Research on New Energy-saving and Efficient Utilization of Buildings Based on Renewable Energy

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Abstract. Against the background of the increasing total energy consumption and the proportion of energy consumption in China, the energy crisis is intensifying. The application of renewable energy such as solar energy, wind energy and geothermal energy to building energy conservation is a major decision to solve the energy problem of buildings. The thesis combines the theories of green building evaluation standards, the problems facing the use of renewable energy, the value expression and use of renewable energy, and the impact of renewable energy on green building research. The influence of outdoor buried pipe layout and the arrangement of heat collector panels in the solar system on the feasibility research method in green building research, with a view to providing a certain reference for the subsequent research of new green residential projects in China.

Key words. Renewable energy, building energy saving, energy utilization, geothermal system, solar system.

1. Introduction
Renewable energy refers to clean energy that cannot be exhausted with its own transformation or human development and utilization. It can be continuously regenerated and continuously used. It is the ultimate energy choice to meet the sustainable development needs of human society. Renewable energy mainly refers to non-fossil energy such as solar energy, water energy, wind energy, biomass energy, geothermal energy, ocean energy and hydrogen energy. Applying renewable energy to building energy saving not only reduces the consumption of primary energy, but also reduces the damage to the environment. It is a combination of open source and throttling, and it is a major choice to solve the problem of building energy. This article takes energy saving as the theme of building research, and in-depth discusses the application strategies of solar energy, wind energy and geothermal energy in building energy saving research [1].
2. Theory and Concept

2.1. Renewable energy
The concept of renewable energy: Resources that can be regenerated in a short period of time and can be reused are renewable resources. Typical renewable resources include water resources, renewable biological resources, climate resources, land resources, and so on. Recyclable resources can be regenerated after a certain period after being collected and processed and used, so that they can be reused. They can self-generate and be recyclable, such as water, biomass, wind, and tidal energy. Both have strong self-recovery ability and can be generated again after being developed and used. But renewable energy does not include limited energy sources, such as solar energy, wind energy, tidal energy, geothermal energy, nuclear energy, and biological energy.

2.2. Green building engineering research
Green buildings can be regarded as "efficient use of resources" buildings, and they are also called "4R" buildings. The so-called "4R" refers to Reuse, which allows reuse of old materials when permitted; Recycle, for buildings Recycling materials, some materials are ready for reuse; Renewable, try to use renewable resources or energy to reduce the proportion of traditional energy consumption; Reduce, reduce building energy consumption, especially the use of non-renewable resources. Green buildings can reduce the waste of resources by improving the utilization efficiency of resources, and reduce the pollution of buildings to the environment by using renewable energy, thereby creating a healthier living environment.

For green buildings, the most fundamental principle is people-oriented, creating a healthy and comfortable living environment for users in terms of environment, and focusing on the integrity of building functions in terms of functions. However, compared with traditional buildings, the advantages of green buildings are reflected in the fact that the building itself can reduce the impact on the surrounding environment, so that the building and the environment coexist harmoniously, and adapt to local conditions to build a living environment that integrates with nature.

2.3. Thermal conductivity
Here (HA) is a series combination of equivalent thermal resistance from the well to stabilize the infinite surface temperature and convection resistance from the well to the on-resistance wall at the infinite boundary temperature \( T \) of the well wall [2].

\[
\frac{\partial \theta}{\partial \tau_s} + \frac{\partial \theta}{\partial \varsigma} + NTU(\tau_s)\theta + \frac{Pe_2 2H_{w}}{Pe_2 \pi R_0} \left( \theta_w - 1 \right) \frac{3\pi^2}{\pi \varsigma^2} \theta_{well}(\phi, Pe, \tau_s) d\phi = 0
\] (1)

The scaling factor is temperature \( \theta = \frac{(T - T_g)}{(Q/2\pi H k_w)} \). \( \theta_w \) is the well-water temperature, \( k_w \) is the thermal conductivity of the formation, and \( \varsigma = z/H \) is the Z direction. Proportionally

\[
\tau_s = \frac{m_w C_{pw} t}{\rho_w C_{pw} V} = \frac{t}{t^*}
\] (2)

The interpretation of \( \tau_s \) is the dwell time, which is more than \( t^* \), for the fluid flowing through the well.

\[
P_{e_i} = \frac{\rho_w C_{pw} U_i R_0}{k_g}
\] (3)

\[
NTU(\tau_s) = \frac{(hA)_e}{m_w C_{pw}}
\] (4)
An analytical solution is obtained by assuming that the thermal mass of the well absorbs most of the energy input to the well at a temperature \( t < t^* \) with good thermal stability. It is assumed that in-line non-linear third and fourth clauses (2) are negligible production

\[
\frac{\partial \theta}{\partial t} + \frac{\partial \theta}{\partial \zeta} = 0
\]  

\( \theta_e \) is the temperature used to represent the early time scale. Solution of Equation (5)

\[
\theta_e(\zeta, \tau_e) = \frac{2}{Pe_e R_0} \left( 1 - \frac{\zeta}{\tau_e} \right) \tau_e \leq 1.0 \leq \zeta \leq \tau_e
\]  

3. Application of geothermal energy in building energy saving

Although the geothermal pump can make full use of the temperature difference between the building and the ground to provide a comfortable environment for the living space, this technology also requires a large space for heat exchange, and at the same time occupies a large land area. Under the background, the occupation of land for well installation will undoubtedly cause waste of land resources. Therefore, the use of soil source heat pump technology for green buildings must first solve the problem of land occupation. To effectively solve the impact of ground source heat pump on building research and propose an effective solution, first, you must have a certain understanding of the principle of ground source heat pump system and research and construction.

3.1. Refrigeration process of ground source heat pump system

The underground soil layer can maintain a lower temperature in summer. When the temperature in the building is higher in summer, the heat pipe buried in the soil exchanges heat with the soil, so that the water medium in the pipe is cooled; then the condensed water medium passes through the compressor. The heat is further released and converted into a cooler water medium, which is eventually supplied to the user to reduce the ambient temperature in the building. After the water temperature rises, it is transmitted to the condenser for cooling. The whole process is a closed-loop water condensation temperature adjustment system, which can achieve building temperature control with very little energy.

3.2. Ground-source heat pump underground heat exchanger

Ground-source heat pump underground heat exchangers are buried tube heat exchangers buried in the soil, generally below 100m in depth. The types of heat exchangers are single U-type, double U-type, and W-type. In the system, there are special media for water. The flowing pipeline and the water flow are driven by a special water pump. Since the temperature of the underground soil can be maintained at 19 degrees Celsius, water passes through the soil to generate heat exchange, which can bring heat into the building, thereby achieving temperature regulation in the building. Using the system to cool buildings in summer will raise the soil temperature to a certain extent, which is equivalent to storing heat in summer and using it in winter. Buried pipe heat exchangers usually require heat exchange pipes to be located below one meter in the frozen soil layer, the number of water pipes is not less than five, the drilling depth is usually below one hundred meters, and some projects have drilling depths of more than 180 meters. The buried pipe method also needs to be selected according to the land resources of the specific project. For projects with less land resources, vertical pipe buried methods are usually used, but this method requires more pipeline resources, larger drilling depth, and overall cost. Higher. Some projects tend to adopt the method of horizontal buried pipe, or a combination of horizontal and vertical buried pipe [3].

3.3. Ground source heat pump cooling and heating principle

Ground source heat pump air conditioning system is mainly divided into three parts: outdoor ground energy heat exchange system, water source heat pump unit system and indoor heating and air conditioning end system. There are two main types of water source heat pump units: water-water units
or water-air units. The three systems rely on water or air heat exchange medium for heat transfer. The heat exchange medium between the water source heat pump and the ground energy is water, and the heat exchange medium with the building heating and air conditioning end can be water or air. Ground source heat pump schematic diagram shown in Figure 1.

![Heat pump schematic - summer mode](image)

**Figure 1.** Schematic diagram of ground source heat pump

4. **Impact of solar system utilization on green building research**

4.1. **Principle**

The status quo and existing problems of the integration of solar energy and high-rise buildings. At present, Beijing, Shanghai, Shenzhen, Shandong and other cities have begun to construct residential buildings with less than 12 floors, and promote the construction of solar water heating systems in schools, government agencies and other units [4]. The large-scale and large-scale use of solar water heaters has made the energy-saving effect of the building obvious, and successfully achieved more than half of the energy-saving goals. Against the background of the compulsory requirements for building energy saving and emission reduction, local governments have also introduced relatively favourable support policies, such as giving certain cash subsidies to solar products, which effectively increased the sales of related products and made solar products cover. In addition to schools, enterprises and institutions, residential quarters and other types of housing, there are also more households in rural areas using solar products for hot water supply. With the large-scale use of solar products in buildings, the solar industry has taken new construction as a development object, and more and more projects have been implemented by construction units. The solar engineering market has developed rapidly, which is mainly reflected in the installation and use of domestic residential building hot water projects, public building hot water systems, and the rapid growth of the number of Huinong solar hot water projects, greatly increasing the enthusiasm of solar water heating systems for industrial and agricultural production. As shown in Figure 2, it is a solar energy-saving application system.
4.2. Building Strategy
In order to avoid obstruction, solar collectors are often installed on the roof of the building. The optimized inclination angle (the angle between the collector and the horizontal line) can refer to the empirical value: when used to prepare hot water, the empirical value of the tilt angle is equal to the latitude of the area. Value; when used for heating, the empirical value is latitude plus 15° [5]. How to integrate solar devices with buildings has been a hot issue in recent years. The research idea of solar building integration was advocated by the American Solar Energy Association founder Steven Strong 20 years ago. That is, instead of installing a bulky device on the roof to collect solar energy, semiconductor cells are directly embedded in the walls and roof. According to Steven Strong's research idea, the US Department of Power Supply and the Department of Energy have jointly launched solar building materials, such as residential roof solar panels and "curtain wall" products.

4.3. Application

4.3.1 Solar LED Lighting. (1) Residential solar LED corridor lights. The problem of the corridor lighting system in many residential quarters is a common problem: the corridor lights are often damaged due to frequent opening and closing, and many corridors have become "blind corridors". The solar LED corridor light system is composed of solar cells, batteries, LED bulbs, control systems and control switches. In terms of control, charge and discharge control systems, light control systems and timely control systems can be used. During the day, the solar cell module converts solar energy into electrical energy, which is then stored in the battery through the charge and discharge controller; at night, the battery provides power to the load. In order to ensure the lighting in rainy days, you can increase the battery capacity or choose grid-connected operation [6].

(2) Solar LED lawn light. Solar LED lawn light consists of solar battery, super bright LED light, battery, automatic control circuit, etc. Due to its unique advantages, it has developed rapidly in recent
years. The power of the LED lawn light is provided by a solar battery. The solar battery collects solar energy during the day and converts it into electrical energy and stores it in a battery. It supplies the LED lawn light at night. According to the actual situation of solar irradiation, select the control method of independent system or cluster control system.

### 4.3.2 Solar water heater.

Solar water heaters have been rapidly developed and widely used for their advantages of energy saving, environmental protection and simple use. Solar water heaters have functions such as heat absorption, heat conduction and heat retention, and have a large energy efficiency ratio. Under the same environment, the amount of hot water produced by the water heater is the largest. In order to avoid many shortcomings of ordinary solar water heaters, such as low thermal efficiency and too little heat exchange water, the new solar water heater technologies that are currently widely promoted mainly include the following aspects:

1. Flat panel solar water heaters not only have better thermal efficiency than vacuum tubes, but also can be flexibly combined with buildings and the surrounding environment, and are widely used in high-rise and small high-rise houses. 
2. The wall-mounted solar water heater cannot only be combined with the building, but also the heat collector and water tank are separated. The heat collector is flexibly installed outside the balcony or south facing wall, and the water tank is placed in the balcony or indoor corner, reducing the number of Restrictions on the use of solar water heaters. 
3. The solar water heating system is integrated with the building. The roof covering or insulation layer can be completely replaced by solar collectors, which not only protects the building from heat and leakage, but also avoids repeated investments and reduces cost [7].

### 5. Conclusion

Accelerating the application of renewable energy in building energy saving and adjusting the building energy consumption structure are the keys to alleviating energy problems and improving the quality of the atmospheric environment, and will contribute to building a resource-saving society, adjusting the economic structure and transforming growth patterns. It took more than 30 years for the western developed countries, such as the United Kingdom, to realize this structural transformation, while China has begun implementing large-scale energy structure adjustment for a short time. Therefore, in order to complete the task of adjusting the energy structure in a short period of time, it is of course dependent on policies and secondly, it must have enough financial support, but the most important thing is to develop and rely on high-tech energy and environmental technologies. Only by relying on high and new technology can we solve the problems encountered in the adjustment of the energy structure in China, and we can guarantee that the tasks completed in the western developed countries in 30 years can be completed in a short period of time. This article is a study of building energy-saving strategies, mainly discussing the application prospects of renewable energy. The thermal insulation strategy based on energy-saving research is discussed, the basic principles of renewable energy such as solar energy, wind energy and geothermal energy are emphasized, and corresponding building research strategies are proposed. It will provide an important basis for accelerating the adjustment of China's energy structure and promoting building energy conservation.

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