

The Low-carbon Transition Exploration of China's Traditional Manufacturing Industries

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Abstract—Aiming at the problems existing in low-carbon technology of Chinese manufacturing industries, such as irrational energy structure, lack of technological innovation, financial constraints, this paper puts forward the suggestion that the leading role of the government is combined with the roles of enterprises and market. That is, through increasing the governmental funding the adjustment of the industrial structures and enhancement of the legal supervision are supported. Technological innovation is accelerated by the enterprises, and the carbon trading will be promoted so as to trigger the low-carbon revolution in Chinese manufacturing field.

Keywords—Low-carbon Economy, Traditional Manufacturing Industry, Industrial Structure, Carbon Emission Reduction.

I. INTRODUCTION

IN 1988, an American meteorologist, Dr. James Hansen first put forward the concept of the Global warming. In 1990, the United Nations passed the Kyoto protocol which aimed to preventing global warming; it is the first time in history for the human being to limit the emissions of greenhouse gases in the form of regulations [1]. By end of the 2009, global carbon emission reduction has reached more than 400 million dollars, while China occupied more than one-third of the share. Chinese government solemnly promises: the carbon intensity, i.e. unit of gross domestic production in carbon dioxide emissions will decline to 40 to 50 percent by 2020, the proportion of non-fossil energy which accounts for one-time energy consumption will reach about 15 percent. With the promise the sincerity of Chinese government to develop low-carbon economy and respond to global climate change is fully expressed. Also, it shows that China will conform to the development trend of the global economy, and take "developing low carbon economy, building the low carbon society" as the basic state policy. As for the traditional manufacturing industry, which is the pillar industry of the national economy, low-carbon transition is of great significance.

II. THE CONNOTATION OF LOW-CARBON ECONOMY

In 2003, the United Kindom published "Energy White Paper" which put forward the concept of low-carbon economy in the first time. After that, scholars expressed their various views, which improved the content of low-carbon economy. Rubin, British environmentalists, considered that the kernel of low-carbon economy lie in the regulation of market mechanism, to promote the development of new energy technologies. Zhang Kunmin, a Chinese Professor, defined low-carbon economy as a kind of new economy with low pollution, low power, and low emissions, which is opposite to

traditional economic development model with high pollution, high energy consumption, and it is a global war which involves low-carbon production, low-carbon life, and low-carbon concept. Hu Dali believes that the development of low-carbon economy is driven by policy measures and technological innovation[4]. In essence, it is the issues of the structure of energy efficiency and clean energy, and scientific proposal about the five aspects of the environment indexes which are energy-based low-carbon technology, industry, consumption and waste disposal, social system to evaluate the level of low-carbon economy. Qin Jun pointed out that government's leading role is necessary, not only to the independent Carbon Fund established by British government, but also to the carbon reduction law improvement by the United States and Australia [5].The development of the low-carbon economy is to build modern social and economic development and consumption pattern of minimum carbon dioxide emission, and to promote social and economic development transition from highly dependent on energy consumption to low energy consumption. With conceptual innovation of economy, technological innovation, industrial innovation, clean energy development and other ways coal and other non-renewable energy consumption can be reduced so as to reduce greenhouse gas emissions. The low-carbon transition of the manufacturing industry is to achieve low-carbon or carbon-free target in the entire product lifecycle from designing, manufacturing, packaging, transporting, distributing to servicing stages.

III. BOTTLENECK AND CONSTRAINTS IN LOW CARBONIZATION TRANSITION OF CHINESE MANUFACTURING INDUSTRY

In 2008, the industrial gross of China reached to 50.75 trillion RMB yuan, an increase of 9.5% as compared to that in 2007; in construction industry, the increase was over 1.19 trillion RMB yuan, 19.8% to 2007; manufacturing industry took up to 11,568 foreign-funded projects, accounting for 42.04% of the total foreign-funded projects. Figure 1 shows, in the five years from 2003 to 2007, the key gross index in traditional manufacturing industry of China had being increased to form large production scale. It shows that the traditional manufacturing industry is still a pillar of the national economy, and the basis of national economic growth. Although China is a large country of manufacturing industry called as the "world factory," it is still not the power country. In the low-carbon economy, low-carbon transition in traditional manufacturing industries has to face the following problems.

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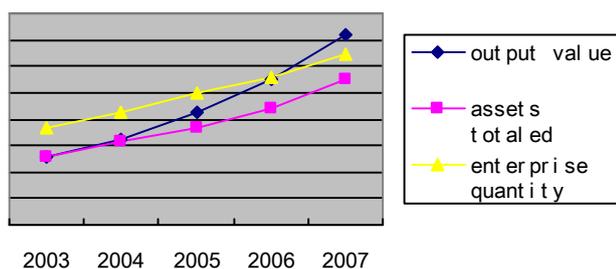


Fig.1 Gross index growth chart of Chinese manufacturing industry [6]

A. Irrational structure and low efficiency of energy use

As for the carbon dioxide emissions, China is in the second largest rank of the world and 4.12 tons of carbon dioxide is produced for each ton of coal burned. The following equation can be deduced from the famous Kaya equation [8]:

$$\text{carbon intensity} = \frac{\text{total emission}}{\text{GDP}} = \frac{\text{total emission}}{\text{population} \times \text{GDP per capita}}$$

= energy consumption per unit of GDP × emission per unit of energy consumption

Therefore changes in the carbon intensity of energy consumption primarily depend on the energy consumption per unit of GDP, i.e. energy use efficiency, and emission per unit of energy consumption. In the aspect of energy comprehensive use efficiency, as shown in Figure 2, compared with other countries, China is lower than the United States and Japan, and even lower than the world average. According to the conclusion from Li Daokui that energy consumption and economic development has the S-type relationship, at the early stage of economic development energy consumption growth is relatively slow, the situation leads to the less space for carbon dioxide emission control and regulation, while during the rapid developmental procedures of industrialization and urbanization, there is sharp rise in energy demand and carbon emissions, which leads to greater space for carbon dioxide emission control and regulation [8]. China is in the process of industrialization, the energy demand by the traditional manufacturing industry is great and most economic growth is still dominated by extensive type, and there is low comprehensive use efficiency of energy. On the other hand, in analysis of the carbon density by the energy production sector, there are 94% of coal energy, 5.4% of oil energy, and 0.6% of natural gas in China energy resources, that is, "rich in coal and less gas, short of oil", which limits the choices of low-carbon energy resources.

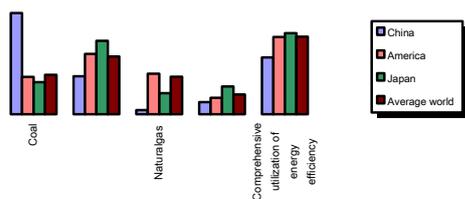


Fig. 2 Energy use level comparison of China with the United States, Japan, and the world's average [9]

B. Lack of technological innovation

In traditional manufacturing field, China is still a technology importer, lack of innovation in technology. China's traditional manufacturing industry has low additional value and less profit, and it becomes "a world factory" by relying on the advantages of labor-intensive industries, resulting in the situations of low-cost labor and wage level far from that of developed countries. The available low-carbon technologies primarily include energy saving low-carbon technologies, such as building energy conservation, energy-saving materials and equipment development, and emission reducing low-carbon technologies, such as comprehensive utilization technology of thermal and electrical power in thermal power generation, comprehensive utilization and development technology of mineral resources in recycling economy, recycling technology of the renewable resources, and so on. In China, the low-end technology takes the dominant position and the ratio of transition to market of the low-carbon R&D achievements is less than 20%, and final industrialization percentage is only about 5%, far lower than 70-80% level of the developed nations [10]. According to the research of Zou Jitao and other scholars, if the carbon intensity in the year of 2020 is half of that in 2005, more than sixty kinds of key technologies are required in six manufacturing fields, among which forty-two kinds are not in the hands of China.

C. Inadequate R&D funds

McKinsey report says, 40 trillion RMB Yuan is needed for China to build "green economy" from today to 2030, namely 1.8 trillion Yuan of funds per year to achieve "green economy" effectively. These investments of funds have the features of great amount, long recycle time period in putting into low carbon technologies. Although Chinese government strengthens financial budget, promotes green credit by the commercial banks, actively cooperates with the international financial institutions, and expands financing channels, the funding by these efforts is very limited. The shortage of traditional manufacturing R&D funding and financing innovation module aggravate the lack of huge amounts of money required for low-carbon technology, and the speed of new energy industry development is constrained.

IV. THE COUNTERMEASURES OF TRANSITION TO LOW-CARBON PRODUCTION

A. The government's leading role to realize carbon unlocking

Due to the existence of "carbon locked", namely, the original technical lock and path dependence hinder the development of alternative technologies such as zero carbon or low carbon. The fundamental problem the low carbon reform of traditional manufacturing industry faces is the absence of promotion by the powerful interest groups, so the government's leading role is especially important.

90% energy consumed by China's traditional manufacturing enterprises is from the burning of fossil fuels. According to the

forecast, in low carbon situation, by the year of 2020, 2030 and 2050 ,in the energy field the reduction of emission will be up to 3.8 million tons, 8.3 million tons and 15.9 million tons, and the total emission reductions will be 20.3%, 27.3% and 40.9% respectively[9]. To realize the above targets of emission reduction, it is necessary to accelerate the development of natural gas, hydroelectric, nuclear power and the exploitation of renewable energy. Effective measures should be taken to encourage the east manufacturing enterprises to the Midwest regions, to build power plants of wind and water.

Secondly we should accelerate the mergers and acquisitions of high-energy- consumption and high-pollution industries such as steel, automobile, power, textile and so on. High-energy-consumption and high-pollution production capacity should be constrained, and new industries are strived to foster, and the development of low carbon industry is encouraged. For example, Zhejiang has perfect internal condition to develop low-carbon economy so that it can promote the transition of traditional manufacturing industry from labor-intensive module to capital-intensive module [11]. As for the relevant laws, regulations and policies, it is advisable to promulgate and implement the "energy law", "coal law", "energy conservation law" and other laws as soon as possible to promote economic cycle development.

B. Motivation of enterprise active role to speed up carbon transition

The enterprises must introduce, study, and absorb the advanced low carbon technologies. Innovative talents should be employed and trained. Long-act system to train innovative talents should be established to realize the continuous supply and meet the requirements of low-carbon tech talents. The development of low-carbon economy is combined with enhancement of management in manufacturing industry, and the reduction of carbon emission is introduced to the performance evaluation of the employees. Low carbon marketing strategy is carried out to advocate low-carbon consumption thought and to guide the low-carbon requirements of the consumers. And the win-win situation of enterprise economic benefits and social benefits will be achieved [12]. The manufacturers must promote the energy efficient buildings internally and low-carbon transportation outside and to introduce the energy saving calculators in staff community, vigorously promote the concept to guide low-carbon consumption and low-carbon behavior.

C. Improvement of the market mechanism to encourage the carbon trading

To put the market adjustment into function, it is necessary to build combination of the market mechanism and enterprise leading role and governmental macro-control, and to promote enterprise "carbon trading" and to realize the voluntary emission reduction. "Carbon trading", namely is the deal for carbon dioxide emission rights by considering carbon dioxide as a commodity. Due to the energy utilization efficiency of developed countries is higher and higher, and new energy

technology is more and more mature, so that the emission reduction cost is getting grater. On the other side, the energy utilization efficiency in developing countries is low; the emission reduction cost is relatively lower, which leads to the situation that the unit cost of emission reduction in different countries is different, so that high price difference is generated. For Chinese manufacturing enterprises, after entering carbon trading market, a certain number of carbon dioxide emissions can be reduced, at the same time, the extra emission amount can be dealt with the stock exchange to gain an extra profit. The manufacturing enterprises should actively participate in the carbon trading of the world, strengthen cooperation with the partner enterprises of European Union and the United States, and carry out collaborative activities and projects in low-carbon fields.

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