Countermeasures Research on China's Promotion of Solar Building

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It shows the huge and practical demand in the development of Chinese solar building. With SWOT analysis, the paper presents the reasons why the deciders of China have much enthusiasm for promoting solar building but with users in power shortage. Although China is eager for energy, it is imperative in energy conservation of building without showing the smooth application for solar building. Through the brief reviews on the solar technology application process, this thesis suggests the countermeasures on China promoting solar building and points out that it's the solar building promoting measure to strengthen the social awareness of energy conservation, horizontal united research, vertical united management, adopt multidimensional incentives, and promote proactively.

Keywords: Solar building; SWOT analysis; Countermeasure research

1 INTRODUCTION

Energy is the important material base for human society developing. Fossil energy continues to push forward the economic development and social progress of human since Britain started industrialization in 1840s. However, human faces a double dilemma as the depletion of conventional energy and the environmental destruction caused by human using energy [1].

According to the proven recoverable reserves, China's remaining exploration time of traditional energy include 20 years of petroleum, 50 years of natural gas and 116 years of coal. The energy shortage has become the constraint bottleneck for the development of China's economy. The national safety is threatened by the excessive dependent on imports.

China is undergoing the fast urbanization, which is the largest population migration in the world history with doubled energy consumptions. During this process, energy plays a significant role on how to avoid the development risks effectively and realize sustainable development of social economic environment.

The fast urbanization and the building of new socialist countryside arouse the deep thinking of "fast" and "new". During this process, it's absolutely a huge challenge for China on how to build the society of "energy conservation and environmental favor", which is the developing country facing "3P crises" (poverty, pollution, population).

The architecture field is the large energy consumer, and the ideal solution is to promote and apply solar building for solving the two difficulties on China's energy crisis and environmental pollution. People are devoted to working in the theoretical and practical levels. In the aspect of theory, Chinese scholars conduct many effective discussions and researches on new types of solar material, optimization of solar water heater, solar building integration, solar LED street lamp, solar power generation, solar application in different fields and different functional buildings, and solar building development in foreign countries. In the practical field, many results of landmark have been obtained. In 2003, the building covering 8000m^2 in Tianpu Industrial Park of Daxing District, Beijing is considered to be China's first building demonstration project with the integrated solar application for solving energy problems, which has been evaluated by experts. On Oct 18, 2008, Baoding Valley Jinjiang International Hotel was officially put into operation as China's first self-power generation building with solar application. As the main venue of the 4th world solar conference 2010, Sun-Moon Mansion is located in Dezhou of China Sun City, which adopts the world's first solar technologies united with building including hot water supply, heating, refrigeration and Photovoltaic (PV) system. As the energy conservation efficiency up to 88%, Sun-Moon Mansion is regarded as the World Solar Landmark.

2 SWOT ANALYSIS ON CHINA PROMOTING SOLAR BUILDING

Although China has a huge and practical need in promoting solar building, because of the insufficient understanding on this, China's deciders show much enthusiasm for promoting solar building but with users in power shortage.

2.1 S

China has a huge advantage of applying the solar building.

Solar is the energy existing more widely, safer, cleaner (with no pollution), more economic (for one investment with no transportation fees), more sufficient (periodic regeneration without disappearing) compared with other energies like coal gas and power.

China owns abundant solar resource, where annual duration of sunshine is over 2200 hours in 2/3 of the total areas. The total amount of solar radiation in China is equivalent to 2.4 trillion tons of standard coal, approximately as the total power generation of tens of thousands of Three Gorges Project.

Chinese government always focuses on the solar development and application, which regulates the development of solar building in the legal and industrial standard levels and supports with the financial policies.

Because of the large amounts of stock buildings and annual incremental buildings in China, promoting solar building is helpful for conserving energy, protecting environment, and reducing energy consuming expenditures for consumers.

The price of solar building materials will be cut down with the scale effect of promoting solar building; meanwhile, with the development of technology and new materials, the photoelectric conversion rate will upgrade and the solar power generation cost will be reduced at a large margin correspondingly.

It was indicated from the foreign researches that with the full application of solar in the building design of middle and primary schools, the schools full of sunshine are helpful for the development of students and upgrading the teaching quality [2].

In conclusion, the promoting solar building has many benefits with no damage to China's future social and economic development.

2.2 W

As Murray Lawless said " modern building seems to be sealed glass box unable to open, which becomes the real solar furnace and will become the large refrigerator incredibly with the mechanical refrigerating method"[3]. Modern building is excessive dependent on limited energy, especially those with high energy consumption and low efficiency, which will not only lead to be the important element for the tough energy, but also the hidden cause for atmospheric polluter. According to the estimate of European Institute of Architects, the energy consumption in the whole building consumes 50% of the total energy. On the completion of building, the operation and final disposal of the building also needs energy consuming. Building is always the crucial for the occurrence of either energy and material consuming or pollution.

China is in the scarcity of land in city, mainly consisting of "Three High (high level, high density and high volume rate) Building". The building energy consuming mode is mainly dependent on power, and the unit energy consumption of general buildings are 2-3 times over the energy conservation buildings in Europe[4].

With the increasing of China's population year by year and the fast development of economy, people is in a higher requirement in thermal comfort, which results into the continuous high energy consumption of China's building. Some experts point out that at present, the built houses of 40 billion sq m are the high energy consumer and 95% of the newly built houses as well, which are unable to satisfy the energy conservation requirements. Those exist widely in China's urban and countryside[5].

Although China is eager for energy, the application of solar building will not be smooth because of some constraints including:

Solar is a type of radiation energy, which needs to be transformed into other types of energy when applying. With the climate and circadian influence, the solar radiation has the features of spatial and temporal discontinuities, resulting into the unstable energy supply, which brings the difficulty in solar application at a large scale.

Because most of solar technologies have not been commercial, it has the feature of decentralized regional,

and its energy production is affected by market more than nonrenewable energy products, which limits the application rate of solar energy resource.

The solar thermal utilization has several disadvantages, including the water heater in a short service life, low water pressure, small water flows, the pipeline easy to freeze in winter and inconvenient installation and maintenance.

In recent years, taking the economic benefits into consideration, many real estate developers are likely to build the duplex residence in the top floor, change the residence's flat roof into the slope top, change the accessible roof into the inaccessible and reduce the public area in the high-rise building roof, which constrains the development of solar thermal application.

The installation of solar is probably to destruct roof waterproofing and lead to water leaks, and the crisscross water-sewage system will damage the external image of the building, which result into the prohibition of installing the solar water heater in the new medium-high end residences.

The promoting of the solar building has two aspects: one is the government shows its vision and vigorous promoting; the other aspect is the market indicates the eager for quick success to gain instant benefit but impassively. The solar building design consumes more time, but the designer with the same payment and the developer taking the profit at first should do more activities in promoting the solar building.

Therefore, although China's energy conservation in building is imperative, as one aspect to promote the energy conservation reform in existing stock buildings proactively, and the other aspect to strengthen the technology application in energy conservation and emission reduction for the new building, many constraints exist.

2.3 O

The effect of *Kyoto Protocol* becomes the serious challenge for China, and the great opportunity as well. China is the best region for applying the solar resource at a large scale. With the policy in place and obtaining the related technology transfers and fund supports of developed countries, China will also become the leading of solar resource application globally[6]. Under the current economic crisis, some developed countries are pleased to sell the solar technology to China. With the huge foreign exchange reserve, China is able to introduce the solar application technologies, products and facilities, and it's the heaven-sent opportunity for China to merger[7].

China is the developing country, at present, which takes not large pressure on the tasks of emission reduction in the world, and has abundant time to plan. Up till now, China invests a lot in infrastructures, providing a favorable opportunity of the government promoting the solar application in public projects and being the demonstration. It will greatly boost the real estate industry of promoting solar application, which adds the selling point for projects. China undergoes the building of new socialist countryside, where the power resource is shortage in many underdeveloped areas. Promoting the solar photovoltaic system is adaptable for the advantage of dispersing the power supply in the remote areas for solving the power supply problem to people with power outage.

2.4 T

It's needlessly to say that China is still a developing country, who enters the conflict highlighting phase. Many problems exist to be solved, and deciders prefer to solve the urgent problem in the real among the long-term conflicts and practical conflicts.

Different from the U.S. of household heating and emphasizing the energy conservation tradition in abundant in resource, the living method of many Chinese citizens is only focused on the area of residence and the style with the extravagance and waste in vogue. In the large numbers of stock buildings and the new buildings without applying the solar in China, it's destined to consume the large amounts of energy in a long term with the considerable hazards of lock-in effect.

Additionally, compared with the world advanced countries, China is described with the lagging theoretical research level and construction practice of solar application now. The technology cost is huge for finding the best joint between the facility investment and energy conservation benefit. In the meantime, the current solar power generation cost is 8-10 times over that of the coal, as the high-end product, some disadvantages limit the development of solar application including the high cost and low efficiency.

Conclusively, China promoting solar building shoulders heavy responsibilities.

3 APPLICATION PROCESS OF SOLAR TECHNOLOGY

At abroad, the solar building is used more widely, especially in some developed countries, the solar building is developed from the passive type to the active type, from the remote areas to the urban regions, from the small building to the large building, and from the residential building to the public building.

Influenced by the urban planning requirements, the building shape and the difficulty degree of construction, China uses the solar building mainly in a passive mode.

The solar technology application process shows as below[8]:

In 1891, Clarence Kemp invented the first solar water heater in the U.S.

In 1954, the US-based Bell Laboratories invented the first solar battery.

In 1958, the first solar water heater appeared in China.

In 1972, the Club of Rome issued The Limits to Growth.

In 1977, China's first passive solar house was established in Minqin County, Gansu Province.

In 1987, the UN Environment and Development Committee published Our Common Future.

In 1992, the UN World Conference on Environment and Development was held in Brazil, and papers including 21st Century Agenda were approved.

In 1996, the UN held World Solar Summit in Zimbabwe.

China's State Development Planning Commission, State Science and Technology and the State Economic and Trade Commission prepared Solar Energy Development Program 1996-2010.

In 1997, the U.S. implemented Million Solar Roofs Plan.

In 1998, China implemented Energy Conservation Law of P.RC., and signed to attend Kyoto Protocol.

From 2002 to 2003, China implemented the project of transmitting power to countryside.

In 2006, China approved to implement Renewable Energy Law.

Since 2007, the Delta Cup - International Solar Building Design Competition will be held annually by International Solar Energy Society, China Renewable Energy Society and Architectural Society of China.

In 2007, China published China's Long-term Development of Renewable Energy Planning.

In 2008, China implemented Energy Conservation Law and Building Energy Conservation Regulation.

By the end of 2008, China's accumulative photovoltaic capacity reached 200,000 kilowatts, and the PV battery output was up to 2500 megawatts. The available total operational collector area of solar water heater is around 135 million sqm, and the annual production capacity is over 25 million sqm.

4 COUNTERMEASURES OF SOLAR BUILDING PROMOTION

Internationally speaking, though the solar application has aroused people's high attentions at an early time, the development of solar building is not smooth, because in 1970s, the western developed countries showed over-hastiness, and it was affected by the other energy development like nuclear and wind power and the oil price fluctuations [9]. Due to the difficulty in solar development and application, it is unable to use at a large scale, which constrains the development of solar building. In China, caused by the lack of continuous market boosting in the development of solar building, China's solar building technology undergoes the slow developing.

In order to change this situation, several aspects are suggested to push forward the development of China's solar building as soon as possible.

4.1 Changing idea: it□s not the work for one person, but needs to enhance the social awareness of energy conservation

The current building design is excessively dependent on artificial HVAC to adjust the building thermal environment, and doesn't take more focuses on the building location, building external shape and sunshine feature. It should be to recognize the building back from the original point of building function, not to isolate human from the natural ecosystem, form the hardship concept of demand limitless but resource limiting, abandon the traditional Chinese culture concept of comparison and hierarchy. The government conducts the urban and countryside building with the fashion of conservation being a virtue, and the

residents form the living mode of adaptable consumption and thriftiness.

It needs to establish the concept of treating the earth well and protecting the eco-resource and enhance the popularization and education on building energy conservation and emission reduction, in order to clarify to people that the energy conservation and emission reduction is not the work for one or several persons, which is the social mutual understanding during the full life-cycle of building.

4.2 Enhancing research: it's not the work for one industry, which needs to enhance the horizontal united researches

The promotion of solar building is not the work for one industry, which needs the multidisciplinary common works with solar building such as urban and rural planning, architecture, matcrial science, psychology, management, ecnvirontology, climatology and structure. The horizontal united researches between different industries need to be enhanced in the base selection, building layout, the detailed building design and the building material selection. The purpose is the solar building to satisfy the demand in different areas, terrains, functions, floors, locations, climates and users. In the meantime, the international cooperation communication is being taken proactively.

It's more important that the solar building must be energy conservation firstly. The development of solar building is dependent on the high application efficiency of solar, the development of new materials, and the upgrade of construction technology. The building energy conservation is united applied with land saving, water saving, material saving, which will reach the purpose of the integrated energy conservation and emission reduction. Secondly, the solar application needs to combine other building specialties to realize the perfect union between the energy conservation and emission reduction and features like applied, economic, beautiful and safe, which consist six elements of architectural design and then the solar building will have a great vitality(Shown in Figure 1).

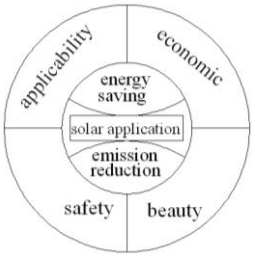

Figure 1 Six elements of architectural design

4.3 Strengthen management: it's not the work for one department, which needs to strengthen the vertical united management

The related industrial standards should be prepared as soon as possible to regulate the healthy development of sunrise industry, such as the issue of China's first solar industrial standard of *Solar Battery Glass*.

The effective mechanism should be established with the vertical united cooperation by many departments including the social groups, consulting companies, plan, design, management, construction, property management and facility production enterprises. The management of solar building is undertaken in the full life-cycle to assure that related principal to be responsible for their own works in the different chains like location selection, design, construction, acceptance and utilization. The focus is emphasized on the crucial chain management of solar building as plan, design, construction, completion acceptance and product quality of solar producers.

4.4 Stimulating solution: it's not the wishful work, which needs multi-dimension stimulating solutions

The stimulating economic solutions are adopted as the preferential loans, compensation and tax reduction for the building users, the real estate developers and solar producers.

The solar product design or construction project is promoted proactively during the design and construction, which will obtain the awarding priority.

The qualification assessment of design units, the accreditation of construction unit and tender access are controlled to promote the solar building proactively.

4.5 Promoting proactively: it's not the work of reaching the goal in one step, which needs the providence

The solar complete technology is promoted gradually in the full consideration of economic and social development degree and the market orientation in different areas to adapt the local conditions with the

regional climate features and building utilization features[10]. The cities, towns and villages with the building transformation and demonstration of energy conservation should be established at national, provincial, and city levels. The government is the leading to control the demonstration and promote radiantly. Meanwhile, the civil organizations take active effect on the government failures and market failures.

The major of integrated direction on solar and building should be established in universities as soon as possible, in order to educate professional personnel on the plan, design, materials and construction management. The atmosphere of solar building is promoted proactively in the society, such as with the design competition held to reach the purpose of propaganda and promotion.

It should be established of the quality supervision and test center on the solar water heater, providing the test and research platforms for solar industry and complete services like technical standards.

5 CONCLUSIONS

China promoting solar building is based on the external drive from the two pressures of energy and environment, and internal demand on improving the environment and quality for living. At the crucial time with a historical perspective, it must be to adopt the compulsory measures, encourage looking for incentives and lead on how to optimize the evaluation system. Thereafter, the way of promoting solar building will extend continuously based on national conditions and Chinese characteristics. The idealist purpose of solar building application is to realize the "Two Zero Building" (zero emission and zero energy consumption). The eco-culture will be formed finally as the significant basis for rejuvenation of the Chinese nation [11].

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