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Application of Renewable Energy in Green Buildings and Energy Consumption Optimization

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Abstract

INTRODUCTION: With the increasing global awareness of sustainable development and environmental protection, green building has become one of the important development directions in the construction industry. The application of sustainable type energy in the construction industry is of great significance in reducing building energy consumption and environmental pollution. This study aims to explore the application of sustainable types of energy and conduct research on energy consumption optimization.

OBJECTIVE: The aim of this study is to analyze the current situation of the application of sustainable types of energy in the construction industry, to explore its impact on the energy consumption of buildings, and to propose corresponding optimization strategies in order to achieve the goal of sustainable development of green buildings in China.

METHODS: This study adopts a combination of literature review and case study; firstly, a literature review on the application of sustainable types of energy, sorting out its technical characteristics and application effects; then, several typical cases are selected to analyze its energy application and energy consumption in buildings; finally, relevant strategies and suggestions for optimizing the energy consumption are put forward by combining the results of the literature review and the case study.

RESULTS: Through the literature review and case analysis, it is found that sustainable types of energy, such as solar energy and wind energy, have been widely used in buildings and achieved certain energy-saving effects. However, there are also some problems, such as inefficient energy utilization and high cost. To address these problems, this study proposes a series of optimization strategies, including suggestions for optimizing energy system design, improving energy utilization efficiency, and reducing energy costs.

CONCLUSION: This study concludes that the application of sustainable types of energy in green buildings is an important way to optimize building energy consumption and sustainable development. Through measures such as optimizing energy system design and improving energy utilization efficiency, building energy consumption can be further reduced, environmental pollution can be reduced, and the development of the construction industry can be promoted. However, further research and practice are still needed to continuously improve relevant technologies and policies to promote the application and development of sustainable types of energy in buildings.

Keywords: renewable energy, green building, construction industry, energy consumption optimization

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1. Introduction

The rapid growth of China's construction industry has been remarkable in the recent past. However, it has been accompanied by high energy consumption and environmental issues brought about by the traditional construction model, which have attracted widespread attention from all sectors of society. Against this backdrop, the concept of green building has gradually emerged and has quickly become a key trend in China's construction industry, signaling the industry's transition towards a more sustainable direction(Arenas & Shafique, 2023). In response to this challenge, the Chinese government has clearly proposed a so-called dual-carbon strategy in its Tenth Five-Year Plan, the purpose of which is to facilitate the country's overall economic and social transition to a green ecosystem and to take a leading position in the global competition for energy consumption. Specifically, by 2060, the plan aims to achieve a non-fossil energy share of more than 80% in total energy consumption and to promote the country's progress toward sustainable development by significantly reducing pollutant gas emissions. Therefore, the role of the construction industry in promoting economy and sustainable development has become particularly crucial and has become an indispensable part of building an ecological civilization(Thirunavukkarasu et al., 2023). The government has not only actively promoted the development of the environmental protection sector in recent years but has also actively implemented a series of energy-saving policies to cope with the increasing environmental pressure(Yang et al., 2021). Official reports have also clearly stated that the promotion of socio-economic development and the realization of ecological and low-carbon development is the key to promoting rapid and high-quality economic growth. In view of this, strengthening research and widely promoting energy-saving and emission-reduction technologies have become an urgent task, aiming at laying a solid foundation for sustainable economic development. With the strong support of national policies, the contradiction between energy supply and demand is becoming more and more prominent, which requires people to take more active measures to cope with it. Future developments in the building sector will focus more on preserving natural resources, consuming less energy, and ensuring that people can live in safe, comfortable, and healthy environments(Dar et al., 2022). At the same time, the sustainable development of environmentally friendly and energy-saving buildings will also become an important way to realize a win-win situation for both ecology and the economy.

Nowadays, environmentally friendly and energy-saving buildings have attracted the attention of all walks of life and are showing a booming trend. Its evaluation and analysis must organically combine different advanced technologies and disciplines and adopt a comprehensive research methodology in order to achieve better results(Zhang et al., 2021). The requirements for the evaluation of environmentally friendly and energy-efficient buildings can be greatly improved and enriched by the introduction of BIM technology, which when combined with the standards for environmentally friendly and energy-efficient building evaluation can also help to increase the evaluation's efficiency.

Studies have examined pollutant gas emissions from buildings from the perspective of their life cycle and construction phases. Some researchers have focused on certain areas of whole buildings, while research based on the construction process is relatively limited(Ishraque et al., 2021). This study will help to calculate the pollutant gas emissions of BIM-based homes from the perspective of the construction process and suggest appropriate recommendations and corrective measures. I hope this will provide a theoretical basis for similar pollutant gas management projects. First, carbon calculations were performed in the residential areas affecting the project's pollutant gas emissions to provide information and support for optimizing the management of pollutant gases during the future construction process, as well as information and methods to reduce them(Farghali et al., 2023). Secondly, by analyzing the results of the study and comparing them with national pollution gas standards and environmental legislation for relevant buildings, they can be used as a basis for similar projects and provide valuable suggestions and recommendations for low-carbon green buildings. Buildings consume 40% of the world's energy and produce 33% of its carbon(Tushar et al., 2021). As one of the top three pollutant gas emitters in China, the construction industry accounts for more than 40% of the pollutant gas emissions of the whole life cycle of buildings. Therefore, reducing pollutant gas emissions from buildings is an urgent and important task(Akarsu & Genç, 2022). Incorporating carbon into the building sector is essential for measuring trends in pollutant gas emissions, studying the factors affecting them, and developing ways to reduce them. Many Finnish and foreign studies are examining the accumulation of polluting gas emissions(Rehman et al., 2021). The development of green, low-carbon, environmentally friendly, and high-quality buildings in accordance with the two-carbon target has become the trend of the future.

2. Background of the study

Increased global warming has had a serious impact on the environment, to the detriment of human production and life. In the face of this global environmental challenge, China has taken positive action by setting "dual-carbon" targets and taking the initiative to assume the responsibility of a major country. Reducing pollutant gases and their emissions has become a top priority. China's construction industry's contribution to global emissions reductions is critical, and it is a responsibility that cannot be shirked. A key challenge for the construction industry is to achieve high-quality development with low carbon and environmental emissions(Ahmad et al., 2021). Only if the construction industry truly achieves its pollutant gas emission targets will it be able to change the problems of the past, such as the challenges of high pollution, poor working conditions, high energy consumption, and poor governance.

The construction industry, as an important part of the development of human society, shapes the environment in which people live and work, as well as influences economic, social, and environmental sustainability. The construction business is confronted with unparalleled opportunities and challenges as a result of the rapid urbanization of the world and the ongoing enhancement of people's standard of living. Thus, it is crucial to do a thorough analysis of the construction industry's evolution and investigate its trends, cutting-edge technology, and sustainable development approaches. This will have significant theoretical and practical implications. The development of the construction industry is not only a pure construction activity but also a comprehensive industrial system, covering design, materials, construction, management, and other aspects(Ghalambaz et al., 2021). In the past decades, the construction industry has experienced great changes and development, from traditional manual construction to modernized digital construction, from the use of traditional materials to new sustainable building materials, and from simple building functions to focusing on spatial experience and ecological protection(Abdou et al., 2021). These changes have not only improved the quality and efficiency of construction but also provided people with a more comfortable, safer, and more environmentally friendly living and working environment. However, the development of the construction industry also faces many challenges. On the one hand, global resources are becoming increasingly strained, and energy consumption and environmental pollution have become important constraints on the sustainable development of buildings; on the other hand, the pressure on land, energy, and transportation brought about by urbanization has led to higher requirements for building planning and design(Zhao et al., 2022). In addition, factors such as population aging, climate change, and natural disasters have put forward new challenges and demands for the construction industry(Guo et al., 2021). Therefore, the study of the development of the construction industry is of great theoretical and practical significance. Through the discussion of architectural design, construction technology, and material application, it can promote the improvement of construction quality and efficiency; through the analysis of the relationship between the construction and the environment, society, economy, and other factors, it can achieve the goal of the construction industry and the goal of sustainable development. The study of the development trend, innovative technology, and sustainable development strategy of the construction industry can provide a scientific basis and policy suggestions for the future development of the industry(Mokhtara et al., 2021). In this context, the purpose of this paper is to conduct an in-depth study on the development of the construction industry, explore its development trends, innovative technologies, and sustainable development strategies in order to provide theoretical support and practical guidance to promote the healthy development and sustainable development of the construction industry.

This study analyzes the problems in the field of high-carbon buildings by examining national top-level decisions, top-level routes, and low-carbon green buildings. It also puts forward policy recommendations for the development of high-quality green buildings. This study uses different computational models to calculate the pollutant gas emissions from buildings in households, provinces, and districts and to study the factors affecting them. This study uses a top-down CAS model to predict the pollutant gas emissions from the building sector and a vector regression model (SVR) to support and study the carbon emissions from the building sector(Liu et al., 2021). Pollutant gas emissions from the construction industry are expected to peak around 2029-2030, with a stabilization peak of 2-3 years. The study of regional factors affecting harmful gas emissions is mainly based on modeling(Shehata et al., 2022). Choose one or more methods from the IPAT family of models, including exponential distribution analysis methods and structural distribution analysis methods used in the tests. The impacts of different factors, perspectives, and directions are assessed, and the impacts of three factors are examined: low levels of polluting gases, technical efficiency, and the value of different phases of polluting gases; the main impact is cost-effectiveness, followed by technical efficiency. Public and urban buildings are the main sources of growth of polluting gases in the construction sector. Urbanization of cities is the main factor influencing the emission of polluting gases from urban buildings, followed by per capita living space and per capita affordable income(Merabet et al., 2021). Most of the present study conducted a life cycle study of pollutant gas emissions from individual buildings and found that the largest share of pollutant gas emissions is recorded during the use phase of the building and during the production of building materials. Pollution gas emissions were relatively low during construction and demolition.

In the People's Republic of China, the annual growth rate of housing construction has remained steady at between 3% and 5%, a growth trend that is directly correlated with the rapid pace of urbanization. As of 2021, the total area of construction in China has touched an impressive figure of 157.58 million square meters. The phenomena of the annual growth in overall energy consumption in the construction industry has been noted, coinciding with society's growing demand for living space. The Chinese government has been actively pushing for the construction industry to adopt low-carbon and environmentally friendly practices over the past few years. The government has made significant progress in this regard by integrating information technology, popularizing environmentally friendly building materials, promoting prefabricated building technologies, and greening existing structures(Hoang et al., 2021). According to the National Bureau of Statistics, between 2011 and 2021, China's new residential floor area has continued to show an increasing trend, with 14,637,856 new buildings expected to be completed in 2021, with an average floor area of approximately 1,000 square meters per building. However, the fact that emissions of pollutant gases during the construction phase occupy a significant position compared to the whole life cycle of a building emphasizes the importance of exploring the emissions of pollutant gases during the construction process(Abdalla et al., 2021). Therefore, in-depth research and implementation of strategies and measures to reduce emissions during housing construction are indispensable for the construction industry to achieve the goal of sustainable development.

3. Research methodology

3.1 Efficiency accounting for renewable energy

In order to study the pollutant gas emissions during the construction phase of a single project, an in-depth analysis and study of the pollutant gas balance process during the construction phase was conducted. In this study, the pollutant gas emissions during the construction phase of residential buildings were first calculated, and the corresponding harmful gas emission limits were set to ensure that the emission levels were controlled during the construction process. Subsequently, the sources of harmful gas emissions were scrutinized, and the balancing methodology for the construction phase was explained to ensure that the emissions did not exceed the limits. In order to create an effective accounting model, it is important to clearly define the purpose and scope of the study and to make it clear that the subject of this paper is concrete, not stand-alone residential construction. Pollutant gas emissions generated during the construction phase of the project were categorized into five main components, including piling technology, foundation construction technology, surveying technology, installation technology (including heating technology, electrical technology, electrical and drainage technology, fire detection technology, low-energy technology, ventilation, and fire protection technology), and temporary on-site installations. A carbon emission calculation model based on the construction process and construction content on the construction site was established for each phase of the project; additionally, a model based on quantitative inventory was created and its key components were thoroughly examined. This paper focuses on the pollutant gas emissions during the construction phase of residential concrete structures, provides an in-depth analysis of the construction phase and the high-emission process, and proposes corresponding emission reduction measures to guide future construction practices and reduce the negative impacts on the environment.

The construction phase is a phase from start to finish. Direct and indirect pollutant gas emissions from construction and related activities were studied from the perspective of the entire construction phase. GHG emissions from energy consumption (e.g., construction machinery, construction workers, and office equipment) during the construction phase are expressed by converting the associated pollutant gas emission factors to pollutant gas equivalents. The extent of pollutant gas emissions varies from the time employees arrive on-site to the time the project is completed and handed over to the owner. The spatial limit is the amount of pollutant gas emissions generated during project preparation and completion. The boundaries of this area are determined by materials, equipment, semi-finished products, etc. Arrival. Energy consumption at the construction site is not considered when calculating transportation to the construction site. The construction sequence is ranked as shown in Figure 1.

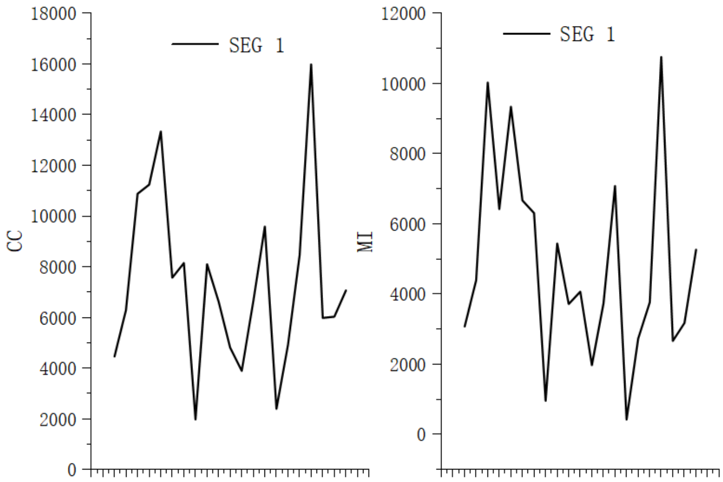

Figure 1 Construction sequence ranking

Carbon Calculation Methods: There are three common carbon calculation methods, the carbon factor method being applied to the carbon calculation of a single building. Therefore, this study decided to apply the carbon factor method to the harmful gas balance. In order to accurately calculate the pollutant gas emissions from a single building, the calculated limit values must first be determined, and then the appropriate emission factor must be selected to accurately calculate the carbon source. According to the equation "Activity Level Data x Emission Factor," the activity level data and the emission factor are related to the cost calculation. This document analyzes the selection of emission factors in national standards and the selection of emission factors for pollutant gases from the power sector in the Northwest Territories in the Guidelines for the Preparation of a Regional Greenhouse Gas Inventory. Based on the emission factors, work inventories, and machine consumption data, emissions of pollutant gases from individual buildings can be calculated quickly and accurately.

The model of renewable energy application and energy optimization in green buildings is shown below:

$$I_{pv} = I_{ph} - I_0 \times (e(\frac{q(V_{pv} + R_{s*Ipv})}{akt} - 1)) \tag{1}$$

Then Equation (1) is the first term of the *I* vector.

$$I_{ph} = \frac{G}{Gref}\left[I_{sc,ref} + \mu(T - T_{ref})\right] \tag{2}$$

$$I_o = I_{o,ref}(\frac{T_{ref}}{T})^3 e\left[\frac{q}{nk}(\frac{1}{T_{ref}} - \frac{1}{T})\right] \tag{3}$$

$$X(k) = X(k) + Z \times R_2 \times (w - X(k)) \tag{4}$$

Gref in Equation (2) is the infinitely convergent value of the *f* function; $\frac{1}{T_{ref}}$ in Equation (3) is the infinitesimal function; and $X(k)$ in Equation (4) is the function *X* with coefficient *k*.

$$Z = 1 - L \times (\frac{1}{I_{ter}}) \tag{5}$$

Z in Equation (5) denotes the extreme variance function of natural positive integers. The energy consumption optimization algorithm, as shown in Figure 2.

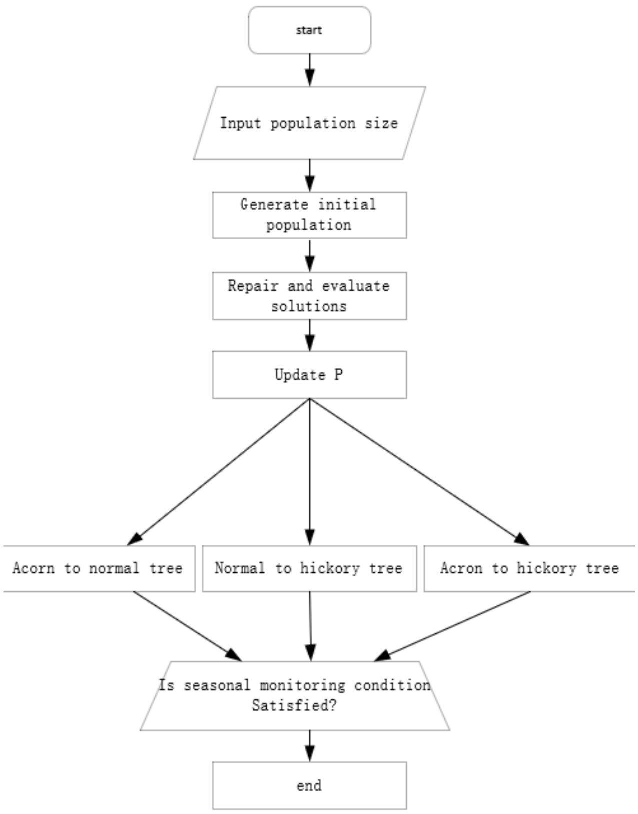

Figure 2 Energy consumption optimization algorithm

3.2 Accounting pathways

In this document, harmful emissions during project construction are calculated based on the design characteristics of the project and the design inventory. The study focuses on the construction machinery, equipment, and personnel required during the construction phase, including the mechanical energy consumption of the various special design projects, the GHG emissions from project energy consumption, and related project implementation measures expressed in terms of harmful gas equivalents. A construction site is a densely populated area with employees from a variety of industries. Hazardous gas emissions from human activities should be calculated based on the working days shown in the table. During the construction process, project management requires proper administration and management of all aspects of project construction. The detailed bill of quantities does not match the energy consumption of the office space. Project management services should be provided from start to finish. Hazardous emissions should, therefore, be calculated according to the project plan. Operational data can be broken down into different construction projects by specialty, department, and profession. Based on the design drawings and pricing rules of a Northwest Provincial Wood Design Catalog, the fixed lighting model and BIM software can be used to publish the scope of work and install the design catalog summary. Calculate the energy, utility, and labor consumption for each project based on project size and organize the collection of data for various specialized activities based on the consumption of architectural and interior design projects in a northwestern province. Calculated harmful emissions for each project using computational modeling and determined the total amount of harmful emissions during the construction phase of the project. The SEG analysis for green energy is shown in Figure 3.

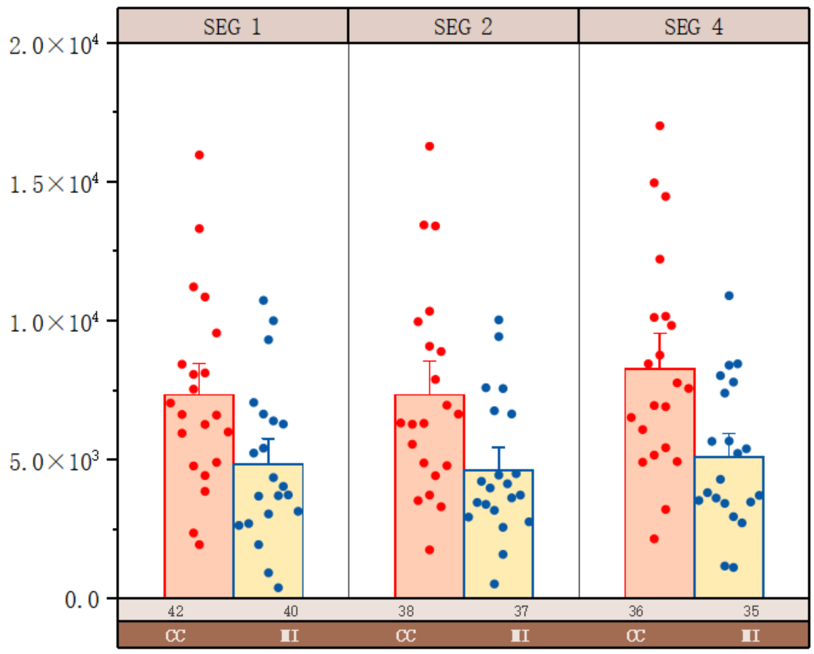

Figure 3 SEG analysis of green energy

The process of calculating harmful gas emissions during the construction phase included the use of a research tool to simulate the project measurement software and the creation of a list of sub-projects. Activity data needed to calculate NWI harmful emissions were converted using the NWI planning software; appropriate emission factors were selected; and equations were used to calculate carbon emissions during the different construction phases of the project and to synthesize the harmful emissions during the construction phase of the project. The process of calculating harmful gas emissions during the construction phase included simulating the project measurement software using the study tool and creating a list of sub-projects. Activity data required to calculate NWI harmful emissions were converted using the NWI planning software; appropriate emission factors were selected; and equations were used to calculate carbon emissions during the different construction phases of the project and to synthesize the harmful emissions during the construction phase of the project. Broadband measurement software and BIM software allow for the sending of work lists and the conversion of design drawings into building models. In this study, a building model was printed for each specialized project's bill of quantities. Due to the lack of BIM, broadband software was used to measure the volume of the technology. However, the list of technical parameters published by this software cannot be directly used to calculate the harmful emissions of existing projects. The application of green building is judged as shown in Figure 4.

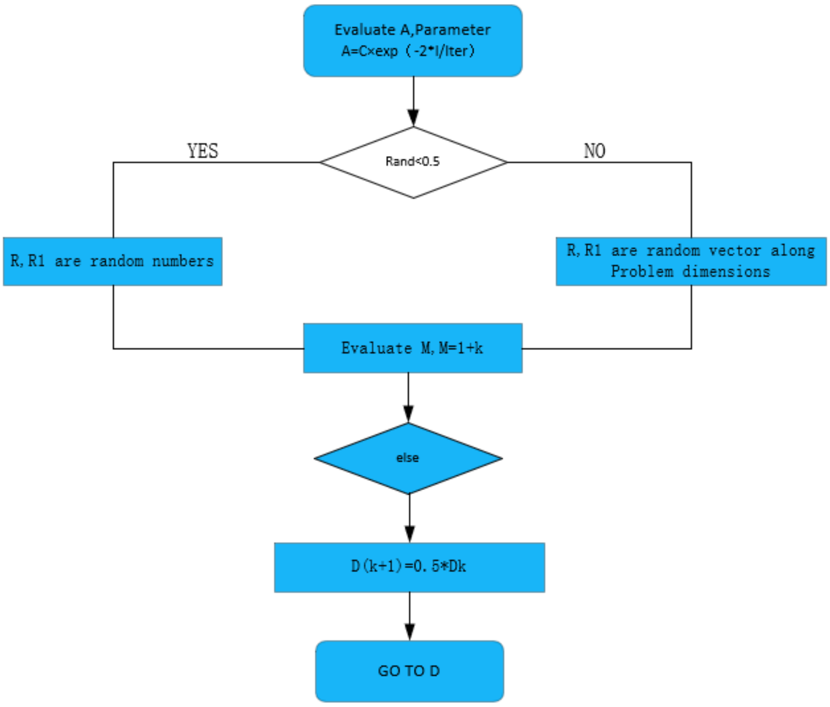

Figure 4 Green building application discrimination

Technical consumption in a northwestern province is applied to the conversion of technical inventory data published by the software, as well as to the acquisition of activity data on energy consumption, energy consumption, and labor requirements for each part of the construction phase. Hazardous gas emissions can be calculated directly from the converted data. Consumption accounts should include machinery changes, working days, and quantities of materials required to fill in specified unit elements that can be converted directly into technical quantity consumption tables. By combining pricing software, design quantities, and required hardware, changes in machine models, labor, and hardware costs can be accurately calculated. These quantities can reflect the average level of industrial consumption, and the operational data obtained is reliable. Inventories of harmful emissions from offices and houses on construction sites are prepared on the basis of measurements of construction equipment.

Hazardous gas emission factors are a key parameter for accurately calculating hazardous gas emissions per product unit during construction. Hazardous gas emission factors are important information for calculating hazardous gas emissions because they can combine energy consumption with hazardous gas emissions, simplify hazardous gas emission calculations, and facilitate and expedite hazardous gas emissions for certain projects.

Hazardous gas emission sources are derived from official government data, industry data, and calculations from various databases and research organizations. Hazardous gas emission factors vary depending on the publishing facility, the test method, and the target of the measurement. Emission factors for the same energy source may vary by industry and region of calculation. Hazardous gas emissions also vary by region. To ensure the accuracy of the calculations, the appropriate hazardous gas emission factors are selected based on the location of the research project and individual buildings. In selecting the Hazardous Gas Factors, this document considers the principles of authority, regionality, punctuality, and applicability. Only harmful gas equivalents are considered in the selection and calculation of appropriate harmful gas emission factors. The necessary emission factors are energy and human activities.

4. Results and discussion

4.1 Construction optimization analysis

Building plans are determined from architectural drawings. When selecting a construction program for a worker's site, choose a complete and proven construction program. These construction plans take into account the principles of simplifying construction, ensuring construction quality, and reducing costs. Currently, harmful emissions from construction sites during construction are not controlled due to a lack of planning, construction, and owner's attention. In recent years, the country has been increasing its efforts to promote assembly, low-emission, and environmentally friendly energy-saving buildings, but the proportion of demolished structures in housing is relatively high. When organizing construction, it is necessary to meet the requirements of ecological and energy-saving buildings. Before implementing the project, it is necessary to develop a project plan, select appropriate drawings, and strictly adhere to them. Introduction of advanced construction technology and advanced energy-saving technology machinery and equipment. When preparing the construction organization design and professional building plans, it is necessary to give full consideration to the reasonableness of the construction technology, implement environmentally friendly and energy-saving building plans, and strictly comply with environmentally friendly and energy-saving building plans in the construction process. Strengthen the quality management in the construction process to avoid energy consumption caused by non-compliance. Reduce the amount of materials and construction waste during construction and increase the use of recycled materials. Rotating materials includes increasing the rotation speed of models and scaffolding. Large smart machines should be installed to reduce efficiency and idling. Energy conservation, material conservation, water conservation, and soil conservation measures will be implemented during construction to reduce electricity and water usage. A comparison of green buildings with conventional buildings is shown in Figure 5.

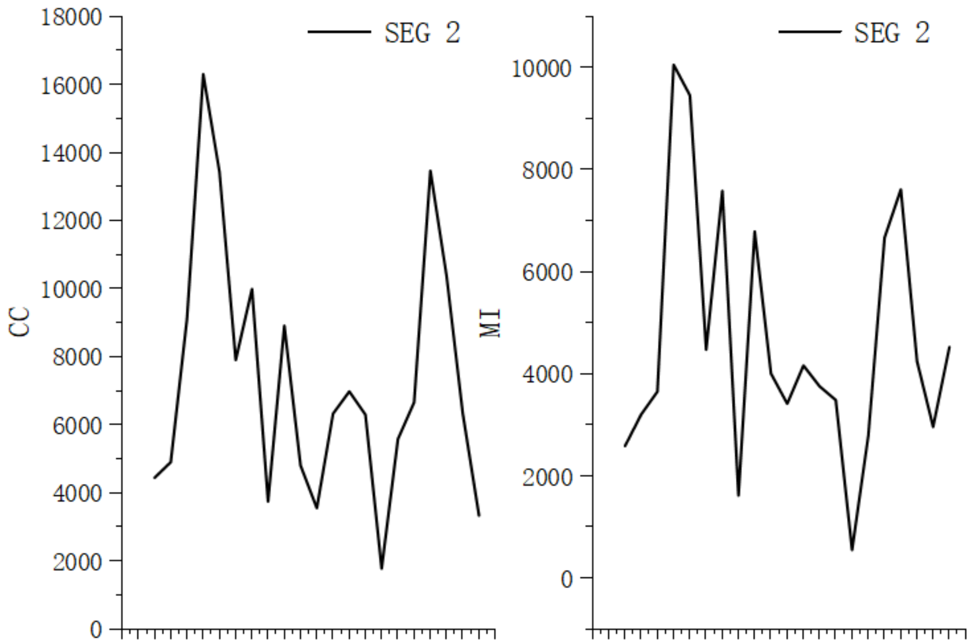

Figure 5 Comparison between green and conventional buildings

The use of advanced design techniques and rational organization of the construction process can reduce the frequency of replacing mechanical equipment. During construction, the layout of the house must meet the building organization, energy conservation, and soil protection requirements. The location of on-site processing areas and material stacking areas meets the requirements for design comfort and secondary use; during on-site installation, reasonable coordination and organization of processing plants, material storage, and vertical transportation must be ensured. Material handling and storage areas requiring vertical transportation methods should be installed within the confines of the vertical equipment to reduce the reuse of machinery and equipment for secondary uses. On-site vertical transportation typically includes tower cranes, construction hoists, and electric winches. Connectors for vertical steel structures are welded by a large number of welding machines, which requires considerable energy consumption. Strengthen construction machinery management and reduce construction machinery waste. In order to reduce harmful emissions during construction, it is necessary to minimize the low load and energy loss of equipment. A comparison of construction levels is shown in Figure 6.

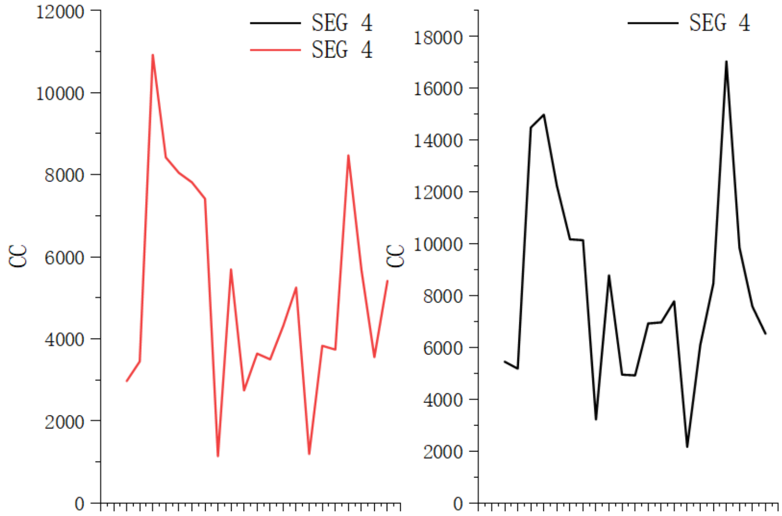

Figure 6 Comparison of building levels

Given that the project was managed by a construction company, it was necessary to set up planning and accommodation offices. The layout and configuration of the office space were based on standard design services provided by the company, which initially took into account the energy consumption and daily living needs of the offices. Although the electricity consumption of the office and residential buildings was not assessed separately, the relatively low electricity consumption of the temporary buildings compared to the architecture reduced the complexity of energy management and consumption. On-site, small integrated wind and photovoltaic (PV) lighting installations were installed, and PV systems were mounted on the roofs of homes and offices and delivered to different areas without the need to purchase electricity. In the construction industry, suitable locations are selected to install solar power equipment and provide power to machinery and equipment on site. During construction, electrical equipment must be manually shut down to minimize energy wastage of standby machinery and equipment. Energy-efficient lighting will be used in residences and offices to minimize power consumption during construction. Office electrical equipment would be installed to meet office requirements, and people would select energy-efficient equipment and disconnect office workers when not in use. Due to the short construction process of the project, monthly harmful emissions are high. In addition, given that most of the building is constructed of concrete, the project's carbon footprint data can be used to support carbon management efforts for similar projects.

4.2 Construction Strategy Study

Hazardous air emissions during the construction phase of a project are closely related to the project's design and construction plan. Since the design and construction of the project did not consider hazardous air emissions, only cost, time, and quality were considered. During the construction of partially poured reinforced concrete structures, large quantities of materials required for construction must be transported from the ground to the working surface. Cast iron construction molds and rebar must be fabricated and installed on-site. During construction, workers must use construction lifts to move from the working surface to the ground. Water is required for on-site concrete construction. A relatively large number of machines are used in the construction of winches and tower cranes at the center; high single-flow multi-stage clean water centrifugal pumps for a wide range of applications; welders with a high carbon emission factor in their primary design and taking advantage of different versions of the machines; and very high levels of hazardous gas emissions. In order to reduce harmful emissions during the construction phase, the project must be initiated and designed to respect the concepts of low emissions, environmental protection, and green design, and the project must be aimed at low-emission and green buildings. From a project perspective, harmful gas emissions must be considered and managed from a project conceptual point of view. Design drawings define the most important design processes. Optimization during the early design phase can significantly reduce harmful emissions during project construction. Optimizing design drawings based on low emissions and environmental requirements during the design phase also has a positive impact on reducing harmful emissions during project construction. Low-emission and green building concepts were integrated with the designers' thinking and experience. During the preparation phase of construction, construction site and project management play an important role in harmful emissions during the construction phase. Only by carefully considering this issue can one find solutions for the next construction process and actively implement measures and instruments to reduce harmful emissions during the construction phase. Comparison of green buildings at home and abroad, as shown in Figure 7.

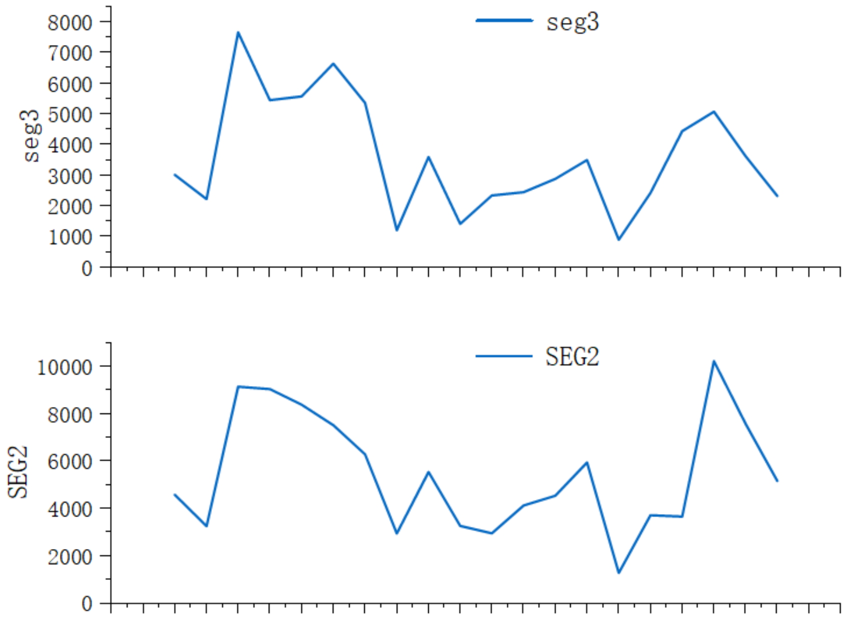

Figure 7 Comparison of green buildings in China and abroad

During the construction phase of the project, a variety of energy-efficient construction machinery and equipment, such as diesel, gasoline, and electricity, will be used. Engineering and construction machinery is a major source of carbon. Energy consumption of mechanical equipment is not considered during construction planning and preparation due to a lack of hazardous gas standards. Since construction uses a large number of mechanical equipment, it is necessary to select energy-efficient construction equipment and introduce new equipment; do not use old machines, high-powered machines, or old machines. There are two main ways to reduce harmful emissions in control projects: one is to choose low-carbon machines, and the other is to reduce the number of machines and equipment replacements. Multi-stage centrifugal pumps have the highest emissions, while tower cranes, single-stage structures, and winches have lower emissions than multi-stage centrifugal pumps. Therefore, when selecting the machinery and equipment needed to carry out the measurement project, it is important to select energy-efficient devices for the first stage of energy efficiency. Low-carbon equipment should be selected to meet the building requirements. The use of energy-efficient systems in multi-stage centrifugal pumps can significantly reduce harmful emissions. Select equipment that meets the design requirements for tower cranes and monocoque cranes to reduce energy consumption, waste, and harmful emissions; packers have a large number of machine replacements and the highest carbon footprint. Energy-efficient AC drives should be prioritized when selecting winches.

Large construction machinery and equipment used on construction sites are traditional energy-using vehicles. Results have shown that fuel produces more harmful emissions than electricity. When selecting dump trucks and trucks, it is important to prioritize hybrid and fuel-efficient models to meet construction needs, avoid the use of traditional fuel-powered vehicles, and reduce fuel consumption and harmful gas emissions from fuel-powered vehicles. Reducing the consumption of fuel-powered machinery and equipment during the construction phase can significantly reduce harmful emissions. When selecting welding equipment, it is important to pay attention not only to the requirements of the building but also to the energy consumption of the equipment. When choosing equipment, consider the market situation and choose energy-saving equipment. In recent years, the country has actively developed new energy sources and increased its support for new energy sources. In the machinery and equipment market, there are also many new types of machinery and power equipment with a variety of low-emission and energy-saving equipment. This plays an important role in reducing harmful emissions from the use of construction machinery during construction.

Once the design has been completed, the design office often organizes the construction to meet the requirements of the client and its own business, taking into account ease of construction, duration, quality, and cost. As a result, the construction techniques and organization used to seek to meet the requirements of on-site construction, such as piling techniques, concrete main window design, measured construction, and all other traditional techniques. If the construction organization is not well laid out during the construction process due to interactions between several industries, it will result in idle and inefficient use of machinery and equipment during the construction process, and the construction organization will not take into account carbon emissions. As a result, optimization of the construction organization to reduce harmful emissions is not considered. Advanced technology and design processes can reduce the wake and idling of mechanical equipment and reduce equipment waste. The technical and organizational rationality of on-site construction directly affects the use of construction machinery and equipment during the construction process. Optimizing the construction process and giving full consideration to the construction conditions can reduce the synergistic effect brought about by the inefficiency of construction machinery during the construction process. There is a building interface optimized in the construction process. Reasonable design of the construction process can accelerate the construction progress, ensure the construction quality, reduce the waste of leisure and other resources, and reduce the use of unnecessary machinery. Strengthen the management of construction equipment in the construction process, maintain construction equipment in a timely manner, and ensure the efficient operation of mechanical equipment. Optimize the construction plan, choose advanced technology and construction materials, optimize the construction process, reduce the wear and tear of machines, and reduce the idleness of machines. During the construction phase of the project, harmful emissions from inefficient and ineffective construction equipment can be reduced. The production of steel wire for the project can be processed in a centralized factory and delivered to the construction site, which reduces carbon emissions from steel wire processing at the construction site and reduces the amount of work involved in steel wire welding, thus reducing the number of welder replacements. Centralized processing can improve the efficiency of the use of mechanical equipment and save the use of construction materials, thus improving the working environment on site. During the construction of the main structure, different construction teams will be required to maximize the labor requirements during the construction of the project. In the short term, the majority of the workforce will be focused on the project area. Roof and interior technologies focus on hazardous emissions for workers who will require a small number of vehicles during the work period. Renewable energy is applied, as shown in Figure 8.

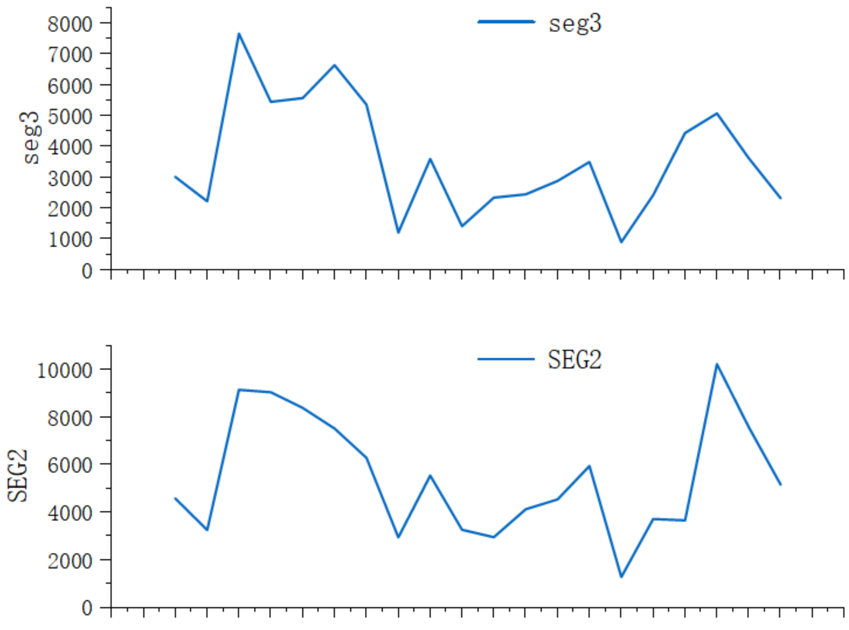

Figure 8 Renewable energy applications

The plant was designed to have a relatively small global carbon footprint, with harmful emissions coming from electricity, energy, and employees. In addition, relatively low-energy machinery and equipment are used in the construction process, and operations are conducted using mainly workers and small equipment. As a result, the harmful emissions associated with the plant design are relatively low. Home operations must select energy products that are reasonably suited to the design of the main structure, make full use of the work area, and reduce idle work.

5. Conclusion

This paper is based on the modeling of hazardous gas balances introduced during the construction of irrigation structures on construction sites. A thematic analysis of a specific urban project was carried out using BIM and broadband software to collect operational and technical consumption. The equation was used to calculate the harmful gas emissions during the construction phase. Quantitative methods were used to analyze the impact of carbon emissions during the construction phase of the smelter from the perspective of the project's construction phase, and strategies for reducing emissions were investigated. Provides information on similar projects. The case study shows that the measures taken during the construction phase, foundation design, and pile construction are the main sources of harmful gas emissions from the project and the key to reducing them. Planning the first phase to optimize the construction process by optimizing construction plans, processes, and technologies; technical structures should include assembly structures; energy efficiency and low emissions should be taken into account when selecting construction machinery and equipment for the different parts of the construction project. Installation of photovoltaic devices to generate electricity for temporary installations; Strengthening of construction process management to reduce harmful emissions through mismanagement. With the continuous development of the construction industry, the current construction industry has moved from wholesale to energy-saving, green, and low-carbon development. Cooperation between construction units is essential to reduce harmful gas emissions during the construction phase. Harmful gas emissions from buildings are determined by a combination of structural and human changes from design to the choice of building materials. The basis for calculating industrial harmful gas emission factors. This paper discusses the construction phase of single and residential buildings. During the construction phase, when the building project is completed, the space is limited to reducing harmful gas emissions. I hope that in the future, people will be able to conduct a more comprehensive and in-depth study of harmful gas emissions over the life cycle of a building. This article only covers residential building forms that are stopped and poured on-site for research purposes. There are different types of buildings, and one hopes that in the future, one will be able to explore different types of buildings. The proposed emission reduction strategy is a theoretical study that should be applied to similar projects in the future to determine the actual impact of emission reductions.

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