ISSN 2959-409X

Comparison and Alternative Feasibility of Biofuels with Other Fuels

Yingzi Li

Agricultural college, Shandong Agricultural University, Tai'an City, Shandong Province, 262500, China
Corresponding author: huishuang@ldy.edu.rs

Abstract:

In modern society, with the gradual rise of environmental protection requirements, various industries have paid attention to green environmental protection and sustainable development. Among them, the direction of fuel is particularly important. The renewable, environmental protection and high energy characteristics of biofuel make it a promising alternative fuel. Therefore, the advantages and disadvantages of biofuels compared with other fuels and the feasibility of alternative fuels are major issues that need to be understood. According to the existing research data, compared with other fuels, there are still some problems related to the cost and immature technology of biofuel, and there are also problems in its promotion and application. However, biofuel has excellent environmental protection, low carbon and sustainable characteristics, through policy support and technological development, most of the above problems will be solved, biofuel is still the most promising alternative fuel. Therefore, biofuels will replace other fuels to become the main energy in the future, sorting out the advantages and key development directions of biofuels compared with other fuels, and providing new ideas for fuel replacement and environmental protection.

Keywords: Biofuel, Conventional fuel, Environmental protection, sustainable

1. Introduction

As global climate change continues to intensify and traditional energy prices continue to fluctuate at a high level, biofuels have gradually attracted the attention of all countries. According to Statista, the global biofuel market is worth about $116.4 billion in 2022 and is expected to exceed $200 billion by 2030[1]. The International Energy Agency's 2023 medium-term oil Market report said that as the promotion of clean energy expands, the growth of global oil demand will slow significantly in the next few years, mainly because of the increase in the use of biofuels[2]. As a kind of sustainable energy that can replace the traditional fossil fuel, biofuel has attracted much attention from various countries. With the increasing demand for environmental protection and energy in society, the importance of environmental sustainability and energy security is growing. Traditional fuels can no longer meet people's growing needs, while biofuels provide the possibility of reducing carbon emissions and alternative energy. The world's attention is gradually shifting towards biofuels. The common point of the European Union and the United States' policies on biofuels is to promote the use of biofuels through mandatory addition legislation, and to encourage the use of high-grade biofuels with better emission reduction effects and no threat to food security. China has implemented bioethanol addition policy; Biodiesel has been introduced to expand pilot policies, but has not yet been widely forced to promote [3]. The global biofuel industry has the following characteristics: first, it relies on policy-driven growth, second, there is still a large room for growth in the future, third, the development of the raw material supply bottleneck, fourth, the development of the biofuel industry in each country depends on its policies and resource endowments, and fifth, it often becomes the object of trade protection policies [4]. Although China has made some progress in the promotion of biofuels and has certain biofuel production capacity, it still has the characteristics of small scale and loose distribution, and the promotion risk is high. China's understanding and demand for biofuels are very limited, so China's biofuel industry is in a very unfavorable position when facing foreign anti-dumping and other trade protection measures[5].

The comparative advantages and disadvantages of biofuels compared to other fuels, as well as the feasibility report of their use as alternatives, can better analyze the current status and next development direction of biofuels globally, as well as whether to adhere to the development path of biofuels as alternative fuels. This paper introduces the background of the current situation of global biofuels and introduces the definition and classification of biofuels and other fuels, as well as their advantages and disadvantages. It analyzes the feasibility of biofuels as an alternative fuel, and the parts of the biofuel industry that are insufficient

and still need to be developed, as well as the efforts that each country needs to make to develop biofuels.

2. Biofuels

2.1 Biofuels Definition and Types

biofuels generally refer to solid, liquid or gaseous fuels composed of or extracted from biomass, which can replace gasoline and diesel made from petroleum to a certain extent Biofuel has the characteristics of renewable, environmental protection, high calorific value and good safety, which is an important direction for the development and utilization of renewable energy, and is of great significance for reducing greenhouse gas[6]. It can also be used for transportation, power generation, heating and other industrial purposes.

According to the production sequence and feedstock type, biofuels can be classified into four generations (Fig. 1), and their development process is the evolution from traditional energy sources to more sustainable energy sources.

The first generation of biofuels, whose raw materials are corn, soybeans, sugar cane and other food crops, are converted into ethanol and bio-diesel through fermentation or refining processes. The production process of the first generation of biofuels is simple, but because of the large consumption of food crops, competition with food for arable land resources will cause food problems. As a result, an EU study has questioned the sustainability of conventional biofuels. A new European Commission draft report, Greenhouse Gas emissions from transport in the European Union: A route to 2050, states that conventional biofuels such as bio-diesel increase greenhouse gas emissions. And it's expensive. Not suitable as an alternative fuel. The study estimates that indirect effects are not considered. The cost of reducing emissions from biofuels will be 100 to 300 euros per ton of CO2.The second generation of biofuels very well circumvents the shortcomings of the first generation of biofuels, mainly using non-edible plants or waste biomass as raw materials, such as straw, bark and waste plants. The use of these raw materials reduces the impact on arable land and biodiversity and ameliorates environmental problems to some extent. biofuels upgraded to environmentally friendly energy sources. Third-Generation biofuels use specially grown algae as feedstock. Algae with high oil content have shown excellent characteristics in the production of bio-diesel. More importantly, algae can be cultivated and grown on non-arable land, further reducing the need for agricultural land. The latest is fourth-generation biofuels, which combine highly innovative gene-editing and nanotechnology. Fourth-generation biofuels not only extract energy from biomass, but also capture and store carbon dioxide in the atmosphere, which plays a very important role in the global carbon balance and can improve ecological climate issues.

From another perspective, the types of biofuels include bio-diesel, bio-ethanol, bio-methane and other types. Biodiesel is a fatty acid methyl ester (FAME) formed by esterification of vegetable oil, animal oil, waste oil or microbial oil with methanol or ethanol, or a second generation biodiesel (HVO) formed by hydrogenation[7]. The main component of hydrotreated vegetable oil is alkane, which has the same character as diesel oil. Bioethanol is produced by the fermentation of sugar in plants, mostly starchy plants as raw materials. Cellulosic ethanol is fuel ethanol produced from straw, crop hulls and stalks, leaves, fallen leaves, forestry scraps and urban and rural organic waste, and is an advanced bio ethanol. Bio methane, or purified biogas, is produced from the fermentation of agricultural waste and can be used to replace some fossil natural gas. The use of biofuels can effectively reduce carbon emissions. Replacing some fossil fuels with biofuels and reducing the consumption of fossil fuels can avoid the carbon emissions generated when these fossil fuels are burned. The carbon emissions generated by the combustion of biofuels can recover carbon dioxide from the atmosphere through the growth of crops and animals, so carbon can be recycled in nature.

2.2 Development Status and Prospect

As a sustainable energy alternative to traditional energy sources, the use of biofuels can effectively reduce carbon emissions, promote the realization of carbon peak and carbon neutrality goals, and provide the possibility of reducing greenhouse gas emissions and reducing dependence on fossil fuels. According to the EU Climate Law, the EU will be carbon neutral by 2050 and reduce net greenhouse gas emissions by at least 55 percent from 1990 levels by 2030. To this end, the EU has introduced 15 pieces of legislation, including the carbon border tax, collectively known as "Fit for 55", three of which are directly related to the use of biofuels added, including the Renewable Energy Directive (RED), the EU Renewable Aviation Fuel Regulation and the EU Ship Fuel Reduction Regulation. With the advance of the first generation of biofuels to the fourth generation of biofuels, biofuels are gradually reducing the dependence on food crops and the impact on the ecosystem, and continue to improve energy efficiency. This also shows that in the field of biofuels, we should not only adhere to the development of technology but also pay more attention to the sustainable use of energy and ecological environmental security. But most biofuels have higher unit production costs than fossil fuels, making them a policy-driven industry.

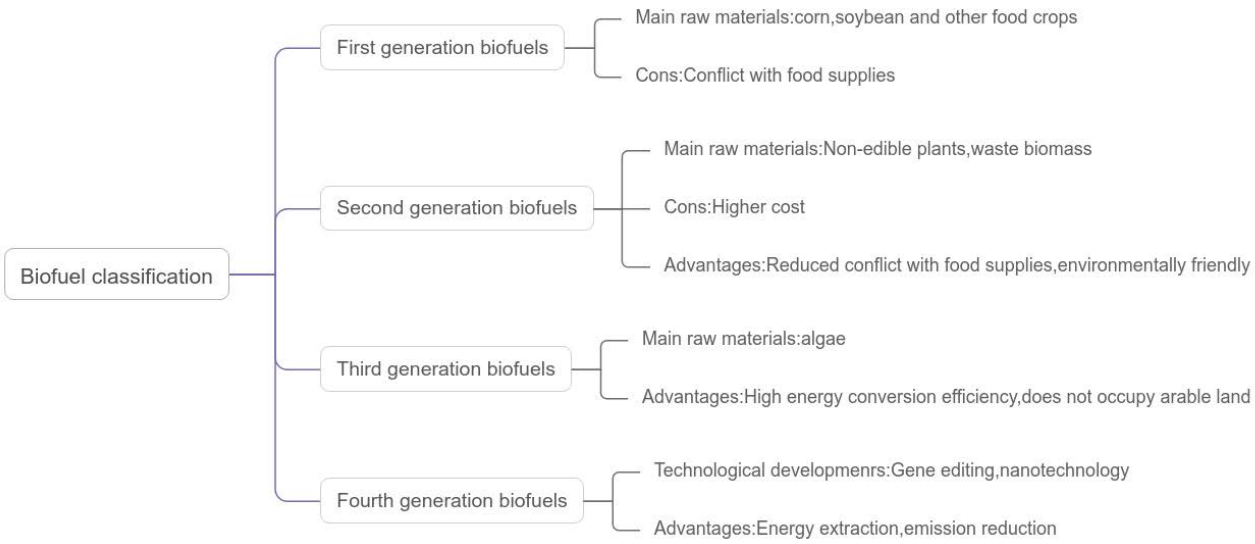

Fig. 1 Fourth generation biofuel

3. Other fuels

Other fuels are common solid fuel, liquid fuel, gas fuel and man-made fuel, nuclear fuel and so on. Refers to the ability to produce thermal chemical energy or kinetic energy of the substance, generally through combustion reaction to release energy. It is commonly used as an energy source in all areas of life.

Solid fuels are solid combustible substances that generate heat or provide power, mostly containing carbon or hydrocarbons. Naturally there are wood, peat, anthracite, oil shale and so on. After processing there are charcoal, coke, briquettes and so on. In addition, there are some special varieties of solid fuels, such as solid alcohol, solid rocket fuel and so on. Liquid fuel refers to a liquid combustible substance that can produce heat or kinetic energy. Contains mainly hydrocarbons or mixtures thereof. Naturally there is oil or crude oil. Processed into gasoline, kerosene, diesel and artificial petroleum. Gaseous fuels refer to gases that generate heat, including conventional and unconventional natural gas, that is, natural gas that cannot be extracted with conventional technology in a given period of time (such as coal bed methane, combustible ice, shale gas, etc). Nuclear fuel refers to the material that can produce practical nuclear energy through nuclear fission or fusion in a nuclear reactor. Such as uranium 233, uranium 235, deuterium, tritium and so on.

These fuels are still the most important source of energy for people's lives and the energy they produce supplies the vast majority of the world's energy industries. But with the development of The Times, the shortcomings of other fuels have gradually become magnified[8]. The exploitation of non-renewable energy is becoming more and more difficult, and the harm to the environment and ecology is also an urgent problem to be solved.

4. Biofuels and Other Fuels Comparative Analysis and Discussion

4.1 The Feasibility of Biofuels as an Alternative to Conventional Fuels

For the development and application of biofuels, the feasibility of biofuels replacing traditional fuels is a very important indicator[5]. Economic viability is a key factor, which includes production costs as well as market price and competitiveness considerations. Production costs, including raw material procurement, processing technology, energy consumption, and transportation and distribution, are the first important factor in assessing the economic viability of biofuels. For different types of biofuels, the raw materials and production processes are different, so the cost is not the same. In terms of market prices, the competitiveness of biofuels varies with the price of fossil fuels. When oil prices rise, biofuels become more attractive as an alternative, but when oil prices fall, biofuels become less competitive[9]. In addition, the economic feasibility of biofuels is also affected by scientific and technological developments. With the emergence of efficient production technologies and optimized biomass resource management, it is possible to reduce production costs and thus improve market competitiveness. For example, improved fermentation techniques, more efficient biomass pretreat-

ment methods, or more efficient thermochemical conversion techniques can all reduce the cost of Biofuel production.

Second, the environmental feasibility of biofuels. The impact of biofuels on ecosystems, greenhouse gas emissions and their contribution to biodiversity conservation are central considerations. The impact on the ecosystem is particularly important. Biofuel production involves large amounts of land and water resources and can put pressure on local ecosystems. For example, the production of first-generation biofuels often requires large areas of arable land, which can lead to the destruction of forests, the loss of biological habitats and the decline of biodiversity. In addition, fertilizers and pesticides used in agricultural activities can pollute water and soil. In contrast, second - and third-generation biofuels have less ecosystem impact due to the use of marginal land and non-food crops. Greenhouse gas emissions are another very important environmental assessment indicator. biofuels are considered an effective way to reduce greenhouse gas emissions because plants absorb carbon dioxide as they grow, which can offset emissions during combustion. However, the GHG balance along the entire production chain needs to be considered in an integrated way, including raw material production, processing, transportation and use. For example, if large amounts of fossil fuels are consumed in the production and transportation of biofuels, their environmental benefits may be significantly reduced.

Social viability is also a key aspect. Including but not limited to the impact on agricultural production and farmers, as well as public acceptance and education. In addition, overcultivation of Biofuel crops can lead to homogenization of land use, which affects soil quality and agricultural sustainability. The successful promotion of biofuels basically depends on public awareness and acceptance. The market environment and economic advantages of biofuels should be widely publicized, as well as their role in reducing dependence on fossil fuels and combating climate change. Through education and awareness campaigns on biofuels, the public's understanding of the definition, production process and environmental impact of biofuels is deepened. Provision of information in schools and mass media as well as participation and dialogue at the community level. Through education and participation, all sectors of society can better understand the challenges and prospects related to biofuels and thus support their development.

4.2 The Advantages and Prospects of Biofuel Compared with Other Fuels

The development of new biofuels as alternative energy sources shows positive prospects, as the fastest growing field of alternative energy, its environmental protection, low carbon and sustainability have been recognized by the market and experts. At present, Biofuel is the only renewable energy that can exist in three forms: gas, solid and liquid, which is unmatched by other renewable energy sources[10]. They have significant advantages in reducing greenhouse gas emissions, increasing energy diversity and supporting agricultural sustainability. Success stories from around the world further demonstrate the important role of biofuels in achieving energy transition and promoting green development. Economic, environmental and social analyses show that, despite the cost and technical challenges, progress is being made in the promotion and application of biofuels. Therefore, the comparison between Biofuel and other fuels can be seen that Biofuel has better development prospects and potential than other fuels. In the future, through policy support and technological innovation, biofuels are expected to occupy a more important position in the global energy mix.

In the subsequent era of development, with the increasingly severe threat posed by climate change to human society, biofuels are gradually developing as part of the global energy supply system. In the future, the world's major economies are gradually approaching the goal of carbon peak and carbon neutrality, and the trend of energy-green transformation is more intense, and more possibilities will be placed on biofuels. More development of Biofuel technology, experimenting with new feedstock plants, shifting the focus away from food crops such as corn. Develop new production technology to reduce cost consumption (achieve scale: reduce costs, improve efficiency, occupy the market). Vigorously developing Biofuel as an alternative energy source is an important means to solve the world energy crisis.

5. Conclusion

Compared with other fuels, biofuels have significant advantages in reducing carbon emissions and improving global ecological issues. The promotion and utilization of biofuels around the world is an inevitable result. The development of first-generation biofuels to fourth-generation biofuels is reflected in the continuous reduction of the dependence on food crops and the impact of biofuels on ecosystems and in the improvement of energy efficiency. This shows that in the field of biofuels, we should adhere to the development of technology and pay attention to the sustainable use of energy and ecology. The economic feasibility, environmental feasibility and social feasibility of biofuels are shown in positive aspects. Even compared with other renewable resources, biofuels still have a big advantage. This paper mainly directly analyzes the ad-

vantages and excellent development prospects of biofuels compared with other fuels, which can help readers understand the current situation and future development trend of biofuels. At present, there are still various problems caused by insufficient technology for biofuels, the most common one being cost. The biofuel industry is still not fully mature. In the future, with the further development of biofuel technology and the promotion of various national policies, biofuels will play a decisive role in solving the world energy crisis as an alternative energy source.

References

[1] ShuLi Wang. Global biofuel development: the path of green energy exploration under the new situation[N]. China Petroleum News,2023-08-29(005).DOI:10.28716/n.cnki.nshyo.2023.001854.

[2] Dan Zhou. Development potential of biofuels in China [J]. China and Foreign Energy,2023,28(08):57.

[3] Tao Wang.Comparative analysis and implications of biofuel policies in Europe and America [J]. International Petroleum Economy.,2024,32(05):42-52.

[4] Tao Wang. Characteristics of domestic and foreign biofuel industry development and its implications for China [J]. International Petroleum Economy.,2024,32(06):51-61.

[5] Qiang Li. Feasibility of new biofuels replacing traditional fuels [J]. Science and Technology Information of China.,2024,(07):116-118.

[6] Ye Y ,Guo W ,Ngo H H , et al.Biofuel production for circular bioeconomy: Present scenario and future scope.[J].The Science of the total environment,2024,935172863-172863.

[7]]Hidalgo K ,Giachini A ,Schneider M , et al.Recent advances in bioremediation of biofuel blends[J].International Biodeterioration & Biodegradation,2024,188105750-.

[8] H. C G ,Joonjae R ,T. C M .The future of biofuels in the United States transportation sector[J].Renewable and Sustainable Energy Reviews,2024,192114276-.

[9] Bórawska B A .Performance of the Polish Biofuel Industry after Accession to the European Union in the Area of Sustainable Development Concepts[J].Energies,2023,16(22):

[10] Din U Z S ,Somvir B ,Arti D , et al.Nanotechnology based technological development in biofuel production: Current status and future prospects[J].Enzyme and Microbial Technology,2023,171110304-110304.