Serious air Pollution in China: Can it be Bolved?

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Abstract: The air quality in China is facing a big challenge nowadays. This paper aims to investigate the possible solutions to deal with air pollution problems. The solutions are based on three perspectives-- policy, technology, and insurance. The paper will discuss each aspect's well-done part according to various published reliable articles. We will then focus on the unsolved problems and prove that we can reduce air pollution in China by using a well-implemented policy, advanced technologies, and subsidies for environmental pollution liability insurance.

Keywords: air pollution, policy, technology, insurance

1 Introduction

China's GDP has increased by 69% in 2022 comparing with 2013, but PM2.5 concentration in the air has decreased by 57%, and the emissions of sulfur dioxide and nitrogen oxides have also decreased by 85% and 60% respectively [1]. Compared with 2014, the air quality of Chinese cities in 2023 has significantly improved; the proportion of days with an AQI of less than 100 increased from 66.5% in 2014 to 82.0% [2]. This may be the China realized its serious air pollution because of industrialization and the Chinese government is determined to control the seriously polluted air. Under the advocacy of "green water and green mountains are gold mountains and silver mountains.", many local governments have abandoned the "GDP-only theory" to develop tourism and increase people's welfare by governing the environment. Most local governments in China (except Hong Kong, Macao, and Taiwan) began to record the air data in detail after December 2013 [3].

A strong correlation is shown between China’s health economic losses and changes in air quality (Figure 1). The former and their ratio to GDP increased until 2014, but the health financial losses began to decrease. This, too, can be especially seen in Beijing's data (Figure 2).

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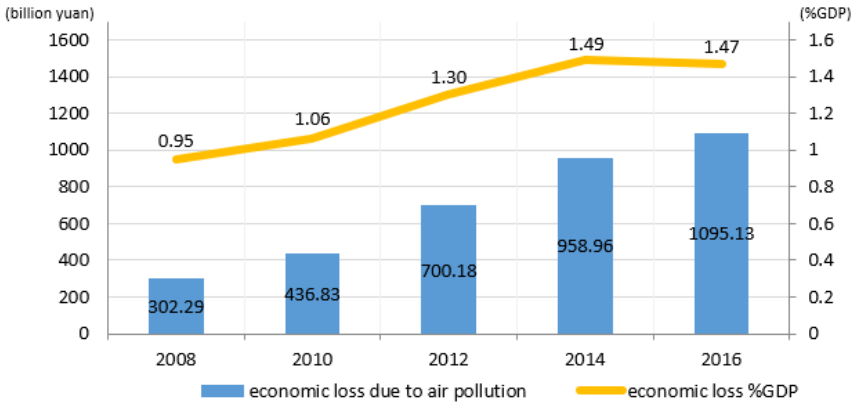

Fig.1: China's health economic losses attributed to air pollution in 2008-2016 [4]

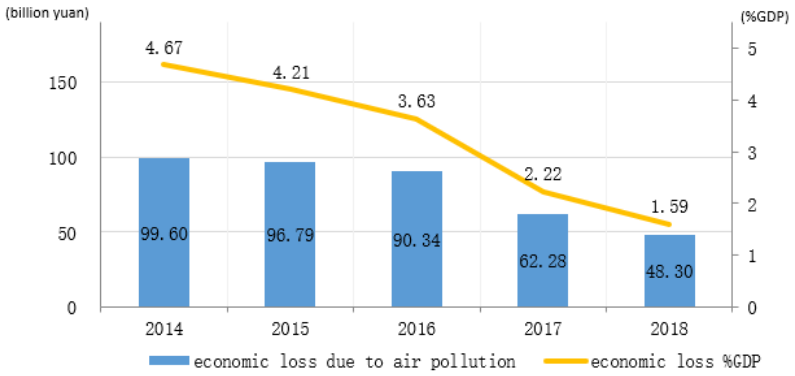

Fig. 2: Beijing health economic losses attributed to air pollution in 2014-2018 [5]

Components of health and economic loss of air pollution in China represented by Beijing are shown below (Table 1). Among them, early death and chronic bronchitis are essential factors. This is because the economic loss is reflected in the increased productivity that would have been achieved in people who die early and those with chronic bronchitis.

Table 1: Main causes of Beijing health economic losses attributed to PM2.5 in 2018 [5]

Chronic bronchitis	￥29.17 billion
Early death	￥18.58 billion
Acute bronchitis	￥0.35 billion
Hospitalization	￥0.16 billion
Asthma	￥0.04 billion

Therefore, we can conclude that despite significant improvements in air quality since 2013, China has enormous room for progress to reduce its health economic losses.

There are three problems affecting economic loss related to air pollution: continuous advancement of urbanization, technology shortage on air pollution control, and lack of insurance coverage. These three problems echo policy, advanced technology, and insurance, respectively, and we will discuss them individually in the later text.

2 Policy

2.1 History of air pollution control in China

China's air pollution prevention and control work mainly started in the 1970s, and the history of it can be roughly divided into four stages. Firstly, the period from 1972 to 1990 was the initial stage of air pollution control. At this stage, air pollution prevention and control objects were smoke dust and suspended particles. Secondly, the period from 1991 to 2000 was the development stage. And the control objects were SO_2 and suspended particles. Thirdly, the period from 2001 to 2010 was the transition stage. The main control objects at this stage transformed into SO_2, NOx, and PM10. Finally, from 2011 to the present was the challenging stage. At this stage, the main objects of atmospheric control were PM2.5 and PM10 [6].

2.2 Ten Years of Air Pollution Control Policies in China

In 2013, smog was more severe than ever in China. According to the data released by the China Meteorological Administration, the pollution affected 25 provinces and more than 100 large and medium-sized cities, and the average number of days of smog in the country reached 29.9 days, the highest in 52 years.

Due to the heavy smog, in September 2013, Ten Atmospheric Measures were launched, stipulating that by 2017, the concentration of PM2.5 should be reduced. The Ten Atmospheric Measures policy is the first landmark policy in the Tough stage [7], and China became the first developing country to implement large-scale PM2.5 control.

Apart from the Ten Atmospheric Measures, the government has formulated many policies to control air pollution over the past ten years. For example, the Air Pollution Prevention and Control Law was officially implemented in 2016, legalizing effective measures since implementing the Ten Atmospheric Measures. The National Joint Center for Air Pollution Prevention and Control was established in 2017 to strengthen the governance of heavy air pollution. The Three-year Action Plan for Winning the Blue Sky Defense War was released in 2018, requiring the number of days with good air quality in cities above the prefecture level to reach 80% by 2020. In November 2021, the Opinions of the CPC Central Committee and The State Council on Deepening the Battle against Pollution Prevention and Control proposed deepening the battle to protect the blue sky. In 2023, the government will speed up the Action Plan for Continuous Improvement of Air Quality promotion.

2.3 2013-2022 Air Pollution Control Achievements in China

The Ministry of Ecology and Environment held a regular press conference for March on March 28, 2013. At the meeting, Liu Bingjiang, director of the Atmospheric Environment Department of the Ministry of Ecological Environment, introduced the achievements of China's air pollution prevention and control in the past ten years.

From 2013 to 2022, China's total GDP increased by 69%, PM2.5 concentration decreased by 57%, and heavy pollution days decreased by 92%. The sulfur dioxide and nitrogen oxide emissions of the country have dropped from more than 20 million tons to more than 3 million tons and more than 9 million tons, respectively [8]. China has achieved rapid economic growth, while air quality has improved significantly.

2.4 Problems and Effective Measures of Air Pollution Policy

There are many reasons for the poor implementation of air pollution control policies, including the GDP-only Theory. The GDP-only Theory refers to using GDP statistics as the core or the only indicator for assessing government performance. Local governments are influenced by the traditional concept of GDP-only Theory. Under this standard, the government takes for granted that economic growth is the most important. As a result, in this seesaw of "keeping the blue sky" and "keeping economic growth," "keeping the blue sky" is often abandoned [9].

To pursue economic growth, enterprises and governments continue to develop and utilize natural resources and increase waste emissions, leading to the deterioration of the ecological environment, especially air quality. Xie Tingting and Wang Yong found that air pollution reduces the speed and quality of urban economic growth by analyzing data such as China's census, nighttime lights, and air pollution based on satellite retrieval [10]. Severe air pollution will also increase the incidence of respiratory diseases, chronic lung diseases, and cardiovascular and cerebrovascular diseases. What's worse, the government and enterprises need to spend a lot of money to control air pollution, and the cost of treatment will significantly affect economic development.

Therefore, the government and enterprises have gradually changed the traditional concept of focusing on the economy. The government formulated many policies to control air pollution and incorporated the effectiveness of air pollution control into the assessment indicators of local governments. For example, by the requirements of the Ten Atmospheric Measures, the State Council issued the Measures for the Assessment of the Implementation of the Air Pollution Prevention and Control Action Plan in 2014, which used the assessment results of air pollution control work as an important basis for the comprehensive assessment of leading cadres in various regions [11].

3 Technology

3.1 Data

Data on technologies dealing with air pollution problems is based on the Literature indexed by CNKI and press by the media in China mainland from 2010 to 2023. The data is mainly about the technologies already being manufactured or put into actual practice, not including the ideas that have not been turned into reality.

3.2 Method

The data found was evaluated and screened regarding innovation and practical feasibility. The paper covers technologies invented by Chinese scientists or companies and corporations in other countries.

3.3 Result

Four technologies are shown and discussed in the following pages.

The Green Hospitals and “the Air Steward” system

According to a press by China Daily [12] in 2023 covering the 24th National Hospital Construction Conference, the conference suggested that "Green Hospital" has become the trend of future hospital construction, and a technology named “the air steward” called much attention.

The technology is designed by an energy-saving technology company in Chongqing, and it serves to monitor and control the air quality in hospitals. This “digital air steward “technology is composed of different parts. It has a central controlling system using big data and IoT technology to record the air quality and several air cleaning systems. Once the computer detects that the air quality is worse than the standard, it will automatically start the air purification machines to clean the air.

About the plan, the problem is that many hospitals nowadays in China lack incentives to employ this kind of air pollution technology [13]. Surveys [14] show that people generally care more about the medical level of hospitals than air quality; in that case, hospitals are more likely to spend their budget on developing medical technologies or hiring more skilled physicians to treat patients instead of buying air cleaning technologies. Another issue worth considering is precisely evaluating and setting the air quality standards for “green hospitals.” From my perspective, to promote the construction of green hospitals, a set of standards with practical feasibility and clear indicators needs to be developed.

Air quality detectors carried by birds

Based on a press by Hou AiBing [15] in 2017, pigeons are used for detecting air pollution in London.

This idea was originally from a company named Plume Labs. this company worked with some universities to attach air pollution detectors to pigeons' backs. While the pigeons fly around the city, the sensor can record and evaluate the air quality.

This company also developed a mobile application that allows users to see the data collected by pigeons and make pollution predictions. Once people know the air quality status of exposure, they can decide when to go out and reduce the impact of air pollution on their health.

Turning Air Pollution into harmless things

It is technologically possible that air pollution can be made into different valuable objects.

Due to a press in 2017 [16], Anirudh Sharma, who graduated from the Massachusetts Institute of Technology with his team, invented the equipment for producing environmentally friendly ink, “AIR-INK,” by absorbing air pollution. And it only takes about 45 minutes to use the air pollution to create an ink pen.

According to a press by LiYiwen in 2016 [17], a Dutch inventor named Daan Roosegaarde collected the smog and made them into "diamond" rings, priced at 5 euros.

Dacs

DACS means Direct Air Carbon Capture and Storage, a complicated technology that can remove carbon dioxide directly from the atmosphere[18]. Air is sucked into the DACS system through an industrial-grade fan; then, the DACS solution system passes air through a chemical solution to remove carbon dioxide and return the remaining air to the atmosphere.

As the Special Report on Global Warming of 1.5 Degrees Celsius [19] has shown, the cost of carbon dioxide removal by DACS is 100~300US dollars per ton, and the carbon dioxide emission reduction potential is 0.5-5Gt in 2025.

3.4 Discussion

All these technologies have positive externality because they can help reduce air pollution. As far as I'm concerned, the government should use subsidies or rewards to encourage technological innovation in dealing with air pollution.

However, there is still one problem that I can think of about using these technologies. ——Will anyone intentionally create more pollution to encourage more people to continuously purchase and use these technologies for profit? I think this is a question worth further attention.

4 Environment Pollution Liability Insurance

4.1 The advantages of implementing EPLI policy

According to Liyang Wang and Ning Zhang [20], air pollution can also influence people's financial and health conditions. It will lead to economic losses for both individuals and enterprises by increasing expenditure [21] and decreasing the labor force's productivity and work time. When an air pollution occurrence happens, the enterprise may face colossal fines, which sometimes even cause small businesses to bankrupt. However, environmental pollution liability insurance can help these enterprises to separate their risks and cover those uncertain fines due to it operation mechanism.

Moreover, according to Shi, Jiang, Bao, Zhang, and Kang [22], environmental pollution liability insurance can also promote the reduction of air pollution. This function appeared because of the incentive mechanism and punishment mechanism implemented by the insurance company. Insurers have the right to regularly check the environmental risks of insured enterprises. If the enterprise fails to reach ecological assessment standards, the insurance company will strengthen the compensation constraint, which is a situation that insured enterprises want to avoid. Moreover, the public and government also have the right to supervise the pollution enterprises, further decreasing moral hazard and adverse selection. After buying environmental pollution liability insurance, companies will devote more effort to preventing air pollution accidents and end up reducing air pollution.

Table 2: The effect of EPLI policy [22]

	SO_2		Dust	
	(1)	(2)	(3)	(4)
EPLI Policy	-0.1694*** (0.0539)	-0.1066** (0.0517)	-0.3026*** (0.0766)	-0.2463*** (0.0754)
Control variables	No	Yes	No	Yes
City fixed effects	Yes	Yes	Yes	Yes
Year fixed effects	Yes	Yes	Yes	Yes
Constants	19.5299*** (0.0308)	4.8165 (6.8290)	18.8484*** (0.0361)	5.4425 (6.0487)
Observations	3677	3465	3674	3462
F	21.0608	17.7585	29.4977	20.3736
R^2_a	0.0563	0.0934	0.1565	0.1706
Notes: Robust standard errors in parentheses (clustered at the city level). *p < 0.1, **p < 0.05, ***p < 0.01.				

Figure 3 shows the frame of EPLI policy. This also implements the EPLI policy beneficial not only for individuals and companies since they get their risk covered but also for insurance companies, because they can pay less compensation due to less-frequent accidents and thus increase their profits (Table 2).

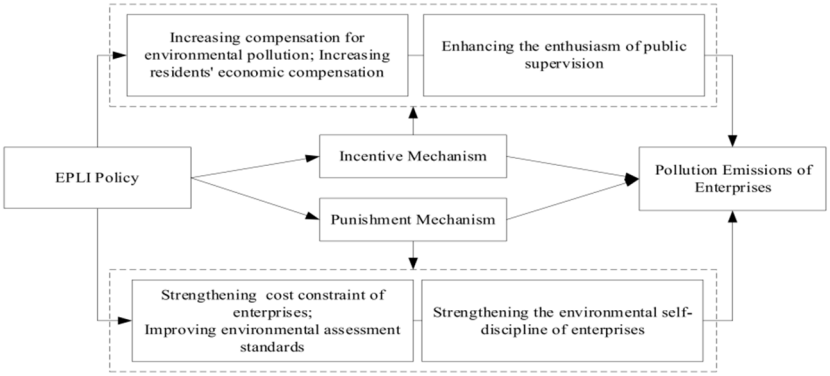

Fig. 3: The frame of EPLI policy [22]

4.2 Current problems with the policy implementation

In contemporary times, the development of EPLI in China is facing some problems. Firstly, EPLI first appeared in China around 2008, which was pretty late compared to those developed countries [23]. Secondly, for those heavy-polluted industry companies, EPLI is supposed to be compulsory for them. However, the penalty for not following the EPLI policy is even less than the premium they have to pay to buy the insurance, making the supervision from the government very inefficient. Thirdly, companies that are not compulsory to buy EPLI have even less motivation due to the high premium and the limitation of the insurance's small coverage.

4.3 Solution

The solution I want to suggest is that the government should provide subsidies for companies that buy EPLI. Implementing the EPLI policy can bring a positive externality to society since

clean air also benefits the physical condition of those who don't pay for insurance, so the government should use subsidies to encourage more enterprises to buy EPLI. This way, as the EPLI policy is implemented better, we can form a positive cycle of the public's better health and air condition.

This solution can be proved efficient by comparing the air condition of two regions in China -- Jiangsu Province and Gansu Province. According to Ruigang and Xuezhen [23], Jiangsu Province has already proposed a policy to subsidize no more than 40% of the annual premium to companies that take out environmental pollution liability insurance in the province in 2019. The procedure was so efficient that by the end of 2019, there were more than 8,461 insured enterprises in Wuxi, a city in Jiangsu Province (There are only 2213 insured companies in the whole of Jiangsu Province in 2015), with a total liability risk of 8.361 billion yuan and a total premium income of 125 million yuan, ranking first among prefecture-level cities in China. To make the efficiency of the subsidy policy seem more precise, we also mention Gansu Province here for comparison. By the end of 2019, without any subsidy for insured companies, the number of insured enterprises in the whole Liaoning Province had only reached around 450 (an increase of less than two hundred compared with the number in 2015), and the accumulative compensation limit of insurance liability had reached only 1.384 billion yuan. Comparing these two regions, we can easily get the conclusion that providing subsidies can encourage more enterprises to buy EPLI and thus reduce air pollution.

5 Conclusion

Though the air quality in China is facing challenges nowadays, we should face the future situation with a positive attitude. After abundant investigations, we concluded that well-implemented policies, continuously appearing advanced technologies, and subsidies for environment pollution liability insurance can all be efficient to reduce air pollution and improving people's physical condition. As long as the government combines these factors well and deals with the current existed problems stated above, we believe we can overcome this serious challenge in the near future.

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