Study and Suggestion on Industrial Energy Efficiency of 13th Five Year Plan

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Abstract. The determination of energy consumption and conservation targets during the 13th Five-Year Plan lies in the core of the 13th Five-Year energy conservation planning. In this paper, the top-down decomposition methods was been employed to calculate China energy consumption, and research on the prediction of the development of industrial energy efficiency. In the end, author gave the suggestions to show the double control for energy consumption intensity and total consumption is the best way to fulfil the target of industrial energy efficiency of 13th five year plan energy consumption plan.

1 INTRODUCTION

As China's fast-growing economy transits into a "new normal" and with the strategically economic restructuring, the growth of energy consumption during the 13th Five-Year Plan will gradually slow down. The general energy consumption however will remain growing until 2020. The determination of energy consumption and conservation targets during the 13th Five-Year Plan lies in the core of the 13th Five-Year energy conservation planning. In this paper, top-down decomposition method was employed to calculate China energy consumption.

The Energy Development Strategy Action Plan (2014-2020) issued by the State Council in June 2014 has set the target of controlling the total primary energy consumption in 2020 at about 4.8 billion tce, according to which, if the 12th Five-Year energy conservation target can be realized as scheduled, the average annual rise of energy consumption will be 149 million tce in the 12th Five-Year Plan and may be relaxed to 157 million tce in the 13th Five-Year Plan. Therefore, it is a relatively relax target to control the total energy consumption at 4.8 billion tce. See figure1.

Fig. 1. Incremental Energy Consumption in the Last Three Five-Year Plans.

Based on the target set forth in the State Council document, the research group further decomposes the national energy consumption into three major energy consumption sectors, namely, industry, construction and transportation, and by combining the judgment on the future strategically economic restructuring as well as the change trend of the economic activity level and energy efficiency in these three sectors, predicts the energy consumption prospects in a top-down manner, see the table below.

Table 1. Top-Down Assumption of Energy Consumption Changes in Three Major Sectors.

	2010	2015	2020
Total energy consumption	324939	398978	477373
Agriculture, forestry, animal husbandry and fishery	6477	7142	7924
Industry	232019	269749	294730
Construction	5309	6783	7638
Transportation, warehousing and post industry	26068	37903	57285
Wholesale, retailing, accommodation and catering	6827	13964	26256
Other	13681	16757	21482
Living consumption	34558	46680	62058

Through analysis, the research group found that the energy consumption allocated to the three end-use

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energy consumption sectors (industry, construction and transportation) is relaxed for their productive and living activities. Therefore, the target of controlling the total energy consumption at 4.8 billion tce in 2020 can be further tightened by intensifying energy conservation.

2 Prediction of Economic Activities and Energy Consumption of Industrial, Construction and Transportation Sectors in the 13th Five-Year Plan

2.1 Prediction of the development of key economic and social activities in key areas

The rate of economic growth and the level of economic and social development activities in sectors such as industry, construction and transportation are the fundamental factors determining the level of future energy consumption demand. Considerable assumptions have been made by the research group in the course of study. For example, as shown in Table 2, the research group has assumed the development of key activities in the industrial sector.

Table 2. Output of Main Energy-Intensive Products at the End of the 13th Five-Year Plan.

	Unit	2010	2015	2020
Paper and paperboard	10,000t	10036	12190	14342
Synthetic ammonia	10,000t	4970	5500	5470
Caustic soda	10,000t	2087	2500	2800
Sodium carbonate	10,000t	2029	2400	2800
Calcium carbide	10,000t	1700	1950	2000
Ethylene	10,000t	1419	2900	5000
Cement	100,000,000t	18.8	25.6	28.7
Sheet glass	100,000,000t weight cases	6.3	7.2	7.5
Crude steel	100,000,000t	6.27	7.32	7.9
Aluminum oxide	10,000t	2894	3971	4545
Electrolytic aluminum	10,000t	1565	2200	2600
Copper	10,000t	457	700	1200

2.2 Calculation results of energy consumption in key areas

Based on the previous data, the research group calculated the energy consumption in industrial, construction and transportation sectors in 2020 by a bottom-up method, see table 3.

Table 3. Sectoral Structure of Energy Consumption in China in 2020 (Unit: 10,000 tce)

	2005	2010	2015	2020
Total energy consumption	235997	324939	402793	465257

Agriculture, forestry, animal husbandry and fishery	6071	6477	7142	7924
Industry	168724	232019	279409	311635
Construction	3403	5309	6458	7276
Transportation, warehousing and post industry	18391	26068	38610	52003
Wholesale, retailing, accommodation and catering	4848	6827	8778	10339
Other	9255	13681	17591	20718
Living consumption	25305	34558	44806	55362
Private car	1363	2909	5019	7505
Building energy consumption in life	23942	31649	39787	47857

2.3 Activity level and efficiency of energy consumption actions in industrial, construction and transportation sectors

The research group, based on the systematic analysis and the expert analysis, assumed the indicators of key activity level and energy efficiency in industrial, construction and transportation sectors. Due to the limited space, only the prediction of energy efficiency improvement in the industrial sector by the research group is presented here (see table 4 and 5)

Table 4. Comprehensive Energy Consumption of Main Energy-Intensive Products at the End of the 13th Five-Year Plan

Product	Unit	2010	2015	2020
Crude steel	kgce/t	605	580	560
Cement	kgce/t	100	93	87
Electrolytic aluminum	kWh/t	13979	13300	13000
Sheet glass	kgce/weight case	17	15	14
Ethylene	kgce/t	950	857	840
Paper and paperboard	kgce/t	380	330	300
Calcium carbide	kgce/t	1000	900	830
Synthetic ammonia	kgce/t	1402	1350	1300

Table 5. Added-Value Energy Consumption in Major Non Energy-Intensive Industries at the End of the 13th Five-Year Plan Unit: tce / CNY 10,000 (2010 price)

Industry	2010	2015	2020
Electronic equipment manufacturing	0.297	0.255	0.214
Transportation equipment manufacturing	0.113	0.097	0.081
Machine manufacturing	0.19	0.163	0.137
Metal product	0.248	0.213	0.179
Rubber and plastic products	0.386	0.332	0.278
Pharmaceuticals	0.402	0.346	0.289
Culture and printing	0.279	0.223	0.184

Woodwork	0.165	0.135	0.116
Textile and chemical fiber products manufacturing	0.262	0.197	0.157
Food and tobacco processing	0.411	0.337	0.288

3 Main Approaches to the 13th Five-Year Energy Conservation Target

On the basis of the above analysis, the research group calculated the main approaches to the 13th Five-Year energy conservation target. In general, these approaches can be divided into four categories, i.e., economic restructuring and industrial, building and transportation energy conservation.

3.1. Firmly carry out strategic adjustment of the economy

Calculation results show that about 182 million tce will be contributed for reduction target of energy consumption per unit GDP during the 13th Five-Year Plan due to the change of the three industrial structures. About 13.18 million tce will be contributed for the reduction target of energy consumption per unit GDP during the 13th Five-Year Plan by energy conservation of the internal structure of secondary industry (namely the savings caused by the change of proportions of the industry and the building industry). About 13.18 million tce will be contributed for the reduction target of energy consumption per unit GDP during the 13th Five-Year Plan by energy conservation of the internal structure of tertiary industry (namely the savings caused by the change of proportions of the transportation industry and service industries in addition to transportation). The total contributed savings is about 211 million tce, accounting for 29.4% of the total energy conservation task (716 million tce).

3.2. Strengthen energy conservation of the industrial sector

Calculation results show that 246.84 million tce will be contributed for the reduction target of energy consumption per unit GDP during the 13th Five-Year Plan by the structural adjustment inside the industry. 139.79 million tce may be saved due to technological progress in energy conservation, technological improvement, scale production and backward production capacity elimination in the energy-exhaustive industries, and product structure adjustment inside various industries. 59.62 million tce may be saved by technological progress of non-energy-exhaustive industries and structural adjustment inside various industries. The three industries contributed the total energy savings of 446.25 million tce, accounting for 62.3% of the total energy conservation task.

4 Control target for incremental energy consumption of all regions during the 13th Five-Year Plan

For the purpose of promoting energy resource conservation and utilization, the target of the energy conservation plan during "the 13th Five-Year Plan" will be transformed from single energy conservation target to the "double control" for energy intensity and total energy consumption. The control targets for intensity and total consumption shall be coordinated and complementary. These two targets shall be consistent based on the consistent expectations for GDP. For this, the total consumption target can be derived from energy intensity targets of all regions, which is a way to obtain the total energy of various regions. Besides, the energy consumption elasticity coefficient of one region is kept stable essentially over a period of time. The regional total energy consumption distribution plan can be obtained by the elasticity coefficient method. Due to a certain difference between the national and regional total statistical data in China, regional decomposition for incremental energy consumption is more direct and definite plan.

Table 6. energy Increment Control Targets of All Regions during the 13th Five-Year Plan by Two Methods

Regions	Increment by the intensity target (10,000 tce)	Increment by the elasticity coefficient (10,000 tce)	Difference between the two schemes*
Beijing	564	512	9.7%
Tianjin	2242	2234	0.4%
Hebei	2409	3323	31.9%
Shanxi	2414	2499	3.4%
Inner Mongolia	3517	3711	5.4%
Liaoning	3185	3535	10.4%
Jilin	1484	1410	5.1%
Heilongjiang	1200	1485	21.2%
Shanghai	856	1042	19.6%
Jiangsu	4765	5036	5.5%
Zhejiang	1963	2190	10.9%
Anhui	2550	2448	4.1%
Fujian	2460	2595	5.3%
Jiangxi	1530	1463	4.5%
Shandong	6173	6147	0.4%
Henan	4173	3937	5.8%
Hubei	3854	3616	6.4%
Hunan	3484	3182	9.1%
Guangdong	3261	4230	25.9%
Guangxi	1766	2109	17.7%
Hainan	381	458	18.3%
Chongqing	2733	2416	12.3%
Sichuan	4380	3916	11.2%
Guizhou	3092	2716	13.0%
Yunnan	2484	2554	2.8%
Tibet	-	-	-
Shaanxi	2621	2646	0.9%
Gansu	1500	1360	9.8%
Qinghai	1115	1297	15.1%
Ningxia	813	958	16.3%
Xinjiang	3896	7019	57.2%

Regions	Increment by the intensity target (10,000 tce)	Increment by the elasticity coefficient (10,000 tce)	Difference between the two schemes*
Regional total	76868	82045	6.5%

* The difference between the two plans is defined as $\frac{2|c-d|}{c+d}$, c represents the increment by the intensity target, and d represents the increment by the elasticity coefficient.

5 Suggestions for the Energy Conservation Target

Based on the aforesaid research, the research group proposes the following suggestions to ensure the energy conservation target during "the 13th Five-Year Plan":

5.1. Intensify "double control" for energy consumption intensity and total consumption

It is suggested that the central government should emphasize importance of the ecological civilization construction, promote energy conservation and emission reduction unswervingly, strive to find out a new way to lower energy emission and improve economic development, and make unremitting efforts to promote energy consumption revolution firmly. The decline rate of energy consumption per unit GDP of "the 13th Five-Year Plan" will be determined to be about 15%, and the total energy consumption control target is set as 4.8 billion tce. The above two indexes will be incorporated into the national economy and social development planning outline of "the 13th Five-Year Plan". The total energy consumption targets of industry, building and transportation sectors are respectively 3,100 million, 800 million and 600 million tce as the anticipatory indexes. The targets of unit activity level (product, unit area or unit turnover) of the industry, building and transportation are incorporated into the relating national energy conservation planning as the anticipatory indexes.

5.2. Carry out industrial structure adjustment firmly

It is suggested to focus on "boosting growth" during "the 13th Five-Year Plan", optimize and adjust the economy based on its development rule by virtue of properly lowering the economic growth speed, and exert the market force more greatly with the aid of deepening the form, so as to reduce the excessive intervention to the economic growth from the governmental "visible hand". We strive to improve the proportion of the third industry by 5% during "the 13th Five-Year Plan" based on the strategic adjustment for the economic structure.

5.3. Boost the industrial energy conservation to improve quality and efficiency

It is necessary to speed up the development of such advanced technologies as informatization, network technology and cloud computing, actively cultivate such strategic emerging industry as energy conservation and environmental protection, and promote the internal structure adjustment of the industry. Haphazard development of steel, cement and building materials shall be strictly limited. The central government shall strengthen early warning and monitoring for new energy-exhaustive and high-pollution projects, set more severe energy conservation and environmental protection access threshold, and take the approval policy of "decremental substitution". There is a necessary to control the industrial sector development speed, and strive to achieve peak production of steel, cement and other basic raw material industries by 2020. The energy efficiency levels of main energy-exhaustive products will reach the leading level of the world in 2020 by virtue of transforming the industrial energy conservation technology, eliminating the out-dated energy production line and energy-exhaustive equipment, and boosting transform of such universal equipment as industrial boiler and electric motor driving system.

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