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# Energy Consumption per GDP in Various Regions of China and Its Mode

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## Abstract

Based on the analysis of the changes of Energy consumption per GDP in various regions of China, we can summarize modes of Energy consumption per GDP in various regions of China. The modes are Conventional mode, Gradational mode Contemporary mode, Low-carbon mode. Then, analyse the energy consumption characteristics of each mode and give optimizational initiatives.

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*Keywords:* China; Energy consumption per GDP; mode; optimization

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## 1. Introduction

Energy consumption per GDP, also known as energy consumption per 10,000 yuan, means that per 10000 Yuan GDP (gross domestic product) produced with the consumption of one ton of standard coal. Energy consumption per GDP is the main index of the lever of energy consumption and the state of Energy saving and consumption reducing. The ratio of total primary energy supply and GDP is an index of efficiency of energy using. This index indicates the degree of utilization of energy in a country's economic growth and the changes of economic pattern and the efficiency of energy utilization. The formula of this index is:

$$\text{Energy consumption per GDP} = \text{Total energy consumption} / \text{GDP}$$

Note: Total energy consumption is Comprehensive energy consumption (Equal value and base on the standard unit), GDP is the sum of various industrial added value.

The purpose of this paper is to develop better energy saving measures according to their own circumstances of each region in china.

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## 2.General analysis of Energy consumption per GDP of various regions of China

### 2.1 .The overview of Energy consumption per GDP of various regions of China

There are 34 provinces and autonomous regions in china (including Hong Kong, Macao and Taiwan). Energy consumption per GDP varies across regions of China. According to the provinces, autonomous regions and municipalities’ energy consumption per GDP data that released by the National Bureau of Statistics(The data does not contain the Hong Kong SAR, Macao SAR and Taiwan Province; The Tibet autonomous region data is left vacant for the time being), we can see changes in China's overall situation of energy consumption per GDP after data processing (Figure 1 and Figure 2).

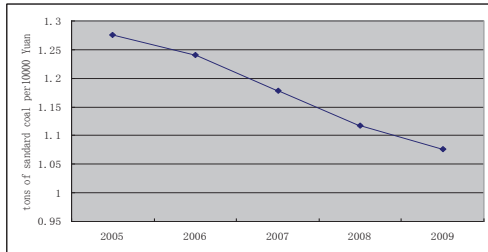


Figure 1 Decline of unit GDP energy consumption (2005-2009)

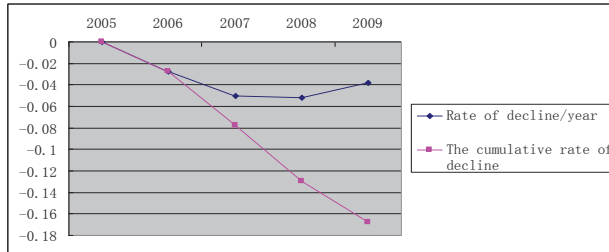


Figure 2 the completion of China's "Eleventh Five-Year Plan" in lower energy consumption

Figure 1 shows that energy consumption per GDP was under the state of being in steady decline, which was closely related to China’s industrial restructuring, energy saving policy. According to "Eleventh Five-Year Plan", China's energy consumption per unit of GDP should be reduced about 20% in five years. Meanwhile, the Plan had been developing according to the provinces’ actual situation ,therefore each region have its own energy-saving plan. such as: compared with 2005 , Jilin energy consumption per GDP should be decreased by 30% by 2010, Shanxi, Inner Mongolia were required to be decreased by 25%, Guangdong, Fujian should be decreased by 16%,most provinces were 20% decrease requirements.

According to the plan, the indicators of national Energy consumption per GDP should be reduced from 1.22 tons of standard coal in 2005 per 10000 yuan to 0.98 tons of standard coal in 2010 per 10000 Yuan. Figure 2 clearly shows that, the national unit of GDP energy consumption is already very close to the Plan standard by 2009, Energy consumption per GDP nationwide has dropped 16.78% in total.

### 2.2. Mode analysis

From 2005 to 2009, the national unit of GDP energy consumption decrease to 16.78% in total. There are 22 provinces or municipality higher than the national level,9 lower than the national level.The highest Energy consumption per GDP is Ningxia, followed by Qinghai, Guizhou, Shanxi.The lowest Energy consumption per GDP is Beijing,followed by Guangdong, Shanghai, Zhejiang.Following,we will analysis 7 provinces with the largest reduction in total of energy consumption per GDP (more than 19%) and 7 provinces with minimum (less than 15%)from 2005 to 2009(Table 1). These provinces are representative in China.

Table 1 changes of Energy consumption per GDP and the overall ranking from 2005 to 2009

Regio	Unit GDP energy consumption in 2005	Unit GDP energy consumption in 2009	the total reduce(Tons of standard coal / 1000 Yuan)	Total rate of decrease(%)	Overall ranking
Beijing	0.8	0.606	0.194	-24.41	1
Tianjin	1.11	0.836	0.274	-21.76	2
Inner Mongolia	2.48	2.009	0.471	-20.25	3
Shanxi	2.95	2.364	0.586	-19.61	4

Shandong	1.28	1.072	0.208	-19.93	5
Hunan	1.4	1.202	0.198	-19.64	6
Hubei	1.51	1.23	0.28	-19.53	7
Yunnan	1.73	1.495	0.235	-14.89	-7
Guangdong	0.79	0.684	0.106	-14.67	-6
Fujian	0.94	0.811	0.129	-14.22	-5
Guangxi	1.22	1.057	0.163	-14.21	-4
Qinghai	3.07	2.689	0.381	-11.33	-3
Xinjiang	2.11	1.934	0.176	-8.82	-2
Hainan	0.92	0.85	0.07	-7.33	-1

From the overall ranking of the Top 7, their total reduces are higher than the national average level of 16.78%. These provinces can be divided into two cases, one is began in lower energy consumption per GDP, end in high decrease of proportion through general reduce of energy consumption per GDP in total, Such as Beijing, Tianjin. The other is began in higher energy consumption per GDP, end in high decrease of proportion through high reduce of energy consumption per GDP in total, Such as Inner Mongolia and Shanxi; From the overall ranking of the last 7, their total reduces are lower than the national average level of 16.78%. This was mainly due to the relatively low of reduce of energy consumption per GDP. Specifically, these provinces can be also divided into two cases. one is began in lower energy consumption per GDP, end in lower decrease of proportion with low reduce of energy consumption per GDP in total, Such as Hainan, Guangdong. The other is began in higher energy consumption per GDP, end in lower decrease of proportion with low reduce of energy consumption per GDP in total, Such as Xinjiang, Sichuan. Thus, inter-regional energy consumption per GDP are very different.

According to the above four changes, We do a sort that take amount of energy consumption per unit GDP as the first order (high on the left -low on the right), when two regions were at the same level of energy consumption, putting the high drop of energy consumption per GDP on the right. In other words, the right is the dominant position. Analysys the changes of the energy consumption per GDP between 2005-2009 time period, taking the regional units GDP energy consumption in 2005 as a starting point, 2009 is the result. Thus, The four cases that can be shown by the following Figure (Figure 3).

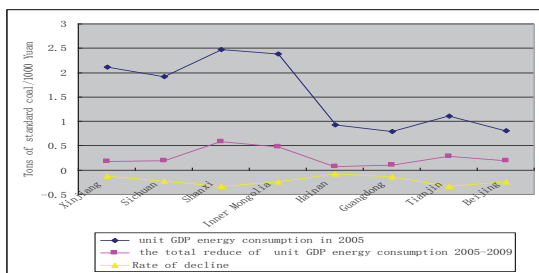


Figure 3. 2005-2009 some provinces ‘status of energy consumption per GDP and saving

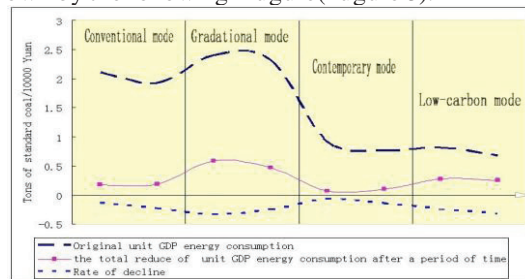


Figure 4. Four modes

Note: Take national average energy consumption per GDP as the standard, and take the initial energy consumption per GDP in 2005 as basis for comparison. Energy consumption per GDP will be seen as high when it higher than the national average level of 1.276 tons of standard coal per 10000 Yuan, low when it is lower. Broken line in Figure 3 can be smoothed to be Figure 4. Now we can obviously see regularity

that there is symmetry on both sides of X-axis. There are one peak and two valleys in Figure 4, if there are separated between peak and two valleys, the following four modes can be summarized.

- a High - low -Low Conventional mode
- b High - high - high Gradational mode
- c Low - low - low Contemporary mode
- d Low - high - high Low-carbon mode

Note: the first word stands for the degree of Energy consumption per GDP; the second word means the level of amount of energy reducing; the third word is about the rate of decline of energy consumption.

From the perspective of energy saving and consumption reducing low-carbon mode is Optimal, conventional mode is the worst, which can be seen from Figure 4. If the X-axis stands for timeline in Figure 4, it requires optimization of 4 modes over the positive direction, in particular, conventional mode and gradational mode. That is, Energy consumption per GDP should be changed from high energy consumption per GDP to low energy consumption per GDP.

### 3. Optimizational Strategies

#### 3.1. Adjust the industrial structure

From the perspective of the industrial structure, the proportion of secondary industry and the number of per capita energy consumption have greatly influence on the energy consumption per GDP and energy consumption. An Empirical Analysis of Guangdong shows that the decline in energy consumption per GDP is mainly due to the improvement of energy efficiency. The share of promoting the efficiency of Guangdong about the decline in energy intensity is mainly due to the energy efficiency of the secondary industry, in particular the energy efficiency of industrial sector. The tertiary industry also has some positive effect[1]. Therefore, vigorously promoting three industrial restructuring, accelerating the development of services industry, especially in productional services and new services industry, increasing the proportion of tertiary industry and appropriate control of the industrial sector growth are necessary for different types of models to reduce energy consumption.

#### 3.2. Optimizational strategies for each mode

The main problem of conventional mode in Xinjiang, Qinghai and other similar provinces is that it's difficult to reduce energy consumption per GDP. The fundamental reason of this is that the rapid growth investment in fixed assets, especially in the industrial investment, which will inevitably bring about the rapid growth of energy consumption in the current context of extensive economic growth mode and irrational industrial structure. To reduce the energy consumption per GDP, they should possess Long-term perspective, the concept of sustainable development, efficiency of improving energy using. Next, do not blindly pursue modernization. Change the traditional view of building and maintain the existing regional style. Last, do not always pursuit of the high GDP growth but pursuit of the harmonious development among natural, economic and social.

The provinces in gradational mode mainly locate in central and western of China. As China's eastern provinces' industrial structure relatively better than central and western of China, these areas are undertaking part of industry from eastern provinces which are high energy consumption. In addition, some of these provinces are in the increase of heavy Industry. Futhermore, the coal take a high proportion in the structrue of energy. Generally speaking, The greater proportion of coal, the smaller proportion of oil, natural gas and electricity, the lower level of energy efficiency of city, the energy consumption per GDP will be higher[2]. Objectively, energy consumption in this region is difficult to be reduced soon. For these areas' optimization, they should pay attention to energy conservation, selectively undertake industries. At the same time they should protect the environment and adjust energy structure.

The provinces in Contemporary mode mainly locate in eastern of China. these areas' economy are relatively developed. For these areas' optimization, they should accelerate the development of tertiary industry. Base on the certain level of economic development, the tertiary industry can be a long-term means of decline in energy consumption per GDP. Upgrading industries to high-end is another way of optimization. This way is the main reason for the decline of Energy consumption per GDP of the developed countries. The main direction of energy efficiency is optimal adjusting the industrial structure within the industry, promoting new industrialization, strictly controlling high growth rate of industrial sectors with energy consumption, further accelerating the high value-added and high-tech industries.

Low-carbon mode is the example of the former three modes on energy using. The industrial structure of this mode is reasonable, having a high proportion of new energy using. This areas have strong awareness of energy conservation and high level of innovation.

Based on the above discussion, we can form a optimizational framework of those modes.

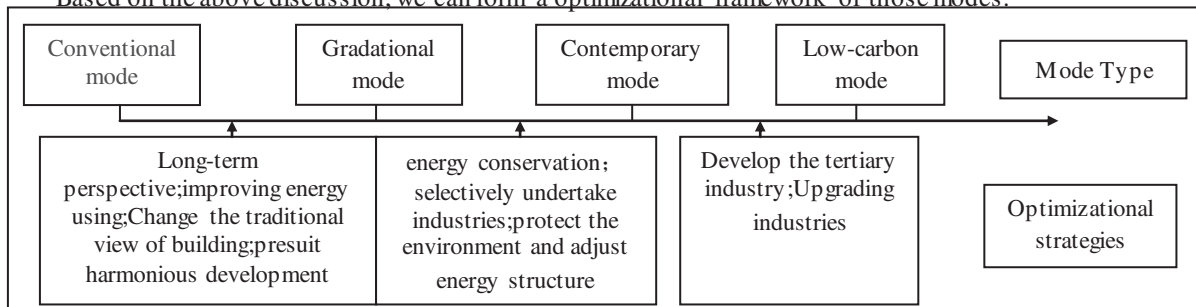


Figure 5 the optimizational evolution and the corresponding measures for each model

#### 4. Conclusion

As technology advances and the promotion of energy conservation, energy consumption per GDP decreases continually. However, various regions have different levels of energy consumption per GDP. The highest is as 5 times as the lowest. There are common characteristics within the region. They have their own mode of development on Energy consumption per GDP and they can reach the purposes of optimization, fell of Energy consumption per GDP, Low-carbon and energy saving through a number of initiatives.

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