Research on Virtual Game Innovation under the Background of Carbon Neutralization and Sustainable Development

Xizhen Ning[*]

College of Communication, White City, Royal College of Art, London, UK

ningxizhen5648@126.com

[*]*corresponding author*

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Abstract: With the increasing global concern about climate change, carbon neutrality and sustainable development have become important issues in the global society. As a new form of entertainment, virtual games have great potential to promote the concept and action of sustainable development. The purpose of this paper is to study the innovation of virtual games under the background of carbon neutrality and sustainable development, and to explore the application of virtual games in education, publicity, social participation and technological innovation, as well as their potential impact on the goal of sustainable development.

1. Introduction

Under the background of increasingly severe global climate change, carbon neutrality has become an important topic and focus of attention around the world. The emission of greenhouse gases and energy consumption have caused great pressure on the earth's environment and ecosystem, and it is urgent to take action to reduce these unsustainable effects. Therefore, the global community responded positively and put forward the concept and goal of carbon neutrality, aiming at achieving zero net emission, that is, by reducing emissions and taking compensation measures to achieve a state of carbon balance. At the same time, as a new form of entertainment, virtual games are increasingly favored by the public. The characteristic of virtual game is to create a virtual world through computer technology, so that players can interact and experience in it. The audience of virtual games is huge, including players of all ages and backgrounds. It has become a media for widespread communication and social interaction. It is of great research significance and practical value to combine carbon neutrality and sustainable development with the innovation of virtual games. As a brand-new form of entertainment, virtual games provide new channels and ways to

spread the concept of carbon neutrality and sustainable development. Through the innovative design and interaction of virtual games, more players can be attracted to participate in the theme and action of sustainable development, thus expanding their cognition and influence on sustainable development. Secondly, virtual games have the characteristics of simulation and experiment, which can provide a virtual environment for players to experience and learn knowledge and skills about carbon neutrality and sustainable development. Through the innovative application of virtual games, players' environmental awareness and sustainable development thinking mode can be cultivated, thus promoting the realization of sustainable development goals[1-3].

Combining carbon neutrality and sustainable development with the innovation of virtual games will help to explore new ways and possibilities, promote the process of sustainable development, and provide new ideas and strategies for achieving the goal of carbon neutrality.

2. Overview of Carbon Neutrality and Sustainable Development

2.1 The Concept and Significance of Carbon Neutrality

2.1.1 The Concept of Carbon Neutrality

Carbon neutrality means to achieve the goal of zero net emission by reducing or offsetting the emitted carbon gas, as shown in Figure 1. Its core idea is to take measures to offset or balance these emissions in the process of producing carbon emissions, so as to reduce the contribution to the concentration of carbon dioxide in the atmosphere. The main means of carbon neutrality include reducing emission sources, improving energy efficiency, using low-carbon technologies and energy substitutes, carbon capture and storage technologies, and realizing carbon emission compensation through afforestation.

Carbon emission is one of the main greenhouse gases, and the increase of greenhouse gases is one of the main reasons leading to global warming. By achieving carbon neutrality, greenhouse gas emissions can be effectively reduced, thus slowing down the speed and impact of climate change and creating a more sustainable environment for human beings and ecosystems. A large amount of carbon emissions will lead to the accumulation of carbon dioxide in the atmosphere, which will further aggravate global warming and climate change. This has a negative impact on the stability of the ecosystem and biodiversity. Through carbon neutral measures, carbon emissions can be reduced, the pressure on the ecosystem can be reduced, and the ecological balance can be protected and restored. The implementation of carbon neutrality needs to adopt innovative technologies and the use of sustainable energy to promote energy transformation and green economy development. This will help to reduce dependence on limited natural resources, improve resource utilization efficiency and promote sustainable economic growth. Carbon neutrality can also create economic opportunities for enterprises and society, and stimulate innovation and green industry development (Figure 1).[4].
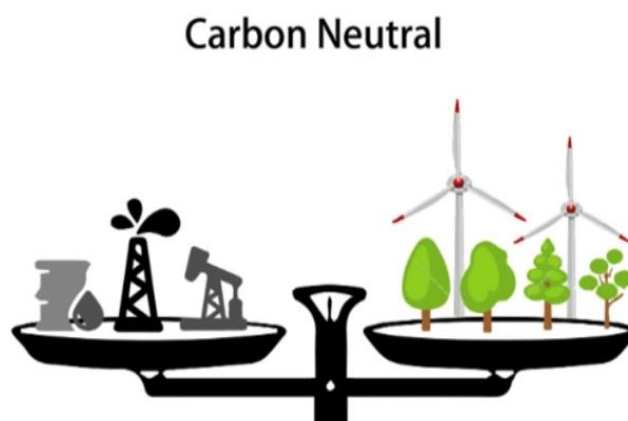
Figure 1. Carbon Neutralization

2.1.2 The Significance of Carbon Neutralization

Carbon neutrality is of great significance for coping with climate change and reducing greenhouse gas emissions. According to the scientific research and suggestions of international think tanks, the world needs to achieve net zero emissions in the middle of this century to curb global temperature rise and avoid catastrophic consequences. As a goal and action framework, carbon neutrality guides countries, enterprises and individuals to take measures to reduce the emissions of greenhouse gases such as carbon dioxide, including energy transformation, energy efficiency improvement, renewable energy development, and the application of carbon capture and storage technologies. By implementing carbon neutrality, we can slow down the impact of climate change, protect the stability of ecosystem and maintain the sustainable development of human society.[5].

The traditional energy industry relies on fossil fuels, which leads to a large number of greenhouse gas emissions. However, through the goal and practice of carbon neutrality, people are forced to find alternative energy sources and technologies to reduce carbon emissions. This will promote the development and utilization of renewable energy, such as solar energy and wind energy, and accelerate the research and application of technologies such as energy storage and smart grid. In addition, carbon neutrality also encourages energy efficiency improvement and energy management measures to improve resource utilization and reduce energy consumption. Through energy transformation and innovation, carbon neutrality brings new growth opportunities to the economy and creates new jobs and market demand for employment.[6].

Climate change is a global challenge and no country can solve it alone. Carbon neutrality has become the common goal of the international community, which has inspired countries, enterprises and citizens to take active actions. International cooperation and coordination have become an important means to achieve carbon neutrality. For example, through the carbon market mechanism, countries can trade carbon emission reduction quotas to minimize the cost of emission reduction and accelerate the implementation of carbon emission reduction measures. At the same time, developed countries should provide support and assistance to developing countries in carbon emission reduction and technology transfer to ensure the common realization of global carbon neutrality.

Carbon neutrality also has positive social and economic significance. On the one hand, carbon neutrality promotes the concept and practice of sustainable development, and helps to improve the living environment and improve the quality of life of residents. For example, promote clean energy and low-carbon transportation, reduce air pollution and noise pollution, and improve the health status of urban residents. On the other hand, carbon neutrality also creates business opportunities

and markets for innovation and green industries. Taking carbon capture and utilization technology as an example, it can not only reduce the concentration of carbon dioxide in the atmosphere, but also transform it into useful products.[7]Such as building materials, chemicals and fuels, bring new opportunities and competitive advantages to economic development.

Many existing low-carbon technologies and renewable energy sources are still relatively expensive, and further research and innovation are still needed to reduce costs. At the same time, in energy-intensive industries and developing China countries, the resources and technical support needed for transformation and investment are also scarce. Secondly, the uncertainty of laws, regulations and policy environment may also affect the implementation and promotion of carbon neutrality. Clear objectives, regulations and incentives should be formulated to provide stable market expectations and support for enterprises, institutions and individuals. In addition, monitoring, reporting and verifying carbon emission reduction actions and ensuring brightness and reliability are also key issues in the process of carbon neutralization.[8].

Carbon neutrality is of great significance, aiming at meeting the challenge of global warming. It not only helps to protect the environment, cope with climate change, promote energy transformation and innovation, but also promotes the importance of international cooperation and shared responsibility. Therefore, carbon neutrality has also created positive opportunities and development prospects for society, economy and employment. However, the implementation of carbon neutrality still faces challenges in terms of technical cost, environment and monitoring and verification, which need global coordination and action to deal with. Through joint efforts, we can achieve the goal of carbon neutrality and create a healthier and sustainable earth home for the future.[9].

2.1.3 Principles and Objectives of Sustainable Development

Sustainable development refers to meeting the current needs without compromising the ability to meet the needs of future generations. It is a comprehensive development concept, aiming at balancing environmental, social and economic needs to achieve long-term sustainability, as shown in Figure 2. The following is a detailed description of the principles of sustainable development[10]:

(1) Environmental balance: Sustainable development emphasizes environmental protection and sustainable utilization, ensuring the rational utilization of natural resources and the health of ecosystems. In principle, human activities should be coordinated with the natural environment to avoid excessive damage and pollution to the environment.

(2) Social justice: sustainable development requires social justice and equality, paying attention not only to economic growth, but also to people's well-being and social equity. This means that in the process of economic development, human rights, social justice and public participation should be guaranteed, and social inequality and exclusion should be reduced.

(3) Economic feasibility: Sustainable development requires economic feasibility, that is, economic development should be carried out in a sustainable way, considering not only short-term economic benefits, but also long-term economic stability and sustainability. This requires a balance between economic growth and resource utilization efficiency, innovation and ecological environment protection (Figure 2).[11].

Figure 2. Principles of sustainable development

The goal of sustainable development is to meet the needs of the current generation without compromising the ability of future generations to meet their needs. It includes three main objectives: economic development, social progress and environmental protection.

(1) Economic development: Sustainable development aims at achieving sustained economic growth and prosperity and improving people's living standards and quality. This includes promoting the creation of employment opportunities, promoting innovation and technological development, and improving production efficiency and resource utilization efficiency. Sustainable economic development pursues long-term economic stability and sustainability, and avoids over-exploitation of natural resources and environmental damage. (2) Social progress: The goal of sustainable development also includes the promotion of social justice and inclusiveness. It emphasizes the equality of people's rights and opportunities, including education, health, gender equality, poverty reduction and social inequality. The goal of social progress of sustainable development is to ensure that everyone enjoys dignity and opportunities, regardless of gender, race, identity or location[14].

(3) Environmental protection: Sustainable development seeks to protect and restore the health of the ecosystem and reduce the adverse impact on the environment. It emphasizes taking measures to reduce pollution, protect biodiversity, rationally utilize natural resources and promote the use of renewable energy. The environmental protection goal of sustainable development is to ensure that the earth's ecosystem can be maintained for a long time and provide suitable environmental conditions for future generations.[12].

3. Virtual Game Innovation

3.1 The Innovation Potential of Virtual Games

As a form of entertainment, virtual games have unique advantages and potential, and can play an important innovative role in the context of carbon neutrality and sustainable development.

(1) Realistic simulation environment: Virtual games can create a highly realistic simulation environment, so that players can experience different situations and scenes on the spot. This makes virtual games an ideal platform to simulate the challenges and solutions related to carbon neutrality and sustainable development.[13].

(2) Practice and experiment space: Virtual games provide a space for players to practice and experiment. They can try different strategies and actions in the virtual environment and observe their results and effects. This practical learning method can help players better understand the concepts of carbon neutrality and sustainable development, and cultivate their ability to take sustainable actions in real life.

(3) Interaction and cooperation: Virtual games are highly interactive and cooperative, and players can interact and cooperate with other players or virtual characters. This social game experience can promote knowledge sharing, collaboration and teamwork among players, and help solve the complex problems faced by carbon neutrality and sustainable development.

(4) Incentive mechanism: Virtual games usually use incentive mechanisms, such as task rewards, achievement systems and leaderboards, to stimulate players' active participation and efforts. This incentive mechanism can encourage players to take sustainable actions in the game and get corresponding rewards and recognition.

3.2 Characteristics of Virtual Game Innovation

(1) immersive experience: Virtual games can make players feel immersive by introducing a variety of sensory experiences such as vision, hearing and touch. This immersive experience can increase players' participation, make them more involved in the game world, and have a deeper cognitive and emotional connection with the environment and tasks in the game. Virtual game innovation is usually driven by technological progress and innovation. With the continuous development of computer graphics technology, virtual reality and artificial intelligence, game developers have more creative tools and platforms, which can create a more realistic and immersive virtual game experience. Virtual game innovation is usually driven by technological progress and innovation. With the continuous development of computer graphics technology, virtual reality and artificial intelligence, game developers have more creative tools and platforms, which can create more realistic and immersive virtual game experiences.

(2) Autonomy and individuation: Virtual games usually have the characteristics of openness and nonlinearity, and players can freely choose the tasks and activities they are interested in. This independent and personalized game experience can meet the needs and interests of players and enhance their participation and sense of involvement. Virtual game innovation tends to cross-border cooperation and creative combination in different industries. They integrate music, movies, literature, art and other elements into the game, creating a unique theme and style of the game. This cross-border cooperation not only brings new inspiration and content to the game, but also expands the audience of the game.

(3) Virtual games provide opportunities for interaction and cooperation with other players, and can promote communication and interaction among players through social functions, online chat and multiplayer games. This social interaction not only increases the fun of the game, but also encourages players to participate in teamwork and common goals in the game. Virtual game innovation emphasizes the interaction and sociality between players. Players in the virtual world can interact and cooperate with other players through multiplayer online games, social platforms, real-time communication and other functions. This interactive and social experience makes players feel more involved and enhances the fun and playability of the play.

3.3 Research on Virtual Game Innovation

(1) Technological innovation: Virtual game innovation research focuses on the innovation and application of game technology. For example, the application of virtual reality (VR), augmented reality (AR) (Figure 3) and mixed reality (MR) (Figure 4) technologies in games, and the

role-playing and behavior generation of artificial intelligence in games are studied. These studies aim to improve the immersion, realism and interactivity of virtual games.

(2) Game design innovation: The research of virtual game innovation focuses on the novel and innovative ways of game design. It involves innovative research in game mechanism, level design, task design and role design. This study aims to provide a compelling game experience, challenge the traditional rules of the game, and improve players' participation and satisfaction.

Figure 3. Augmented Reality (AR) Technology

Figure 4. Mixed reality (MR) technology

(3) User experience research: Virtual game innovation research focuses on the improvement and innovation of user experience. It includes user interface design, interactive design and emotional design. Researchers try to understand the players' perception, emotion, cognition and behavior of the game, and use these understandings to improve the game. 4. Cross-media innovation: The research on virtual game innovation involves cross-innovation between virtual games and other media. For example, the film, music, literature, art and other elements into the game, a unique game experience. In addition, this field also studies the integration and interaction between games and social media, audio and video platforms and other media.

(4) Social and cultural research: the social and cultural impact of virtual games on creating games. It discusses the shaping role of game pairs, values, social identity and cultural identity. Researchers consider social and cultural factors to promote the cumulative benefits of games.

Research on sustainable development: The research on virtual game innovation includes the

research on the sustainable development of games. It explores ways to reduce the consumption of energy, resources and environment by games, and promotes the sustainable use of games in education, health and social welfare.

3.4 Virtual Game Innovation Case

GreenQuest is a virtual game with the theme of sustainable development and carbon neutrality, which aims to educate players about the importance of carbon neutrality and inspire them to take practical actions to reduce carbon emissions and protect the environment. In the game, the player plays the role of an environmental protection agent and accepts various tasks and challenges to promote the practice of carbon neutrality. The innovation research of virtual game is not limited to the theoretical and conceptual level, but also involves empirical research, case analysis, market research and other methods. Through these research methods, researchers can obtain information about the innovation trend of virtual games, user needs, business models and strategies, and provide practical guidance and decision-making suggestions for the development of virtual game industry. As shown in fig. 5.

Figure 5. Virtual game example

The game educates players about the importance and actions of carbon neutrality in the following ways:

(1) Tasks and challenges: Players will receive various tasks and challenges, involving energy consumption, transportation mode, resource management and so on. For example, players need to optimize energy use, improve building energy efficiency and promote the application of renewable energy to reduce carbon emissions. By completing these tasks, players will gradually understand the concept and practice of carbon neutrality and learn how to take sustainable actions in real life.

(2) Virtual simulation environment: The game provides a virtual simulation environment in which players can conduct carbon emission simulation and experiments. They can adjust different factors, such as energy use, transportation mode and living habits, to observe the impact of these factors on carbon emissions. This interactive simulation environment helps players intuitively understand the principle of carbon neutrality and inspires them to actively think and explore ways to reduce carbon emissions.

(3) Social interaction and cooperation: Social interaction and cooperation mechanism are

introduced in the game, so that players can cooperate with other players to complete tasks and share experiences and ideas of carbon neutrality. They can join virtual communities or organizations, work out carbon-neutral action plans together, and achieve their goals through collective efforts. This social interaction and cooperation mechanism enhances players' sense of participation and social responsibility, and urges them to participate more actively in the practice of carbon neutrality.

GreenQuest has had a positive impact on carbon neutrality education and awareness raising. The following is the impact of the game on the player's awareness and behavior change:

(4) Awareness-raising: Players gradually understand the concept, principle and practical methods of carbon neutrality in the game. Their understanding of carbon emissions has been improved, and they are aware of the impact of personal behavior on the environment and climate change. Players begin to pay more attention to the importance of carbon neutrality and incorporate it into daily life and decision-making.

(5) Behavior change: Players are exposed to various methods and practices to reduce carbon emissions through tasks and challenges in the game. They began to take sustainable actions in real life, such as reducing energy consumption, choosing low-carbon transportation modes and supporting renewable energy. Players are aware that their actions can have a positive impact on the environment and are willing to make efforts for the goal of carbon neutrality.

This case study shows the potential of virtual games as an educational tool. Through tasks and challenges, virtual simulation environment and social interaction, virtual games can educate players about the importance of carbon neutrality in an interactive and entertaining way and inspire them to take sustainable actions.

4. Conclusion

Virtual games have great potential in the fields of carbon neutrality and sustainable development. Through the comprehensive means of education, interaction and action, virtual games can improve players' awareness of carbon neutrality, inspire them to take sustainable actions, provide inspiration for innovative research and practice, and promote the process of carbon neutrality and sustainable development.

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Data Availability

Data sharing is not applicable to this article as no new data were created or analysed in this study.

Conflict of Interest

The author states that this article has no conflict of interest.

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