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# An overview of biofuels policies and industrialization in the major biofuel producing countries

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## ABSTRACT

Biofuels are important substitute for fossil fuel with the advantages such as sustainability, environmental friendly and good adaptability. In the last 10 years, biofuels development has been driven by the government policies. Many countries and areas have authorized laws and regulations to ensure the sustainable development of biofuels. By the support of the government, some biofuel projects have been commercialized. This paper reviews the national biofuel policies and strategy plans of the world's leading states, the government has provided sustained and cost-sharing privileges decreasing subsidies for the whole process from feedstock, from experimentation to industrialization of bioenergy industry in order to reduce investment risk. As a result of these supports, bioethanol and biodiesel have commercialized in several states, aviation biofuels are developing rapidly in the support of world's major airlines and US military. While there is political debate over the impact of biofuels on climate change and food security, it would be a challenge for the policy makers to continue trends of biofuels production while complying with sustainable production requirements.

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## 1. Introduction

Due to the development of economic globalization, the output and consumption of transportation fuels increase continually. Global primary energy consumption increased by 2.3% in 2013, and global oil consumption grew by 1.4 million barrels per day (b/d) or 1.4% to 91.3 million barrels per day, while total world proved oil reserves was 1687.9 billion barrels at the end of 2013, only sufficient to meet 53.3 years of global production [1]. Climate change is a vital challenge now, and by the estimate of the Intergovernmental Panel on Climate Change (IPCC), the global temperature will rise by 1.4–5.8 °C. The United Nations Framework Convention on Climate Change (UNFCCC) set the goal of keeping global temperature rises to be below 2 °C in 2012 [2], which needs to decrease the greenhouse gas (GHG) emission. Bioenergy is a low-carbon and sustainable energy, and is well adaptable for existing fuel storage systems and transportation equipment. Biofuels have already covered 2% of the total transportation fuels, and it is expected that the proportion of biofuels will be promoted rapidly with the development of science and technology [1].

## 2. Policy

Policy support must be the main driven force for the sustainable and healthy development of biofuels industry at the beginning, because biofuels industry is at the developing phase, it is less competitive than traditional energy in terms of high production cost, immature technology, poor supporting infrastructure, etc., but by the support of the government policy, in the last 10 years, the production of biofuels has increased dramatically, and from 2003 to 2013, the world fuel ethanol production experienced an increase from 6.4 to 23.4 billion gallons [3].

### 2.1. The United States

The United States, as a large producer of industrial commodities and supplier of agricultural products, is world's leader of the development of biofuels. The main driving forces for the development of biomass in the United States are: (1) to reduce dependence on oil imports and guarantee oil security; (2) to create more employment opportunities and develop agriculture; (3) to promote the development of low-carbon and sustainable economy; and (4) to explore new industries and new technologies so as to form a situation of diversified energy sources and production supply.

#### 2.1.1. Objectives of the biofuel development in the United States

In order to guarantee the national energy security, the United States put forward positive goals and clearly scheduled the development of biofuels, which greatly facilitated the development of biofuels. The Energy Policy Act of 2005 [4] established a renewable fuel standard (RFS), which was expanded by the Energy Independence and Security Act of 2007 (EISA2007) [5]. The RFS required that the use of renewable fuels should be increased from 9 billion gallons per year in 2008 up to 36 billion gallons per year in 2022 (Fig. 1). EISA2007 also set a strict limit on the total amount of greenhouse gas emissions to ensure environmental friendly and sustainability during biofuels producing processes. EISA2007 defined the advanced biofuel as biofuels produced from non-corn feedstock and with 50% lower lifecycle greenhouse gas emissions relative to gasoline. EPA is required

to set the renewable fuel standards each year based on the R&D and production of biofuels and assessments of production capability from industry. For example, the output goal of cellulosic ethanol was adjusted to 17 million gallons in 2014 from the 6 million gallons of 2013 [6]. In the long term, the renewable fuel standard may be proven even more significant than tax incentives formulated by the government in promoting the use of biofuels [7] (Table 1).

#### 2.1.2. Main policy for the development of biofuels in the United States

In order to promote the development of biofuels, the United States has authorized a series of laws and regulations related to renewable energy in recent years, including tax policies as well as financial supports and loan guarantees for R&D of biofuels and construction of biofuel plants. There are already more than 10 legislations related to renewable energy field so far. The Energy Tax Act of 1978 [8] passed as early as in 1978 provided investment tax credits for the renewable energy investors. The introduction of new laws and regulations is not only a supplement or adjustment to the originals, but more closely reflect the latest research and development results of technology and economic efficiency. In order to stimulate the development of new technology for the second and third generation biofuels, EISA2007 expanded renewable fuels standards, released advanced biofuels development objectives and provided \$550 million funding for reducing greenhouse gas emissions, R&D and commercial application of advanced biofuels [5].

To spur the low-carbon economy development, create more jobs and reduce the dependence on foreign oil to guarantee the nation energy security, Obama stated a series of new policies after he was elected as president in 2009. The American Clean Energy and Security Act of 2009 issued in 2009 was consisted of four parts: clean energy, energy efficiency, reduction of global warming pollution and transition to clean energy. The bill announced that the investment on clean energy technology and energy efficiency technology reached \$190 billion, of which \$90 billion for source efficiency and renewable energy, \$60 billion for carbon capture and sequestration technology. The bill also set a limit on the total GHG emissions in the United States as well as targets for renewable power generation by 2020 [9]. In the spring of 2012, President Obama started the "All-of-the-above energy" policy, to make a long-term strategy that uses every available source of energy—including oil, gas, wind, solar, nuclear, biofuels, and more. In this policy, the president would propose a \$2 billion program to aid research on alternative vehicle fuels like biofuels and fuel cells.

The U.S. biofuels policy mainly supports the R&D and industrialization of bioethanol and biodiesel. Gasoline suppliers who blend ethanol with gasoline are eligible for a tax credit of 45 cents per gallon of ethanol through the end of 2011 according to the Volumetric Ethanol Excise Tax Credit (VEETC) [7]. On August 2012, the U.S. Senate Finance Committee announced to provide tax credits of \$1.01 per gallon for cellulosic biofuel production, which extended to algae fuels, and of \$1 per gallon for biodiesel. The tax credit policy lasted for 1 year, which was actually traced back from December 31, 2011 to December 31, 2013. The legislations related to bioenergy are shown in Table 2.

The U.S. Department of Energy, the U.S. Department of Agriculture and other government departments initiatively involved in strategic research of biofuels formulated a detail program ranging from bioenergy raw materials to bioenergy products, and released

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