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Environmental Behavior Factors Influencing the Outlook of Chinese College Students on the Domestic Adoption of Solar Photovoltaic Technology

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Abstract

Over the last century, China has soared in economic growth and now stands as the world's second-largest economy. However, rapid economic growth has given rise to environmental degradation. New visions and innovative technological systems, such as domestic solar photovoltaic systems, have been introduced to mitigate pollution from power generation. Despite the positive individual and environmental benefits associated with adopting this innovative system, adoption rates of solar PV system remain comparatively low in China. Survey data targeting environmental behavior factors were distributed among Chinese college students in Shanghai and Beijing to facilitate understanding of the low adoption rate and to shed light on the environmental behavior dimensions influencing Chinese students regarding residential rooftop solar PV adoption. The findings of this study suggest that Chinese college students have high levels of concern for the environment and hold pro-environmental beliefs, suggesting a high potential for their engaging in environmental-oriented purchasing, such as purchasing solar PV technology. However, other studies have indicated a value-action gap, which means that individuals with pro-environmental attitudes will not always invest in green products. Consumer-behavior researchers and those interested in solar PV adoption in China might reference the results of this research.

1. Introduction

1.1 China Solar PV Industry

Over the last century, China has soared in economic growth and now stands as the world's second-largest economy (Haggard, Yao, & Cai, 2014). China's rapid economic growth has led to a rising demand for energy, so China has become the second-largest consumer of energy, after the United States (Crompton & Wu, 2005; Hu & Wang, 2006; Li & Zhang, 2007; Xiao, Dunlap & Hong, 2013). China is the leading producer and consumer of coal in the world, as it is responsible for about 25% worldwide (Haggard, Yao, & Cai, 2014; Liu & Diamond, 2005). Coal is the nation's primary energy source and the main contributor to its air pollution; however, China's use of coal has declined as the use of oil, natural gas, and hydroelectric power have increased in recent years (Liu & Diamond, 2005).

Given the common perception of the Chinese populace as not being attuned to their environmental problems, Chinese people are developing and expressing high concerns for the environment and are not as environmentally apathetic as most people have thought (Chan, 2001). The mass evidence of pollution generated by industrial production and energy usage has prompted environmental concerns among affluent and educated Chinese citizens (Mark & Law, 2015). New visions and innovative technological systems, such as solar photovoltaic (PV) systems, have been deployed to serve as one of the alternatives for efficient power generation to mitigate pollution and to promote sustainable development.

Unlike the conventional pathway of generating electricity, where electricity is generated from fossil fuels such as coal and natural gas, solar photovoltaic systems convert light energy into electrical current through semiconductors where light causes matter to emit electrons. PV power generation has a promising development potential of replacing fossil fuel with the abundant resources and energy made available from the sun without creating emissions as a byproduct during its operations (Zhang & He, 2013; Zou, Du, Ren, Sovacool, Zhang, & Mao, 2016).

Applications of this technological advancement are categorized as either centralized or distributed. Centralized solar applications are typically large-scale systems administered by utility companies, while decentralized applications entail solar PV installations on buildings, including residential buildings, business buildings, warehouses, airports, and others. It is important to note that this research places focus on distributed application solar PV technology, especially rooftop residential systems. According to the plan of the National Energy Administration, China will extend the development of distributed energy applications in cities. By 2020, the total installed capacity of urban building photovoltaic systems will achieve 1 million kW (Dong, Feng, Sun, Cai, Li & Yang, 2016).

China's domestic solar PV market has experienced astonishingly rapid growth in recent years (Zhang & He, 2013), with the upsurge of demand from the world contributing primarily to this immense growth (Zhang & He, 2013; Zhi, Sun, Li, Xu & Su, 2014). The production of solar PV in China was primarily for export to foreign markets until the anti-dumping and anti-subsidy investigations initiated by the United States and the European Union (EU) in 2011 (Zhang & He, 2013; Don, et al., 2016). It was in this context that China had to focus on the development of its domestic market.

Solar PV technology has been acknowledged to produce less pollution and serves as a sustainable alternative in generating efficient renewable energy (Faiers & Neame, 2006). Despite the positive environmental impact carried by the design of solar PV, this micro-generation technology has not taken root as a popular power generating choice among the people of China. China stands as the largest producer of solar PV systems in the world as it contributed more than 50% of the world production from 2009 to 2013 (Zou, et al., 2016). In 2010, Suntech, JA Solar, Yingli Green Energy and Trina, with shares of 6.6%, 6.1%, 4.7% and 4.7% of global cell production respectively, represented China as they stood as the world's four largest Chinese enterprises among the world's five largest PV manufacturers (Zhi,

Sun, Li, Xu & Su, 2014). However, even with China's dominance in the manufacturing of PV modules, the marketdiffusion and adoption of solar photovoltaic systems in China is not ideal (Zou, et al., 2016).

According to the China Photovoltaic Industry Alliance (CPIA) report released in January 2016, the Chinese PV market reached 43 GW installed capacity by the end of 2015, surpassing Germany's capacity of 40 GW and becoming the number one in the world (Don, et al., 2016). However, even with this high status of growth in the PV market, the residential rooftop system only accounts for 16% of the aggregate installed PV solar capacity dictated above (Don, et al., 2016).

An investigation conducted by Labay and Kinnear (1981) highlighted the influential role young educated members among families play in solar adoption. Their research suggested that young educated people have a high likelihood of adopting solar PV systems. Young educated individuals are most likely to adopt due to their knowledge regarding solar energy and the benefits accompanied by the technology. A contributing factor to the slow adoption rate of solar PV was connected to the lack of consumer knowledge about this innovative system (Islam, 2014). Thus, young educated consumers such as college students have the ability to influence others, especially their loved ones in their household, to adopt solar PV. Due to their power to influence others, targeting and making an effort to understand the attitude of college students toward solar PV is significant, as their outlook could serve as a means of getting a glimpse offuture solar adoption.

Gadenne et al. (2011) pointed out six environmental-behavior factors, including general environmental beliefs, environmental norms, drivers of environmental behavior, barriers toenvironmental behavior, social or community influence, environmental attitudes, and government policies and subsidies. The particular interest of this paper is to study three out of the above six antecedents of the environmental behavior factors, namely general environmental beliefs, environmental norms, and environmental barriers.

1.2 Antecedents of Environmental Behaviors

One way to understand this gap between large PV installed capacity and lower adoption is to investigate those environmental behavior factors. This research followed Gadenne, Sharma, Kerr, and Smith's (2011) frame work.

1.2.1 General environmental beliefs.

Positive environmental behaviors have been observed among consumers who are familiar or aware of environmental issues; with that, individuals with strong pro-environmental beliefs typically engage in environmentally-oriented purchasing behaviors (Gadenne, et al., 2011). For instance, a general environmental belief of a consumer could be that everybody should be committed to developing and making efforts to minimize our overall ecological footprint to sustain the environment (Niemeyer, 2010). In this research, the general environmental beliefs factor has two sub-factors; one is environmental limits factor (ELF) and another is environmental adoption factor (EAF).

1.2.2 Environmental norms.

A feeling of responsibility is evoked in consumers when information on environmental issues and potential

future consequences of their actions are made known to them. Normative action is the side effect as consumers become aware of environmental issues and foresee it being a reality. In that respect, predominant adoption of an innovation transitions into a norm and thus creates an enticing appeal that leads to others adopting that practice. A prime example is recycling, which has become a normative behavior (Gadenne, et al., 2011). Relating to this factor is price norms factor (PNF) and action norms factor (ANF).

1.2.3 Environmental barriers.

Environmental barriers are the prominent factors that discourage consumers from making ecofriendly purchases. Barriers involving "economic reasons, primarily initial cost and expected or long paybacks, the need for more information, demand for greater additional/professional assistance, lack of time, lack of knowledge and trust in the provider, concern over product performance, poor brand image and lack of information on the environmental and social performance of both products and manufacturers" (Gadenne, et al., 2011) have been noted by previous researchers as forces hindering the adoption of green product or systems such solar PV. These barriers are believed to be: professional assistance factor (PAF), Cost Factor (CF), and Regulation factor (RF).

Following Gadenne et al.'s (2011) three environmental behavior factors, the research aims to understand the environmental behaviors of the Chinese younger generation with higher education and how these behaviors influence the current or the future solar PV adoption by using primary data collected in China in May 2016. The following section starts with a literature review for this research. Section 3 elaborates on the methodology and survey design; Section 4 discusses the statistical results in detail; and the last section concludes the paper with managerial implications and future research.

2. Literature Review

As discussed earlier, environmental concerns have accompanied salient environmental behavior and attitudes among Chinese citizens, especially those in the cities, in recent years (Edmonds, 1998). Xiao (2013) addressed education as being a powerful predictor of environmental concern between the Chinese. Xiao's (2013) work supported that the higher educated, males, government employees, residents of large cities, and those affiliated with the Chinese Communist Party are more environmentally concerned than their counterparts. According to Mark and Law (2015), environmental concern refers to consumers' emotional reactions, such as worries, dislikes, and compassion, toward the environmental problems.

Individuals tend to adopt positive environmental behavior as they become more knowledgeable about environmental issues (Tanner & Kast, 2003), and, in many cases, typically engage in environmentally oriented purchasing behaviors (Pickett-Baker & Ozaki, 2008; Mark & Law, 2015). Sharma and Gadenne (2014) noted,

> Environmental behaviors and green practices include recycling, waste reduction, energy saving, energy conservation, travel mode choice, travel behavior, car-use, bus-use, public transportation, cycling, walking, pro-environmental mobility behavior, water conservation, organic food, green consumerism, green purchases, ethical behavior,

> environment-friendly buying behavior, environmental consumer behavior, ecological consumer behavior, green consumption, green consumer behavior, ecological behavior, pro-environmental behavior, conservationism, environment-friendly behavior, environment protection behavior, ecological behavior and personal norms, ecological behavior and morality, and pro-environmental attitudes. (p. 26)

In that context, Whitmarsh and O'Neil (2010) have proposed looking at environmental behavior in four broad categories: domestic energy and water use, waste management and recycling, energy-efficient vehicles, and eco-friendly buying practices. Gadenne et al. (2011) have made links between consumer attitudes and energy-saving behaviors by looking at antecedents of environmental behavior factors: general environmental beliefs, environmental norms, drivers of environmental behavior, barriers to environmental behavior, social or community influence, environmental attitudes, and government policies and subsides. They found that an individual's attitude toward green purchase is influenced by all of the factors.

Many researchers have broadly debated the adoption and diffusion of green technological advancements such as residential solar energy systems. Labay & Kinnear (1981) investigated the purchase-decision process of residential solar energy considering both adopters and non-adopters. Their work indicated that young, educated consumers were the parties most likely to adopt solar PV systems. Factors affecting the decision-making processes of adoption include: aesthetics, knowledge, cost, facility ownership, psychology, geographical locations, sociocultural traditions, demographic distributions, and economic status and policies (Li X., Li H. & Wang, 2013). Faiers & Neame's (2006) work suggested that unless electricity prices rise and more efficient panels are developed, solar energy or solar PV will not be competitive with conventionally produced electricity. "Generally speaking, the global electricity supply is dominated by coal, natural gas, hydroelectric, nuclear and oil power plants, which generate 40.9, 20.1, 16.4, 14.7, and 5.7% of electricity respectively" (Chen, 2014).

Various studies have made investigations to bring to light factors influencing the adoption of solar PV power diffusion in China (Dong, et al., 2016; Li, et al., 2013). Li, et al. (2013) investigated the willingness of Chinese farmers in rural China to transition to solar houses by examining nine factors. They found that the desire to improve quality of life, government commitments, and neighbor/friends' assessments contributed significantly to the willingness of Chinese farmers to adopt solar houses. Dong, et al. (2016) explored the development of photovoltaic by diving into the policy options in developing distributed generation in China; they discussed four aspects: polices, regulations, financing channels, and development patterns for promoting energy production and innovation of energy utilization.

Previous explorations, in an effort to gain insight into solar PV adoption, have revolved around policies, regulations, financial barriers, consumer behavior, and other factors. In order to establish a differentiating factor, this paper examines the highlighted environmental-behavior factors for educated Chinese citizens, specifically Chinese college students, to get a comprehensive

Table 1. Demographics Information

		(%)
Gender	Male	52.1
	Female	47.9
Employed	Yes	7.1
	No	92.9
Degree concentration	Science	4.2
	Engineering	56.8
	Humanities	10.0
	Business	16.9
	Other	12.2
Geographic Distribution	North	28.9
	Northeast	6.3
	East	31.1
	Southwest	6.3
	Northwest	6.5
	South central	21.0

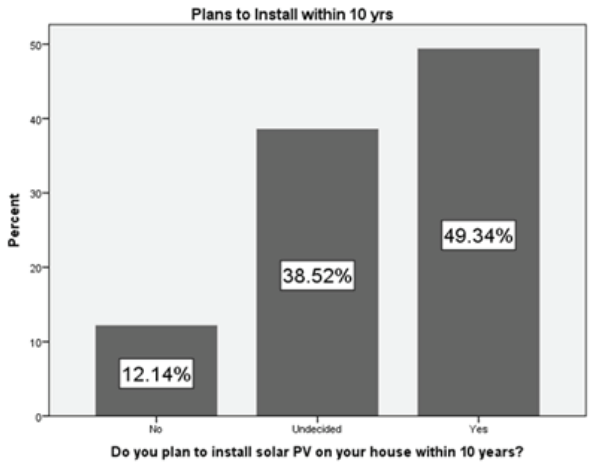
glimpse of their perspectives on adopting domestic solar PV technology.

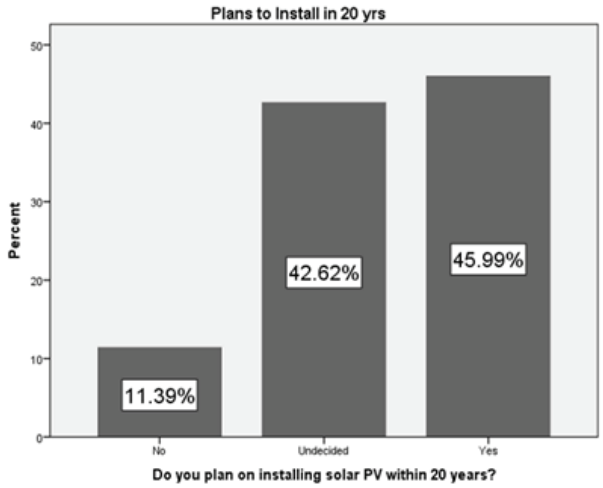
3.Methodology

3.1 Data Collection

Surveys were distributed among a random sample of 452 post-secondary students of Beijing Jiaotong University and Shanghai Normal University in China. The questionnaires were administered to undergraduate and graduate students in their classrooms; this was made possible due to the partnership between our university and these two institutions of higher education in China. Prior to the start of every survey-taking session, there was a brief introduction elaborating on the purpose of this research. The surveys that were distributed consisted of 51 questions and 4 sections. The first section asked whether they had already adopted solar PV and/or their future plans regarding solar PV. The second section included questions relating to cultural values and preferences, which was the focus of another working

Chart 1. Descriptive statistics





paper. The third section was designed to highlight environmental-behavior variables such as general environmental beliefs, environmental norms, and environmental barriers; in the last section of the survey, questions were asked concerning demographics. Survey data collected from the college students was analyzed utilizing Excel to initiate data inputs and conduct basic statistical analysis, and SPSS to construct cross-tab tables.

3.2 Survey Design

Our survey adopted measures from Gadenne et al. (2011). We focused on three of the environmental behavior factors described in their framework: (a) environmental limits and environmental adoption factors for general environmental beliefs; (b) price norm and action norm factors for environmental norms; and (c) professional assistance, cost, and regulation factors for environmental barriers. In order to get a sense of the environmental behaviors of our respondents concerning energy savings and solar PV adoption, we designed our survey with predominant items or questions targeting the aforementioned sub-factors relating to each of the three major environmental behavior factors. All of the items were analyzed on a 5-point Likert scale, where 1 = strongly disagree and 5 = strongly agree. Because most of the Chinese college students had had years of English education and a good understanding of English in writing, the questionnaire was in English. However, during the distribution process, if they asked for help with understanding some wording, our researchers offered very basic help.

As Table 1 shows, male and female respondents were evenly distributed; 52.11% of the respondents were male and 47.9% female. A great majority (92.9%) of the respondents were unemployed, which was not much of a surprise to us as they were preoccupied with schooling and supported by their parents or guardians. Furthermore, a large percentage (56.8%) of our participants were in the process of earning an undergraduate or graduate degree in engineering, with Business (16.9%) and Humanities (10.0%) following behind.

Table 2. Cross-tab Analysis on ELF1

Environmental Limits Factor (ELF1)		The earth is like a spaceship with only limited room and resources. Strongly Disagree	Disagree	Undecided	Agree	Strongly Agree	Total
Do you have solar PV panels on your house?	No	9.6%	18.1%	7.4%	34.2%	30.7%	100.0%
	Yes	8.3%	16.7%	13.1%	33.3%	28.6%	100.0%
Total		9.4%	17.8%	8.5%	34.1%	30.3%	100.0%

Table 3. Cross-tab Analysis on ELF2

Environmental Limits Factor (ELF2)		There are limits to which our industrialized society can expand. Strongly Disagree	Disagree	Undecided	Agree	Strongly Agree	Total
Do you have solar PV panels on your house?	No	3.9%	13.2%	13.0%	52.4%	17.5%	100.0%
	Yes	3.6%	14.3%	20.2%	38.1%	23.8%	100.0%
Total		3.9%	13.4%	14.4%	49.7%	18.7%	100.0%

Table 4. Cross-tab Analysis on ELF3

		When humans interfere with nature it often has disastrous consequences.					
Environmental Limits Factor (ELF3)		Strongly Disagree	Disagree	Undecided	Agree	Strongly Agree	Total
Do you have solar PV panels on your house?	No	5.0%	13.1%	26.8%	36.0%	19.0%	100.0%
	Yes	4.7%	10.6%	28.2%	37.6%	18.8%	100.0%
Total		5.0%	12.6%	27.1%	36.3%	19.0%	100.0%

The greatest number of respondents (31.1%) resided in the Eastern region of the country (Shanghai, Jiangsu, Zhejiang, Anhui, Fujian, Jiangxi, Shandong).

As shown in Chart 1, among the 452 respondents, 18.81% indicated the utilization of solar PV in their homes. Domestic solar PV adoption is relatively low among our participants as our data showed 81.19% had not adopted it. Nevertheless, a large percentage of respondents showed interest in the adoption of solar PV in later years. Overall, the current installation is low. The future installation in terms of 10-year plans is increasing, but still not very promising; with that, the 20-year plan doesn't increase much (45.99%).

5.2 Cross-Tab Analysis

A cross-tabulation analysis tool on SPSS was implemented to analyze the relationship between student adopters and non-adopters, and their environmental behaviors and attitudes about the adoption of domestic solar PV technology.

5.2.1 Environmental limits factor (ELF).

Environmental limits factor (ELF) is among the subgroups of environmental beliefs; it shows people's attitudes concerning the environment. The questionnaire had three ELF questions. "The earth is like a spaceship with only limited room and resources" (ELF1); "There are limits to which our industrialized society can expand'(ELF2); "When humans interfere with nature it often has disastrous consequences" (ELF3).

As shown in Table 2, 61.9% of student adopters agreed or strongly agreed with ELF1, while 64.9% of student non-adopters also were in agreement. This revealed that our respondents (both adopters and non-adopters) have a good sense of the importance of being sustainable as they acknowledge the limited resources of our planet.

Non-adopters showed a high level of agreement (70.2%)

Table 5. Cross-tab Analysis on EAF1

Environmental adoption factor (EAF1)		Plants and animals exist primarily to be used by humans.					
		Strongly Disagree	Disagree	Undecided	Agree	Strongly Agree	Total
Do you have solar PV panels on your house?	No	32.4%	35.7%	10.7%	15.4%	5.8%	100.0%
	Yes	31.8%	37.6%	15.3%	11.8%	3.5%	100.0%
Total		32.3%	36.1%	11.6%	14.7%	5.3%	100.0%

Table 6. Cross-tab Analysis on EAF2

Environmental adoption factor (EAF2)		Humankind was destined to rule over the rest of nature.					
		Strongly Disagree	Disagree	Undecided	Agree	Strongly Agree	Total
Do you have solar PV panels on your house?	No	32.1%	33.5%	14.8%	15.1%	4.5%	100.0%
	Yes	25.3%	30.1%	20.5%	16.9%	7.2%	100.0%
Total		30.8%	32.9%	15.9%	15.4%	5.0%	100.0%

Table 7. Cross-tab Analysis on EAF3

Environmental adoption factor (EAF3)		Humans have the right to modify the natural environment to suit their needs.					
		Strongly Disagree	Disagree	Undecided	Agree	Strongly Agree	Total
Do you have solar PV panels on your house?	No	23.1%	33.5%	19.2%	18.7%	5.5%	100.0%
	Yes	24.7%	38.8%	12.9%	20.0%	3.5%	100.0%
Total		23.4%	34.5%	18.0%	18.9%	5.1%	100.0%

with ELF2. Current installers indicated strong support for this factor, as 61.9% agreed or strongly agreed. By agreeing with this statement, they showed concern for the environment, as industrialization typically leads to expansion to lands that typically serve as a habitat for other organisms or species.

A large percentage of student adopters and non-adopters agree or strongly agree with ELF3, 56.4% and 55%, respectively. Respondents indicated strong association with the ELF3 variable, which means that they assume a high responsibility of protecting nature and are knowledgeable of the possible consequences that will accompany careless actions if nature is not protected.

5.2.2 Environmental adoption factor (EAF).

Environmental adoption factor (EAF) is the second sub-factor of general environmental belief. To highlight respondents' connection to EAF, question items concerning "Plants and animals exist primarily to be used by humans"(EAF1); "Humankind was destined to rule over the rest of nature" (EAF2); and "Humans have the right to modify the natural environment to suit their needs" (EAF3) were considered.

A large percentage of our respondents (69.1% of adopters and 68.1% of non-adopters) disagreed or strongly disagreed with EAF1, which indicates their high awareness of proper management of earth's resources.

Respondents reflected a low connection with EAF2, as 55.4% of adopters and 65.6% of non-adopters disagreed or strongly disagreed with the supremacy of humans over the rest of nature, suggesting evidence of ecological behavior.

Adopters (63.2%) and non-adopters (56.6%) showed high disagreement with EAF3, indicating participants' awareness about the importance of the natural environment. 5.2.3 Price norms factor (PNF). The price norms factor (PNF) represents one of the twosub-factors of Environmental Norms. This variable exposes participants' sensitivity to added expenses and investing more financial resources in protecting the environment. To measure this sub-factor we imposed question variables regarding "I would be prepared to pay higher prices overall in order to protect the environment" (PNF1); "I would be prepared to spend $5 more per week for everyday items in order to protect the environment" (PNF2); "I would be prepared to reduce my standard of living in order to protect the environment" (PNF3). Among the respondents, 69% of adopters and 56.9% of non-adopters agreed or strongly agreed with PNF1. The high level of agreement with PNF1 suggests that participants are willing to invest money into products that will be favorable for the environment.

In relation to PNF2, a relatively high percentage of the respondents (61.2% of adopters and 48.8% of non-adopters) revealed their willingness to pay more for ecological products in an effort to protect the environment.

Survey data showed similarly strong agreement of adopters and non-adopters (48.8% and 52.8%, respectively) with PNF3, suggesting they would be willing to sacrifice some aspects of their lifestyle to protect the environment.

5.2.4 Action norms factor (ANF).

Action norms factor (ANF) is one of the subgroups of Environmental norms. ANF highlights participants' willingness to make decisions or take action that's favorable to the environment. The following survey items were employed to highlight participants' actions and willingness to purchase products that leave a smaller ecological footprint and less atmospheric pollution: "As an individual I must do what I can to prevent climate change" (ANF1); "Business and industry could be responsible and help prevent climate change by reducing their emissions" (ANF2); "I would purchase a green product with a payback period of less than 10 years" (ANF3).

Respondents showed a high level of agreement with the ANF1 environmental-behavior variable; 80% of adopters and 73.4% of non-adopters agreed or strongly agreed that they have a personal obligation to make decisions that could lessen the effects of climate change.

The student participants indicated strong agreement with ANF2; 83.4% of adopters and 80.4% of non-adopters agreed or strongly agreed that businesses have a role to place in reducing their emissions to reduce atmospheric pollution.

In regard to ANF3, student adopters (67%) and non-adopters (67%) showed an even distribution in responses, as the majority of both groups said they would be willing to purchase a green product with a payback period of less than 10 years.

5.2.5 Professional assistance factor (PAF).

Professional assistance factor (PAF) falls among the subgroups of Environmental Barriers. PAF reveals respondents' need for external opinions or professional

Table 8. Cross-tab Analysis on PNF1

Price norms factor (PNF1)		I would be prepared to pay higher prices overall in order to protect the environment.					
		Strongly Disagree	Disagree	Undecided	Agree	Strongly Agree	Total
Do you have solar PV panels on your house?	No	2.2%	10.1%	30.7%	46.8%	10.1%	100.0%
	Yes	1.2%	7.1%	22.6%	57.1%	11.9%	100.0%
Total		2.0%	9.6%	29.2%	48.8%	10.5%	100.0%

Table 9. Cross-tab Analysis on PNF2

Price norms factor (PNF2)		I will be prepared to spend $5 more per week for everyday items in order to protect the environment.					
		Strongly Disagree	Disagree	Undecided	Agree	Strongly Agree	Total
Do you have solar PV panels on your house?	No	3.3%	13.2%	34.8%	38.4%	10.4%	100.0%
	Yes	1.2%	8.2%	29.4%	54.1%	7.1%	100.0%
Total		2.9%	12.2%	33.8%	41.3%	9.8%	100.0%

Table 10. Cross-tab Analysis on PNF3

Price norms factor (PNF3)		I would be prepared to reduce my standard of living in order to protect the environment. Strongly Disagree	Disagree	Undecided	Agree	Strongly Agree	Total
Do you have solar PV panels on your house?	No	2.2%	17.0%	27.9%	46.0%	6.8%	100.0%
	Yes	1.2%	14.3%	35.7%	40.5%	8.3%	100.0%
Total		2.0%	16.5%	29.4%	45.0%	7.1%	100.0%

Table 11. Cross-tab Analysis on ANF1

Actions norms factor (ANF1)		As an individual I must do what I can to prevent climate change. Strongly Disagree	Disagree	Undecided	Agree	Strongly Agree	Total
Do you have solar PV panels on your house?	No	3.6%	9.6%	13.5%	52.2%	21.2%	100.0%
	Yes	4.7%	4.7%	10.6%	52.9%	27.1%	100.0%
Total		3.8%	8.7%	12.9%	52.3%	22.3%	100.0%

Table 12. Cross-tab Analysis on ANF2

Actions norms factor (ANF2)		Business and industry could be responsible and help prevent climate change by reducing their emissions.					
		Strongly Disagree	Disagree	Undecided	Agree	Strongly Agree	Total
Do you have solar PV panels on your house?	No	7.4%	7.2%	5.0%	39.9%	40.5%	100.0%
	Yes	2.4%	7.1%	7.1%	42.9%	40.5%	100.0%
Total		6.5%	7.2%	5.4%	40.5%	40.5%	100.0%

aid in investing in or installing green products. Question items including "I need professional or additional assistance before using/installing green products" (PAF1) and "I need other people to assist in my decision to purchase green products" (PAF2) were considered to highlight this view of our respondents.

A large percentage of our respondents (60% of adopters and 62.7% of non-adopters) indicated a need for professional or additional assistance before considering to using or installing green-labeled products (PAF1).

In relation to PAF2, respondents indicated a high need of assistance (44.7% of current installers and 41.1% of non-adopters) in decision-making in regards to purchasing green products.

5.2.6 Cost Factor (CF).

The cost factor (CF) is a proven major barrier to rooftop solar PV adoption (Gadenne et al., 2011). CF is a sub-factor of Environmental Barriers. This variable gives insight into the cost sensitivity level of individuals in regard to purchasing green products such solar PV. To measure this variable we considered question items including "The fuel savings from green products is not worthwhile" (CF1); "I will not live in this house long enough to recoup the cost" (CF2); and "Green products are unlikely to last long enough to recoup the cost" (CF3).

Respondents indicated high awareness of the saving benefitsof investing in green products or systems. Among the participants, 86.5% of adopters and 72.2% of non-adopters disagreed or strongly disagreed with CF1, suggesting that they are aware of the potential savings perks of eco-friendly products or systems.

In regards to CF2, survey data indicated an even distribution in positioning between respondents. Twenty percent (20%) of our responders indicated that they

believe they will not live in their house long enough to gain a return in their investment. Nonetheless, 23.9% of respondents suggested a strong agreement contrary to the statement proposed in CF2.

Respondents indicated a high level of awareness of the benefits of investing in green products; 37.7% of adopters and 44.6% of non-adopters said that green products will typically last long enough for investors to realize a return on their investment. 5.2.7 Regulation factor (RF). Regulation factor (RF) is one of the sub-factors of Environmental Barriers. To measure respondents' sensitivity and attitude about this factor, question items "It is difficult for me to find a suitable location or space for green products"(RF1) and "It may be difficult to get the necessary planning/building permission from the relevant government agency" (RF2) were considered.

Nearly half of respondents (47.6% of adopters and 46.7% of non-adopters) indicated that finding a suitable location or space for a green product would be arduous.

The need for government-agency approval in China stands as a prominent barrier to solar PV adoption. as 38% of respondents agreed or strongly agreed that getting necessary planning or building permissions from government agencies would be difficult. However, roughly the same percentage of respondents disagreed or strongly disagreed that it would be difficult.

6. Conclusion

This research investigated the environmental behavior and beliefs of educated Chinese citizens, specifically focusing on college students, to get their perspectives or attitudes toward the adoption of domestic solar PV systems in their country. Respondents showed evidence of high levels of concern for the environment and pro-environmental behavior beliefs. Among the three environmental behavior factors, a large percentage of respondents agreed with the favorable aspects of the question items, suggesting that respondents have positive environmental behavior beliefs and would be interested in purchasing green products or systems such as solar PV rooftop systems. The results also indicated that professional assistance factor, cost factor, and regulation factor might have a negative influence on educated Chinese citizens or Chinese college students'attitudes about adopting solar PV.

6.1 Limitations

Nevertheless, it should be acknowledged that there are several limitations of the research, as its analysis is based on a sample that is quite specific, which gives one snapshot in time of one group – Chinese college students from two universities. Furthermore, this analysis focuses on only three environmental behavior factors. There are other pertinent environmental behavior factors, namely, Drivers of environmental behavior, Social/community influence, and Government policies/ subsidies (Gadenne et al., 2011) that were not explored as the research only focused on the most important factors due to the size limit of the survey. Conclusions about respondents' environmental behavior and possible interest in purchasing green products or ecological systems such as solar PV are based on the rationale that subjects will follow through in purchasing green products if they indicated positive environmental behavior and attitudes. However, other studies have highlighted the "value-action gap" (Ajzen and Fishbein, 1980; Gadenne et al., 2011), which suggests that in-

dividuals with positive environmental attitudes will not always purchase ecological products.

6.2 Future Research

Respondents indicated positive environmental behavior and attitudes toward purchasing solar PV systems. Further educational means and platforms should be established to sustain those attitudes and knowledge concerning the benefits of the technology. Future research could consider all known environmental behavior factors to gain a wider scope of understanding the environmental behavior and attitudes of respondents. In any case, this research provided supporting data and supplementary insight into the prominent buildup of positive environmental attitudes of Chinese students and their attitudes about the adoption of domestic solar PV.

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From left to right, Dr. Xiangrong Liu, Emmanuel Amoako, Dr. Quoc Tran, and John Taylor Wilson.

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Table 13. Cross-tab Analysis on ANF3

Actions norms factor (ANF3)		I would purchase a green product with a payback period of less than 10 years.					
		Strongly Disagree	Disagree	Undecided	Agree	Strongly Agree	Total
Do you have solar PV panels on your house?	No	3.6%	8.2%	21.2%	50.5%	16.5%	100.0%
	Yes	2.4%	10.6%	20.0%	54.1%	12.9%	100.0%
Total		3.3%	8.7%	20.9%	51.2%	15.8%	100.0%

Table 14. Cross-tab Analysis on PAF1

Professional assistance factor (PAF1)		I need professional or additional assistance before using/installing green products					
		Strongly Disagree	Disagree	Undecided	Agree	Strongly Agree	Total
Do you have solar PV panels on your house?	No	3.6%	14.5%	19.2%	49.0%	13.7%	100.0%
	Yes		11.8%	28.2%	49.4%	10.6%	100.0%
Total		2.9%	14.0%	20.9%	49.1%	13.1%	100.0%

Table 15. Cross-tab Analysis on PAF2

Professional assistance factor (PAF2)		I need other people to assist in my decision to purchase green products					Total
		Strongly Disagree	Disagree	Undecided	Agree	Strongly Agree	
Do you have solar PV panels on your house?	No	5.0%	28.1%	25.9%	35.0%	6.1%	100.0%
	Yes		22.4%	32.9%	37.6%	7.1%	100.0%
Total		4.0%	27.0%	27.2%	35.5%	6.3%	100.0%

Table 16. Cross-tab Analysis on CF1

Cost factor (CF1)		The fuel savings from green products is not worthwhile.					Total
		Strongly Disagree	Disagree	Undecided	Agree	Strongly Agree	
Do you have solar PV panels on your house?	No	24.8%	47.4%	9.6%	13.8%	4.4%	100.0%
	Yes	22.9%	50.6%	13.3%	12.0%	1.2%	100.0%
Total		24.4%	48.0%	10.3%	13.5%	3.8%	100.0%

Table 17. Cross-tab Analysis on CF2

		I will not live in this house long enough to recoup the cost.					
Cost factor (CF2)		Strongly Disagree	Disagree	Undecided	Agree	Strongly Agree	Total
Do you have solar PV panels on your house?	No	4.7%	18.8%	56.8%	17.7%	1.9%	100.0%
	Yes	3.6%	21.7%	53.0%	20.5%	1.2%	100.0%
Total		4.5%	19.4%	56.1%	18.2%	1.8%	100.0%

Table 18. Cross-tab Analysis on CF3

		Green products are unlikely to last long enough to recoup the cost.					
Cost factor (CF3)		Strongly Disagree	Disagree	Undecided	Agree	Strongly Agree	Total
Do you have solar PV panels on your house?	No	6.3%	38.3%	33.9%	18.7%	2.8%	100.0%
	Yes	2.4%	34.9%	36.1%	22.9%	3.6%	100.0%
Total		5.6%	37.7%	34.3%	19.5%	2.9%	100.0%

Table 19. Cross-tab Analysis on RF1

Regulation Factor (RF1)		It is difficult for me to find a suitable location or space for green products.					
		Strongly Disagree	Disagree	Undecided	Agree	Strongly Agree	Total
Do you have solar PV panels on your house?	No	2.7%	18.0%	32.5%	41.8%	4.9%	100.0%
	Yes	1.2%	12.9%	38.8%	41.2%	5.9%	100.0%
Total		2.4%	17.1%	33.7%	41.7%	5.1%	100.0%

Table 20. Cross-tab Analysis on RF2

Regulation Factor (RF2)		It may be difficult to get the necessary planning/building permission from the relevant government agency.					
		Strongly Disagree	Disagree	Undecided	Agree	Strongly Agree	Total
Do you have solar PV panels on your house?	No	2.3%	34.6%	24.8%	32.7%	5.6%	100.0%
	Yes	3.7%	41.5%	18.3%	34.1%	2.4%	100.0%
Total		2.5%	35.9%	23.6%	33.0%	5.0%	100.0%

Appendix

Antecedents of Environmental Behavior Factors		Question Items	Adopters	Non-adopters
			Positive Association (%)	Positive Association (%)
General Environmental Behavior	Environmental Limits Factor (ELF)	"The earth is like a spaceship with only limited room and resources" (ELF1)	61.9	64.9
		"There are limits to which our industrialized society can expand" (ELF2)	61.9	70.2
		"When humans interfere with nature it often has disastrous consequences"(ELF3)	56.4	55
	Environmental Adoption Factor (EAF)	"Plants and animals exist primarily to be used by humans" (EAF1)	69.1	68.1
		"Humankind was destined to rule over the rest of nature" (EAF2)	55.4	65.6
		"Humans have the right to modify the natural environment to suit their needs" (EAF3)	63.2	56.6
		"I would be prepared to pay higher prices overall in order to protect the environment" (PNF1)	69	56.9