Analysis of Energy Structure in Northeast China

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Abstract. As the old industrial base of our country, the utilization of energy in Northeast China has a certain influence on the implementation of the overall strategy of our country. After comparing and analyzing the data, it is concluded that the primary energy sources such as coal and oil account for a large proportion in the energy production and consumption structure of Northeast China, and after SPSS time series forecast, it is known that the energy structure will not change much in the short term. In view of this problem, we can promote the improvement and development of energy structure in Northeast China by developing new energy economy, perfecting the system of laws and regulations related to energy, and developing or introducing energy saving and efficiency-enhancing technology to improve energy utilization efficiency. Energy is the material basis for the survival and development of human society, and the revolution and innovation of energy is also an important manifestation of a country’s comprehensive strength. As the old industrial base of our country, Northeast China has abundant energy reserves such as coal and oil, and its energy utilization has a certain influence on the implementation of the overall strategy of our country. In October 2003, the CPC Central Committee and the State Council issued "Some Opinions on the Implementation of the Revitalization Strategy of the Old Industrial Base in Northeast China", which clarified the guiding ideology, principles, tasks and policy measures for the implementation of the revitalization strategy. How to optimize the energy structure and make rational use of the energy in Northeast China will be an important issue to be considered in the energy innovation revolution in Northeast China. This paper will analyze the energy structure of Northeast China by means of data analysis, and then find out the problems and solutions [1].

Keywords: Northeast China, energy structure, data analysis.

1. Characteristics of Energy Structure in Northeast China

1.1. Production level: Primary energy sources such as coal and oil are the main sources of production
As the old industrial base of our country, the northeast region has abundant natural resources, huge stock assets and good industrial base, especially the reserve of primary energy such as coal and oil occupies a large proportion in the energy production structure of the whole northeast region.
### Table 1 Different types of energy production in Northeast China, 2008-2017\[2\]

| Year | Coke (10,000 tons) | Crude oil (10,000 tons) | Gasoline (10,000 tons) | Kerosene (10,000 tons) | Diesel (10,000 tons) | Fuel oil (10,000 tons) | Natural gas (100 million cubic metres) | Electricity (100 million kilowatt hours) |
|------|-------------------|-------------------------|------------------------|------------------------|---------------------|----------------------|--------------------------------------|----------------------------------------|
| 2008 | 2838              | 5918.3                  | 10764.3                | 255.07                 | 2917.33             | 673.3                | 44.55                                | 2449                                   |
| 2009 | 3269              | 5640.6                  | 10918.6                | 260.36                 | 3011.41             | 590.41               | 49.76                                | 2428                                   |
| 2010 | 3244              | 5657.2                  | 10911.2                | 255.7                  | 3317.52             | 694.57               | 51.7                                | 2677                                   |
| 2011 | 3523              | 5745.4                  | 11279.4                | 256.7                  | 3306.77             | 653.2                | 53.2                                | 2915                                   |
| 2012 | 3502              | 5811.9                  | 11325.9                | 335.6                  | 3314.35             | 532.6                | 63.1                                | 2982                                   |
| 2013 | 3457              | 5705.7                  | 11175.7                | 419.87                 | 3363.78             | 447.52               | 67.22                                | 3172                                   |
| 2014 | 3392              | 5685.8                  | 11091.8                | 463.27                 | 3243.58             | 373.43               | 65.78                                | 3326                                   |
| 2015 | 3156              | 5541.2                  | 10712.2                | 519.17                 | 3154.91             | 262.27               | 62.72                                | 3270                                   |
| 2016 | 3121              | 5263                    | 10400                  | 606.27                 | 2876.24             | 220.63               | 63.33                                | 3439                                   |
| 2017 | 3291              | 4885.4                  | 2056.89                | 621.88                 | 2758.97             | 195.61               | 64.23                                | 3546                                   |

![Fig. 1 Energy Production Structure for Northeast China in 2017\[2\]](image-url)
From the point of view of data analysis, we can know the following contents: first, from the
analysis of figure 1, figure 2, we can see that coal, oil and other primary energy occupy a large
proportion in the energy production of Northeast China, and its power generation type is mainly
thermal power generation. This is mainly caused by the accumulation of energy structure and natural
resources in Northeast China for a long time; secondly, from the analysis of Table 1, it can be seen
that although the energy output in Northeast China fluctuates on the whole, it shows an upward trend
as a whole. It can be seen that the energy production structure of Northeast China is relatively stable.
There will be no major changes in the short term without strong external factors. The above contents
further illustrate the advantages of Northeast China as an old industrial base and energy enrichment
land such as coal and oil, and its energy production structure has obvious regional dependence and
stability.

1.2. Consumption: primary energy consumption
Due to the northeast region has good regional advantages in resources, the local heavy industry is
relatively developed and it is a famous old industrial base in my country. This has also led to problems
such as a large proportion of primary energy in the energy consumption structure of Northeast China,
a small proportion of clean energy, and difficulties in improving the energy consumption structure.
Fig. 3 Energy Consumption Chart for Northeast China 2008-2017[^3-7]

Fig. 4 Energy consumption structure in Northeast China, 2017[^2]
Table 2 Statistical tables of energy consumption in Northeast China, 2008-2017[

| Year | Coal (10,000 tons) | Coke (10,000 tons) | Crude oil (10,000 tons) | Gasoline (10,000 tons) | Diesel (10,000 tons) | Fuel oil (10,000 tons) | Natural gas (100 million cubic metres) | Electricity (100 million kilowatt hours) |
|------|-------------------|-------------------|------------------------|-----------------------|---------------------|----------------------|-------------------------------------|-----------------------------------------|
| 2008 | 34918             | 3209.94           | 8596.4                 | 819.84                | 1531.53             | 489.34               | 61.51                               | 2605                                    |
| 2009 | 35672             | 3710.19           | 8790.07                | 921.89                | 1651.2              | 426.56               | 63.1                                | 2692                                    |
| 2010 | 38710             | 4074.85           | 9605.41                | 1123.57               | 1925.58             | 485.29               | 70.97                               | 3055                                    |
| 2011 | 42289             | 4416.82           | 9971.04                | 1354.68               | 2120.02             | 518.13               | 89.42                               | 3310                                    |
| 2012 | 43267             | 4443.27           | 10144.44               | 1429.43               | 2254.66             | 555.64               | 56.47                               | 3515                                    |
| 2013 | 41813.32          | 4258.73           | 9609.22                | 1115.43               | 1860.25             | 487.36               | 137.5                               | 3508.14                                 |
| 2014 | 41977.14          | 664.72            | 9506.13                | 1212.37               | 1904.69             | 510.24               | 142.06                              | 3539.41                                 |
| 2015 | 40574.52          | 3906.06           | 9524.11                | 1262.8                | 1966.47             | 456.82               | 112.51                              | 3505.83                                 |
| 2016 | 40394.93          | 3654.85           | 10318.71               | 1281.07               | 1682.79             | 437.49               | 110.18                              | 3647.35                                 |
| 2017 | 41410.7           | 3780.09           | 27218.17               | 1376.54               | 1722.86             | 414.5                | 127.35                              | 3804.89                                 |

From the point of view of data analysis, we can know: first, from figure 3, we can see that the overall energy consumption in Northeast China has gradually stabilized after a period of rising and developing stage, and there has been no significant fluctuation in recent years, which shows that after the policy of revitalizing the old industrial base in Northeast China, the economic development has led to the energy industry consumption gradually stabilized in recent years; secondly, from figure 4, we can see that coal and other primary energy sources account for a considerable proportion of the energy consumption structure in Northeast China, which is directly related to the abundant coal, oil and other reserve resources in Northeast China; finally, from the analysis of Table 2, it can be seen that in recent years, the consumption of all kinds of energy in Northeast China has an upward trend, which further confirms that the energy consumption in Northeast China rises with the development of economy, but the overall structure tends to be stable.

2. Analysis of Energy Structure in Northeast China

2.1. Production level

First of all, for the production level, although the Northeast region has abundant fossil fuel resources such as coal and oil, it is also easy to lead to the energy production structure too dependent on its geographical advantages, which leads to the singularity of the energy production structure.

Table 3 Forecast of Different Types of Energy Production in Northeast China

| Year | Energy Types          | 2018     | 2019     | 2020     |
|------|-----------------------|----------|----------|----------|
|      | Coke (10,000 tons)    | 3290     | 3290     | 3290     |
|      | Crude oil (10,000 tons) | 4507.8   | 4130.2   | 3752.6   |
|      | Gasoline (10,000 tons) | -4834.28 | -11791.11 | -18747.93 |
|      | Kerosene (10,000 tons) | 662.64   | 703.39   | 744.15   |
|      | Diesel (10,000 tons)  | 2539.29  | 2333.70  | 2128.10  |
|      | Fuel oil (10,000 tons) | 142.53   | 89.46    | 36.38    |
|      | Natural gas (100 million cubic metres) | 66.42   | 68.60    | 70.79    |
|      | Electricity (100 million kilowatt hours) | 3722   | 3852    | 3981    |
|      | Raw coal (10,000 tons) | 9815.79  | 8487.71  | 7159.62  |
After using the SPSS to forecast the energy production structure in Northeast China in the past ten years, comparing Table 1 with Table 3, we can know that the consumption of coal, oil and other energy sources fluctuates in the next three years, but the overall level is relatively stable. Although this kind of production structure saves the production cost and can guarantee the economic benefit in a short time, from the point of view of long-term development, this method is undoubtedly a mode of production that will overdraft natural resources. With the gradual depletion of primary energy sources such as coal and oil, this mode of production is bound to change.

2.2. Consumption level

The consumption structure of Northeast China is affected by its production structure, mainly taking primary energy such as coal and oil as the main consumption body.

**Table 4** Forecast of Energy Consumption of Different Types in Northeast China

| Year | Energy Types          | 2018       | 2019       | 2020       |
|------|-----------------------|------------|------------|------------|
|      | Coal (10,000 tons)    | 42325.35   | 43242.06   | 44158.77   |
|      | Coke (10,000 tons)    | 3611.95    | 3611.95    | 3611.95    |
|      | Oil (10,000 tons)     | 7225.76    | 7225.76    | 7225.76    |
|      | Crude oil (10,000 tons)| 44115.91  | 61013.65   | 77911.39   |
|      | Gasoline (10,000 tons)| 1376.54    | 1376.54    | 1376.54    |
|      | Kerosene (10,000 tons)| 160.03     | 174.07     | 188.12     |
|      | Diesel (10,000 tons)  | 1722.86    | 1722.86    | 1722.86    |
|      | Fuel oil (10,000 tons)| 478.14     | 478.14     | 478.14     |
|      | Liquefied petroleum gas (10,000 tons)| 404.70 | 404.70 | 404.70 |
|      | Natural gas (100 million cubic metres)| 140.68 | 148.98 | 157.27 |
|      | Electricity (100 million kilowatt hours)| 3938.21 | 4071.53 | 4204.85 |

**Table 5** Statistics on the proportion of energy consumption in Northeast China

| Year | Total energy consumption in Northeast China (10,000 tons of standard coal) | Total national energy consumption (10,000 tons of standard coal) | Energy consumption in the Northeast |
|------|---------------------------------------------------------------------------|-----------------------------------------------------------------|-----------------------------------|
| 2008 | 35001                                                                     | 306455                                                          | 0.114212527                       |
| 2009 | 37277                                                                     | 321336                                                          | 0.116006299                       |
| 2010 | 40478                                                                     | 343601                                                          | 0.117805245                       |
| 2011 | 43934                                                                     | 370163                                                          | 0.118688254                       |
| 2012 | 45727                                                                     | 381515                                                          | 0.119856362                       |
| 2013 | 42219                                                                     | 394794                                                          | 0.106939315                       |
| 2014 | 42318                                                                     | 400299                                                          | 0.105715977                       |
| 2015 | 41935                                                                     | 402164                                                          | 0.104273381                       |
| 2016 | 41325                                                                     | 405144                                                          | 0.10200077                        |
| 2017 | 42107                                                                     | 416091                                                          | 0.101196613                       |

By using the SPSS to predict the consumption of each energy type in Northeast China, the time series is shown in Table 4. At the same time, combined with Table 2, Table 4, we can know that the energy consumption in Northeast China is relatively stable in the next few years. At the same time, there is a gradual upward trend. According to Table 5, the proportion of energy consumption in northeast China to national energy consumption, After a period of rising, the proportion of energy consumption in Northeast China has a downward trend in recent years due to the relative lag of economic development, but the overall fluctuation is not very large.

Although the Northeast region has relatively rich coal and petroleum resources and a relatively complete production system, it can maintain its consumption structure operation in recent decades;
however, just like the shortcomings of the production structure analyzed in the previous article, the energy consumption structure of the Northeast region is also an unreasonable consumption of natural resources. For the unreasonable consumption of resources, we should pursue a more reasonable energy consumption structure and promote the reform of the energy system with the concept of sustainable development.

3. Some Suggestions on Energy Utilization in Northeast China

3.1. Development of a new energy economy
In order to overcome the problems of single structure of energy production and consumption and unfriendly environment, Northeast China can develop the potential of new energy industry on the basis of existing energy structure, and develop technological innovation as the core driving force of new energy development and utilization. To develop the potential of new energy development in Northeast China, we should pay attention to the overall planning and layout of new energy technology research and development, formulate reasonable development plans and strategic objectives according to local conditions; perfect the new energy policy support system to provide sufficient living space for its industrial development; and actively introduce advanced human resources, encourage the introduction and exchange of technology, and promote the development and innovation of new energy industries in Northeast China\(^8\).

3.2. Improving the system of energy-related laws and regulations
Laws and regulations are the necessary system guarantee for the development of an industry. For our country, energy, especially for local strong regional laws and regulations are relatively rare. Therefore, for the government should increase legislation and law enforcement, such as China in the deepening development of energy reform, General Secretary Xi Jinping put forward a "four revolutions, one cooperation" new strategy for energy security, as a guide to build a clean, low-carbon, safe and efficient energy system, promote high-quality energy development, energy legislation must be strengthened to achieve the modernization of energy governance system and governance capacity, through the government's ability to promote the reform of the energy industry structure, thus playing a supervisory and urging effect.

3.3. Development or introduction of energy-efficient technologies to improve energy efficiency

| Energy | Purpose           | Consumption structure (%) | Utilization efficiency (%) | Total efficiency |
|--------|-------------------|---------------------------|----------------------------|-----------------|
| Coal   | Thermal Power     | 45                        | 80                         |                 |
|        | Industrial boilers| 30                        | 65                         | 0.646           |
|        | Industrial kiln   | 20                        | 40                         |                 |
|        | Civil combustion  | 5                         | 22                         |                 |
| Oil    |                   |                           |                            | 0.750           |
| Gas    |                   |                           |                            | 0.800           |
| Electricity | Line loss :10 |                           |                            | 0.900           |

The present situation of economic development and industrial structure in Northeast China determine that it will still consume fossil fuels such as coal and oil for a long time. It can be seen from Table 6 that the utilization efficiency of coal is 0.646, and there is still room for development. Therefore, in the short term, we can not reduce the proportion of coal use passively, we can improve
the conversion rate of energy by developing or introducing energy saving and efficiency technology, thus reducing the energy loss in the process of energy utilization and saving energy.

4. Conclusion
As an old industrial area and heavy industrial area in China, Northeast China has a unique natural resource reserve and strong industrial foundation, but this makes its energy structure in a state of consuming nature for a long time. To improve the energy structure of Northeast China, we can take measures to develop new energy sources, improve the system of laws and regulations related to energy resources, and develop or introduce energy-saving and efficiency-enhancing technologies to improve energy efficiency, so as to provide favorable conditions for the change of energy system, and then promote the reform of energy system in Northeast China.

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