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Exploring Ways to Green Aviation Energy and Reduce Carbon Emissions in Civil Aviation in China

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Abstract: The rapid expansion of China's civil aviation industry has brought about economic prosperity, but it has also exposed the growing problem of carbon emissions. To meet the challenge of climate change and promote the process of sustainable development, China's civil aviation industry is actively exploring innovative ways to green aviation energy and reduce carbon emissions. These include utilizing renewable energy, promoting the use of renewable aviation fuels, applying energy-saving and emission-reduction technologies, and conducting carbon capture and offsetting. Through these efforts, they will help significantly reduce carbon emissions and make an important contribution to the fight against climate change, as well as open up a new path for the sustainable development of China's civil aviation industry.

Keywords: Civil Aviation of China; green aviation energy; emission reduction and carbon offsetting; exploring pathways

Introduction

Over the past decades, China's civil aviation industry has made remarkable achievements. However, with its rapid development, the environmental problems brought about by air transportation have become increasingly serious, especially the increase in carbon emissions. In the face of this challenge, China's civil aviation has been actively exploring innovative ways to green aviation energy and reduce carbon emissions and is committed to promoting the aviation industry in a more environmentally friendly and sustainable direction.

1. The Current Situation of Carbon Emissions in China's Civil Aviation

The rapid development of China's civil aviation industry has brought great economic benefits, but it has also generated carbon emission problems. Professional research data show that carbon emissions from aircraft aviation fuel combustion account for nearly 80% of total civil aviation carbon emissions. With the prosperity of the aviation industry, the number of airplanes is increasing, and flight mileage is also growing, resulting in a continuous rise in carbon emissions from combustion (You et al., 2022). Long-haul flights, in particular, require large amounts of fuel, further exacerbating the carbon emissions problem. In addition, ground facilities such as airports, airline office buildings, and maintenance facilities also require large amounts of energy supply, which is also one of the important sources of carbon emissions. Currently, the civil aviation industry mainly uses traditional fuels such as kerosene and aviation gasoline, which release a large amount of greenhouse gases such as carbon dioxide during combustion (Liu et al., 2017), directly leading to an increase in carbon emissions. The use of traditional fuels also has safety hazards in storage and transportation, as well as poor stability due to fluctuations in the international crude oil market.

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2. The Importance of Exploring the Green Aviation Energy and Emission Reduction and Carbon Reduction Pathway of Chinese Civil Aviation

2.1. Improvement of energy utilization rate

Civil Aviation of China can effectively improve the energy utilization rate by actively adopting green aviation energy and emission reduction and carbon reduction technologies. Traditional aviation fuels mainly rely on fossil energy sources such as oil, which are limited and produce large amounts of greenhouse gas emissions. Through the introduction of new clean energy sources such as bio-fuels and electric power, it is possible to diversify the aviation energy supply, reduce the over-reliance on traditional fuels, and increase the diversity and flexibility of energy utilization. At the same time, new clean energy sources usually have higher energy utilization efficiency. For example, the production process of bio-fuels can utilize crop residues, waste oil and grease, and other resources, while electric power can directly convert energy into power output, which is more efficient than traditional fuels. The application of these clean energy sources can achieve lower energy consumption and higher energy utilization in the aviation field, as well as help reduce carbon emissions and protect the environment (Liu, 2023). In addition, the introduction of new energy technologies will also give rise to related industrial chains, further promoting the comprehensive utilization of energy resources. For example, the production of bio-fuels requires a large number of biomass resources, which will lead to the development of agricultural waste utilization, biomass energy development, and other related industries; the promotion of electric power technology will also lead to the development of batteries, electric motors, and other emerging industries, and promote the comprehensive utilization and recycling of energy resources.

2.2. Protecting the ecological environment

Exploring the ways of green aviation energy and carbon reduction in China's civil aviation is conducive to the protection of the ecological environment. The aviation industry is one of the important sources of greenhouse gas emissions, and the impact of carbon dioxide, nitrogen dioxide, and other emission substances in the exhaust of airplanes on the greenhouse effect of the atmosphere cannot be ignored. By introducing new types of clean energy such as bio-fuels and electric power, the greenhouse gas content of aircraft exhaust emissions can be reduced, the adverse impact of climate change on the ecological environment can be slowed down, and it is conducive to maintaining the global ecological balance and climate stability. Meanwhile, traditional aviation fuels mainly come from fossil energy sources such as petroleum, whose extraction and utilization have caused serious damage to the natural environment, such as desertification of land and pollution of water resources caused by oil field development. The introduction of new clean energy sources can reduce the dependence on traditional fuels and the consumption of natural resources, which is conducive to the protection of the integrity of land, water, and other natural ecosystems. In addition, the nitrogen oxides, particulate matter, and other emissions in aircraft exhaust have a certain impact on air quality and the ecological environment, and the introduction of new energy technologies can reduce the emission of these harmful substances and improve air quality, which is conducive to human health and the virtuous cycle of the ecological environment.

2.3. Sustainable economic development

In the current context of global economic integration, air transportation is an important mode of transportation linking the world, and its development has a far-reaching impact on the economy. Promoting green aviation energy and reducing carbon emissions, can provide strong support for China's civil aviation industry to realize sustainable economic development. On the one hand, the introduction of green aviation energy and emission reduction and carbon reduction technologies can help reduce fuel costs and improve the operational efficiency of airlines (Yan, 2020). The price of traditional aviation fuel fluctuates greatly, which puts greater pressure on the cost of airlines.

The use of green aviation energy can reduce the dependence on traditional fuels, which not only reduces the sensitivity to the fluctuation of international oil prices but also promises to reduce the production cost of new energy through technological progress and scale effect, thus reducing the fuel expenditure of airlines and enhancing operating profits. On the other hand, promoting green aviation energy and reducing carbon emissions can enhance the international competitiveness of China's civil aviation industry. As the global awareness of environmental protection rises, countries have put forward higher requirements on greenhouse gas emissions and environmental impacts of the aviation industry. China's active introduction and application of green aviation energy and emission reduction and carbon reduction technologies can not only enhance the environmental image of its civil aviation industry, but also gain more recognition in the international aviation market, expand overseas market share, enhance international competitiveness, and lay a solid foundation for the sustainable development of China's civil aviation industry. In addition, the promotion of green aviation energy and emission reduction and carbon reduction technologies will also give rise to new industrial chains and employment opportunities, and promote the optimization and upgrading of economic structure. From the planting, and production to distribution of bio-fuels, to related scientific research and technology improvement, it will lead to the development of a series of related industries, create more employment opportunities, promote economic growth, facilitate the transformation and upgrading of related industries, and realize sustainable economic development.

3. China's Civil Aviation Green Aviation Energy and Emissions Reduction and Carbon Reduction Path to Explore

3.1. Utilization of renewable energy

In the exploration of green aviation energy and carbon reduction, "utilizing renewable energy" is one of the most important ways. It is a common practice to build solar power stations and wind power generation facilities inside airports. By installing solar photovoltaic panels and building wind power generation facilities in parking lots and runway areas, solar and wind energy is converted into electricity to provide clean, renewable energy for the airport's electrical equipment. This not only effectively reduces reliance on traditional energy sources and lowers greenhouse gas emissions, but also helps improve the efficiency and sustainability of energy utilization at airports. In addition, civil aviation of China is actively exploring other forms of renewable energy utilization. For example, using geothermal energy as a source of energy to power airports through geothermal power stations; or utilizing tidal energy, biomass energy, and other forms of renewable energy for air transportation energy supplementation. These renewable energy sources are infinitely renewable and can continuously provide airports with a clean and reliable energy supply and reduce the consumption of traditional energy sources and environmental impact (Liu, 2020).

3.2. Innovative aviation fuels

Civil Aviation of China actively carries out scientific research and technological innovation in innovative aviation fuels and works closely with universities, research institutions, and enterprises to develop and improve more environmentally friendly and efficient aviation fuels. During the research process, emphasis is placed on the renewability, cleanliness, and airworthiness of aviation fuels to find more environmentally friendly and efficient aviation fuel formulations. In addition to the traditional kerosene fuel, the Civil Aviation of China actively promotes the diversification of aviation fuels and explores the application of new types of aviation fuels such as bio-fuels and synthetic fuels (Liu & Wang, 2022). Bio-fuels can be extracted and transformed from agricultural and forestry wastes such as crop stalks and oil-seed crops, which are more renewable and environmentally friendly; synthetic fuels can be prepared from raw materials such as synthetic gas or biomass, which are characterized by lower carbon and pollutant

emissions. The development and application of these new fuels will help reduce dependence on traditional petroleum resources and lower greenhouse gas and particulate emissions. In addition, Civil Aviation of China has continued to explore innovative ways to combine renewable energy with aviation fuel. Renewable energy sources such as solar energy and wind energy are utilized to produce hydrogen, which is used as an alternative to aviation fuel, to realize the greening of aviation fuel and reduce carbon emissions. At the same time, the Civil Aviation of China is also studying the use of biomass energy sources, such as bio-diesel and bio-methanol, as a substitute for aviation fuels to reduce the pressure on traditional petroleum resources.

3.3. Application of energy-saving and emission-reduction technologies

Civil Aviation of China actively applies energy-saving and emission-reduction technologies in the areas of green aviation energy and carbon reduction to reduce the impact of air transportation on the environment. First, Civil Aviation of China actively promotes the application of energy-saving and emission-reduction technologies in aircraft design and manufacturing. Through the introduction of advanced materials and lightweight design, the aircraft structure and engine design are optimized to reduce the self-weight and air resistance of the aircraft and improve the fuel utilization rate of the aircraft (Wang et al., 2023). At the same time, Civil Aviation of China is also promoting the development and use of a new generation of energy-efficient aircraft, such as the use of more energy-efficient turbofan engines and large composite structures, to realize the improvement of the overall performance of aircraft and the reduction of fuel consumption. Secondly, Civil Aviation of China has continuously introduced advanced energy-saving and emission-reduction technologies in aviation operations and management. By optimizing flight trajectories, improving weather forecasting and weather protection systems, and promoting refined aviation operation management, it achieves the best operating conditions for aircraft and reduces fuel consumption and emissions during flights. Meanwhile, Civil Aviation of China also actively promotes technologies such as single-engine takeoffs and landings, ground power supply, and intelligent control of auxiliary power units (APUs) to reduce energy consumption and emissions during ground operations. Once again, the Civil Aviation Administration of China has also actively explored energy saving and emission reduction in aviation fuels. By promoting the use of new aviation fuels such as bio-fuels and synthetic fuels instead of traditional petroleum fuels, greenhouse gas, and particulate emissions are reduced (Xie, 2021). Meanwhile, the Civil Aviation of China has also conducted research to promote the efficient utilization and recycling of aviation fuels to reduce the waste and improper use of aviation fuels. Finally, Civil Aviation of China is also making improvements in energy conservation and emission reduction of aviation facilities and equipment. It reduces energy consumption and emissions from aviation ground operations by promoting the use of advanced aviation ground equipment and developing energy-saving and emission-reducing aviation facilities and equipment, such as new aircraft roll-out trolleys, electric aircraft tractors, and intelligent lighting systems.

3.4. Carbon capture and offset

In its exploration of green aviation energy and carbon reduction, the Civil Aviation Administration of China has actively addressed the impact of air transportation on the environment through the important approach of “carbon capture and carbon offset”. In terms of carbon capture, Civil Aviation of China is committed to capturing and reducing carbon dioxide and other greenhouse gas emissions during air transportation. The main methods include promoting the use of low-carbon or zero-carbon fuels, such as biofuels and synthetic fuels, in place of traditional petroleum-based fuels, to reduce the amount of carbon dioxide and other greenhouse gases emitted by the combustion of fuels in aircraft. In addition, the Civil Aviation Administration of China is also researching and promoting technologies to capture aircraft exhaust emissions, collect and treat

emissions from exhaust gases during aircraft takeoffs and landings, ground operations, and other aspects of aircraft operation, thereby reducing pollution of the atmosphere. In the area of carbon offsetting, the Civil Aviation Administration of China is committed to exploring how to compensate for carbon emissions caused by air transportation through a series of measures. One effective way is to increase the capacity of forests and wetlands to absorb carbon dioxide by promoting eco-environmental protection programs such as reforestation and forest protection, to compensate for the carbon emissions generated by air transportation. In addition, Civil Aviation of China is also actively exploring the development of market-based mechanisms such as carbon trading and carbon emission quota trading, encouraging enterprises and individuals to participate in carbon emission reduction and carbon compensation by purchasing carbon emission quotas or participating in carbon sink projects, etc. to achieve carbon emission compensation and reduction.

In addition to this, Civil Aviation of China is also actively exploring and advocating the participation of airlines and passengers in carbon-neutral programs. Through donations to support renewable energy projects, conducting carbon-neutral certified flights, and providing carbon-neutral services, carbon emissions from air transportation are compensated. At the same time, Civil Aviation of China is also pushing airlines and related companies to increase their efforts in scientific and technological innovation and to develop more energy-efficient and environmentally friendly aircraft and aviation equipment, to reduce the negative impact of air transportation on the environment. By exploring the above avenues, Civil Aviation of China is striving to promote the green and sustainable development of air transportation and to promote greater effectiveness in green aviation energy and carbon reduction.

Summarize

To summarize, China's civil aviation industry has achieved a series of results in green aviation energy and emission reduction and carbon reduction, as well as significant progress in renewable energy utilization, aviation fuel innovation, energy-saving and emission reduction technology application, and carbon capture and carbon offsetting. These efforts will not only help Civil Aviation of China reduce its negative impact on the environment but will also promote the sustainable development of the aviation industry and contribute to building a clean and low-carbon air transportation system. These achievements and progress demonstrate the commitment and determination of China's civil aviation industry to the goal of sustainable development and provide lessons and inspiration for the green development of the global aviation industry.

Conflict of Interest

The authors declare that they have no conflicts of interest to this work.

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