded an Air Quality Index of 755, over the limit of 500, which was supposed to be the top of the scale. By contrast, New York City rated 19 that day on the scale using the same standards (Wong, 2013).

In general, China's new environmental strategy promises to grant markets a decisive role in allocating resources while more harshly penalizing polluters. The shift underscores top-level concerns that environmental problems are threatening economic prosperity and social stability, as environmental scholars and the government alike now claim the subsidized and inefficient use of resources has contributed to a severely degraded atmospheric conditions (Spegele, 2013). The new policies intend to weaken the hand of government and boost competition in the state dominated economy as a way to build efficiency and cut waste. Policy changes, if carried out, are expected to spell gradually rising prices for resources ranging from natural gas to water. In general, higher taxes and other tools are likely to be used to try to wean the economy off coal, which is abundant and makes up the majority of China's energy use.

Beijing has made several automobile emissions policy changes to combat air pollution. The city is expected to upgrade its exhaust standard from Euro II to Euro III this year, and special petrol suitable for Euro III cars will be on sale in July. Motor vehicles that meet emission standards usually have a yellow or green tag pasted on their front windows after annual inspection. However, cars without such tags are often seen on the roads – with the stricter policies, people driving tag-less cars will be fined. The city also plans to phase out 3,800 old buses and 20,000 taxis, both blamed as major pollution sources (Yu, 2013). The local government says it will reduce the number of license plates it issues over the next four years by 40 percent, to 150,000 license plates total per year by 2017, operating on a lottery system for distribution. At the same time, it says it will slowly increase the share of plates that are reserved for electric cars and other hybrid vehicles to 40 percent of the total by the end of four years (Lim, 2011). However, electric and hybrid vehicles need electricity, and most of the country's power is fueled by coal, so the effectiveness of these vehicles in reducing overall pollution is suspect.

Apart from exhaust fumes, the city will also take tough measures to slash industrial emissions. The new measures include stricter controls on industrial smoke, automobile exhaust fumes and construction dust. About twenty-eight industrial plants surrounding the metropolitan area involved in electricity, heat, and steel smelting have adopted measures to reduce their emissions. The steel giant Shougang Group, which has long been blamed as the biggest industrial polluter in Beijing, was shut down in order to reduce emissions ("Steelmaker removed," 2011). A second batch of heavy polluters is expected to clean up operations within the year. In September 2013, China's Cabinet released an action plan that aims to make a small reduction in the country's heavy reliance on coal to below 65 percent of total energy usage by 2017. According to the Chinese government's statistics, coal consumption accounted for 68.4 percent of total energy use in 2011 (Watt, 2013). Beijing is even taking smaller measures to reduce coal on a municipal level. Hundreds of coal-using barbecue grills had been confiscated and destroyed by the government in a three-month campaign in order to reduce emissions ("Beijing destroys barbecue grills," 2013).

Beijing has also become involved with carbon trading in order to reduce its emissions. China plans to launch pilot carbon trading schemes in Beijing and Shanghai as it strives to cut soaring rates of greenhouse gas, reduce choking smog and determine the best system for a nationwide roll-out (Stanway, 2013). Carbon credits provide financial incentive to close down inefficient steel or cement plants in order to free up the carbon credits to sell on the market. The fines for noncompliance are minimal, but state-owned companies are likely to participate fully given political pressure to take part and the close relationship with local governments. In the first phase, credits will be distributed to member firms free of charge, meaning participants will face additional costs only if they exceed their quotas and have to purchase more carbon credits. The new platforms, which will force industrial firms to buy credits to cover any carbon dioxide they emit above allocated quotas, underscore Beijing's commitment to "market mechanisms" to slow emissions growth.

Since vehicle emissions have increasingly exacerbated pollution, Beijing could encourage alternate transportation by taxing drivers. External costs of road traffic can be internalized by road pricing, but current pricing schemas are insufficient for climate change in that they focus mainly on congestion. Air pollution is not dependent on traffic density, but rather by every kilometer travelled (Creutzig and He, 2009). In order to properly tax car users, Beijing could implement a Vehicle Miles Traveled tax. Instead of using a tax on fuel consumption as a way of financing road infrastructure, a VMT tax charges motorists based on their road usage measured in mileage. A VMT charge is implemented using GPS units on board a vehicle to record distance, assign it to the appropriate taxing jurisdiction, and calculate the amount owed. Such taxes have been piloted in areas of the United States and have been deemed feasible (Hanley & Kuhl, 2011). Beijing could employ a similar technique as they currently intend to do by tagging emissions-approved vehicle – cars with installed GPS systems could receive a marker and those without would be fined. GPS units, however, would be costly, and enacting these measures in its first phases would also require a certain level of cooperation on the part of the drivers. Such a project could incite public outrage from the more heavily taxed populace.

Another option for Beijing could be incorporating more urban forests into the city. Tree planting has been proposed by the municipal government as a measure to alleviate air pollution in Beijing, but the current measures enacted have been insufficient. Analyses of satellite images show that there are 2.4 million trees in the central part of Beijing. The diameter distribution of the trees is skewed toward small diameters and the urban forest is dominated by a few species. The condition of trees in the central part of Beijing is not ideal; about 29% of trees were classified as being in poor condition. Nevertheless, trees in the central part of Beijing removed 1261.4 tons of pollutants from the air in 2002. The air pollutant that was most reduced was PM10 – the reduction amounted to 772 tons. The carbon dioxide stored in biomass form by the urban forest amounted to about 0.2 million tons (Yang et al., 2005). Urban forests have reduced the concentrations of carbon dioxide and have potentiality to reduce more in the future. From these observations, the government should invest in diversifying its urban forests and spreading them out over greater areas. But budgetary as well as spatial constraints in the urban infrastructure could pose an obstacle to such expansion.

Ultimately, Beijing's main goal should be finding an alternative to coal as its most plentiful energy source. Beijing could implement more hydroelectric sources, but in the past such projects have yielded disastrous ecological results, such as with the Three Gorges Dam and the serious disturbance it caused in local ecosystems, sedimentation, and drinking water availability (Gong, 2006; Yang, 2006; Wines, 2011). The government could expand resource taxes, which expect would include shifting how China taxes coal, from a volume-based tax to a value-based one. This would boost revenues, which could then be used to subsidize cleaner energy sources (Spegele, 2013). Perhaps this way, markets will shift towards demanding more clean alternative energy sources, such as wind. Beijing could take advantage of the strong northwestern winds that carry dust from the Gobi desert to Beijing in the spring. Areas of the Gobi desert, especially in the Gansu province outside of Beijing, are usually very windy and could thus be used as areas for wind power generation. Cost-benefit analyses conclude that wind power would be very effective and cost efficient when compared to coal for energy use (Sims et. al., 2005). However, cost of execution and grid connectivity that could complicate wind power implementation.

China is an important leader in international development. The challenges faced by Beijing in its development could be applied further to other countries in the developing world. At the Warsaw climate discussions this year, China's leaders displayed renewed interest environmentalism as it relates to their country's rapid growth. There has been a marked shift in developing countries pursuing economic development in concordance with environmental sustainability, or at least demonstrating awareness of the detrimental effects their development has had on the environment. Such measures should be encouraged as policy makers strive for sustainability in economic prosperity.

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