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## Research on integrated solar and geothermal energy engineering design in hot summer and cold winter area

Qiankun Wang<sup>a\*</sup>, Qian Huang<sup>a</sup>

<sup>a</sup>*Dept. of Civil Engineering and Architecture, Wuhan University of Technology, Wuhan, 430070, China*

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### Abstract

The purpose of integrated application of solar system and geothermal energy is to complement each other perfectly and to fully utilize renewable resources for low-carbon and energy saving ideas. In this paper, the application of the composite energy system in the engineering design of a project in Wuhan which belongs to hot summer and cold winter area will be evaluated in such aspects, including technical feasibility, system efficiency, economic and environmental impacts, in order to provide technical and practical experience for the design and application of integrated energy systems in the future.

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*Keywords:* solar energy; geothermal energy; integrated application; composite energy system; hot summer and cold winter area

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### 1. Introduction

In recent years, solar and geothermal energy as renewable energy is widely applied to buildings what can reduce the use of conventional energy sources in China. The measure responses and implements the policies "energy conservation and emission reduction" and "building energy efficiency" respectively, and has vigorously promoted by the relevant departments<sup>[1]</sup>.

China belongs to the solar energy resources abundant country. Solar theory reserves amount to 17,000 million tons of coal per year, therefore solar energy utilization have great potential. Using solar energy doesn't affect the ecology, also won't cause environmental pollution; Geothermal energy, especially shallow geothermal energy (including shallow soil and water), is also widespread low taste good heat. Because the temperature of earth surface soil and water is relatively stable, so the ground as a great energy

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\* Corresponding author. Tel.: +86-1-397-110-1204

E-mail addresses: [onlinehqq@163.com](mailto:onlinehqq@163.com).

storage body, can save heat for winter and cool for summer. Therefore, solar and geothermal energy as one kind of inexhaustible clean energy, their utilization foreground cannot be ignored<sup>[2]</sup>.

Although solar and geothermal energy although have advantages they still exist deficiencies. Solar energy is uncertainty and intermittent because of low density flow, thus when we collect solar energy, we not only need larger collection hot area, but also heat storage device<sup>[3]</sup>. While low taste of geothermal heat needs lifting device such as tube ground source heat pump to apply. This pump needs checking take heat and row hot thermal equilibrium, if the balance is broken, long-term operation of pump will make the soil temperature field without effective recovery what not only reduces the heat pump units COP value, also can make heat pump unstable, even abnormal operation<sup>[4]</sup>.

It is worth to do extensive research of composite system design in hot summer and cold winter and energy use, especially the energy saving effect of discretion, economic benefit which directly affects energy system feasibility in hot summer and cold winter. We expect this paper can provide related theory to similar projects.

### Nomenclature

$A_c$	solar collector area ( $m^2$ )
$Q$	building heat consumption indicators ( $w/m^2 \cdot d$ )
$A_0$	building area ( $m^2$ )
$J_T$	local average daily solar irradiation quantity ( $kJ/m^2 \cdot d$ )
$f$	solar assurance (%)
$\eta_{ed}$	collector efficiency (%)
$\eta_L$	pipng and tank heat loss rate (%)
$n$	yeas
$\Delta Q_{save}$	save energy
$Q_{co2}$	the amount of emissions of carbon dioxide

## 2. Simulation ideas and solutions

### 2.1. Simulation idea

According to the geographical location of Wuhan, we can use either solar or geothermal energy in buildings<sup>[5]</sup>. And Wuhan belongs to hot summer and cold winter area. Considering the climate characteristics of different seasons, we prefer solar energy in summer and adopt geothermal energy for supplement in winter. Such integrated application can make full use of solar and geothermal energy to realize the length complementary, so that integrated application of renewable energy has broad prospects for development<sup>[6]</sup>. This article will choose a three buildings in Wuhan proposed for simulation analysis object, and we design a set of solar and geothermal energy of composite energy comprehensive application system, then use system software to simulate the energy consumption of energy efficiency, simulation of the ultimate economic and environmental impact, and analyze the load energy the advantages and disadvantages of the system, finally discuss the technical feasibility analysis of the solar

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