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Energy Risks Zoning and Demand Forecasting in Jiangsu Province

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Abstract

This paper takes Jiangsu province as an example, divides the zone of energy risks and uses GM (1, 1) and the combination of BP network model to forecast energy demand in this region.Finally, we adopt ARCEngine secondary development achieving the system simulation, and putting forward a strategic suggestion on energy problem of Jiangsu province. The study provides the scientific data support for making energy policy rationally, reducing the increasingly prominent phenomenon of energy demand and offer support for different levels in different departments. It can provide the scientific basis for risk prevention and comprehensive risk management plan.

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Keywords: Energy risks zoning, Demand forecasting, System simulation, Jiangsu Province

Energy problem which affects the relationship between economic growth and sustainable development is the key issues. In order to maintain this rapid economic growth in future, energy security is particularly critical, and this is the objective demand our country is faced with. However, China's energy demand growth cannot continue as the past extensive use of models, mainly due to: 1) because of a large population, per capita ownership of energy resources is not high, and the geographical distribution of energy resources is very uneven. 2) China's energy use is faced with structural shortage and the efficiency of energy use is relatively low; 3) coal-dominated energy structure in China, but a large number of coal using has led to many ecological, environmental and climate change issues, the negative effect of these problems is emerging, in the long run, having a serious impact on sustainable economic growth in China. Regional energy supply security is one of the major issues related to national development and energy risk management.

Jiangsu province has a big provincial energy consumption and small provincial energy resources,

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which is a typical energy input type region, severely restricts the national economy to achieve sustainable development. This article with the use of relevant statistical data focuses on Jiangsu thirteen prefecture-level cities' energy resources, consumption and utilization and the conflict of supply and demand to make an initial analysis, prediction and assessment, and finally, according to the energy supply and demand, with the application of assessment results to have a further exploration of energy risk conditions in next decade of the region in Jiangsu province.

1. Data and Methodology

1.1. Data sources

The data used in this study is from Jiangsu Statistical Yearbook (2001 ~ 2008), Administrative Map 1:400 million, with the actual situation selecting the population density, GDP, the proportion of secondary industry, energy consumption, energy consumption coefficient and dependence on foreign energy sources as zoning division quota of risk protection.

1.2. Protection district zoning method

Dividing zone exist the difference in dimension, so it is unsuitable to calculate with the original data. In order to eliminate the difference between the dimensions, the index value should be standardized.

By calculation, we know the population density, GDP, the proportion of secondary industry, energy consumption, energy consumption elasticity coefficient and the external dependence of the relative importance of the six indicators of weight W = [0.16, 0.14, 0.13, 0.21, 0.17, 0.19]. By the weight of each index, the value of comprehensive energy security risks in all districts can be calculated with the following formula:

$$SS_{\mathrm{j}} = \prod_{i=1}^{n} W_i \times C_i \tag{1}$$

Where SS_j means j citie that comprehensive energy risk value; Ci is the i indexe the energy risk rating value; Wi means i indexe for the first weight; n is the index number.

According to the energy risk value SS_j of 13 cities in Jiangsu province, the study area was divided into high energy security zone ($0.60 \geq SS_j$), the medium energy security area ($0.60 > SS_j \geq 0.75$), low energy security zone ($0.75 > SS_j \geq 0.90$) and the potential risk area ($0.90 > SS_j$). High-security area of energy has low dependence on foreign energy resources and small and relatively low population density; and low or potential risks energy security areas have high dependence on foreign energy resources, economic development fast and high population density; the economic development potential-risk areas have developed economy fast and relatively high population density, greater dependence on foreign energy sources. Energy consumption elasticity coefficient is larger and the ratio of the secondary industry to tertiary industries is higher.

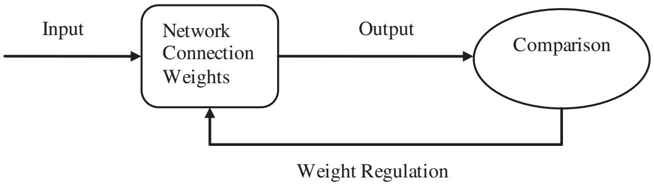
1.3. GM (1, 1) and BP combination forecasting

This paper builds the Grey Theory and Neural Networks combination model, a combination of gray theory to predict and the different advantages of neural network prediction, taking other relevant factors into account, regarding the gray theory to predict the results and other relevant factors as neural network input data samples and the actual value as output, the network training, and eventually predict the future coal and oil consumption. The steps of GM (1, 1) and BP combination model to predict are shown in Figure 1.

2. Analyses

2.1. Division Results

According to methods and zoning district standards mentioned above, the use of Arcgis9.3 to statistics and re-classification method partitions energy security in the study area as follows (Figure 2).
(1) Energy high security area: mainly in Xuzhou and Yancheng two cities, accounted for 26.2% in the whole province, and Xuzhou abounds in coal resources, from 2000 to 2007 the average annual energy consumption was 21, 514, 600 tons of standard coal, with an annual coal production capacity of 24, 478, 800 tons, converted into standard coal was 17, 692, 000 tons of standard coal, accounting for 82.23% of the region energy consumption, 0 dependence on foreign energy sources, basic does not rely on imported energy from outside of the region, the lowest overall energy security risk, was 0.596.



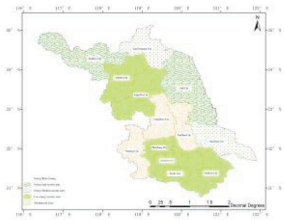


Fig.1. Flow chart of BP neural network

Fig. 2. Comprehensive energy risk zone distribution inJiangsu province

(2) Energy Medium security zone: mainly including Lianyungang, Nantong two cities, accounting for 15.90%, Lianyungang from 2000 to 2007 energy consumption was 3.614 million tons of standard coal, with an annual production capacity of 937, 700 tons of coal, converted into 669, 500 tons of standard coal; annual average generating capacity was 5.212 billion kwh, while the average annual electricity consumption for the whole society was 3.479 billion kwh, so dependence on foreign energy sources is relatively low (0.74), integrated the value (0.697) of energy security risk, so it is the energy medium security risk area.
(3) Low energy security zone: including Suqian, Changzhou, Jiangyin, Wuxi, Zhenjiang and other regions, an area of relatively large area, accounting for 38.77%. Among the districts, Zhenjiang and Jiangyin, the two urban areas, has higher values of energy security risks, respectively more than 0.87, the two areas has higher dependence on foreign energy; followed Changzhou, Wuxi and other cities, energy Security risk values were between 0.8 and 0.85.
(4) The potential risk areas: mainly including Yangzhou, Taizhou and Nanjing. The average annual energy consumption of Nanjing was 53, 141, 100 tons of standard coal, with an annual generating capacity of 15.772 billion kwh, electricity consumption was 18.845 billion kwh, GDP developed rapid, dependence of foreign energy resources was 1.24, higher consumption elasticity coefficient (2.82), integrated energy security risk was 1.191, the highest value in the province; followed Yangzhou and Taizhou, comprehensive energy security risk values were 0.978、0.922.

2.2. Predictions

Using the gray model and its improved model to predict the next decade's crude coal and oil supply and demand in various regions in Jiangsu province, getting predictive data .Then the population, GDP and gray model fitting historical data were accepted as input values of BP network model, which received seven sets of input data, and regarded these seven sets of data as the output of BP network training samples, the network of the BP training , input data of BP is the desired predicted value .

Application of the principle of demand forecasts and historical data of Taizhou, Taizhou supply forecasting is shown in Table 1.

Table.1. Supply and demand of Coal and oil (ten hundred)

Year	*Coal*				*Oil*			
	Supply		Demand		Supply		Demand	
	Physical	Discounted	Physical	Discounted	Physical	Discounted	Physical	Discounted
2008	399.59	285.31	457.92	326.95	356.50	509.08	343.65	491.42
2009	423.57	302.43	470.05	335.62	378.24	540.13	349.87	500.31
2010	448 . 98	320.57	482.23	344.31	401.32	573.09	352.92	504.68
2011	475.92	339.81	496.40	354.43	425.80	608.04	354.29	506.63
2012	504 . 48	360.19	504.49	360.21	451.77	645.13	354.73	507.26
2013	534.75	381.81	508.31	362.93	479.33	684.48	354.88	507.48
2014	566.83	404.72	509.47	363.76	508.57	726.24	354.94	507.56
2015	600.84	428.99	510.03	364.16	539.59	770.53	355.00	507.65
2016	636.89	454.74	510.39	364.42	572.50	817.53	355.05	507.72
2017	675.11	482.03	510.50	364.50	607.43	867.41	356.21	509.38

3. System Simulation

The study constructed the evaluation index system and corresponding risk assessment model and completed a risk assessment to identify potential energy of high-risk areas, targeted to build the energy key technology and risk prevention measures from resources, production, transportation, marketing and consumption of energy risk.

EERZ&EDFS is based on Microsoft Visual C++6.0 object-oriented secondary development environment, designed and developed by the GIS industry leader- ArcGIS Engine 9.3 development. EERZ & EDFS system can achieve the calculation of energy demand growth, energy security risk zoning, energy demand forecasts and other professional functions, which can provide data and technical support for the regional energy management agencies to find out the overall energy supply and demand situation, the scientific management of energy resources, efficient use of energy resources.

EERZ & EDFS system development technology route is shown in Figure 3:

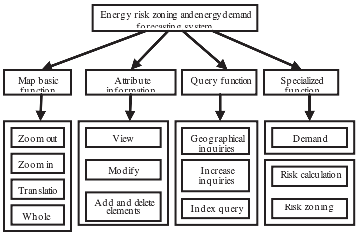


Fig.3. EERZ & EDFS system development technology route

4. Countermeasures and Suggestions

In current research on domestic energy, it is necessary to establish China's own energy demand forecasting model to enhance the capability of energy needs and provide better services for the country's related policies. This study is aimed for offering basis for the future of China's energy demand forecast model by building a framework for forecasting model system, and ultimately, make periodical forecast about changes in China's future energy needs.

Taking the actual situation of energy supply and demand in Jiangsu Province into account, countermeasures and suggestions are as follows: ① Full consideration of environmental factors, energy strategies for sustainable development and environmental development are necessarily needed; ② Comprehensively promoting energy conservation, resource-saving society is going to established; ③Industrial restructuring, it is proper to control the development of energy-intensive industries; ④ Continuously improving the energy, economic efficiency, great efforts are made to save energy; ⑤ Strengthen efforts to develop wind power, wind energy, hydropower and other new energy sources; Develop nuclear power industry, multi-faceted and multi-species to increase energy supply , thereby reducing potential energy risk; ⑥ Focus on making good use of the "North coal south" sea lanes to reduce energy risk; ⑦ Breaking" Point along " the layout of energy industry; ⑧ Playing port advantages to addnew energy supply;⑨ Emission reduction as the goal, rational distribution of regional industrial structure.

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