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Research on the Cost Control of Green Building Project Based on the Application of Renewable Energy

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Abstract. Promoting and optimizing green building projects based on renewable energy applications means that green building projects require more investment than traditional buildings. Green buildings using renewable energy are different from conventional construction cost control. Full-life cycle cost management is a way to analyze and manage the planning, construction, operation, maintenance, and residual costs of construction projects. It would be best if you had the law. This study uses mathematical models combined with relevant accounting theories and research methods to analyze the overall situation of green building cost control based on the application of renewable energy.

Key words. Renewable Energy, Green Building Engineering, Project Cost, Prediction Algorithm.

1. Introduction

In recent years, many industries have begun to realize that the progress of human society has had a profound impact on the long-term stability of the environment [1]. That is why the government has attached great importance to the role of the construction industry in the environment [2], [3]. At the same time, in the whole process of the construction project, the use of renewable energy helps to reduce all the energy demand as far as possible, reduce carbon emissions, give the construction workers a comfortable environment, and reduce their damage to the surrounding natural environment [4]. Generally, environmentally friendly building projects that use renewable energy often have excellent thermal insulation effects, thus enhancing public comfort [5]. With new renewable energy as the core idea of green construction, we are committed to creating a healthy and livable living space. With the progress of the construction field, the leading green construction projects have gradually formed the development direction of the whole construction field [6], [7]. Therefore, China rapidly promotes innovative green building projects using renewable energy sources. Thailand is the first green building project to adopt these technologies fully, covering urban residential areas, garden gardens, urban public service facilities, and office buildings [8]. According to the research, green buildings in many places, especially those using renewable energy, are better quality than traditional buildings. However, balancing the price of renewable energy and other building materials is usually the main difficulty in preventing the development of green buildings.

2. An Overview of Green Building Projects for Renewable Energy Applications

About 45% of the global carbon dioxide is released in the construction industry, and these projects release about a third of the world's total temperature. The damage to the environment of the building is not limited to its initial stage but runs through the whole use process. All of this damage to the environment can be regarded as damage to the environment. For example, when we build an environmentally friendly building that uses renewable energy, we do not incorporate the building's air conditioning, heating system, and insulation into our design. Similarly, the carbon emissions we use these buildings should not be ignored. To achieve the concept of sustainable development, we need to transform the construction industry accordingly [9]. UN2015 One of the main goals of the Sustainable Development Conference is to build a city with sustainable development characteristics [10]. 2019 the Ministry of Housing and Urban-Rural Development published the latest assessment guidelines for green building-led projects (GB / T50378-2019). The regulation revised the 2014 regulations for assessing renewable energy construction projects. China's environmental protection construction projects have significantly progressed in the past decade. Now, in all provinces and above cities, affordable housing projects and large-scale public facilities need to implement comprehensive regulations. This powerfully highlights the concern for environmental protection in construction projects.

3. Analysis of the Cost of Green Construction Projects in the Current Renewable Energy Application

A. The Current Situation of Green Building Project Cost

In general, environmentally friendly buildings with renewable energy are significantly higher quality than conventional buildings because of the wide range of innovative building materials. From the architectural design perspective, most environmentally friendly buildings use steel and metal roofs or green vegetation-covered roofs. In contrast, traditional buildings have concrete frames and asphalt waterproof roofs with fibre concrete slabs. Therefore, green buildings use renewable energy sources, and this difference in building structure will be reflected in their demand for energy sources and the treatment of carbon dioxide methods. This point has already been confirmed. When dismantled, given the low recycling efficiency of traditional buildings, we found that carbon emissions from conventional reinforced concrete buildings will increase, and their recovery effects will improve, rather than green buildings using renewable energy. On the car stage, the carbon emissions are minimal. Compared with traditional buildings, designing and evaluating the cost of renewable energy for green buildings is an investment that must be considered in advance. Many of these inputs assess design techniques, study new building materials, and build green buildings. However, such investments are often implicit, sometimes even preventing us from choosing green building projects that use renewable energy. According to the study and analysis, buildings combined with renewable energy will reduce their average energy consumption by 26 per cent, their total maintenance costs by 13 percent, and their carbon dioxide emissions by 33 per cent. This increased the building satisfaction by 27%. On the other hand, using renewable energy to build environmentally friendly buildings can also help enhance the reputation and brand image of construction companies.

B. Cost Analysis Model and Method of Green Building Engineering

The cost of the current construction projects does not include the operation and maintenance costs of the building but mainly consists of other expenses and the project's construction costs. If the environmentally friendly building theory of renewable energy is introduced, the cost assessment system will be lost. Although ecologically friendly buildings using renewable energy are relatively expensive initially, they will cost much more than traditional buildings in actual use, generally meeting the standard of sustainable development. However, the cost of building green buildings that rely on renewable energy is hard to measure. When we calculate the cost, we must consider the entire life cycle of the building. In other words, as long as the full life-cycle benefits of green buildings built using renewable energy exceed the additional cost, this constitutes an economic investment, as shown in Figure 1.

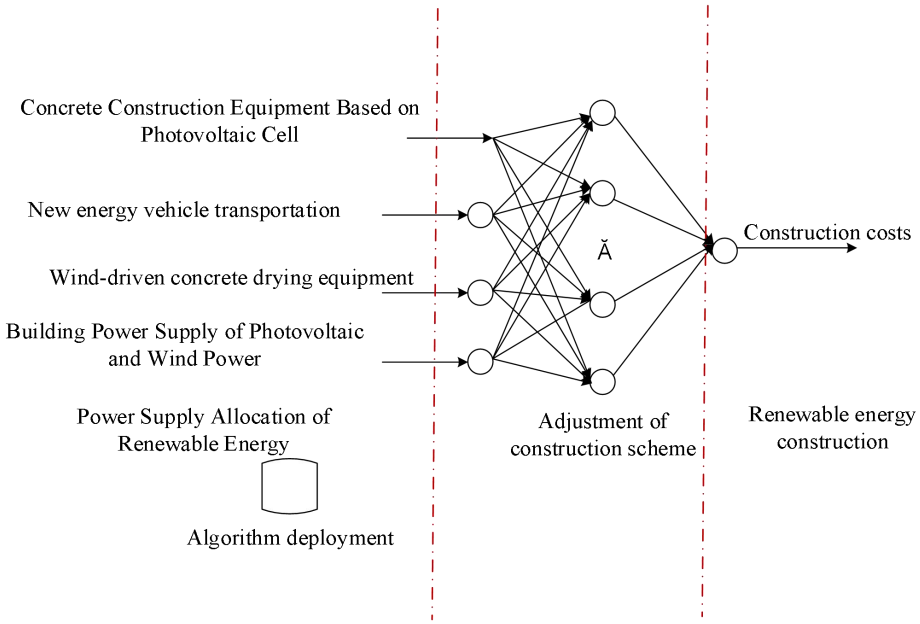

Fig. 1. The Role of Renewable Energy in the Cost of Green Architectural Engineering

Therefore, there are investment evaluation criteria of "general construction cost" and "environmentally friendly building cost using renewable energy-the excess cost of environmentally friendly buildings using renewable energy". Additional costs in planning, constructing, managing and dismantling environmentally friendly buildings using renewable energy are also seen as "overcoats". A significant advantage is that it can reduce the cost of funds for construction and management. Meanwhile, such reductions have other positive effects, such as reducing air quality, carbon emissions, and healthcare costs. While some private funding has only focused on short-term gains, we still need to focus on the community's well-being. We need to measure the profits and the expenses. When customers choose a budget strategy with appropriate measures, they can achieve an adequate budget early, thus laying a solid foundation for the following cost assessment. Increasing your construction budget will guarantee accuracy in your work. Green buildings using renewable energy and traditional buildings differ significantly in building materials and building techniques, which sets a higher standard for the professional skills of construction workers in the field, and the labour cost and the cost of buildings also vary.

Therefore, when we consider how to evaluate and control the investment cost of green building projects in the environment by using renewable energy, we need to implement it according to actual environmental conditions to ensure the real benefits of the investment cost. Some of these investors, however, have little experience in ecological construction projects that use renewable energy. In a diversified situation, the corresponding cost assessment is often complex to make appropriate corrections. They ignored all the needs of innovative technology and construction technology and only adhered to single quotes and conventional budget-setting methods, which significantly weakened the fairness of the project budget set. Still, the stability of the related cost results report was excellent. This substantially weakens the evaluation of the overall economic benefits of environmentally friendly construction projects using renewable energy.

Using predictive technology, professional staff can achieve real-time evaluation in the workplace and grasp the actual cost of individual projects. When studying the cost of environmentally friendly building projects using renewable energy and traditional buildings, a linear approach to managing the cost is an efficient and stable analysis method. Linear model formula 1 is a suitable method to evaluate the cost of green building engineering in the use of renewable energy. When the working cycle of construction engineering increases, we set the working cycle to {xi} =1, and then reshape the economic region by using functional indicators, to obtain the corresponding budget growth matrix L. The specific results are shown in equation (1).

$$L=\begin{bmatrix} x_1^T \\ x_2^T \\ \vdots \\ x_n^T \end{bmatrix}=\begin{bmatrix} x_1 & x_{1+\tau} & \cdots & x_{1+(m-1)\tau} \\ x_2 & x_{2+\tau} & \cdots & x_{2+(m-1)\tau} \\ \vdots & \vdots & \ddots & \vdots \\ x_{N-1} & x_{N-1+\tau} & \cdots & x_{N-1+(m-1)\tau} \end{bmatrix} \quad (1)$$

The cost management range is integrated in the dimension m; τ represents the acquisition value of consumption materials. By screening out the difference variables C between green building engineering and traditional buildings based on renewable energy applications, which obtained the following results:

$$C=(c_1,c_2,\cdots,c_n) \quad (2)$$

In general, according to financial standards, when the discount rate increases, the full-life cost of the building will be correspondingly reduced. This means that when the discount rate increases, the full-life cost of green building projects and older buildings with renewable energy sources will decrease accordingly. In addition, the difference between the cost of the whole life of renewable green buildings and older buildings is narrowing because of the increased discount rate. So, one question we need to explore is whether these buildings can cover the cost of the life cycle and whether they can be used to promote renewable energy. At the same time, we also need to consider that in the traditional building sector, zero-profit investment, and the green building sector, the use of renewable energy depends on its discount rate.

Based on relevant information, the current actual discount rate (3.24%) and the minimum inflation rate are both 1.1%, while the nominal interest rate is 4.34%. The data revealed that, measured by the discount rate of 4.34%, the average life cost of a recyclable green building project is 6703.14 yuan / ㎡, while the average life cost of a traditional residential housing project is 8234.02 yuan / ㎡. The study found that the total life cost of environmentally friendly buildings with renewable energy varies by 22.83 per cent from conventional buildings. Therefore, we can infer that in the whole life stage of the building, the environmentally friendly building projects using renewable energy will be better than the conventional ones. The change in the whole-life cost of ancient and ecologically friendly construction projects using renewable energy is shown in Figure 2.

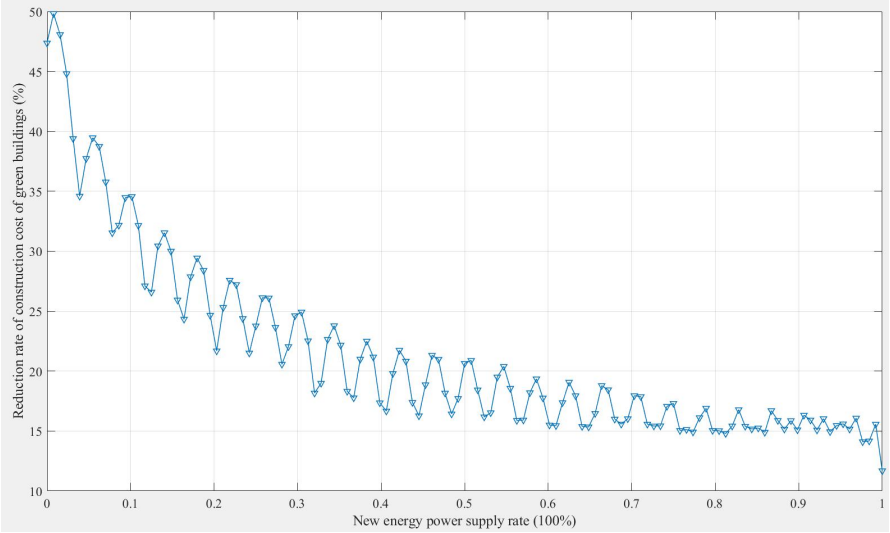

Fig. 2. The Cost Changes throughout the Life Cycle of Traditional Buildings and Green Building Projects

Because it usually takes decades or more to obtain information about the full life of a building, current data studies show that the cost of environmentally friendly construction projects using renewable energy increases by 37 per cent compared to previous ones. However, in-depth follow-up research has revealed that the ongoing environmental construction projects and their lives are significantly less sustainable than traditional construction. As a result, in the life cycle, the cost of environmentally friendly construction projects using renewable energy will be reduced by 21 percent compared with traditional construction methods.

4. Measures to Improve the Cost Control of Green Building Projects for Renewable Energy Applications

A. Improve the Accuracy of Relevant Data

In the push phase of the construction project, the accuracy of all the basic information will affect the final effect. For environmentally protective construction projects using renewable energy, the cost supervisor should make pre-planning and analysis according to the project's specific requirements. Given the adoption of new building materials and renewable energy, these projects cost more money than traditional projects, so they are relatively more expensive. Therefore, the project cost personnel must follow the project's specific needs familiar with the construction project's materials and the construction process's cost, so as to calculate the project cost more accurately. At the same time, the builders of renewable energy application technology and green building projects should plan a special and practical performance cost analysis so as to enhance the budget management of the project cost in the whole life cycle of the project and optimize the project cost scientifically and appropriately, so as to prevent the possible adverse effects.

On the other hand, given the high speed of material procurement and technology iteration in green building projects, the agencies responsible for setting quotas must adjust their quotas according to the latest green building engineering technology. For example, in the new quota release in 2020, we will appropriately add quotas for new materials and new processes needed for green building projects such as concrete to ensure a reasonable budget of green building costs.

B. Strengthen the Training of the Staff

Compared with previous construction projects, the construction process of green building projects is more stringent, and the executive personnel need to adopt environmentally friendly building materials and technologies for specific construction projects. Therefore, all construction engineers need to raise their sense of green building, and the management also needs to have the relevant expertise and legal regulations. The construction field also needs to improve the education of cost managers to have a deeper understanding of the theory and practice of green building projects. In this way, they can skillfully use the cost management strategy of green building projects in the whole life cycle.

C. Further Implement the Cost Control Work of the Whole Life Cycle

Many construction companies fail to fully understand the true meaning of cost management, thus ignoring their core position in improving their operating efficiency. However, good cost management can reduce expenses and enhance revenue. However, in most construction companies, construction experts do not clearly understand cost management. They despise the role of cost management in promoting the company's rapid development, so they fail to implement the cost management related to the construction process.
Since market value is not regarded as the core of cost management in the preliminary design and development stage of products and projects, the in-depth exploration of market conditions and use environment has not received enough attention, and the personal experience and understanding of the development team often influences this phenomenon. In many cases, construction enterprises only regard the cost of products as a guide for market prices, ignore meeting the needs of consumers, and do not carry out comprehensive market competition, which causes a series of problems. If the price is high, it may cause customer flow; otherwise, if the price is low, it may weaken the enterprise's profitability. In addition, if the cost of personnel and raw materials is only in the manufacturing process, ignoring the cost performance considerations in the design and development stage, then the cost of the manufactured product may be high, thus reducing its competitive advantage in the market.

D. The Difficulty of Electromechanical Installation in Green Building Engineering Based on the Application of Renewable Energy

Global attention on environmental protection is increasing, and using low-carbon green building projects is gradually becoming a new trend in renewable energy. This improvement, centred on the construction industry, is driving and enhancing the sustainability of construction and housing. The concept of green building engineering, namely construction engineering using renewable energy, has been implemented in the construction projects of many cities in China. Based on this premise, we compare the cost of current environmentally friendly construction projects and the whole life of traditional buildings that also belong to this characteristic. According to the study, compared with conventional construction projects, the initial construction cost of environmental protection construction projects is about 37%, while the operating cost of environmental protection construction projects is reduced by 28%, the maintenance cost is 22% reduced by 22%, and the final service period is reduced by 11%.

On the other hand, in the whole process of green building engineering, the coherent development and improvement of various innovative technologies, innovative design ideas and environmentally friendly building materials

results from such an energy-saving transformation. However, most current studies focus on the cost comparison of each link of the building life cycle but fail to explore how sustainable factors affect the construction cost deeply. It is still challenging to collect all the information on green construction projects. Our study used only secondary information from documents and actual cases and only used estimated information based on accounting principles to explore the full-life cost of green construction projects. Therefore, our next step will be to track and integrate the operational and demolition costs of green building projects so that their features and costs can be continuously optimized during the later stages of the project to assess their environmental impact better. This will help people who invest in green building projects promote the investment management of green building by mastering the economic benefits that the project brings to them, thus judging whether the project has the value of sustainable development.

5. Conclusion

Overall, identifying the factors that affect the cost of green building projects is crucial to implementing China's "carbon peak, carbon neutral" strategic objectives, promoting the transformation and expansion of the construction industry, and the large-scale adoption of green buildings. Based on the existing research results in the literature and considering the current situation, we established a model for the transformation and expansion of the construction industry. ISM clarified the high and low ratio between the construction project cost and the influencing factors. We deeply explore the driving force and dependence from two key angles through the MICMAC technique. The study found that government incentives are key in controlling the cost of green construction projects for renewable energy. In addition, we will give some practical suggestions on how to improve the cost control of green construction projects.

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