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Community Survey on Installation of BIPV System to residential buildings in a Chinese city

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Summary

This study conducted a community survey to investigate the residents' responses to and expectations for installing BIPV system to residential buildings in a Chinese city. The survey is designed based on Trudgill's framework and consists of six major factors but only questions related to economic, social and political factors are presented in this abstract. The results show no significant relationship between the expected payback period and the income of residents. Only less than half of the residents indicate that they will support the installation of BIPV system for their buildings. No clear policy has been found for the property management company to install BIPV for existing buildings. It is hoped that these results can help develop strategies for more rapid entry of BIPV into the residential sector in China.

Introduction

Chinese government has been encouraging the deployment of renewable energy resources, such as solar PV, for many years. However, up to date building integrated photovoltaic (BIPV) system is still not a common practice in construction industry and encounters many barriers for entry into public realm especially in residential buildings. It is known that most of the city residents in China live in high-rise apartments (above 10 storeys). Compared to other densely populated countries, high-rise apartments are more popular in China. The construction cost in China is relatively low, and most of the costs for the real estate developer are buying or leasing the land rights from the local government. Therefore estate developers prefer to develop high-rise apartments to get the most benefits out of the land. This high-rise living feature may cause some special barriers for installing the BIPV system to residential buildings in China.

A search for literature found that the main factors that affect the PV industry in China are technologies, industry plan, laws, price and incentive polices (Zhao et al. 2013). Shuai et al. (2019) also found that the major problems restricting the rapid extension of distributed solar PV power generation were high initial investment, difficulty in financing, and long investment payback periods. These problems are particularly prominent for household distributed solar PV installations. However, Zhang et al. (2015) found that the soft costs of distributed-generation PV installation in China appeared to be very low compared to those in other countries, suggesting that there must be other important market and policy constraints. Therefore, more studies should be carried out to identify the major barriers for BIPV applications in residential buildings in China.

This study conducted a community survey in Wuhan, China to investigate residents' responses to and expectations for installation of BIPV system to residential buildings in Wuhan, China. To make it clear to the residents, building-integrated photovoltaics (BIPV) was specified as the photovoltaic materials that are used to replace conventional building materials in parts of the building envelope such as the roof, skylights, or facades.

Methodology

The survey was conducted in June 2019 and a total of 206 valid questionnaires were collected from different residential buildings in Wuhan. All the respondents surveyed are the residents who have not installed any solar PV generation equipment at the time of the survey. The questionnaire design was based on Trudgill's framework which consists of six major groups: agreement, knowledge, technology, economic, social and political (AKTESP) (1990). However, in this abstract, only questions related to economic, social and political factors are presented.

Results and Discussion

The economic factor in this study is analysed by the expectation of payback period of the BIPV system. As shown in Figure 1, 68.4% of the respondents hope that the payback period is below 5 years and 14.1% of the respondents hope within 6 to 10 years. Only 4.9% of the respondents indicate more than 10 years. In addition, 12.6% of the respondents reveal that they do not care about the payback period because environment protection is of paramount importance.

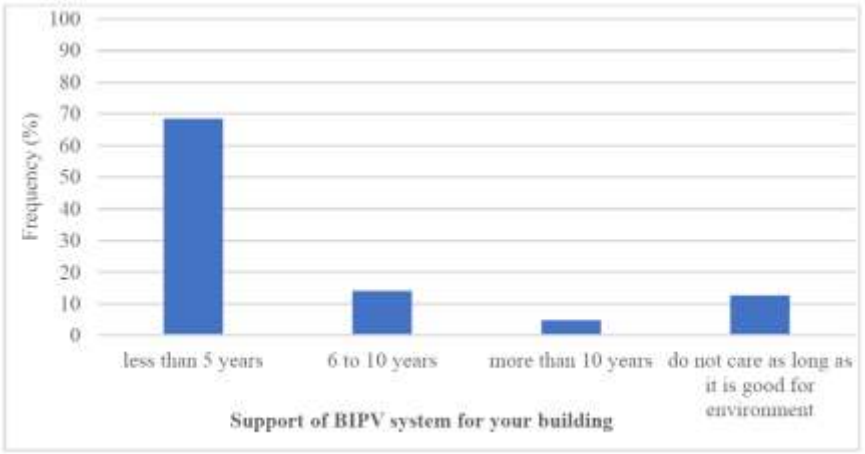

Figure 1. Expected payback period

A further analysis into the payback period and income level is shown in Table 1 which suggests that there is no significant relationship between the expected payback period and income. Even for people with high monthly income (more RMB 10,000 per family per head, which can be characterized as high income in China), 74.6% of those respondents still hope that the payback period is less than 5 years.

The above result indicates that payback period could be a barrier for the development BIPV system in Wuhan. Therefore, reducing BIPV cost in short term is still the major challenge for its development in residential sectors.

Table I. Monthly income and payback period Crosstabulation

Monthly income		Payback period				Total
		Less than 5 years	6 to 10 years	More than 10 years	Do not care	
Below 1500 RMB	Count	2	0	1	1	4
	% within income	50.0%	.0%	25.0%	25.0%	100.0%
1500-2999 RMB	Count	17	2	0	4	23
	% within income	73.9%	8.7%	.0%	17.4%	100.0%
2999-4999 RMB	Count	20	8	3	6	37
	% within income	54.1%	21.6%	8.1%	16.2%	100.0%
5000-6999 RMB	Count	25	8	1	3	37
	% within income	67.6%	21.6%	2.7%	8.1%	100.0%
7000-10000 RMB	Count	27	3	3	5	38
	% within income	71.1%	7.9%	7.9%	13.2%	100.0%
Above 10000 RMB	Count	50	8	2	7	67
	% within income	74.6%	11.9%	3.0%	10.4%	100.0%
Total	Count	141	29	10	26	206
	% within income	68.4%	14.1%	4.9%	12.6%	100.0%

In assessing the social barrier from the respondents, the following question was asked:

Will you support the installation of BIPV system for your building?

As shown in Figure 2, only 48% of the respondents choose “yes”, 35% are “not sure” and 5.4% choose “No”. One reason for the low social acceptance of BIPV could be that BIPV is still a relatively new concept for residents in Wuhan, which impedes a broader penetration of BIPV into residential buildings in Wuhan. Therefore, more demonstration residential buildings with BIPV system should be built and residents should be invited to visit these demonstration buildings more frequently so that residents can appreciate more benefits of BIPV system.

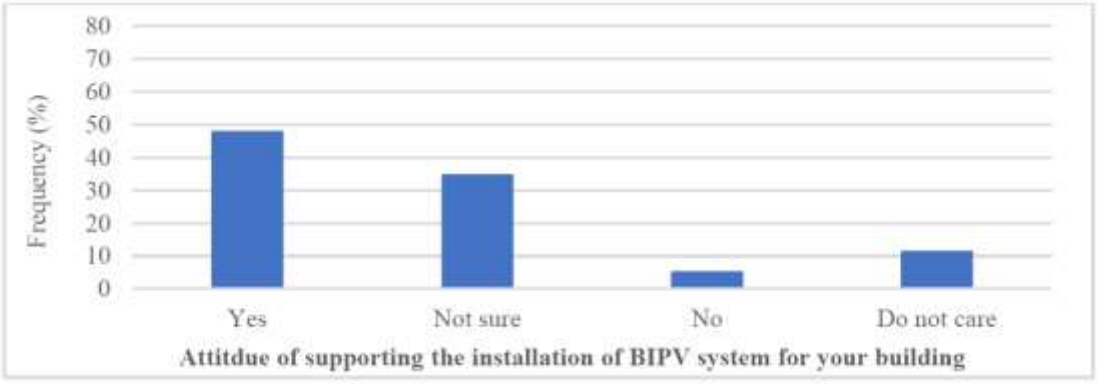

Figure 2. Social barrier

This survey also asked whether the respondent has ownership of the roof top. Only 41.3% of the respondents have ownership of rooftop. Most of the respondents (58.7%) live in high-rise apartment buildings for which the rooftop is shared by all the residents in the building. For existing buildings, the installation of BIPV system requires all the residents to sign on, which needs effective communication and coordination. There is an apparent lack of policy or regulations to govern the installation of BIPV system for existing buildings and to resolve the disputes among residents regarding the different opinions on the installation of BIPV system. Therefore, it is necessary to have some polices in place for the property management company to install BIPV for existing buildings. Regulations to resolve the disputes among the residents for the installation of BIPV are also needed.

Conclusions

Results of a community survey for installing building integrated photovoltaic (BIPV) to residential buildings in a Chinese city Wuhan has been presented in this paper. From the analysis of the survey results, it has been found that economic, social and political barriers are the hurdles for BIPV adoption. There is an apparent lack of policy or regulations to govern the installation of BIPV system for existing buildings and to resolve the disputes among residents regarding the different opinions on the installation of BIPV system. It is necessary to have some polices in place for the property management company to install BIPV for existing buildings.

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