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Researches on application of the renewable energy technologies in the development of low-carbon rural tourism

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Abstract

The rapid development of rural tourism has brought such problems as the environment pollution, resource degradation. The renewable energy technology can be applied in the development of low carbon rural tourism. This paper takes Changsha for example, applying the local biomass energy, solar energy and wind energy in the development of low carbon rural tourism and puts forward some methods on how to apply these renewable energies.

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1. Introduction

As the increasing number of global population and the growing scale of economy, environmental problems caused by the use of the energy have been recognized by the public. The global climate change which is caused by the concentration atmospheric carbon dioxide has also been recognized as an undisputed fact. As a new development concept and development model, "low-carbon economy" has increasingly become the social focus. Low-carbon economy is the low energy consumption, low pollution, low- carbon emission economic model, and it is another achievement after the agricultural civilization and the industrial civilization in human society. Rural tourism has become one of the modern living styles in Chinese urban dwellers because of the participation, experiential, cultural and the unique active object. According to statistics from Hunan Provincial Tourism Bureau in 2009, there were 3,500 million rural tourists and the revenue of rural tourism has reached 4.7 billion Yuan in Hunan Province which indicated that rural tourism has become a new economy growth and the important way to construct the new and modern rural area. The rapid development of rural tourism industry also has brought some negative impacts on rural tourism resources and environment. Thus in the development of rural tourism, the

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introduction of low-carbon and renewable energy technology is the important development way in the future. Renewable energy refers to such renewable resources as solar, wind, hydro, biomass, geothermal energy and ocean energy and so on which are harmless or do little harm to the environment, what's more, these kind of resources are widely spread and it is very easy to develop. Thus the utilization of solar, wind, hydro, biomass, geothermal energy can become an important energy source for the sustainable development of rural tourism.

2. Benefit Analysis on the Renewable Energy Technologies in the Development of Rural Tourism

The development of rural tourism needs the low-carbon renewable energy technologies. Low-carbon renewable energy technology refers to the utilization of such energy as the solar, wind, hydro, biomass, geothermal energy and ocean energy. And it is an eco-technology to produce clean energy which can effectively alleviate the current situation of energy supply in the rural tourism area. This technology can deal with the utilization style of the energy in the rural tourism area fundamentally and it is a "friendly environment" and substantial technology in the tourism industry growth. The application of renewable energy technologies in rural tourist areas development can achieve the sustainable development of rural tourism.

2.1. Cost effective

It is very easy and convenient to use coal and firewood in the rural area which does not need equipment investment, thus the utilization of coal and firewood in the rural tourism area has taken the large proportion, and the utilization style of these kinds of energy just limited to the combustion. But the uppermost investment of the renewable energy is the equipment investment when the renewable energy was first put into use and the costs are relatively large, but in the long run, the equipment investment of the renewable energy only needs the one-time investment, and almost there is little investment in the late operation, it can be cost effective in the operation and do little harm to the environment.

2.2. Reduce conventional energy consumption

It is an important goal to reduce the proportion of the use of conventional energy sources when the renewable energy is applied. Rural tourism area has abundant renewable energy reserves, such as solar, biomass, wind, and some rural tourism areas also are rich in geothermal energy. The rational use of these renewable energy technologies must be based on the combinations of renewable energy of the different rural tourism areas. Then the blue print of the utilization of the renewable energy must be scientifically established and then applied it into all involving tourism industries. The renewable energy can effectively replace the conventional energy sources to reduce the proportion of energy use in the rural tourism area and to achieve ecological development in the rural tourism area.

2.3. Providing the ideas for development

The introduction of renewable energy sources to the development of rural tourism area is a useful exploration, and it also provides a new development idea for the development of the rural tourism industry. Renewable energy can be used for the rural tourism areas, thus, such technologies as the green building technologies, the technology which is used to deal with the rejected resources and the high efficiency use of coal technology can be exploited by the rural tourism industry, and these technologies

can create the more efficient and cleaner products to achieve the sustainable development of rural tourism industry.

3. Application of the Renewable Energy Technologies in the Development of the Low Carbon Rural Tourism in Changsha

Changsha has a moist monsoon climate of the subtropical zone with the average annual air temperature of 17.2℃, four distinct seasons and abundant solar energy resources which make Changsha possess a wealth of biomass energy and hydropower. There are more than hundreds of raw materials which can be used as the biomass energy in Changsha. Thus the renewable energies in Changsha mainly are solar energy, biomass energy and hydropower.

3.1. Biogas energy coupling system

Rural tourism areas in Changsha have the green vegetations in different seasons. The food crops and economic crops are mainly rice, grapes, corns, strawberries, sweet potatoes in the rural area. The vegetation coverage rate takes more than 90%. Thus it is the future main development direction by using biomass energy resources in the rural tourism areas located in Changsha. There are a lot of raw materials for biogas such as the domestic wastewater, the stools of the livestock and human, the forestry barks, leaves, branches and a large number of shrubs in the rural area in Changsha. Thus the biogas coupling model in Changsha rural tourism areas can be divided into the energy system, the breeding system and planting system. The process of the energy system is the biomass raw materials → gas → gas lights / gas power generation → power system. And the process of the breeding system is biomass feedstock → biogas residue → pool →reed pond back to biogas pool. And the process of the planting system is biomass feedstock → Slurry of biomass →fertile field →stalks back to biogas pool. What's more, ecological agriculture sightseeing can be developed in Changsha rural areas by using such biogas energy systems as clean energy production systems and farming systems.

Biogas technology is the most widely used and mature technology in the application of the biomass energy system. The average annual air temperature in Changsha is 17.2℃, thus the biogas can be produced in different seasons. Such materials as the fallen leaves, the deadwoods, dried tree barks, weeds, and abandoned foods, the living garbage and so on can be used to generate the biogas in the rural tourism areas. Digester should be located in the large and sunny open spaces which is conducive to maintain a higher temperature to accelerate the fermentation tanks of raw materials. The size of digesters in the rural tourism area can be determined by the amount of raw materials. Generally speaking, an 8 cubic meters of biogas digesters can provide biogas which can be used for more than 10 persons for cooking in the case of sufficient raw materials. Biogas can be used as cooking, lighting, heating for the daily life. But the digester should be built in the living zone in the rural tourism areas which can reduce the cost of pipe lying. Gas lamps can replace all the lightings within the building if the full biogas production, what's more, the biogas can be used to generate the power which can be used as the power source for the electricity-consuming facilities in the rural area. However, the pipe should be cleaned regularly in order to prevent the biomass residues from blocking the pipe, and the digesters and the various interfaces should always be checked in case of the gas leaking.

The rural tourism scenic spots located in Changsha have the rich water resources. The aquaculture is an important aspect in the breeding system in the different rural tourism scenic spots. The water plants can be used as the biogas material after being dried and crushed; biogas liquid residue can be used as fodder for aquaculture. The fish can be used as the cooking material in the rural tourism area and it also can increase the income of the rural tourism area through rural tourists go fishing in the rural tourism area.

The rejectamenta after killing fish can be put directly into the digesters as the material which can generate the biogas, thus it can increase the capacity of biogas production.

The planting and the biogas system have the mutual interaction in the rural tourism area. On the one hand, planting can produce straw, chaff and other bean shells. After being crushed and fermentation, these materials can be put into the biogas digesters directly. On the other hand, biogas residue is the organic fertilizer which can fertilize the plants to increase the production of rice and fruit. Generally speaking, the richer of the biogas materials, the faster updates of the biogas raw materials, in a period of time, if the output of the biogas becomes scare, the reason is that the digester was filled with the surplus slurry and residue. Thus if the surplus slurry and residue can be cleaned up in time, the biogas production capacity will increase. So the biogas digesters have to be cleaned up frequently, and the biogas slurry and the residue are used to fertilize land, at the same time, it can increase biogas production.

3.2. The utilization system of the solar energy

In summer, it is very hot in Changsha which is a typical sub-tropical continental monsoon area and Changsha is regarded as one of the "four furnaces" in southern Yangtze River. The annual average temperature is 17.2℃. The average temperature in January is 13.4 ~ 14℃, while the average temperature of July is 26.3℃. The abundant solar energy can alternate the conventional energy in the rural tourism area in Changsha. The solar energy can be used as the lighting system and the solar house system in the rural area in Changsha.

The solar lighting system can be considered to alternate the common lighting system in Changsha rural tourism areas, such as Baiguo Orchards, Damingshanzhuang, Muyun Ecological Farm and other plantation areas from the house lighting to the surround lighting. Solar street light system in consisted with solar modules, battery, intelligent controller, energy efficient DC lamp, lighthouse, installation material and other components. Under the control of the intelligent controller, the battery can be charged in the solar modules during the day time, in the night the battery can provide power to the DC lamp. The DC lamp controller in such conditions as sunny or cloudy days can ensure that the batteries avoid being damaged due to overcharge or over discharge. At the same time, the DC lamp controller has such protection function as light control, sound control, time control, temperature compensation and lightning protection. The intelligent controller can be turned on automatically at night and turned off automatically during the daytime, what's more, in the night the intelligent controller can switch load capacity. Solar lights do not need to set up transmission lines or cables which can eliminate the erecting line processes between the cabinet and lights. And the solar lighting doesn't need the expert management and control. It can be easily installed in such rural tourism areas as the square, parking lot, living areas, tourist areas. It can also be set up in these places where it is difficult to install the lighting cable especially in the mountainous areas.

The rural tourism areas are located in the sub-tropical regions with the higher temperatures, so solar air conditioning technology is one of key application technologies in the rural tourism areas in Changsha. Because the cost of air conditioning system is higher, according to the status quo of the rural tourism areas, it can be considered to install the solar air conditioning system in such rural tourism areas as conference rooms, reception halls, the tourist centers and other places. Compared with the conventional air conditioning, solar air conditioning can not discharge the fluorine and it is one-time investment facility with small cost maintenance, in the long run, the running cost of the solar air condition is much less than that of the conventional air conditions.

Most rural tourism scenic spots are set up in the mountainous villages where it is far away from the power supply center. Thus through constructing the solar houses, the rural tourism landscapes can avoid being damaged caused by the erecting electricity wires without planning in the rural tourism areas. Solar

houses have such functions as solar collectors, thermal storage, auxiliary power system and the indoor heating and cooling system, thus it can be used as an independent system without any additional equipments and it is very easy and convenient to operate. As an independent system, the solar collector in the room has the large and efficient solar energy storage which can provide the power into the indoor lighting, water heating and other electrical applicants. In the construction of solar houses in the rural tourism area, attentions should be paid to avoid the shadows of the trees covering light-collecting board such as roof and wall, the solar cookers and drying systems. When the rural tourism areas such as living areas, dining area need coal for cooking especially in winter, the solar cookers can be used to do the pre-warm up works. When the water temperature or oil temperature has reached the solar maximum temperature, the natural gas can be used to do the post-processing cooking. Solar dryers can dry food in the kitchen and dried vegetables, and it also can dry clothes.

3.3. The utilization system of the wind energy

At the peak of the Mountain Daweishan and other mountainous rural areas, the annual wind resources are abundant. So it can solve the short power supply in the rural area if we can effectively use the wind power. Small wind power technology has matured and it is cost-effective and it is very convenient to use, so it is the effective way to solve the energy consuming in the remote rural tourism areas.

At the top of the mountain or in the irrigated areas such as litchi forest, mango forests, grapes fields and so on where are faced with the problem of the shortage of water and inconvenience for watering due to the topography. If the wind-drawing water and the saving irrigation technologies are applied to the rural tourism areas, the rural tourism areas can be provided with the abundant water resources. The biggest advantage of wind-drawing water and water-saving irrigation technology is characterized by the separation installation with water pumping machines from wind-drawing water machine. Wind machine can be installed near the river while the pumping can be installed such places where have the rich resources. Wind –drawing water is suitable for 3 to 8 level winds; drawing-distance should be 10 meters to 60 meters, the watering distance should be within 1,000 meters in the mountain regions. According to the drawing-distance, wind turbine can be selected. According to the water demand of the rural tourism areas, pools or water cellars can be built in the high places, the accumulated water can be used for the irrigating the newly planted trees and flowers. As for the rural tourist shops, restaurants, farm happiness, they are centralized and density, comprehensive utilization of wind energy technology can be considered. The wind power can charge the battery which is applied to electric vehicles can achieve the environmental protection in the rural tourism areas. In addition, the farm happiness are centralized and has a lot of programs such as catering, entertainment, culture, accommodation and so on, the energy consuming is also very large, so it is very necessary that the wind technology must be applied to the rural tourism areas. It is necessary to know that when the wind machines are installed, some protective measures should be taken to prevent the operation of the fan from injuring the visitors or birds in the rural tourism area.

References

[1] Chen Chaoqun, Luo Mingchun, Zhong Yongde. Researches on the rural tourist experience authenticity. Ahui Agriculture Science, 2007;35(34):11157-11158,11161.

[2] Chen Chaoqun, Luo Mingchun, Qin Yeyin. Multi-reaches on the rural tourism experience authenticity. Tourism Forum,2008;1(3):357-360.

[3]Yang Weibo, Shi Mingheng. Energy technology of ecological architecture based on ground heat energy utilization. Energy Technology,2005;26(6):251-256.