

Research on the sustainable development of energy and environment in Tianjin

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Abstract.The rapid economic growth greatly increases the pressure of energy consumption, which also brings a series of severe environmental problems such as global warming, which directly restricts the sustainable development of economy and society. Tianjin is an important part of leading and supporting China's economic and social development, as well as a demonstration area for ecological restoration and environmental improvement. However, Tianjin is also one of the areas with the most serious air pollution and the most acute contradiction between resources and environment and economic development. This paper studies the current development of energy and the environment in Tianjin region and correlation. The results show that there is an inevitable causal relationship between energy consumption and environmental pollution in Tianjin. The government can promote the development of environmental protection industry and the development of new energy and other measures to promote the sustainable development of the energy economic and environmental system in Tianjin.

1. Introduction

Nature will suffer some damage due to the development and utilization of energy, and the ecological environment will be seriously polluted due to the emission of pollutants in energy development and utilization [1,2]. Air pollution is usually caused by gas waste, while river and land pollution is caused by liquid waste and solid waste. There are two types of environmental pollution impacts from energy sources: one is regional, which includes air pollution, usually nitrogen oxides, sulfur dioxide, carbon dioxide and other emissions; the other is water pollution and solid waste pollution; the other is global [3]. For example, greenhouse effect and ozone layer destruction are closely related to air pollution of energy [4].

The use of energy can cause a lot of impacts on the environment. Of course, the impacts of different types of energy on the environment vary greatly in the process of use. In general, such as natural gas, wind, solar, and biomass of the environmental impact of the use of clean energy is very small, the environmental impact of oil use will be greater than the electricity use, and coal is the environmental impact of the largest, mainly due to coal burning can cause a lot of carbon dioxide and sulfur dioxide and other harmful emissions of soot. The large amount of carbon dioxide emission is the main cause of the greenhouse effect, has become one of the great challenges that all countries need to face. This kind of pollutant not only causes air pollution, but also causes great harm to human survival and development, which also puts forward higher requirements for energy use in Tianjin. Energy can provide the material foundation for social and economic development, but the irrational use of energy will inevitably lead to the continuous deterioration of the environment. With the development concept of green development, the good development of ecological environment has become an essential part of our life. Therefore, the energy development in Tianjin must meet the requirements of environmental



protection to meet the challenges brought by environmental pollution.

In recent years, Tianjin municipal government has introduced a series of supportive policies to encourage the development of new energy industry, which has maintained an average annual growth rate of over 40%, moreover, there are a wide range of industries, including wind energy, solar energy, biomass energy, chemical energy storage, geothermal energy, ocean energy and hydrogen energy, etc., forming a trend of continuous industrial integration and mutual promotion. With its unique advantages and favorable investment environment, Tianjin has attracted many enterprises with large scale, high technical equipment level and strong r&d and manufacturing capabilities, there are Vestas, Lishen, Jinneng, Kyocera, Gamesa, Suzlan, and so on, gradually forming a new energy industry cluster, with a certain leading edge in China.

2. The development status of energy and environment in Tianjin

Tianjin district covers a total area of 1.197 square kilometers, about 900 kilometers territory circumference, has an estimated population of 16 million, the region adjacent to the capital, Beijing, surrounded by Hebei, the three regions has complete industrial structure and rich in various resources, not only is one of the core of the most dynamic economic zone in the north, is one of most important part of the high and new technology and heavy industry base. Tianjin is not only geographically adjacent to Beijing and Hebei, but also has complementary advantages in regional development. Among them, Beijing can provide necessary knowledge and technical support for regional development by relying on its human resource advantages; Tianjin has the advantage of processing industry and can provide deep processing services for regional products; and Hebei can provide corresponding resource reserves for regional development by relying on its advantages of resources and heavy industry. It can be seen that all regions in the Beijing-Tianjin-Hebei region have clear development priorities and cooperate with each other to jointly promote the coordinated development of the Beijing-Tianjin-Hebei region[5].

2.1. The present situation of fossil energy development in Tianjin

According to the statistics of related energy resources, it is very important to study the development trend of total energy use in Tianjin[6]. According to the analysis in Figure 1, it can be found that the use of main energy fuels in Tianjin increased from 2000 to 2016. In addition to coal, crude oil and coke, the use of gasoline, kerosene, diesel, fuel oil, natural gas and electricity increased slowly.

From variations in each type of fuel consumption, the use of coal and crude oil growth is most obvious in 2010, combining with the Tianjin economic and social development, as part of the enterprise of Beijing city during the evacuation, pressure of Tianjin emissions, compared with Beijing is still in the period of rapid economic development in Tianjin, so in 2010, Tianjin source of coal and oil consumption will increase significantly[7]. In 2014, the trend of the use of various types of energy gradually began to be stable, or even decline, mainly because in recent years, in order to achieve the goal of low-carbon emission reduction, Tianjin has continuously increased the use of new energy, optimize the energy structure, therefore, the use of fossil energy in Tianjin began to show a declining trend.

Figure 1. Energy consumption structure of Tianjin.

Schedule	Coal	Coke	Crude oil	Gasoline	Kerosene	Diesel oil	Fuel	Natural gas	Power
2000	2472.7	143.7	709.8	112.4	18.8	197.6	79.5	5.4	234.1
2001	2635.0	128.8	749.4	116.3	11.4	183.4	87.5	7.9	247.9
2002	2929.0	149.5	675.6	94.8	15.6	183.8	89.0	6.5	274.4
2003	3205.3	143.2	751.0	106.4	18.6	193.8	113.5	7.3	313.0
2004	3508.6	328.0	786.6	118.7	15.0	226.0	113.9	8.6	351.0
2005	3801.5	329.8	863.1	119.0	15.1	243.1	112.7	9.0	384.8
2006	3809.3	541.1	900.5	127.8	16.4	247.0	107.1	11.2	433.7
2007	3926.7	667.8	950.1	140.2	19.4	260.8	29.6	14.3	434.9
2008	3971.8	719.2	790.3	148.8	18.1	289.8	92.5	16.8	515.9
2009	4119.7	868.7	844.6	181.0	20.7	303.6	94.7	18.1	550.2
2010	4806.8	663.9	1566.8	205.1	21.4	333.5	143.7	22.9	645.7
2011	5262.0	709.5	1754.0	222.6	24.5	360.7	150.0	26.0	695.2
2012	5298.0	882.7	1544.6	253.8	29.4	378.2	122.3	32.6	722.5
2013	5278.7	955.5	1759.2	212.2	56.1	324.7	86.9	37.8	774.5
2014	5027.3	954.4	1603.2	226.8	59.9	334.4	78.2	45.5	794.4
2015	4538.8	904.7	1616.7	263.7	65.8	353.4	94.1	64.0	800.6
2016	4230.2	887.3	1433.6	247.5	82.0	370.4	45.3	74.5	807.9

2.2. The development status of new energy in Tianjin.

In recent years, the research and development of new energy in Tianjin has been gradually on the right track and made great progress in its research and development. In particular, the wind energy industry, solar energy industry, geothermal industry, green energy storage batteries and new energy vehicles, such as the five aspects, it can be said that the wind and water.

2.2.1. The wind power industry. As a high-tech industrialization base of wind power generation in China, Tianjin is gradually expanding in scale and has a small reputation in the Beijing-Tianjin-Hebei region, thus attracting many well-known enterprises such as vestas, elm, gomersa, suzlan, sichuan dongfang electric and mingyang to gather here. Binhai new area only one area has brought together more than 30 wind power form a complete set of large enterprises, with the whole machine production accounts for about 19% of production, annual production capacity of up to 30% of the national wind power equipment, has become the domestic one of the largest wind power equipment production base, in our country is kind of metaphor for the "the wind"[8].

At the same time, about 70% of enterprises in Tianjin's wind power sector have strong r&d capabilities. At present, there are nearly 60 enterprises engaged in wind power mainframe, main components and supporting for the mainframe in Tianjin, with a total investment of 12.645 billion yuan, forming a relatively complete industrial system in the country's wind power industry.

2.2.2. Solar energy industry. In the field of photovoltaic power generation, Tianjin has gathered the 18th institute of China electronics technology group, Nankai university and other research institutes. At the same time, the world's only two flexible thin film solar cell manufacturers have successfully settled in Tianjin. The development of the photovoltaic industry in Tianjin covers all fields of the whole industrial chain, including crystal silicon manufacturing, polysilicon cells, amorphous silicon thin film cells, battery modules, etc., which has incomparable advantages in other regions.

Tianjin jinneng company has introduced advanced equipment from EPV company in the United States, and is committed to producing amorphous silicon solar cells. Through the combination of production, learning and research, the company has built a production line of amorphous silicon thin film cells of 5 megawatts. After the expansion, the company has reached the scale of producing glass-substrate solar cells of 100 megawatts.

2.2.3. Geothermal industry. Tianjin is abnormally rich in low and medium temperature geothermal resources. The distribution area of geothermal resources in Tianjin is up to 8,700 square kilometers, accounting for about 80% of the city's total area. Geothermal energy can be widely used in residential heating, hot spring physical therapy, tourism vacation, aquaculture and other fields. The area of geothermal heating in Tianjin has reached 13.2 million square meters, and the area of hot spring swimming pool is about 8,000 square meters.

In the 12th five-year plan of geothermal utilization, the Tianjin municipal government points out that by 2020, the development and utilization of shallow geothermal heating will reach 20 million square meters, which is equivalent to saving 690,000 tons of standard coal every year and reducing CO₂ emissions by 1.65 million tons, making a huge contribution to environmental protection.

2.2.4. Green energy storage battery. Tianjin green energy storage industry occupies a core position in home, binhai new area the lishen, bick, sanyo energy, such as blue sky power supply enterprise, and formed the industrial cluster of green energy storage, formed from the battery materials, technology research and development, production, sales and service very complete industrial chain, such as lithium ion battery market share accounted for about 40% of the country.

Through independent research and development, lisen has undertaken a number of national scientific research projects in Tianjin green energy storage industry base, and has won 249 national patents and 431 independent intellectual property rights. It has formed the production scale of hundreds of millions of different types of lithium ion batteries annually, leading the progress of the energy storage battery industry in China.

2.3. Current situation of environmental development in Tianjin

With the progress of The Times, the development of science, life is more and more convenient. At present, the use of all kinds of fossil energy and new energy in Tianjin is increasing every year. With the introduction of some government policies, the changes in the environment gradually improved. What about the environmental problems in Tianjin in recent years? Here we will show you the results of the air environment test in Tianjin in recent years. Because the data of many years ago cannot be verified, here I will check the data from 2014 to 2018.[9]

In 2014, the city's environmental quality improved steadily. The number of days when ambient air quality reached the standard reached 175, an increase of 30 days over the same period last year. The annual average concentration of fine particulate matter (PM_{2.5}) was 83 micrograms per cubic meter.

In 2015, the city's ambient air quality reached the standard on 220 days, an increase of 45 days over 2014, accounting for 60.3% of the total. On 145 days, PM_{2.5} was the primary pollutant for 110 days, accounting for 75.9%. PM₁₀ was the primary pollutant for 17 days, accounting for 11.7%; 18 days when O₃ and other pollutants are the primary pollutants, accounting for 12.4%; Heavy pollution weather 26 days, a year-on-year decrease of 8 days. The comprehensive index of ambient air quality was 6.86, down 15.7% year on year. The average PM_{2.5} concentration was 70 g/m³, down 15.7% year on year. The average concentrations of PM₁₀, SO₂, NO₂ and O₃ decreased by 12.8%, 40.8%, 22.2% and 9.6% respectively from 2014, while the CO increased by 6.9% year-on-year. Among the six major pollutants, the concentrations of PM_{2.5}, PM₁₀ and NO₂ exceeded the standard by 1.00 times, 0.66 times and 0.05 times respectively.

In 2016, the number of days when Tianjin's ambient air quality reached the standard was 226, an increase of 6 days year on year. There were 29 days of heavy pollution, an increase of 3 days. Among the six major pollutants, the concentrations of PM_{2.5}, PM₁₀, sulfur dioxide and carbon monoxide decreased year on year, but the concentrations of nitrogen dioxide and ozone increased year on year, among which the average concentrations of PM_{2.5}, PM₁₀ and sulfur dioxide still exceeded the national standard value.

In 2017, the Tianjin composite index of ambient air quality was 6.53, reaching the standard on 209 days and heavy pollution on 23 days. The average annual concentrations of PM_{2.5}, PM₁₀, SO₂ and NO₂ were 62 micrograms per cubic meter, 94 micrograms per cubic meter, 16 micrograms per cubic

meter, and 50 micrograms per cubic meter, respectively. The concentrations of CO and O₃ were 2.8 micrograms per cubic meter and 192 micrograms per cubic meter, respectively.

In 2018, the city's average PM_{2.5} concentration was 52 micrograms per cubic meter, down 16.1 percent year-on-year, and the number of days with heavy pollution was 10, down 13 days year-on-year. Compared with 2013, the concentration of major pollutants showed a declining trend, among which SO₂, NO₂, PM₁₀, PM_{2.5} and CO decreased by 79.7%, 13.0%, 45.3%, 45.8% and 48.6% respectively.

Therefore, it can be seen that the air quality in China is constantly optimized every year, but the data is not so satisfactory. With the development of The Times, Tianjin every year, have a sharp increase in energy use, while Tianjin has staged a series of policies, but the change is not particularly big, every year there are still many days in the air pollution of the environment, so we should take more care for the environment, we hope to return to the life of every day is the blue sky white cloud.

3. Solutions to energy and environmental problems

3.1. Fully aware of the importance of environmental protection.

At present, China's environmental situation is still very grim. Although some positive progress has been made, we should not be proud of it. We should put the environment in a more important strategic position, formulate laws and regulations for environmental protection, and make up our minds to solve environmental problems. In the future, China's population will continue to increase and the economic aggregate will double, so the environmental protection is facing increasing pressure. However, the supervision capacity is relatively weak, and the national capacity of environmental monitoring, information, science and technology, publicity and comprehensive assessment is insufficient. Therefore, some leading cadres need to enhance their awareness of environmental protection and the level of public participation.

We should vigorously develop circular economy and environmental protection industry, and at the same time promote the coordinated development of regional economy and environment. All regions and departments should take the development of circular economy as an important guiding principle for the formulation of development plans, formulate and implement plans for promoting circular economy, accelerate the formulation of policies, relevant standards and evaluation systems for promoting circular economy, and strengthen the development of technology development and innovation systems. In accordance with the principle of "reduction, reuse and recycling of resources" and the requirements of ecological environment, the design and transformation of products and industrial zones should be carried out to promote the development of circular economy. We will strengthen policy support and market regulation, break down local and industrial protection in accordance with the law of market economy, promote fair competition, and encourage nongovernmental capital to participate in the development of the environmental protection industry.

We will focus on developing important environmental protection technology and equipment and basic equipment with independent intellectual property rights. On the basis of independent research and development, we will strive to master core and key technologies of environmental protection through introduction, digestion and absorption. We will vigorously improve the independent innovation capabilities of enterprises engaged in manufacturing environmental protection equipment, and promote the independent manufacturing of major environmental protection technologies and equipment.

3.2. Reduce the use of fossil fuels

The direct use of coal is the biggest emission source of air pollutants. Although many industrial sectors that use coal power for production and processing or providing services directly emit less, their emissions of hidden air pollutants continue to increase, gradually becoming an important cause of aggravating air pollution. Therefore, in the long run, to strengthen environmental governance, we should not only limit the key sectors of direct emissions, but also limit the sectors with heavy indirect emissions, such as construction and other industries.

3.3. *We will vigorously develop science and technology for environmental protection and promote the development of the environmental protection industry*

China has joined the WTO, all domestic enterprises have to face the challenges and tests of economic globalization, the government should strengthen the support and policy guidance for environmental protection enterprises. On the fiscal and tax policy to the enterprise of science and technology development activities, if confirmed by the corresponding supervision and surveillance mechanism enterprise investment and technology development, so this kind of investment can tax breaks, if after the corresponding argument, business investment and a technology research can promote the whole area of the whole industry technology progress, then you can get preferential government loans and even subsidised loans. In the field of environmental protection, technology research and development projects are set up for environmental protection enterprises, and supporting funds are provided. Choose the environmental protection enterprises with scale, rich practical experience and technical research foundation as the key support objects, and give full play to the best effect.

Introduce foreign investment to make up for the shortage of funds; Actively carrying out technical exchanges and cooperation with other regions and countries, researching and applying new forms of environmental protection concepts and technologies; Invite domestic and foreign well-known environmental experts to participate in the city's environmental remediation development management work plan, and so on.

3.4. *We will vigorously develop new energy sources*

The shortage crisis faced by traditional energy is becoming more and more prominent. Coal and oil are both non-renewable energy, so the energy crisis will gradually emerge. New energy will alleviate the energy crisis, and it is of great significance to the energy conservation and emission reduction of various countries. All countries in the world are competing for new energy, seeking sustainable development energy strategy for themselves, and accelerating to meet the needs of energy in economic development. What's more, climate change requires us to develop clean energy. The pollution of traditional energy to the environment is beyond doubt. Moreover, the pollution of new energy to the environment is almost zero, so the development of new energy is the best way to solve the energy and environmental problems.

4. Conclusion

With the rapid development of China's economy and the rapid improvement of people's living standards, environmental problems have increasingly become the focus of people's attention, especially in Tianjin because of its frequent air pollution in recent years, it has become the focus of academic research. According to many relevant research results so far, the direct emission of air pollutants is more measured, while the transfer of the emission of hidden air pollutants caused by energy use is less considered. It can be seen that environmental problems must be solved, and at this time, the development of new energy has become an irresistible new research project. Therefore, I think Tianjin should speed up the development and use of new energy to solve the environmental pollution problem at an early date while ensuring people's normal living conditions.

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