International Journal of Energy
ISSN: 2957-9473 | Vol. 2, No. 3, 2023

Spatial Distribution Characteristics of Coal Consumption in Typical Countries in the World from 2020 to 2021

Linwei Yue *

Qingdao No.58 High School, Qingdao, Shandong, 266000, China
*** Corresponding author Email:** nybqdpxjd@126.com

Abstract: As an important energy material in human society, coal is known as black gold and food for industry. It is one of the most important energy sources used in the world since the 18th century. Since the 21st century, due to the massive development and mining of coal, although the value and price of coal have been lower than before, after all, coal is still one of the indispensable energy sources for human production and life for a long time. Besides, the supply of coal is also related to the stability of industry as well as the production and development of the whole society. The security of coal supply performance is also the most important part of energy security. This paper studies the coal consumption characteristics and regional distribution characteristics of typical countries in the world from 2020 to 2021, discusses the relationship between resource consumption and environmental protection, and reflects it through PM2.5 index. Through the comparison of the two data, it can intuitively reflect the environmental pollution caused by resource consumption and provide reference for the global environmental protection cause.

Keywords: Coal; Main Energy; Coal Consumption; PM2.5 Index; Environmental Pollution and Protection.

1. Introduction

Coal is divided into different categories and grades. Different types and grades of coal have different uses. For example, coal with good coking or caking performance is high-quality coking coal. The main raw material of synthetic ammonia plant is anthracite lump coal with good thermal stability. Coal with high volatility and calorific value is usually used to provide power for machinery. Besides, the better raw materials for pressurized gasification to produce gas and hydrogenation liquefaction to produce artificial liquid fuel are some young coal with low ash and low sulfur content [1].

As shown in figure 1, due to the acceleration of economic activity, the growth of global coal consumption in 2020 increased by 68.38% compared to 1990.Among them, the use of fossil fuels accounts for 82% of the total use of primary energy, compared with 83% and 85% in 2019 and five years ago. As shown in Table 1, a noticeable change is that the developed countries in Europe and the United States, which have been vigorously promoting "coal removal", no longer reduce the use of coal as in previous years, but have a significant increase in coal consumption. The following group of data can better reflect this conclusion. In 2021, compared with the previous year, the coal consumption of the United States increased by 15.2% year on year, and that of the European Union countries increased by 13.2%, of which Germany increased by 17.5%, France increased by 20.5%, Italy increased by 8.1%, Poland increased by 9.6%, and the United Kingdom, which has just quit the European Union, also increased by 3.2%. Among Asian countries, India's coal consumption increased by 15.8%, while Japan and South Korea increased by 5.2% and 0.7% respectively, China's growth rate of 4.9% is far below the average growth rate of global coal consumption [2]. The data in Table 1 can intuitively show that the coal consumption of in 2020 has increased compared to the previous year among China, the United States, and other countries.

Table 1. Changes in domestic coal production of major coal producers in the world in 2021 (Data Source: Coal Industry Network)

Number	Country	2020 (a hundred million ton)	2021 (a hundred million ton)	Growth rate
	Total World	77.32	81.73	6.0%
1	China	39.02	41.26	6.0%
2	India	7.59	8.11	7.1%
3	Indonesia	5.64	6.14	9.2%
4	USA	4.86	5.24	8.3%
5	Australia	4.70	4.79	2.1%
6	Russia	4.00	4.34	8.8%
7	South Africa	2.46	2.34	-4.3%
8	Germany	1.07	1.26	17.6%
9	Kazakhstan	1.13	1.16	2.3%
10	Poland	1.01	1.08	7.2%
11	Turkey	0.75	0.86	14.9%
12	Colombia	0.52	0.60	14.2%
13	Vietnam	0.48	0.48	-0.8%
14	Canada	0.45	0.47	3.5%
15	Serbia	0.40	0.36	-7.9%
16	Mongolia	0.43	0.32	-24.8%
17	Czech Republic	0.32	0.31	-0.2%
18	Bulgaria	0.23	0.29	26.8%
19	Ukraine	0.24	0.25	2.3%
20	Romania	0.15	0.18	18.5%

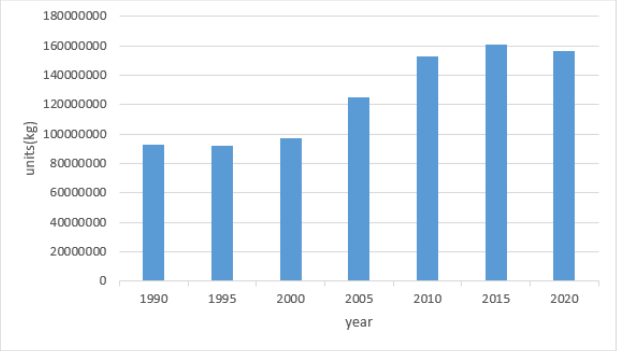


Figure 1. Change trend of world coal production from 1990 to 2020 (Data Source: BP Amoco)

2. Research Method

This paper mainly examines the changes in coal consumption in various countries and the relationship between coal consumption and environmental indicators. Therefore, this article needs to compare resource data with environmental pollution data, find out the relationship between the two, and find out the regional distribution and characteristics of coal consumption. The data sources of this article are divided into two parts: coal consumption and environmental data. Coal consumption data are sourced from channels such as the International Energy Agency and China Coal Network. The air condition index reflected by PM2.5 will be obtained from the United Nations air quality report.

3. Data Analysis

The first country is China. As shown in figure 2, it can be found that in recent years, China's overall coal consumption has been relatively stable and has not increased significantly. In 2020, China's raw coal output was 3.902 billion tons, up 1.4% year on year. In 2021, 5.24 billion tons will be used as China's coal consumption, up 4.9% year on year. Although under the premise of the outbreak of the COVID-19, the coal consumption within 5% is insignificant compared with the growth rate of China's coal consumption in the previous decades or even 50 years.

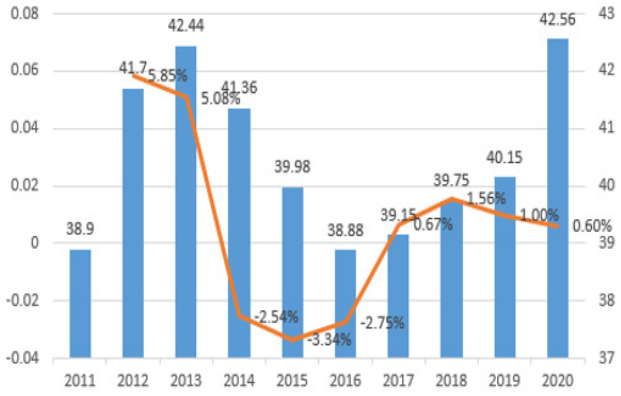


Figure 2. Growth of China's coal consumption from 2011 to 2021 Data Source: State Statistical Bureau

Then when we focus on air pollution, we can also find that the overall air quality of cities in Chinese Mainland continued to improve last year. As shown in figure 3, since 2018, the PM2.5 concentration of cities in Chinese Mainland has declined by 21%. Compared with 2020, the PM2.5 concentration of 66% of cities has declined and the environment has improved. And the average PM2.5 index of China in 2020 has dropped by 9.1 percentage points compared with 2019, which is a very frightening figure.

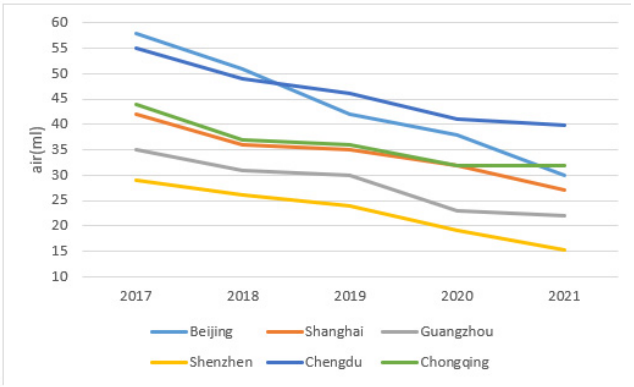


Figure 3. Annual average PM2.5 index of China's six major cities in 2017-2021 (Data Source: State Statistical Bureau)

The second country is the United States. According to the data in Figure 4, through a study of coal consumption data from 1990 to 2021 in the United States, it can be found that in 2021, coal consumption in the United States was 10.66 billion tons, a decrease compared to 1990. The United States Energy Information Administration (EIA) has released the latest short-term energy outlook report, which shows that in 2021, the United States is expected to achieve 588 million tons of coal production (533 million tons in real terms), an increase of 9.88% over the previous year, and a decrease of 13 million tons compared to the expected value last month. Whether it's 15.2% or 9.88%, although this is only a numerical increase, in the United States, where the coal consumption base is so large, this 10% is so surprising.

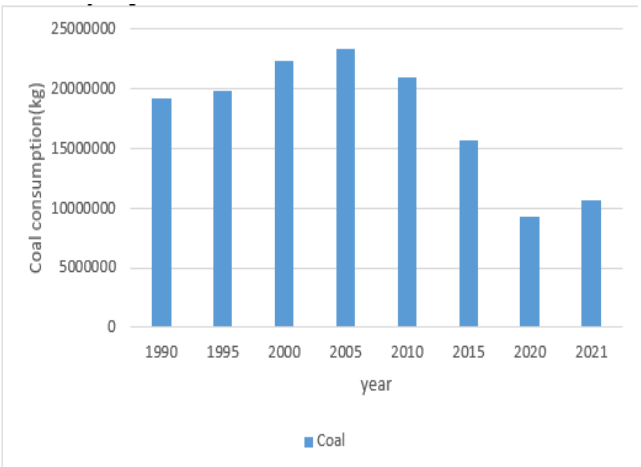


Figure 4. Coal consumption of the United States in 1990-2021 (Data Source: EIA)

As shown in figure 6, the air quality index of the United States can reflect that the average concentration of PM2.5 in the United States will increase from 9.6 μg/m3 to 10.3 μg/m3 in 2021 compared with 2020. Among the major cities in the United States, Los Angeles is the most polluted. However, compared with 2020, the PM2.5 concentration in this "City of Angels" decreased by 6%. At the same time, the national average PM2.5 in 2020 increased by 7.3% compared with 2019. As shown in the figure, from 2017 to 2021, the index of PM2.5 in the six major cities in the United States showed an upward trend, although there were obvious fluctuations and decreases in the process, which means that the air quality in the United States has declined against the background of the

increase in the use of coal resources in the United States.

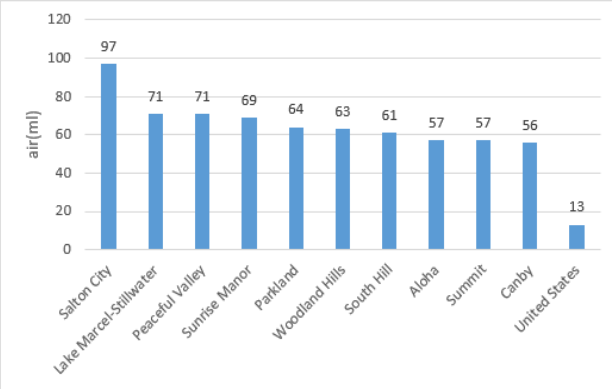


Figure 5. Average annual PM2.5 index of six major cities of the United States 2021

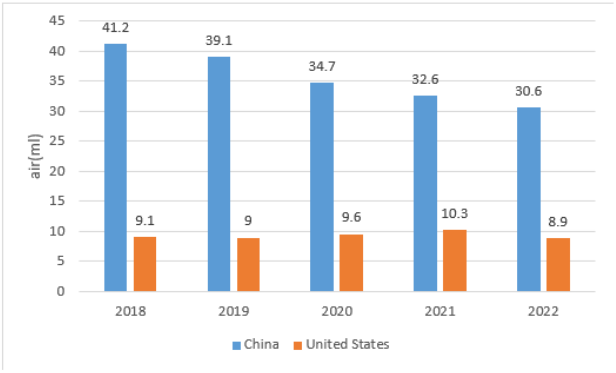


Figure 6. Average annual PM2.5 index in the United States and China in 2021 (Data Source: IQAir)

The third is European Union. The European Union, the Union of European Communities (EU) formed by European countries, is headquartered in Brussels, the capital of Belgium. It is developed from the European Community. It has six founding members, namely Germany, France, Italy, the Netherlands, Belgium and Luxembourg. The major decisions made in Europe are basically determined by the six countries through consultation. The EU is highly representative of the whole of Europe, which is why we choose the coal consumption and air quality of these six countries to represent Europe.

As shown in figure 7, According to the data in Figure 7, through a study of coal consumption data from 1990 to 2021 in Europe, it can be found that the consumption of coal in 2021 in Europe was 9.78 billion tons, a decrease compared to 1990. 97% of the total consumption of lignite in the European Union is accounted for by the following six countries, of which Germany accounts for 46% of the consumption, Poland accounts for 19% of the consumption, and Bulgaria accounts for 11% of the consumption. Romania accounts for 6% of the consumption, and Greece accounts for 5% of the consumption. According to the Eurostat on May 5, in 2021, the coal production and consumption in the European Union will not continue to decline as in previous years, but have an upward trend. The coal consumption in the six countries will increase compared with that in 2020.

According to the survey, in 2021, the apparent consumption of coal in the 27 EU countries and the UK totaled 438 million tons, an increase of 11.1% compared with 394.1 million tons last year. Among them, the output of hard coal in the region was 57 million tons, up 1.2% year on year, the import of hard coal was 106 million tons, up 13.6% year on year and the output of lignite was 275 million tons, up 12.5% year on year.[3]

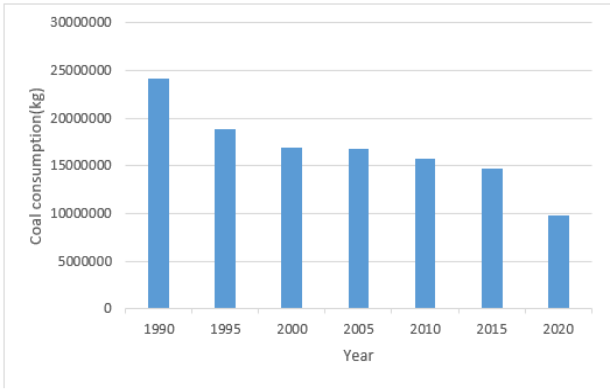


Figure 7. Coal consumption of European countries from 1990 to 2020 (Data source: EIA)

Although the consumption of coal in EU countries has decreased after 2017, the use of coal will increase after 2020. So, what is the environmental impact of the increase in the number of coals consumed in Europe?

Since 1990, the air quality in Europe has reached a very objective level because of the reduction of the emission of various pollutants. The average PM2.5 index is lower than the global average and continues to decline. From 2020, the PM2.5 index has risen from 10.8 μ G/m3 to 11.5 μ G/m3, which up 5.4%.

As shown in figure 8, it can be found that the increase of coal use in 2020 and 2021 in the EU has led to the rise of PM2.5 index in 2020 and 2021, resulting in environmental pollution.

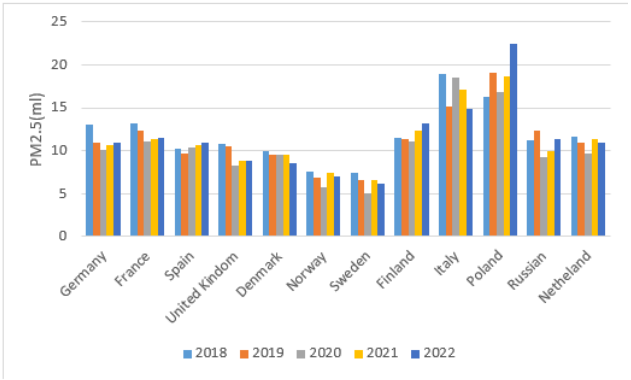


Figure 8. Average annual PM2.5 index of European capital cities in 2018-2022 (Data Source: IQAir)

From the above table, we can generally observe that China's coal consumption in the whole year of 2020-2021 will increase by 4.9% compared with the previous year, and the corresponding increase of PM2.5 will be - 9.1%. The overall environment is in a good trend.

The consumption of coal in the United States in the whole year 2020 to 2021 increased by 15.2% compared with the previous year, and the corresponding increase of PM2.5 was 7.3%. The environmental pollution increased by a lot compared with the previous year.

The consumption of coal in European countries in the whole year of 2020 to 2021 will increase by 11.1% compared with the previous year, and the corresponding increase of PM2.5 will be 5.4%, which is also a state of continuous rising environmental pollution.

Table 2. Comparison of coal consumption and air quality among economic entities (2021-2022)

	2020-2021 Coal Consumption (Unit: 100 million tons)	2020-2021 Coal Increase (Unit: %)	2020-2021 PM2.5 index (Unit: μg/m^3)	2020-2021 PM2.5 index increase (Unit: %)
China	52.4	4.9	30	9.1
The United States	49.5	15.2	10.3	7.3
Europe	11.61	12.2	13.7	6.1
European union	4.3	11.1	11.5	5.5

Data Source: IQAir, EIA

4. Conclusion

We can generally find that although China's coal consumption is an increasing number, the increase is only a single digit, a very small increase in coal consumption, so China's environment has greatly improved. The consumption of coal in the United States and the European Union has increased significantly, which has also led to different degrees of environmental pollution. Therefore, we can find that in 2020-2021, China's coal consumption will increase slightly, and the environmental quality will improve, while the use of coal in the United States and European countries will increase significantly, and the environmental quality will deteriorate. Therefore, the consumption of coal will affect the environmental quality. The more coal used, the higher the PM2.5 index and the worse the environmental quality. The ultimate goal of environmental protection is to improve people's living conditions and promote the common development of human and nature. I hope that I can find new ways to protect the environment through my research on the relationship between resource consumption and environmental pollution, and make my own contribution to the cause of human environmental protection.

References

[1] China Coal Economy Research Association. (2021) the global coal output will reach 8.173 billion tons, up 6.0% year on year. http://ccera.com.cn/40/202206/12753.html.

[2] Liu Changping, Zhang Shicong, Yang Xinyan, Xu Wei. (2021) Study on the Calculation of Total Coal Consumption in China's Construction Sector during the "13th Five-Year Plan". Energy of China, 43(002):28-77.

[3] China Coal Economy Research Association. (2022) EU coal consumption will continue to increase, http://www. ccera. com. cn/135/202205/12204.html.

[4] H Ai, M Guan, W Feng, K Li. (2021) Influence of classified coal consumption on PM2.5 pollution: Analysis based on the panel cointegration and error-correction model. Energy, 215: 1-8.

[5] Zhang F.W., Xu L.L., Chen J.S., Chen X.Q., Niu Z.C., Lei T., Li C.M., Zhao J.P. (2013) Chemical characteristics of PM2.5 during haze episodes in the urban of Fuzhou, China, 11(3):264-272.