

Preliminary Exploration of Green Development in University Infrastructure Construction

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ABSTRACT:As society's concern for environmental protection and sustainable development continues to grow, it has become a top priority for universities to explore green development in infrastructure construction projects. In promoting green development in their infrastructure projects, universities need to overcome various issues related to policies, funding, technology, management, education, and training. Comprehensive measures, including policy guidance, technological innovation, scientific management, and educational promotion, can gradually address these challenges.

KEYWORDS:Higher Education Institutions; Infrastructure Construction; Green Development; Solutions

I. INTRODUCTION

Since the mid-18th century, Western countries have led three industrial revolutions: the "Steam Age," the "Electrical Age," and the "Information Age." These revolutions have brought immense material wealth to human society. However, on the other hand, the contradiction between humans and nature has become prominent, with the global ecological environment deteriorating continuously. Natural disasters caused by abnormal weather have become increasingly frequent, and the supply of resources and energy has become increasingly strained. In 1987, the United Nations proposed the concept of sustainable development, which is "development that meets the needs of the present without compromising the ability of future generations to meet their own needs." In 1992, at the United Nations Conference

on Environment and Development, the concept of sustainable development gained global consensus. Compared to traditional development concepts, sustainable development places greater emphasis on human capital investment and poverty reduction, advocating that economic development should fully consider the carrying capacity of natural resources [1].

Green development is an economic growth and social development model aimed at efficiency, harmony, and sustainability, which aligns with the evolutionary laws of historical trends. It complements the concept of sustainable development and represents a theoretical innovation in the localization of sustainable development in China. Furthermore, it is a significant theoretical contribution made by socialism with Chinese characteristics in response to the deteriorating global ecological environment. Compared to traditional development models, green development innovates upon them by considering the carrying capacity of the ecological environment and resource constraints, and using environmental protection as a crucial pillar to achieve sustainable development. Several key points are worth noting: firstly, environmental resources are intrinsic factors in socio-economic development; secondly, the goal of green development is to achieve sustainable development in the economy, society, and environment; thirdly, the primary content and approach of green development involve "greening" and "ecologizing" the processes and outcomes of economic activities.

In 2006, the journal "Environmental Protection" pointed out that to achieve a green

transformation in China's economic development, it was necessary to formulate a national green development strategic plan [2]. In the same year, the "Research on Scientific Management" published an article establishing a green development indicator system by analyzing the relationship between green development indicators and economic development levels [3]. In 2015, the "Proposal of the CPC Central Committee on Formulating the 13th Five-Year Plan for National Economic and Social Development" integrated green development with the development concepts of innovation, coordination, openness, and sharing to form the five major development concepts. In 2013, China established a standardized system for green campus construction and officially released the "Green Campus Evaluation Standard," providing strong support for green campus construction [4]. In the same year, the General Office of the State Council issued the "Green Building Action Plan," clarifying the comprehensive implementation of green building standards in schools. In 2019, the national green campus evaluation standard and indicator system began to be announced and implemented. In April 2020, the "Green School Creation Action Plan" required local education administrative departments to actively carry out green school creation initiatives. As an essential part of universities, the infrastructure department directly affects the quality of life of teachers and students, as well as the reputation and image of the school. The continuous innovation of university infrastructure levels and service capabilities plays a vital role in the green development of schools.

University infrastructure refers to the physical engineering facilities that provide services for teaching, production, administrative offices, and other activities in universities. It encompasses the construction, expansion, renovation, and restoration of various buildings and facilities such as teaching buildings, libraries, gymnasiums, laboratory buildings, sports fields, and campus roads, covering most of the construction projects in universities. The construction and renovation of university infrastructure are indispensable parts of university teaching and scientific research development. In terms of attributes, university infrastructure projects are more akin to social public projects, carrying the mission of leading social values and cultural heritage. They are not only the cradle of talent cultivation but also the base for various scientific research activities. According to the "Basic Situation of National Education Development in 2022" [5], there are 3,013 institutions of higher learning nationwide,

with a total building area of 113,080.55 square meters for general and vocational universities. As the number of university students has increased significantly, and the scale of higher education has continued to expand, various regions have experienced waves of university town and new campus construction in different forms. In addition, due to the needs of universities' own educational and scientific research development and the continuous expansion of higher education services to local societies, many universities in China undertake large-scale renovation and reconstruction projects annually, including the construction of new buildings and infrastructure, as well as seismic retrofitting and repair maintenance of aged buildings that need to be carried out in batches. Initiating green construction from the vast campus building facilities is of great significance to improving the level of green development in the construction industry.

Currently, academic research on green buildings is abundant, but there is relatively little research on the difficulties and pain points of green development in university infrastructure construction. Therefore, scientifically and reasonably studying the difficulties and pain points of green development in university infrastructure construction and their solutions has become an important issue that universities need to address urgently.

II. THE PROBLEMS EXISTING IN THE GREEN DEVELOPMENT OF UNIVERSITY INFRASTRUCTURE CONSTRUCTION.

(1) Funding constraints and cost pressures. Universities often rely on limited resources such as government grants and donations for infrastructure construction. The construction costs of green buildings and facilities are relatively high, while universities typically face limited fiscal budgets. Especially for universities with heavy provincial financial burdens, the proportion of investment in universities is relatively low, making it difficult to bear the high construction costs. For example, the use of environmentally friendly materials, energy-saving and water-saving equipment, and green power generation equipment will increase the investment in the project.

(2) Lack of technology and talent. Green technologies and equipment are relatively new, and there is a shortage of such technology and talent within universities. The lack of relevant professional technicians and engineering experience affects the design, implementation, and operational effectiveness of green construction

plans. The design and implementation of green infrastructure require engineers and technicians to possess specialized skills in green building design and project management, whereas university infrastructure and logistics management personnel lack technical knowledge and management experience in this area.

(3) Operational and management complexity. Green building construction is not merely about constructing an environmentally friendly structure, but also involves long-term operation and management, including the maintenance of energy-saving equipment, waste management, and recycling. This requires universities to have a professional management team and continuous investment. In terms of energy management and environmental monitoring, specialized personnel are needed to ensure the operational efficiency and environmental friendliness of green buildings. The lack of a professional operations team and long-term management plans can affect the sustainable benefits and environmental protection effects of green construction. Universities have a wide variety of infrastructure construction projects with diverse construction forms, which poses significant challenges for project management. It is highly prone to issues such as conservative design, lax supervision, lack of systems, high energy consumption, and cost overruns (exceeding initial estimates in terms of time, scope, and budget). Therefore, effective management of university infrastructure construction is crucial.

III. GREEN SOLUTIONS FOR UNIVERSITY INFRASTRUCTURE CONSTRUCTION

The green development solutions for university infrastructure projects can be considered and implemented from multiple aspects such as policy formulation, green equipment, technological upgrades, scientific management, education, and publicity.

3.1 POLICY GUIDANCE

(1) Formulate and implement green building standards. National or provincial-level housing and urban-rural development departments and education departments can formulate and implement rigorous green building standards and evaluation systems to ensure that newly constructed and renovated projects meet the requirements of environmental protection, energy conservation, and high resource utilization efficiency. These standards can include specific requirements in areas such as architectural design, energy utilization, material selection, and water

resource management, thereby promoting the application of green building technologies. The government can also introduce clear green construction policies and guidance to encourage and support universities in implementing green development measures in infrastructure projects. These policies can include financial incentives, construction standard requirements, energy conservation targets, etc., providing policy guarantees and guidance for universities.

(2) Develop an action plan for green development on campus. Universities should, based on national or provincial green construction standards and their own conditions, formulate a campus green development action plan that aligns with their own development patterns [6], further clarifying the approach to green development. They should develop specific action plans and safeguard measures in areas such as water conservation, land conservation, material conservation, and energy conservation [7], actively guiding and encouraging all faculty and students to implement the green development action plan, thereby creating a clean, comfortable learning, working, and living environment for them.

3.2 ADVANCED TECHNOLOGICAL SUPPORT

(1) Ecological environmental protection and landscape design. During the planning and design stages of infrastructure construction, full consideration should be given to ecological protection and landscape beautification. Existing green spaces and vegetation should be preserved, and technologies such as green roofs and vertical greening should be introduced [7] to increase the area of vegetation cover, improve the ecological environment within the campus, enhance air quality and living comfort, lower indoor temperatures, and reduce building energy consumption. Universities should combine their geographical location and climatic conditions, make long-term and comprehensive plans, and invest funds reasonably to integrate landscape design, the layout and configuration of trees, flowers, and shrubs, and ecological civilization education, making the campus a verdant forest with changing scenery as one walks, and allowing green development on campus to better play the role of "environmental education." The planning of campus land use requires careful consideration of the layout of buildings and transportation networks within the campus. The layout of various parts such as teaching areas, sports facilities, green belts, walkways, leisure squares, and parking facilities should be carefully arranged [8] to achieve

effective utilization of surface and underground spaces, and strictly adhere to the principle of land conservation.

(2) Adoption of advanced energy-saving technologies and equipment. Introduce advanced energy-saving technologies such as intelligent control systems and efficient energy management systems to improve energy utilization efficiency. Select and install energy-saving equipment, such as LED lighting and high-efficiency air conditioning systems, to reduce energy consumption. Install intelligent control systems to monitor and adjust energy usage within buildings in real-time, automating lighting and air conditioning adjustment systems to optimize energy usage based on real-time data and improve energy utilization efficiency. Universities with the necessary conditions can utilize geothermal energy for heating, cooling, and power generation [9], thereby enhancing energy utilization efficiency. Install photovoltaic panels and wind power generation equipment on campus roofs and open spaces [10] to partially or fully cover the campus's energy needs, reducing the use of traditional energy sources, promoting energy transformation, and lowering carbon emissions. Universities with the appropriate conditions can opt to use biogas for power generation, with the waste products of biogas slurry and biogas residue utilized as fertilizers and feed in ecological agriculture and animal husbandry, thereby reducing the harm caused by chemical fertilizers and pesticides. Additionally, they can adopt organic farming fertilizers for grass planting and tree cultivation.

3.3 SCIENTIFIC MANAGEMENT

(1) Establish a smart construction site management system. A smart construction site can not only improve construction efficiency and safety but also reduce resource waste and environmental impact. Universities should integrate technologies such as the Internet of Things, big data analysis, and artificial intelligence to build a smart construction site management system [11], enabling real-time monitoring, data collection, and intelligent decision-making during the construction process. This will optimize resource utilization, reduce costs, and improve work efficiency.

(2) Strengthen the construction of an energy-saving and emission-reduction assessment system. Implement a dedicated personnel and full-time management approach, assigning specific responsibilities and targets to individuals. Establish a special inspection system for energy-saving and emission reduction, organize regular special inspections for energy-saving and emission

reduction, and severely investigate and punish acts of energy waste [17]. Set up hotlines for reporting violations and incidents related to energy conservation and environmental protection, actively mobilizing and leveraging the supervisory role of the broader teaching staff, students, and employees. Implement responsibilities at all levels, incorporate the completion of energy-saving and emission-reduction targets into the comprehensive evaluation system of each unit, and formulate specific implementation methods for evaluation and assessment.

3.4 EDUCATION AND PROMOTION OF GREEN DEVELOPMENT

(1) Conduct environmental protection education and encourage full participation from the entire university. Strengthen green technology training for university teachers, students, infrastructure, and logistics management personnel [18], thereby enhancing their technical application capabilities and management levels.

(2) Strengthen education and promotion of the concept of green development among teachers and students, and raise public awareness and participation in environmental protection and sustainable development.

(3) Organize class meetings and thematic seminars focused on environmental protection themes to cultivate a sense of social responsibility and awareness of sustainable development. Increase education and promotion of green buildings and facilities [19] to enhance support and understanding of projects both within and outside the university. Utilize campus activities, notice boards, and official accounts to raise public attention to the university's sustainable development efforts.

IV. CONCLUSION

Based on summarizing previous research results, this paper presents prospects and suggestions for the future green development of universities, pointing out future research directions and priorities, and providing scientific basis and guidance for the green development of university infrastructure departments. University infrastructure projects face multiple challenges in promoting green development, including issues related to policy, funding, technology, management, education, and training. Comprehensive measures such as policy guidance, technological innovation, financial support, scientific management, and education and promotion can gradually address these issues and promote university infrastructure

projects towards a more environmentally friendly, energy-efficient, and sustainable direction.

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