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Cultural Factors Influencing Chinese Residents and Students' Views on Solar Photovoltaic Rooftop Adoption

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Cultural Factors Influencing Chinese Residents and Students' Views on
Solar Photovoltaic Rooftop Adoption

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Submitted in Partial Completion of the
Requirements for Commonwealth Honors in Management

Bridgewater State University

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Abstract

With a large focus on global warming, the idea of using solar energy has become popular worldwide. However, the adoption rate of solar energy in China is relatively low in comparison to the sizeable quantities of solar Photovoltaic (PV) products produced in the nation. By using Hofstede's six cultural dimensions (Hofstede & Minkov, 2013) this paper investigated cultural factors and their impact on solar adoption based on the responses of surveys. This research used primary data collected from both Chinese residents and Chinese college students in the major cities: Shanghai and Beijing, China and secondary sources to examine the cultural factors and how these factors impact their current solar PV system adoption. Data indicated when comparing the group of college students who installed solar PV systems with those who didn't adopt, there were differences in the percentages of each group agreeing to the statements regarding the following cultural dimensions: power distance, individualism, masculinity, and long term orientation. When comparing the group of college students who didn't install solar PV systems with the group of residents who didn't install, there were differences in the percentage of each group agreeing to masculinity and uncertainty avoidance.

Acknowledgement

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1. Introduction

1.1 Solar Photovoltaic Industry

China is ranked second in the world for energy consumption (Li & Zhang, 2007). Solar PV technology has been proven to be an effective and efficient way to reduce carbon emissions (Faiers & Neame, 2006). Several countries, including the United Kingdom, have implemented policies to help promote solar energy systems and reduce carbon emissions (Faiers & Neame, 2005). Since 2012, China's Photovoltaic (PV) application market has been ranked the largest in the world, with the nation's annual PV grid connected installation capacity contributing to a quarter of the world's installation capacity (Fang, Honghua & Sicheng, 2014).

Moreover, solar panels are designed with urban areas in mind (Hernandez, Hoffacker, & Field, 2015), making China's large cities leading areas for installations. This research will concentrate on the adoption of distributed solar PV systems. Distributed systems are located at or near the source of where the energy being produced will be consumed (Distributed Solar, n.d.). Most often, residents install distributed solar PV systems on the rooftop of their homes. In contrast, centralized solar systems are commonly solar farms built in centralized locations. The energy produced from the vast number of solar panels is outsourced to local buyers who purchase it at a standardized price (Utility-Scale Solar Power, n.d.).

However, as the study by Faiers & Neame (2006) proves, barriers within the adoption and diffusion process exist, contrary to the fact that PV systems are affordable and work to improve air quality by reducing the amount of pollution released into the atmosphere. China has a low adoption rate of solar PV systems despite the major beneficial factors this clean energy source can have on a highly polluted region (Liu, Sun and Kaloustian, 2015). The purpose of this

paper is to explore the barriers of solar PV rooftop adoption, particularly among the potential consumer-college students as well as Generation X residents with first-hand data collected from China.

1.2 Millennial Consumer Behavior

Due to China's strict policy on the number of children a family can have, especially in urban areas between late 1970 and 2010, children in China are gaining more authority within the household than they historically had (Goh & Kuczynski, 2009). Many families have just one or two children, making them a valuable asset as their parents and grandparents grow older. More respect is given to children because they are expected to provide for a three-generation family by themselves. This newfound sense of importance within a family is allowing children to be more assertive and dominant within the household (Goh & Kuczynski, 2009). The younger generation can now utilize their power to advocate for their own beliefs, which is beneficial if they are adopting the green lifestyle. Younger generations could not only be the future leaders in adopting solar PV system, but also be at an advantage to persuade their elders to switch to a solar PV system: an environmentally friendly product and a smart financial investment as well.

1.3 Generation X Consumer Behavior

Generation X consumers have often been looked at as "hard to reach" when it comes to marketing new products or services (Richie, 1995). Although Generation X consumers may have "differing social, economic, and cultural backgrounds, they understand the common needs of their peers to be successful, to value their heritage, to be a part of their chosen group" (Richie, 1995). Generation X consumers do not have the same drive, demand, and hopes that the highly literate millennial Chinese citizens have. Generation X consumers are not as interested in technology and innovative adoptions that the well-educated younger generation is demanding.

They value their heritage and are less accepting of western ideas and products (Inside the Minds of a Chinese Consumer, 2006).

1.4 Hofstede's Cultural Dimensions

A culture's values can influence an individual's behavior (Hofstede, n.d.). Geert Hofstede defines six cultural factors that distinguish national culture and can have an impact on individual behavior (Hofstede, n.d.). These six cultural dimensions are power distance, individualism, masculinity, uncertainty avoidance, and long-term orientation. Hofstede designed a full version score system, which evaluated all these six factors in different nations (Hofstede & Minkov, 2013). The national score can be used to conduct some comparisons between countries to further understand the differences and similarities in their respective cultures. This paper specifically analyzes the cultural factors of China (Refer to Figure 1).

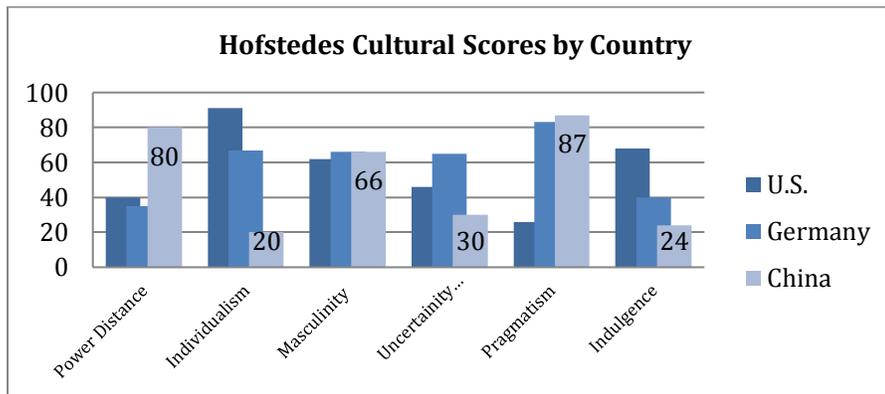


Figure 1 Hofstede's Cultural Scores by Country

Data sources: <http://geert-hofstede.com/national-culture.html>

The explanation and breakdown of the national score for China are below:

Power Distance is defined as the extent to which people accept unequal power distribution. Those who rank high in power distance understand the hierarchical system in place and accept that they have a lesser influence on society. China has a high power distance, ranked at 80 out of 100.

An individualistic society is defined as one in which the ties between individuals are loose. In contrast, China is a very collective nation which reflects the low score of 20. Generations are raised under the same roof and their main priority is to care for one another as opposed to other nations such as the United States who have a more individualistic approach to life.

Indulgence is defined as a society that allows relatively free gratification of some desires and feelings. Historically, China ranks very low overall as a nation in this category with only a score of 24 out of 100. Citizens tend not to indulge in desires that are not necessities.

Long term refers to a society that fosters virtues, oriented towards future rewards. China is a nation that is always looking toward the future and the advancements that can be made to enrich the nation. This is reflected as the highest-ranking value with an overall score of 87 out of 100.

Masculinity is defined as a society in which gender roles are clearly distinct. In China, men act as the dominant figure and hold a majority of the power, making China a very masculine nation. According to Hofstede's dimensions, China ranks at 66 out of 100.

Uncertainty avoidance is the extent to which the members of institutions and organizations within a society feel threatened by uncertain situations. China ranks low in this category with an overall score of 30. Chinese residents are comfortable with ambiguity and learn to adapt when change is necessary.

Each of the questions on surveys relate to one of Hofstede's six dimensions and based on the answer given (1-5 scale) it can be determined how the surveyed individual ranks on the index. Hofstede's research indicates that China, as a whole, ranks high as a power driven, masculine society that focuses on the long-term orientation of actions. China is a collective

nation that is influenced by family as opposed to individual gains. Furthermore, it ranks low in uncertainty avoidance and indulgence. (See the Figure 1)

In order to understand Chinese occupants' views on adopting solar energy, it is beneficial to look at Hofstede's cultural dimensions. Since China experiences large amounts of pollution in the major cities, the data will originate from surveys distributed in Shanghai and Beijing, China. Specifically, this research will focus on the Millennial generation, represented by college students and Generation X, represented by residents.

2. Literature Review

2.1 Factors Influencing Technology Adoption

When considering adopting a new technology, there is a series of phases that consumers experience when considering their purchase. Faiers & Neame (2006) described the five phases of the technology adoption stage new consumers will experience before fully investing in a new system as; 1. Knowledge, 2. Persuasion, 3. Decision, 4. Implementation, 5. Conformation. When considering whether or not to adopt a solar PV system, customers will often experience most, if not all of these phases (Faiers & Neame, 2006). The most important stages of the adoption process are educating future consumers and then persuading them to make the conversion to a more technologically advanced PV system. Individuals who are educated and informed about the benefits of the system will be easier to persuade than uneducated individuals.

2.2 Factors Influencing Solar PV Adoption

Several researchers in the field have considered various factors to be influential in shaping potential consumers' decision processes in solar PV adoption. Kaplan (1999) conducted an empirical analysis on how government policies impacted a consumer's willingness to adopt solar PV panels. The study went on to discuss that potential consumers are skeptical to convert to

solar PV systems due to a lack of confidence in the systems as well as their poor aesthetic appeal (Faiers & Neame, 2005). Furthermore, many of the studies, such as Kaplan's study (1999) and Faiers & Neame's study (2006), center their hypotheses on the environmental benefits solar PV systems offer as well as the policies that influence adoption. There is very limited research that studies the relationship between cultural factors and solar PV adoption.

Finally, several studies conducted looked at individuals' attitudes toward adoption in comparison to their social, educational, and economic backgrounds, as well as lifestyle choices. Fraj and Martinez's (2006) empirical study concluded that those who are striving to fulfill an ecological lifestyle are more apt to install a solar PV system on their home. Yuan, Zuo, & Ma (2010) collaborated on a survey questioning residents in Jinan City, Shandong province China about various solar energy systems and their viewpoints on adoption. The research concluded that while the idea of implementing solar energy systems is accepted, solar water heaters are favored over solar photovoltaic systems. Furthermore, income, age, and education were discovered to have a significant level of importance in explaining why solar PV systems are not being implemented, despite the levels of awareness the public has about the system. A study by Islam (2014) further claimed that "younger households who have a higher awareness level and are less sensitive to cost related factors are prone to higher early adoption rates" (p. 348).

2.3 Cultural Factors Influencing Adoption

Hofstede conducted a study on how values influence national culture. Hofstede examined employees in the workplace to see how their values were influenced by culture (Hofstede & Minkov, 2013). He provided national rankings for each country for each off of his six established cultural dimensions. To date, there are rankings for 73 countries. Liu, Sun and Kaloustian (2015) followed the framework of Hofstede (Hofstede & Minkov, 2013) and elaborated all the

cultural factors and potential influences on the solar PV adoption based on the context of China. This paper aims to explore the potential influences identified through a survey modeled off of Hofstede and Minkov's published Values Survey Module 2013 Questionnaire.

2.4 Chinese Millennial Generation

There is a general belief that the younger generations are more likely to adopt solar PV systems. Labay and Kinnear's work (1981) established the most likely adopters of a solar PV system are young, educated people. By dividing potential adopters into various categories, results concluded that education, income level, and being a younger member of the family are characteristics of those most likely to adapt to a solar PV system. Younger generations categorized the benefits of solar energy to fall more in line with their personal values and consciousness for the environment. Millennials are usually believed to be more likely to adopt because of their knowledge and education about solar energy and the benefits it has on the environment. Towhidul Islam (2014) attributes slow adoption rates to the lack of knowledge potential consumers may have regarding the new technology. Older generations could potentially be hesitant to invest in a more technologically advanced heating system when they have been using a traditional source their entire life. Moreover, older generations of Chinese residents have not been found to possess the same ecological behavior traits that younger generations are being introduced to (Fraj & Martinez, 2006). A study conducted by Chen (2014) in Taiwan supports the idea that younger residents are being raised in a culture where there is a strong push to live an environmentally conscious life. Furthermore, consumer innovativeness and the willingness to experiment with new things are key characteristics in young adults willing to adopt solar photovoltaic products.

2.5 Our Contribution

Our research complements previous research with the empirical study using first-hand data collected in China. More specifically, our research bridges the gap identified as the lack of research addressing how the Chinese culture impacts the viewpoints and opinions of their young citizens. Specifically, the Millennial generation with higher education (college students) that is being raised in a world centered on global warming and pollution debates. Therefore, this paper researches current Chinese college students' and residents' attitudes to these fundamental cultural factors and further investigates how these factors differently influence different generations willingness to adopt solar PV systems. Unlike the previous studies, the survey was designed for and distributed to a large variety of Chinese occupants who reside in both urban and rural areas and have varying demographic backgrounds.

3. Methodology

The data for this project was collected during a three-week research trip to China in the summer of 2016 by surveying residents and college students. Throughout this trip, our research team distributed a survey to college students at two Universities: Shanghai Normal University and Beijing Jiaotong University. The data collected from college students was obtained from visiting undergraduate and graduate classrooms and inviting them to participate in our survey. The college students' survey consisted of 51 questions with a majority of them relating to Hofstede's cultural dimensions. There was also a section focused on demographics such as age, income, and education. A shorter version of the survey was distributed to residents at local tourist attractions in Shanghai and Beijing. The survey consisted of 24 questions, all of which were also asked on the college student survey. Residents were approached in busy areas of the

city such as shopping centers and tourist locations and were asked to participate by taking the survey.

We strategically chose to visit universities and tourist attractions to ensure a variety in the demographics of participants. Many of the surveyed college students have traveled from all over the nation to attend these two major universities, which provides for a wide array of geographic backgrounds. Moreover, many of the residents surveyed at the tourist attractions were visiting the sites from other areas of the country, further expanding our range of responses. These locations ensured that not everyone surveyed lived locally in Shanghai and Beijing, but instead created a mix of rural, suburban, and urban upbringings.

The college student survey was distributed in English since many of the students have had over ten years of experience learning the language. However, since many of the Generation X respondents are not as well educated and are not fluent enough in English to comprehend the survey, they were given surveys in Mandarin and the results were later translated into English. Prior to the completion of the survey, all of the participants received a brief explanation of the purpose of the survey and agreed to participate. In total, 452 college students and 63 residents filled out the questionnaire. The results of both generations were compared to show any significant differences between the two.

All of the collected data was entered into an Excel data sheet and imported into SPSS. By conducting basic cross-tab analysis on each cultural factor, as well as linear regressions, this research compares and contrasts Chinese college students' and residents' viewpoints based on cultural factors.

3. Hypotheses

Due to the lack of studies conducted within this field of research focusing on cultural factors, this paper focuses on the influence cultural factors may have on adoption for both college students and the residents surveyed. The following two sets of hypotheses were proposed for each environmental factor and were tested for accuracy:

H0: Comparing the group of college students who installed solar PV systems with the group who didn't, there is no difference in the percentage of each group agreeing to this statement.

H0': Comparing the group of college students who didn't install solar PV systems with the group of residents who didn't install, there is no difference in the percentage of each group agreeing to this statement.

5. Survey Design

The surveys distributed were designed to assess how significant Hofstede's cultural dimensions were to influencing participants' viewpoints on solar rooftop photovoltaic adoption. The survey had three parts: questions about solar PV current adoption, questions about the cultural dimensions and questions about demographics.

The cultural factor questions were adopted from Hofstede's cultural dimensions framework (Hofstede & Minkov, 2013). For every question, it used a 1-5 like value scale. In most questions, participants were asked on a 1-5 scale how much they agreed or disagreed with the following statements. Some of the questions asked evaluated the importance of statements with the response of 5 signifying the utmost importance and a response of 1 signifying the least importance.

6. Results

6.1 Demographics of College Students

In total there were 453 college students who answered the survey at both universities. There was an equal representation of gender with 48% of respondents being female and 52% male. All participants were well educated and are currently in the process of earning either a graduate or undergraduate degree. The most popular major was Engineering with approximately 57% of all students studying this field, followed by Business and Humanities. Almost 93% of students stated they do not work while in school and are instead supported by their families; a common societal norm for Chinese students.

The following Table 1 indicates the demographic characteristics of the college student respondents.

Table 1: Demographics of College Student Participants

Characteristic	Range	Percentage from College Students % (N= 453)
Age	Under 20	40.13
	20-30	59.42
	31-40	01.11
Gender	Male	48.00
	Female	52.00
Main Occupation	Do Not Work	92.87
	Part Time Job	07.13
Major	Science	14.21
	Engineering	56.76
	Humanities	39.98
	Business	16.85
	Other (Law, Medical)	12.20
Geographic	North China	28.86
	Northeast China	06.26
	East China	31.10
	Southwest China	06.26
	Northwest China	06.49
	South Central China	21.93

Sixty-three residents were surveyed on the streets of Beijing and Shanghai, China. There was an even ratio of male to female participants and approximately 75% of them had at least some level of college education. The average income for those surveyed was between 60,000-200,000 RMB (\$8,700- \$29,000 USD) and 46% reported living with family members. Overall, there were a variety of geographic locations covered with 24% reporting living in North China, 36% living in East China and 22% living in South China.

The Following Table 2 indicates the demographic characteristics of the resident - respondents.

Table 2: Demographics of Resident Participants

Characteristics	Range	Percentage from Residents % (N=63)
Age	Under 20	03.51
	20-30	63.16
	31-40	15.79
	41-50	08.77
	51-60	03.51
	61 and over	05.26
Gender	Male	49.20
	Female	50.80
Highest Education	Primary School	03.33
	High School	25.00
	Some College	26.67
	Bachelor Degree	31.67
	Graduate Degree (Masters and Above)	11.67
Main Occupation	Have no work	05.00
	Unskilled or semi-skilled manual worker	18.33
	Professional	11.67
	Management	30.00
	Other	35.00
Income Range	0-60,000 RMB	42.86
	60,000-200,000 RMB	37.50
	200,000-400,000 RMB	08.93
	Above 400,000 RMB	07.14
Living Arrangement	Own a detached home	08.47
	Own an apartment/condo	23.73
	Renting	18.64

	Living with family	49.15
Geographic	North China	25.00
	Northeast China	06.67
	East China	38.33
	Southwest China	00.00
	Northwest China	05.00
	South Central China	23.33
	Other	01.67

6.2 Cross-tab Analysis Results

Cross-tab analyses were applied to establish which cultural factors had an impact on respondents' viewpoints of solar rooftop PV adoption. These cross-tab analyses were conducted for each group surveyed and broken down by cultural dimensions. They were then compared to identify significant differences in the results. Refer to Tables 3 through 14 for breakdowns of each factor and the influence they had or didn't have on solar PV adoption.

6.2.1 Power Distance

In terms of Power Distance, the following question was selected to analyze: "Be consulted by your boss in the decision involving you work". The questions selected on the survey relevant to this value asked participants to rate on a scale of 1-5 how important certain personal issues were to them. If they believed it is important, it means they do not agree with power distance, and instead are looking for some equality in the division of power. Those who answered with disagree or strongly disagree actually accepting inequality.

Table 3: Cross-tabulation on Power Distance: College Students

College Students	Be consulted by your boss in decision involving your work					
	Of little or no importance	Of little importance	Of moderate importance	Very Important	Of utmost importance	Total
No	1.67%	10.12%	39.94%	38.29%	9.92%	100.00%
Yes	3.53%	43.53%	40%	7.1%	4.71%	100.00%

Data indicated that a majority of college students who have installed solar PV systems agreed with this statement and, in turn, disagreed with power distance. In total 26.32% of students who have adopted a solar PV system responded to this question with “very important” or “of utmost importance” find power distance to be of little importance. Of those who answered no to having solar PV systems installed on their homes, 29.63% agree with this statement, showing they do not agree with power distance.

Table 4: Cross-tabulation on Power Distance: Residents

Residents	Be consulted by your boss in decision involving your work					
Response	Of little or no importance	Of little importance	Of moderate importance	Very Important	Of utmost importance	Total
No	5.56%	12.96%	37.03%	29.63%	14.82%	100.00%
Yes	0.00%	40.00%	0.00%	20.00%	40.00%	100.00%

Data indicated residents who have installed solar PV system agreed with this statement, opposing the idea of power distance. In total, 40% of those who answered yes found this to be of little importance, while 60% found it important, indicating they do not agree with power distance. Of those who have not installed a solar PV system on their home, nearly 70% found this to be important, also indicating that they disagree with power distance.

6.2.2 Individualism

In terms of individualism or collectivism, the responses for the question “If a coworker gets a prize, I would feel proud” were analyzed. Participants were asked on a 1-5 scale how much they agree or disagree with the following statement, “If a coworker gets a prize, I would feel proud.” Based on the results, if participants strongly agreed with this statement, it indicates

they have collectivist views as opposed to individualistic ones. If they agree or strongly agree, they are collectivists; otherwise, they would be individualists.

Table 5: Cross-tabulation on Individualism: College Students

College Students	If a coworker gets a prize, I would feel proud					
Response	Strongly Disagree	Disagree	Undecided	Agree	Strongly Agree	Total
No	2.45%	10.08%	19.35%	52.04%	15.80%	100.00%
Yes	1.18%	7.06%	9.41%	63.35%	20.00%	100.00%

The results of the individualism question show that a majority of the college students surveyed have a collectivist viewpoint. This result was expected when considering China’s high overall ranking as a collectivist nation. 83.35% of students who have installed solar PV panels agreed with this statement, signifying they have a collectivist notion. Those who have not adopted a solar PV system also agreed with this statement. In total, 67.84% agreed with the statement.

Table 6: Cross-tabulation on Individualism: Residents

Residents	If a coworker gets a prize, I would feel proud					
Response	Strongly Disagree	Disagree	Undecided	Agree	Strongly Agree	Total
No	1.82%	3.64%	23.64%	52.73%	18.18%	100.00%
Yes	0.00%	0.00%	25.00%	75.00%	0.00%	100.00%

Similar to the college students, the residents’ responses indicated a collectivist viewpoint, which was expected considering the national ranking for the country. In total, 75% of all respondents who have adopted as solar PV system agreed with this statement. It is also important to note that of the participants who have adopted solar PV systems, none of them disagreed with

the statement, but 25% of respondents remained undecided. Of those who have not adopted a solar PV system, 70.91% agreed with the given statement and 5.46% disagreed. Overall, roughly 75% of residents agreed with this statement, proving they have collectivist viewpoints.

6.2.3 Masculinity

In order to understand if participants have masculine viewpoints, individuals taking the survey were asked how important a variety of questions were to them. The question that was consistent on both surveys and specifically focused on masculinity asked participants to rate how important they viewed the phrase: “have chances for promotion.” Those who answered that this statement was important to them are more apt to have the same masculine outlook on life as Hofstede determined in his high masculine rating for China.

Table 7: Cross-tabulation on Masculinity: College Students

College Students	Have Chances for Promotion					
	Of little or no importance	Of little importance	Of moderate importance	Very Important	Of utmost importance	Total
No	3.54%	5.45%	12.81%	43.33%	34.88%	100.00%
Yes	0.00%	4.71%	8.34%	48.24%	38.82%	100.00%

When considering China’s high ranking as a masculine nation, it was expected that a majority of students would agree with the aforementioned statement and the idea of a masculine society. Of the students who have adopted solar PV panels, 87.06% agreed with the given statement, representative of a masculine viewpoint. Similarly, 78.21% of students who have not adopted solar PV systems also found this statement to be important signifying they strongly agreed with a masculine society.

Table 8: Cross-tabulation on Masculinity: Residents

Residents	Have Chances for Promotion					
Response	Of little or no importance	Of little importance	Of moderate importance	Very Important	Of utmost importance	Total
No	10.87%	13.04%	18.48%	36.96%	20.65%	100.00%
Yes	0.00%	0.00%	25.00%	87.50%	0.00%	100.00%

As expected, many of the survey residents found the statement, “have chances for promotion” to be important, showing their acceptance for a masculine society. Of those who have adopted solar PV panels, 87.5% of participants agreed with the statement and approximately 57% of those who did not adopt agreed as well. These responses support Hofstede’s ranking of China’s high masculine values.

6.2.4 Uncertainty Avoidance

The question relevant to Uncertainty Avoidance asks how much participants agree or disagree with the statement: “One can be a good manager without having a precise answer to every question that a subordinate may raise about his or her work.” If participants strongly disagreed with this statement, it shows they strongly avoid uncertainty because they believe that a good manager needs to have a precise answer to every question so that the system functions well and vice versa if they did agree with the statement.

Table 9: Cross-tabulation on Uncertainty Avoidance: College Students

College Students	One can be a good manager without having a precise answer to every question that a subordinate may raise about his or her work					
Response	Strongly Disagree	Disagree	Undecided	Agree	Strongly Agree	Total
No	4.96%	23.97%	33.06%	33.61%	4.41%	100.00%

Yes	4.82%	31.58%	33.73%	31.33%	6.02%	100.00%
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When answering the questions on uncertainty avoidance, about one third of all students were undecided on this topic. However, 28.93% of students who have adopted and 36.40% of those who have not adopted disagreed with this statement strongly or somewhat. However, when comparing these percentages to those who agreed with the statement, those who have not adopted a solar PV system and those who have had agreement rated 38.02% and 37.35% respectively. These percentages are fairly even and the remaining one third of participants answered “undecided”, making it difficult to argue a strong favor one way or another.

Table 10: Cross-tabulation on Uncertainty Avoidance: Residents

Residents	One can be a good manager without having a precise answer to every question that a subordinate may raise about his or her work					
Response	Strongly Disagree	Disagree	Undecided	Agree	Strongly Agree	Total
No	10.91%	5.45%	32.73%	38.18%	12.73%	100.00%
Yes	0.00%	20.00%	40.00%	40.00%	0.00%	100.00%

Approximately 50% who have not adopted a solar PV system on their home agreed with the statement, “One can be a good manager without having a precise answer to every question that a subordinate may raise about his or her work.” Of the residents who have adopted a solar PV system, only 20% disagreed with the statement and 40% agreed while another 40% answered “undecided.”

6.2.5 Long Term Orientation

When looking at long-term orientation, the statement, “Frugal (not spending more than needed)” was analyzed. By answering with a one, the participant indicated they are not frugal and a five indicated they are very cautious with their spending habits. Those who agreed with

this statement are focused on long-term orientation and are always thinking about the future and how to be prepared for any situation.

Table 11: Cross-tabulation on Long-term Orientation: College Students

College Students	Frugal (not spending more than needed)					
Response	Not Important	Of Little Importance	Of Moderate Importance	Very Important	Of Utmost Importance	Total
No	2.18%	14.71%	45.23%	28.24%	9.54%	100%
Yes	7.14%	10.71%	36.90%	34.52%	10.71%	100%

When answering the question regarding frugality, 45.23% of students who adopted and 37.78% of those who have not believed being frugal is important. This reflects the nation’s viewpoint about long-term orientation. The future needs to be considered and individuals need to be prepared for a future event that may cause unforeseen costs.

Table 12: Cross-tabulation on Long-term Orientation: Residents

Residents	Frugal (not spending more than needed)					
Response	Not Important	Of Little Importance	Of Moderate Importance	Very Important	Of Utmost Importance	Total
No	3.77%	11.32%	43.40%	22.64%	18.87%	100.00%
Yes	0.00%	0.00%	50.00%	50.00%	0.00%	100.00%

Half of the residents surveyed who have adopted agreed with the idea of being frugal and living a modest lifestyle. This percentage is slightly higher in comparison to the participants who have not adopted a solar PV system. Of those who have not adopted, 41.51% agreed and 43.4% remained undecided on their opinion regarding this concept. These results were expected when

taking into consideration China’s very low ranking for the indulgence factor. Chinese residents are used to living modestly and not indulging on items they don’t need or cannot afford.

6.2.6 Indulgence

Indulgence is defined as a society that allows relatively free gratification of some desires and feelings. The question selected on the survey relevant to the value of indulgence asked participants to rate on a scale of 1-5 how much they agreed with the statement: “Moderation: having few desires.” If they agreed or strongly agreed, it means they show some restraint and don't indulge on all of their desires and feelings. Those who didn't agree with the statement agreed with the indulgence factor.

Table 13: Cross-tabulation on Indulgence: College Students

College Students	Moderation: having few desires					
Response	Not Important	Of Little Importance	Of Moderate Importance	Very Important	Of Utmost Importance	Total
No	2.19%	13.11%	39.89%	37.43%	7.38%	100.00%
Yes	5.95%	10.71%	39.29%	38.10%	5.95%	100.00%

Less than half of all of the students surveyed agreed with this statement, showing restraint. This is consistent with China’s low ranking of 30 on the indulgence scale. In total, 44.05% of students who have adopted solar PV panels and 44.81% of those who have not adopted agreed with this statement and show restraint as opposed to indulgence.

Table 14: Cross-tabulation on Indulgence: Residents

Residents	Moderation: having few desires					
Response	Not Important	Of Little Importance	Of Moderate Importance	Very Important	Of Utmost Importance	Total
No	1.85%	9.26%	50.00%	22.22%	16.67%	100.00%
Yes	0.00%	40.00%	40.00%	20.00%	0.00%	100.00%

Of those who have not installed a solar PV system, 50% found this statement to be moderately important and 38.89% found it to be important. Of those who have adopted, 40% stated that this statement was moderately important to them and 20% found it important. When compared to college students, college students who have adopted showed more restraint than the residents.

6.2.7 Summary of Results

Table 15: Summary of Percentage of Each Group Agreeing on Each Statement Regarding to Cultural Factors

	Residents N=63		College Students N=453	
	Install	Not Install	Install	Not Install
Power Distance	60.00%	44.45%	11.81%	48.21%
Individualism	75.00%	70.91%	83.35%	67.87%
Masculinity	87.50%	57.61%	88.06%	78.21%
Uncertainty Avoidance	40.00%	50.91%	37.35%	38.02%
Long Term Orientation	50.00%	41.51%	44.93%	37.78%
Indulgence	20%	38.89%	44.05%	44.81%

6.3 Hypotheses Testing

Based on the above summary results in Table 15, we conducted the two-tail hypotheses tests to see whether there is difference in the percentages of each group agreeing to the statement regarding each cultural dimension comparing the group of college students who installed solar

PV systems with those who didn't install; and whether there is a difference in the percentage of each group agreeing to the statement regarding each cultural dimension comparing the group of college students who didn't install solar PV systems with the group of residents who didn't install. The p-value results are listed in Table 16.

Table 16: Results of Two-tail P-Values by Factor

	Students Installed vs. Students Not Installed	Students Not Installed vs. Residents Not Installed
Power Distance	<.0002**	.5837
Individualism	<.0002**	.7414
Masculinity	<.0002**	.0003**
Uncertainty Avoidance	.8368	.0394*
Long Term Orientation	.0309*	.5899
Indulgence	.8407	.9623

6.3.1 Power Distance

In the first null hypothesis test, we compared the percentage of the group of college students who installed solar PV systems agreeing on this statement (11.81%, see Table 15) with the group that did not install solar PV systems (48.21%, see Table 15) to see whether there is any difference in the percentage of each group agreeing to this statement. Since the p-value is less than 0.0002 (See Table 16), the null hypothesis is rejected and the difference is significant. A further analysis was conducted to determine whether the percentage of college students who installed solar PV agreeing on this statement is higher than the percentage of college students who did not install. The p value was <. 0001 (See Table 16), showing the percentage of college students who installed solar PV agreeing on this statement is significantly higher. It is a strong indicator that college students who had installed solar PV panel are most likely to have high democratic viewpoints. The college group who installed solar installed solar power panel showed lower power distance.

In the second hypothesis test, the percentage (48.21%, see Table 15) of the group of college students who didn't install solar PV systems was compared with the percentage (44.45%, see Table 15) of the group of residents who did install solar PV systems to see whether there was a difference in the percentage of each group agreeing to the statement. Since the p-value was 0.583 (See Table 16), we cannot reject the hypothesis. The two groups have no difference in agreeing with this statement. There is no difference in power distance.

6.3.2 Individualism

In the first null hypothesis test, the group of college students who installed solar PV systems (83.35, see Table 15) was compared with the percentage of the group who didn't install solar PV systems (67.87%, see Table 15) to see whether there was a difference in the percentage of each group agreeing to this statement on individualism. Since the p-value was less than 0.0002 (see Table 16), the null hypothesis was rejected and there is a significant difference between the two groups. A further analysis was done to determine whether the percentage of college students who installed solar PV agreeing on this statement is higher than that of the college students who did not install. The single-tail p value was $< .0001$, this shows that the percentage of college students who installed solar PV agreeing on this statement is significantly higher. It is a strong indicator that college students who had installed solar PV panel are most likely to have collectivist viewpoints. This contradicts the prediction that the people who hold individualism are more likely to install solar power panel and prefer the distributed power system.

In the second hypothesis test, we compare the percentage of college students who have not installed solar PV systems agreeing on this statement (67.87%, see Table 15) with the percentage of the group of residents who didn't agree (70.91%, see Table 15) to see whether there is no difference in the percentage of each group agreeing to the statement pertaining to individualism. Since the p-value is 0.7414 (see Table 16), we could not reject the null

hypothesis. The two groups have no difference in agreeing this statement and the view of individualism.

6.3.3 Masculinity

When comparing the percentages of the group of college students who have installed solar PV systems (88.06%, see Table 15) with the percentage of college students who have not (78.21%, see Table 15) to see whether there was no difference in the percentage of each group agreeing to this statement on individualism. It was determined that the p-value is less than 0.0002 (see Table 16) and the null hypothesis was rejected. The difference between the two is significant. Further testing indicated that the single tail p value was $< .0001$, which means that the percentage of college who installed solar PV agreeing on this statement is significantly higher. It indicates that college students who had installed solar PV panel are most likely to have masculinity viewpoint. This is consistent with our general assumption that college students who are more competitive are more likely to install solar PV panel.

The second hypothesis test compared the percentage group of college students who have not installed solar PV systems (78.21%, see Table 15) with the percentages of residents who have installed solar PV systems (88.06%, see Table 15) to determine whether there is no difference in the percentage of each group agreeing to the statement pertaining to individualism. Since the p-value is 0.0003 (see Table 16), the null hypothesis was rejected because the difference is significant. A second test was conducted to determine the difference in percentages. The p value was $< .0001$. College students indicated they were more likely to have a masculine viewpoint. This could be related to their higher education and more ambition to succeed and be promoted within their career.

6.3.4 Uncertainty Avoidance

When the percentage of the group of college students who have installed solar PV systems (37.35%, see Table 15) was compared to those who have not adopted a PV system (38.02%, see Table 15) to see whether there is no difference in the percentage of each group agreeing to the question relating to uncertainty avoidance, it was determined that the p-value is .8368 (see Table 16). The hypothesis was not rejected and there is no difference for the two groups regarding uncertainty avoidance.

The second hypothesis test compared the group of college students who have not installed solar PV systems (38.02%, see Table 15) with the residents who have (50.19%, see Table 15) to determine whether there was no difference in the percentage of each group agreeing to the statement. Since the p-value is 0.0394 (see Table 16), the hypothesis was rejected because the difference is significant. A further analysis was done to determine whether one of the two groups is significantly larger. The p value is .0255. Residents agreed with the statement, which is an indicator of risk pursuing at a higher percentage, showing they are more willing to take risks than the college students who were surveyed.

6.3.5 Long Term Orientation

The first null hypothesis test compared the percentage of the group of college students who installed solar PV systems (44.93%, see Table 15) with the group who didn't (37.78%, see Table 15) to see whether there was a difference in the percentage of each group agreeing to the question relating to long-term orientation. Since the p-value is .0309 (see Table 16), the null hypothesis was rejected and the difference was significant. A further analysis was done to determine the difference between the two. The p value is .013. Therefore, the students who

installed solar PV show significant long-term orientation compared with the students who didn't install.

In the second hypothesis test, regarding long-term orientation, the group of college students who have not installed solar PV systems (37.78%, see Table 15) was compared with the percentage of the group of residents who didn't (41.51%, see Table 15) to see whether there was a difference in the percentage of each group agreeing to the statement. Since the p-value is 0.5899 (see Table 16), the hypothesis was not rejected. The two groups have no difference in agreeing with this statement. There is no difference in the long-term orientation. For people who didn't install solar PV panel, whether college students or residents, there was no difference regarding long-term orientation.

6.3.6 Indulgence

The first null hypothesis test compared the group of college students who installed solar PV systems (44.05%, see Table 15) with the group who didn't (44.81%, see Table 15) to see whether there was a difference in the percentage of each group agreeing to the question relating to long-term orientation. Since the p-value is .8407 (see Table 16), the null hypothesis was not rejected. There was no significant difference.

In the second hypothesis test, the group of college students who haven't installed solar PV systems (44.81%, see Table 15) was compared with the percentage of the group of residents who didn't adopt (38.89%, see Table 15) to see whether there was a difference in the percentage of each group agreeing to the statement. Since the p-value is 0.9623 (see Table 16), the null hypothesis was not rejected. The two groups had no difference in agreeing with indulgence.

7. Conclusions

There is a limited percentage of installation of solar PV rooftop systems among residents and college students. When comparing the group of college students who installed solar PV systems with those who didn't adopt, there were differences in the percentages of each group agreeing to the statements regarding the following cultural dimensions: power distance, individualism, masculinity, and long term orientation. It was expected that there would be a difference in masculinity because our assumption was that college students who are more competitive are more likely to install solar PV panels. Further, college students who have long-term orientations would be more focused on saving money in the future and would be more willing to make the investment now to install a PV system. In terms of power distance, the difference in percentage indicated that of those who have adopted a solar PV system are more likely to have democratic viewpoints as opposed to the traditional viewpoints of china.

When comparing the group of college students who didn't install solar PV systems with the group of residents who didn't install, there were differences in the percentages of each of the following factors: masculinity and uncertainty avoidance. It was expected that college students who are well educated might be more ambitious and open to new technologies that may help them succeed later in life. However, the residents agreed more with the idea of uncertainty avoidance. This indicated that they are more likely to take risks than college students. This could be because they are more established in life, have more money, or are less educated on the impact of the transition.

8. Limitations and Future Research

There were several limitations to this research. The Chinese college students' survey was distributed in English. Despite the students' extensive knowledge and understanding of this

language, there were still some sentences or words the students may have not fully understood. Although we discouraged the situation, we still noticed some students worked together to translate and interpret the survey, resulting in few surveys with identical answers. Further, there were a limited number of resident surveys completed. The low number of participants cannot fully represent the entire Chinese population. Finally, there was only one question for each factor that appeared on both the college students' and residents' surveys. Obviously, the one question was just one indicator of the participants' cultural viewpoints.

For future research, more in-depth linear regression could be done. Preliminary analysis showed no interesting or noteworthy results, but a more detailed analysis could provide more insightful results. Also, other relevant questions could be asked to obtain a more accurate indication of each cultural factor.

9. References

- Chen, K. K. (2014). Assessing the effects of customer innovativeness, environmental value and ecological lifestyles on residential solar power systems install intention. *Energy Policy*, 67, 951-961. doi:10.1016/j.enpol.2013.12.005
- Distributed Solar. (n.d.). Retrieved September 12, 2016, from <http://www.seia.org/policy/power-plant-development/utility-scale-solar-power>
- Faiers, Adam, and Charles Neame. "Consumer attitudes towards domestic solar power systems." *Energy Policy* 34.14 (2006): 1797+. Academic OneFile. Web. 30 June, 2016.
- Fraj, E., & Martinez, E. (2006). Environmental values and lifestyles as determining factors of ecological consumer behaviour: An empirical analysis. *Journal of Consumer Marketing*, 23(3), 133-144. doi:10.1108/07363760610663295
- Goh, E. L., & Kuczynski, L. (2009). Agency and Power of Single Children in Multi-Generational Families in Urban Xiamen, China. *Culture & Psychology*, 15(4), 506-532. doi:10.1177/1354067X09344881
- Hernandez, R. R., Hoffacker, M. K., & Field, C. B. (2015). Efficient use of land to meet sustainable energy needs. *Nature Climate Change*, 5(April), 353-358. doi:10.1038/nclimate2556
- Hofstede, G., & Minkov, M. (2013). Values Survey Module 2013 Manual. Retrieved September 12, 2016, from <http://geerthofstede.com/wp-content/uploads/2016/07/Manual-VSM-2013.pdf>
- Inside the Mind of the Chinese Consumer. (2006). *Journal of Sport Management*, 20(4), 573-574.
- Islam, T. (2014). Household level innovation diffusion model of photo-voltaic (PV) solar cells from stated preference data. *Energy Policy*, 65, 340-350. doi:10.1016/j.enpol.2013.10.004
- Kaplan, A.W. (1999). From passive to active about solar electricity: innovation decision process and PV interest generation. *Technovation*, 19, 467-481.
- Labay, D. G., & Kinnear, T. C. (1981). Exploring the Consumer Decision Process in the Adoption of Solar Energy Systems. *Journal of Consumer Research*, 8(3), 271. doi:10.1086/208865
- Liu, X., Sun, Y., & Kaloustian, T.S. (2015). Cultural Factors Influencing Domestic Adoption of Solar Photovoltaic Technology: Perspectives from China. *China Media Research*, 11(4), 28-41.

- Utility-Scale Solar Power. (n.d.). Retrieved September 12, 2016, from <http://www.seia.org/policy/power-plant-development/utility-scale-solar-power>
- Ritchie, K. (1995). Why Gen X buys brand X. *Brandweek*, 36(20), 22.
- Yuan, X., Zuo, J., & Ma, C. (2010). Social acceptance of solar energy technologies in China—End users' perspective. *Energy Policy*, 39(3), 1031-1036. doi:10.1016/j.enpol.2011.01.003
- Zhang, S. (2016). Analysis of DSPV (distributed solar PV) power policy in China. *Energy*, 9892-100. doi:10.1016/j.energy.2016.01.026

10. Appendix

Questionnaire for Residents

This survey is for research purpose only. There is no correct or incorrect answer and you will not be identified for your selected answers or opinion. This version of the survey is intended for adults. Thank you for your time, we appreciate your open and honest answers.

1. Do you use solar photovoltaic panel on your home? Y/N

Please think of an ideal job, disregarding your present job, if you have one. In choosing an ideal job, how important would it be to you to ... (please circle one answer in each line across):

1 = not important 2 = little important 3 = of moderate importance
4 = very important 5 = utmost important

2. Have chances for promotion (M10)	1	2	3	4	5
3. be consulted by your boss in decision involving your work (P7)	1	2	3	4	5

In your private life, how important is each of the following to you: (please circle one answer in each line across):

4. Moderation: having few desires (R12)	1	2	3	4	5
5. Frugal (not spending more than needed) (L14)	1	2	3	4	5

To what extent do you agree or disagree with each of the following statements? (Please circle one answer in each line across):

1 = strongly disagree 2 = disagree 3 = undecided 4 = agree 5 = strongly agree

6. One can be a good manager without having a precise answer to every question that a subordinate may raise about his or her work. (U21)	1	2	3	4	5
7. If a co-worker gets a prize, I would feel proud (I2)	1	2	3	4	5

Some demographic information about yourself:

D1. Are you: 1. male 2. female

D2. How old are you? 1. Under 20 2. 20-30 3. 31-40 4. 41-50 5. 51-60 6. 61 or over

D3. What kind of education (or their equivalent) did you complete?

- 1. Elementary 2. High school
- 3. Some college 4. Bachelor degree
- 5. Graduate degree (master and above)

D4. If you have or have had a paid job, what kind of job is it / was it?

- 1. Have never work
- 2. Unskilled or semi-skilled manual worker
- 3. Professional
- 4. Management
- 5. Other

D5. What is your household annual income range?

1. 0-60,000 RMB
 2. 60,000-200,000 RMB
 3. 200,000 – 400,000 RMB
 4. Above 400,000 RMB
-

D6. What is your living arrangement?

1. Own a detached house
2. Own an apartment/condo
3. Renting
4. Living with family

D7. Where are your original from?

1. North China (Beijing, Tianjin, Hebei, Shanxi, Inner Mongolia)
 2. Northeast China(Liaoning, Jilin, Helongjiang)
 3. East China(Shanghai, Jiangsu, Zhejiang, Anhui, Fujian, Jiangxi, Shandong)
 4. Southwest China (Chongqing, sichuan, Guizhou, Yunan, Tibet)
 5. Northwest China(Shaanxi, Gansu, Qinghai, Ningxia, Xinjiang)
 6. South Central China (Henan, Hubei, Hunan, Guangdong, Guangxi, Hainan, Hongkong, Macau)
 7. The other countries: (State/ Country)
-

D8. What was your nationality at birth (if different)?

Thank you very much for your cooperation!