

The Research of Renewable Energy Utilization In Beijing's New Airport

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Abstract. This paper analyze and study the condition of renewable energy in Beijing's new airport area, and puts forward the use solutions and suggestions of renewable energy in the new airport area.

Introduction

Beijing's new airport is committed to become a world-class level of efficient, high-quality, green new goalkeeper, establish "green airport bar" and "sustainable, low carbon development paradigm" airport. In order to achieve this goal, new equipment, new technology and renewable energy for energy conservation and environmental protection must be used. It is the important way to realize green airport by effectively using renewable energy. There are many different kinds of renewable energy, which is mainly suitable for Beijing new airport are solar and geothermal resources.

The renewable resource conditions in the new airport area

Solar energy resources

Solar energy resources in Beijing's new airport area is high rich, and the average annual total radiation is up to 5600 MJ/m². According to China's solar energy resources division standard, the region belongs to the "rich" and suitable for use.

Suppose that the area has 27 km², there is sunshine energy more than 40 billion KWh/year in total. In theory, suppose that the solar energy conversion rate is 10% and the area laying solar power systems occupies 1% (270000 m²) of the total area, 40 million KWh of power consumption can be provided in a year.

In addition, solar-thermal use is also very suitable.

Geothermal resources

Shallow geothermal

The new airport is located in southern Daxing district in Beijing, and in the downstream of the river alluvial fans. According to professional survey and evaluation, the new airport regional is belongs to ability good area for strata heat exchange, and it has good drillability. Therefore, if shallow geothermal energy is needed, buried pipe ground source heat pump should be used.

Suppose that heating load estimation is 100 w/m², in theory, the way of adopting ground source heat pump can give heating area for several millions of m².

The deep geothermal resource

There are Lixian fault zone and Anding fault zone surrounding the new airport. Lixian fault zone is the main fracture structure, and Anding fault zone is the secondary fracture of Lixian fault zone.

According to a rough estimation of the survey of the professional company, the project area geothermal resource is about 6.86×10¹⁵ kJ (the average thickness of 2000 m, thermal storage heat reservoir average temperature 60 °C). If 1% of heat energy can be mined, in combination with heat pump of cascade utilization of heating energy, about 2 million m² can be heated.

The use planning of renewable energy

Based on the analysis of the resource conditions , considering the reality such as technology, capital and time limit for a project under the premise, we make the following program planning of renewable energy for Beijing's new airport.

The use of solar heat/solar-thermal

Construction of solar hot water system. In Buildings for passengers for the night, dormitory and office building, all adopt solar domestic hot water supply. Available solar device is installed in the building roof; Installation direction of roof in the south is advisable to 15 ° angle. Set up solar panels of about 64,500 m², it can generate more than 34 million kWh for heat in a year.

The use of solar photovoltaic (pv)

Appropriate using photovoltaic (pv) power generation. According to the functions and features of the airport, can be considered to install solar photovoltaic panels in transfer center, parking building, parking lot and on the roof of the cargo area; Installation direction of roof in the south is advisable to 15 ° angle; Install power 8.4 MW, it can generate 8.4 million kWh energy in a year.

The use of shallow geothermal resources

Use of shallow geothermal energy for heating and cooling for about 80,000 m², Such as executive terminal, the airport shift dormitory, canteen and other low density area. We can extract heating energy every year is about 11 million kWh, refrigeration energy about 19 million kWh.

The use of deep geothermal resources

Adopt deep geothermal resources for heating in public security, armed police room and buildings passengers for the night (heating area of about 100,000 m²), we can extract 14 million kWh in every year.

If the above plan of renewable energy project can be implemented , we can use for at least 86.4 million kWh. According to the Beijing airport energy-saving assessment report, the current ratio of renewable energy can arrive to 10%.

Benefit estimation and analysis

Economic benefits

Usually, the life of a solar pv system is 25 years, solar-thermal systems for 15 years, geothermal system can run 20 to 30 years.

Without the present state and local subsidies, solar photovoltaic power generation system of investment and economic benefit is basic quite or slightly owe. Solar-thermal systems and shallow geothermal energy utilization can get money (disinvestment) within five years .The deep geothermal systems need recoup for 8 to 9 years.

It is obvious that the economic benefit is great in the system life period: At least 10 years, a year has free 78 million kWh, electricity cost saving at least 48 million yuans (price:0.6~0.7 ¥/KWh).

If receiving the current subsidy for the government, to get money needs less time. There are more economic benefits.

Also, many kinds of emissions are reduced ,such as CO₂, SO₂, smoke and dust etc.

Environmental benefits

If use of renewable energy is in accordance with the foregoing scale, the solar photovoltaic system will abate CO₂ 0.837 tons a year, and solar-thermal systems abate CO₂ 3.38 tons a year and the shallow geothermal system abate CO₂ 1.8 tons a year, the deep geothermal system abate CO₂ 2.82 tons every year.

The calculation results show that the solar water heater and electric water heater, per 2 m² installation of solar water heater (assuming that auxiliary heating equipment for the electric heating mode, using the 300 days a year), every tons of hot water will reduced emissions :0.09 kg smoke, 0.10 kg SO₂, , 10.9 kg CO₂ comparable to electric water heater. If 1 ton hot water is gained, the consumption of the

solar energy water heater can power saving 9.27 kWh electricity comparing with the consumption of electric water heater power.

Accordingly the above estimation, per 2 m² installation of solar water heater can reduce : 32.2 kg smoke and dust emissions, 35.8 kg SO₂, 3902 kg CO₂ in its life cycle (15 years), and save 1,257.8 kg TCE. Only this plan of solar hot water system, will reduce emissions of 1,038 tons of soot, 1,154 tons of SO₂ and 125,800 tons of CO₂, save 40,564 tons TCE in its life cycle (15 years).

Conclusions and recommendations

Conclusions

To sum up, we may draw the following conclusion:

There is more abundant and renewable energy in Beijing's new airport area to be used for a long time. We should make full development and utilization of renewable energy for building cooling and heat sources, promote energy grade, and realize clean and sustainable development.

The use of renewable energy in Beijing new airport, in addition to completing the target of renewable energy utility, will also be able to implement the national policy, social responsibility, at the same time also is one of the great innovation for airport energy solutions.

Recommendations

1. The best business model is given priority to with professional company, Set up a joint venture with the relevants, and the professional company as the investment main body, the joint venture will be entirely responsible for investment, construction and operation of new energy system. In this way, it can avoid the risk of system operation to the greatest extent.
2. The ground source heat pump system is used to the monomer buildings for heating and cooling. In line with the energy-saving land-saving green airport construction goal, and considering the ground source heat pump hot and cold load balancing, the ground source heat pump construction area should not be too big.
3. The further detailed investigation must be completed combining with the characteristics of the new airport, before the design and construction of the geothermal system in the airport. Then, the solution should be put forward with giving full consideration to the problems and happens in the operation process.

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References

- [1] The hydrogeologic and engineering geological brigade of Beijing: *Beijing plain of shallow geothermal energy under special geological survey report* (Beijing municipal bureau of geological exploration, China 2008).
- [2] China Wuzhou engineering design group co., LTD: *Beijing's new airport construction projects- Energy-saving assessment report* (Xiaoli Zhai etc., China 2013).