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Development of biodiesel industry in China: Upon the terms of production and consumption

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ABSTRACT

The prices of primary energy have been ineluctably raised up due to the enormous energy consumption in China, and the economy suffers a lot from the severe energy shortage. Therefore, the necessity of using renewable energy in China is particularly important. Biodiesel has become one of the major renewable fuels of biomass energy. Since China's biodiesel industry just starts at the primary stage, improving the production capacity of biodiesel for meeting the soaring on energy demands is more necessary for the sustainable development in China. The materials for biodiesel production are various and sufficient in China, that indicates China could have a brilliant potentiality in the production capacity of biodiesel; however, whether such prediction could be true is still needed to be discussion in depth and further. For well answering the query, the development of biodiesel industry in China has been systematically reviewed upon the terms of production and consumption, and three essential aspects ('how to sufficiently take advantage of such plentiful feedstock for obtaining a satisfied production capacity', 'how to reasonably use such biodiesel in each region', and 'how to scientifically encourage the development of Chinese biodiesel industry') have been discussed. From the review and discussions, it can be concluded that the rising China's biodiesel industry is still behind the actual demand asked by 12th Five-Years Plan and continuous introduction of capitals is the effective method to a further development. Meanwhile, the development of China's biodiesel industry is highly depended on the raw materials whose sources and production capability are remarkably different in different regions, and hence make standards on the quality of biodiesel is essential and crucial to the further development. Furthermore, adjusting tax policies and forcing the application of biodiesel as addition to fossil diesel can effective establish and enlarge the market of biodiesel in China.

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1. Introduction

Energy is generally recognized as the underpinnings of the modern human civilization and the social development. Nowadays, the energy demand is sharply increasing with the rapid development of global economy in the past decades, which causes the global supply and demand crisis of oil resources. According to the current oil production and consumption, the entire world's proven oil can only afford 53.3 years [1], and the reserve-production-ratio for China is just 11.9. The huge energy consumption necessarily raises the global primary energy prices and indirectly makes negative effects on the economic growth [2]. Dramatically rising oil prices and increased concern about dwindling fossil fuel reserves have focused the world's attention on a search for alternative energy sources [3].Therefore, seeking renewable energies even green energies is the key to ensure the sustainable development.

Since 1980s, bio-energies have become the 4th largest energy following coal, oil, and natural gas [4]. Renewable energy technologies are essential to green energy as they generally contribute to reducing dependence on fossil fuel resources. Conceptually, one can define three generations of renewable technologies according to the International Energy Agency [5].

First-generation emerged from the industrial revolution at the end of the 19th century and include hydropower, biomass briquettes combustion and geothermal power and heat. Some of these are still widely being used. For instance Biomass briquettes are used in the developing world as an alternative to charcoal in North Kivu, in eastern Democratic Republic of Congo.

Second-generation technologies include solar heating and cooling, wind power, modern forms of bioenergy and solar photovoltaic. These are now entering markets as a result of research, development and demonstration investments since the 1980s. The initial investment was prompted by energy security concerns linked to the oil crises of the 1970s but the continuing appeal of these renewable has shown their environmental benefits. Many of the technologies reflect significant advancements in our daily life such as: most cars on the road today in the U.S. can run on blends of up to 10% ethanol, and motor vehicle manufacturers already produce vehicles designed to run on much higher ethanol blends.

Third-generation technologies are still under development and include advanced biomass gasification, biorefinery technologies, concentrating solar thermal power, hot dry rock geothermal energy and ocean energy. According to the International Energy Agency, new bioenergy (biofuels) technologies being developed today could allow biofuels to play a much bigger role in the future than previously thought [6].

As one of the two most important renewable liquid fuels of biomass energy, biodiesel has become the major biomass energy due to the most potential for development together with the bio ethanol [7]. Biodiesel is the primary fuel for Rudolf-designed diesels [8,9] until the production capacity of fossil-oil has been significantly sufficient in 1800s. However, biodiesel has been considered again as a promising future fuel after Arab oil embargo in 1973. Some of the researchers even propounded to establish a Biodiesel Era before the depletion of fossil-fuels in the first International Conference on Biodiesel held in Fargo, North Dakota, USA, August, 1982 [10].

China, as a newly-emerging country, is undergoing a great suffering of energy shortage. Great deal of fossil-fuels has been consumed to support China's economic development since they followed the policy of reform and opening. China has become the world's second oil consumer from 2007, and the gap between supply and demand on energy is ceaselessly being enlarged [1]. The gap inevitably leads to an extremely high dependence on foreign fuels, the dependence rate has beyond the ‘red-alarm-line’ since 2007 and raised to 57.39% in 2013 [11] which must causes the deterioration of energy security. Thus, for avoiding the negative effects on the economic growth, China has to play the inversion of oil price for avoiding energies panic. Unfortunately, China's proven oil reserve just can afford within a-dozen-years based upon an impractical assumption that the oil consumption won’t be raised. Practically, China's dependence rate of foreign oil will rise to 60–80% in the coming decade to meet the current development rate [12]. Therefore, seeking alternative fuels to fossil oil has been one important affair to China.

Biodiesel, as one promising alternative fuel, has been considered as one solution to the mentioned issues in China even the world. From the global view, the global biodiesel industry has been rapidly developed within the past decade, and the annual production has been increased by more than 20 times to 20 million tons in 2012. Although the establishment of Chinese biodiesel industry is relatively later, the growth rate of bio-fuels production is noticeable under the driving of Chinese immediate pressures on energy and environment. However, the current production of biodiesel is really unsatisfied when the country suffers from the soaring energy demands, and significantly improving the production capacity of biodiesel is very necessary for China’s sustainable development [13]. Chinese biodiesel industry is just at the primary stage within the global biodiesel development trend [4].

In China, the materials for biodiesel production are various and sufficient, namely, China has a brilliant potentiality in the production capacity of biodiesel. How to sufficiently utilize such abundant feedstock to obtain a satisfied production capacity, how to reasonably use such biodiesel in each region, and how to scientifically encourage the development of Chinese biodiesel industries are three primary issues for China, even for the countries who have China-hood issues. The mentioned issues will be deeply analyzed and discussed, beneficial information and conclusions will be provided in this paper. We hope such information and conclusions will draw the attentions of Chinese energy-policies makers for developing Chinese biodiesel industries in further.

2. Methods and data

The current situation of China's energy consumption and production are primarily reviewed in the present paper. And then it forecasts the future demand and the external dependency of energy in China. After analyzing the significance of developing biodiesel industry in China for the sustainable development, the important factors to the biodiesel production (including the

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