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Article

Psychosocial Implications of Large-Scale Implementations of Solar Power in Malaysia

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Abstract: The present study aimed to investigate the psychosocial impacts of large-scale solar (LSS) power projects. There were 225 participants (n = 109 women, n = 3 did not indicate gender) participated in our study by completing a series of questionnaires. We found that participants who lived farther from the LSS power project location and those who viewed the project as being impactful were optimistic about the benefits LSS power projects could bring. Our participants also demonstrated support for renewable energy development in Malaysia. These findings may provide important implications for the implementation and execution of LSS power projects and policies.

Keywords: attitude; large-scale solar power; relocation; residential distance

1. Introduction

As a developing country which is having an economic take-off, Malaysia has developed a high demand for electricity. To meet the demand while reducing greenhouse gases emission, the Malaysian government has approved projects of large-scale solar (LSS) power [1] to develop solar power in the country. It is of interest to understand how these projects affect the public and the society. The present study aimed to investigate the psychosocial impacts of LSS power projects, particularly how these projects affect the public's energy behavior, opinion about the use of land, and opinion about relocation to make space for the projects.

1.1. Electricity Supply in Malaysia

Tenaga Nasional Berhad (TNB), as the only electric utility company in Peninsular Malaysia currently, generates energy via energy mix by burning biofuels and using other resources [2]. Considering the high reliance on fossil fuel which contributes to the emission of greenhouse gases and the rich solar radiation Malaysia receives daily [3], the government has been taking initiatives to diversify the utility of solar power in the country.

For instance, the government promotes installation of solar photovoltaic (PV) cells at the individual and commercial levels. Alternatively, the government generates solar power in large quantities via LSS power projects and feeds the power to the national grid. For instance, LSS power feeds energy to an electric utility company (e.g., TNB), which then combines the solar energy with the energy produced from other sources (e.g., fossil fuels and hydropower) and supplies electricity to consumers. This approach could overcome the high cost issue related to individual installations. TNB has since signed a 21-year agreement to purchase solar energy through an LSS power project, which occupied a 98-hectare solar farm located in Banting, Selangor [4] and has been in full operation since October 2018 [5].

Researchers have devoted much effort in resolving technical issues pertaining to LSS power in Malaysia. Such efforts include energy storage, which is crucial as the generation of energy peaks at noon but not during the morning and evening when the demand is the highest. This begs a solution to have the LSS power generated at noon stored and supplied later during the peak demand periods [6]. How variations in temperature affect solar panel output performance has also been actively examined [7].

While technical issues related to LSS power have been receiving research attention, the psychosocial implications of LSS power have rarely been studied. LSS power projects aim to benefit end users by fulfilling their demands for electricity and reducing the emission of greenhouse gases. Nevertheless, such projects might raise concerns among members of the public.

1.2. The Psychosocial Implications of LSS Power

Small-scale energy-efficiency programs, such as solar PV installations in households and commercial buildings, have more direct, significant psychosocial impacts on individuals. For instance, installing energy-efficient schemes in low-income households in high latitude countries could reap the benefits of improving subjective well-being and increasing satisfaction in the short term [8]. Large-scale energy projects, on the other hand, usually draw the public's attention due to government's publicity and mass media's coverage because they generally require large areas of land to build solar panels. For instance, the LSS power project in Banting, the biggest solar plant in Malaysia, occupies a 98-hectare piece of land [5], which is equal to 137 soccer fields. Therefore, the psychosocial implications of energy projects of such a scale are largely related to the public's attitude toward the projects and their concern about the ecological impacts. Literature has generally explained public's attitude using the "Not in My Back Yard" (NIMBY) mindset and place attachment [9], which could be related to residential proximity and use of land. The ecological concern of psychosocial implications affects the public's opinion about the use of land [10]. The subsections below describe three main psychosocial implications of LSS power.

1.2.1. Residential Proximity and Attitude

LSS power projects might affect the public's awareness about energy issues and attitudes toward LSS power projects, depending on the public's residential distance to the project locations. On the one hand, it seems reasonable to predict that those who live closer to the project locations will be affected more than those who live farther away. They might form stronger opinions about the impacts of LSS power projects, such as how their lives might be affected by these projects. On the other hand, it seems reasonable to expect otherwise. People living farther away might form strong attitudes about the projects, viewing the project from an objective viewpoint, such as its socioeconomic impacts. Such debate could be discussed using the NIMBY mindset and the construal-level theory [11].

The NIMBY explanation predicts that residents residing near the locations of large-scale energy projects develop stronger opinions against such projects than those residing further from the locations [12]. However, this approach was not supported in previous studies, including a study conducted in the United States [13]. The study compared the public in the Southwest states of the United States with the national sample in terms of their attitudes toward LSS power projects. Even though many LSS power projects were built in the Southwest states, people from those states were not less supportive of the projects than the national sample. The NIMBY approach generally received criticism for being over-simplified by ignoring psychological and environmental factors [14].

The present study would like to take a novel approach by analyzing the public's opinion from the construal level's perspective, instead of a simple dichotomy of agreement or disagreement to LSS power projects. Considering the construal-level theory [11], people who live farther away from LSS power projects might actually form stronger attitudes about the projects. According to the theory, people generally form low-level construals (i.e., concrete and specific features) of spatially near objects or events and form high-level construals (i.e., abstract and global features) of spatially distant objects or events [15]. Therefore, it follows that people who live farther from the solar farm in Banting might form high-level construals or attitudes of the solar farm.

1.2.2. Use of Land

The use of large areas of land for LSS power projects might draw the attention of the public. The public might disagree with the use of land for LSS power projects, thinking that large areas of land could be used for various purposes, such as building houses, recreational parks, and commercial/industrial parks. These usages could improve the well-being of the public and the development of the country, benefits that are more tangible than the benefits LSS power projects could bring. However, it is possible that the public agree with the use of land for LSS power projects. The public are generally supportive of renewable energy systems because these options could protect the environment [16]. Solar power reduces the use of fossil fuels and hence could reduce chemicals, carbon dioxide, soil erosion, and noise [10,17]. Although LSS power reduces wildlife's habitat, this issue could be overcome by monitoring wildlife and restoring habitats if there are signs of threat. Additionally, the ecological hazards associated with fossil fuels are no lesser than those associated with solar power [10]. Considering positive examples from other countries where renewable energy consumption has been associated with GDP growth [17,18] and quality of life [19], the public might view LSS power projects favorably. It is important to understand how the majority of the public view the use of land as it might affect the implementation of LSS power projects and policies.

1.2.3. Relocation of Residents

LSS power projects might cause some residents to have to relocate to make space for the large geographical area needed for the projects. How the public, especially those who are potentially affected by the relocation, respond to the relocation is also important for the implementation of LSS power projects.

In addition to social roles and social relationships, people form their identities based on the places they live. Therefore, people develop emotional attachments to a location, seeing it as a concrete place filled with meaning and as an extension of their self-identity [9]. Based on previous studies, when residents with strong attachment to their place were required to relocate, they experienced a threat to their identity and were more likely to oppose against the project [20].

Relocation of residents is sometimes compensated by new job opportunities in building the infrastructure and operating LSS power farms, which may lead to the burgeoning of services and commercial infrastructure [21]. The trade-off between relocation and urban development are planned by the government [22]. However, how acceptable the trade-off is to the public is important for the efficiency of such planning.

1.3. Research Aims and Significance

The present study aimed to use the LSS power project in Banting, Selangor as an anchor to examine how LSS power projects affect the public's opinions about renewable energy and environmental issues in general. Using questionnaires and open-ended questions, we examined the following research questions: How will residential distance to the Banting project location affect the public's energy behavior and awareness of energy-related issues? How will the public think of the benefits and hazards associated with the LSS power project in Banting, Selangor? What are the public's attitudes toward use of land and relocation due to LSS power projects?

To answer the first research question, we investigated respondents' geographical distances from the solar farm in Banting, Selangor. It was predicted that respondents who live farther from the solar farm would form abstract, holistic attitudes about renewable energy and the LSS power projects. To examine the second and third research questions, we showed a list of the advantages and disadvantages of the project for respondents to rate. With this we were able to examine how the awareness of the Banting Project affect respondents' attitudes toward the project and energy behaviors. Respondents also answered several open-ended questions regarding their opinions about relocation to make space for LSS power projects.

2. Methods

2.1. Participants and Design

We invited adults who were above the age of 18 to participate in our study. We first used the snowballing approach to recruit 15 students of various disciplines from our university and then have them approach their family and friends to participate. To gather the opinions of the residents who lived nearer to the Banting project, we also visited the residents in the neighborhoods near the project location and collected responses from 22 residents. Altogether, 225 adults (M_{age} = 30.17, SD = 13.43) participated. Because of the various methods of approaching participants, about half of the participants were students, and the other half were those with a full-time job (e.g., accountants, doctors, business owners) and housewives. Table 1 summarizes the demographic characteristics of the sample.

Table 1. The demographic characteristics of the sample.

Variable	Categories	Number of Participants	Percentage
Gender	Female	109	48.4
	Male	113	50.2
	Did not indicate	3	1.3
Highest Education	Primary school	4	1.8
	Secondary school	51	22.7
	Diploma	48	21.3
	Bachelor	91	40.4
	Master	20	8.9
	Doctorate	6	2.7
	Did not indicate	5	2.2
Individual income	Less than RM1000	102	45.3
	RM1000–RM2000	14	6.2
	RM2000–RM3000	20	8.9
	RM3000–RM4000	21	9.3
	RM4000–RM5000	12	5.3
	RM5000–RM6000	12	5.3
	RM6000 and above	28	12.4
	Did not indicate	16	7.1
Frequency of electricity interruption	0 - Never	39	17.3
	1	102	45.3
	2	46	20.4
	3 - Always	21	9.3
	Did not indicate	17	7.6
Questionnaire version	English	217	96.4
	Malay	8	3.6

This study was a correlational study. Between April and May 2018, we administered a series of questionnaires and some open-ended questions to gather respondents' opinions about the Banting project. Participants answered either the English or Malay version of the questionnaires.

2.2. Measures

Of the questionnaires we administered, only four were relevant to the present paper. These questionnaires measured participants' energy-related knowledge, energy attitude, and energy behavior. A demographic questionnaire was added to collect information regarding participants' background. The questionnaires were presented to participants in the following order.

2.2.1. The Energy Quiz

To measure participants' knowledge in energy and renewable energy-related issues, we created an energy quiz by adapting five multiple-choice questions from Abrahamse, Steg, Vlek, and Rothengatter [23] and creating three additional multiple-choice questions. To make the questions more culturally relevant, we adapted Abrahamse and colleagues' questions accordingly. For instance, we changed the question "Which appliance uses more energy, a washing machine or a video recorder?" to "Which appliance uses more energy, a washing machine or a radio?" The three additional questions we created were related to solar power, and were: "Have you seen a photovoltaic (PV) panel before (roof top or on empty land)?", "Do you know what PV panels do?", and "Have you heard of large-scale PV farms or large-scale solar farms?" To compute the energy knowledge scores, we first coded the answers with 1 for every correct answer and 0 for every incorrect or no answer (missing values). Higher scores in this variable indicated having greater energy-related knowledge.

2.2.2. Energy Attitude Scale

We constructed a 14-item questionnaire to measure participants' attitudes toward renewable energy and the Banting LSS power project. Of these, 10 items were relevant to the present paper. Three of them were yes–no questions asking about the awareness of the Banting LSS power project, and the purpose of the project. One item asked participants their preferred compensation method if they were to relocate to make space for the project. There were six items (some with sub-items). These items asked participants to rate on Likert scales the extent to which they agreed with the improvement, advantages, disadvantages, and concerns related to the Banting project, how much they knew about the project, and how much they were likely to be affected the project. See Table 2 for the items. In addition, there was one open-ended question that comprises two sub-items asking participants to indicate why they disagreed and agreed to use vacant land of the size of several football fields for solar plants. We did not compute any composite scores for this scale. Each item was analyzed separately.

2.2.3. Energy Behavior Scale

We constructed the energy behavior scale to measure how well participants conserve energy. The scale had multiple-choice items that required participants to indicate the average room temperature in their houses, the number of light bulbs in their houses (items adapted from [23]), and the frequencies of cooking, using washing machine, and watching television. Participants also needed to indicate how long in general their electrical appliances and vehicles lasted before being replaced, and whether their vehicles were fuel efficient. Some participants left some items unfilled. For instance, leaving the item regarding vehicles empty could mean this item was not applicable to participants, probably because they did not own a vehicle. To compute the energy behavior scores, we reverse scored five items before standardizing each item and averaged the standardized scores. Higher average scores indicated more energy-conserving behaviors.

2.2.4. Demographic Questionnaire

This seven-item scale required participants to indicate their age, gender, highest education, occupation, individual income, frequency of experiencing electricity interruption in their households, and residential area. The residential area item was used to measure participants' residential distance from the solar farm in Banting. Participants indicated where they lived, and the researcher (the first author) computed the distance by referring to the Google Map (https://www.google.com/maps). She checked the direction from "Kuala Langat Power Plant, Banting" to participants' residential area (e.g., "Cyberjaya, Selangor") by driving. From the routes generated, she chose the shortest distance to indicate how far participants lived from the power plant. For those who lived in Banting, the distance was recorded as zero. On average, participants lived 51.47 km (SD = 56.68) from the project location (8 did not indicate their residential area).

Table 2. Correlation coefficients between distance and energy-related variables.

Topics	Variables	Correlation Coefficient
Energy behaviors		−0.02
Energy knowledge		0.01
Demographic variables	age	0.03
	education level	0.02
	income	0.00
Attitudes	knowledge about the Banting project	−0.01
	impact the project has to household	0.02
	Benefits of the Banting project	
	improve the electricity supply at home	0.07
	improve the electricity supply in public facilities	0.07
	improve the electricity bill	0.07
	improve the quality of life	0.12
	Disadvantages of the Banting project:	
	Take up too much space	−0.10
	Some toxic materials and hazardous products	−0.07
	Light reflection from the PV panels	−0.09
	Energy storage for solar power is inefficient	0.05
	Create noise pollution	−0.02
	Create unseemly view	−0.01
	Very expensive investment	0.05
	Advantages of the Banting project:	
	Reduce greenhouse gas	0.06
	Require less water to generate electricity	0.00
	Require less maintenance	0.10
	Create new job	0.14
	Main concerns for the Banting project:	
	The potential environmental impact	−0.08
	Disruption to the current lifestyle	−0.04
	Potential job opportunities	0.16 *
	Economic growth due to this project	0.15 *
	People migration due to this project	−0.05
	Increase of foreign workers due to this project	0.08

Note. * $p < 0.05$.

2.2.5. Malay Translation

We prepared an English and a Malay version of the questionnaires, since some participants might be more comfortable with using English or Malay. The Malay version was translated from the English version by the second author of the paper. After that, the third author back translated the Malay version into an English version. The first author then compared the original English version with the back-translated English version and found that the two versions did not differ much from each other. The several minor discrepancies highlighted by the first author were resolved after the second and third authors discussed with one another. Altogether, only 8 participants completed the Malay version of the questionnaires and the rest (n = 217) completed the English version.

2.3. Procedure

We prepared two versions of the questionnaires (English and Malay versions) by conducting back translation. Upon the approval from the ethics committee from the university, we distributed questionnaires. After explaining to participants their rights as participants, they signed an informed consent form and completed the questionnaires. A numeric code was assigned to each participant to protect participants' identities.

3. Results

3.1. Preliminary Analyses

We performed Pearson's correlational analyses to give a glimpse into the associations among the variables. As shown in Table 3, those who had more energy knowledge were generally younger. It is important to note that energy knowledge was not associated with energy behavior.

Table 3. The correlation coefficients among variables.

	1	2	3
1. Energy behavior	1.00		
2. Energy knowledge	0.07	1.00	
3. Age	−0.02	−0.24 **	1.00
Means	2.53	5.73	30.17
Standard deviations	0.41	1.59	13.43

Note. ** $p < 0.01$.

Because we administered two language versions of the questionnaires, we performed several t-tests and non-parametric tests to examine whether language versions had affected the variables. In general, participants who completed the Malay version showed a tendency to be less knowledgeable in energy issues, t (223) = 3.68, $p < 0.001$, and less educated, U = 325.00, $p = 0.002$. See Table 4 for the means and standard deviations. Therefore, we included language version as a covariate in subsequent parametric analyses.

Table 4. The means and standard deviations of the variables by language version.

		English	Malay
Energy behavior	*n*	217	8
	M	2.53	2.43
	SD	0.41	0.35
Energy knowledge	*n*	217	8
	M	**5.80**	**3.75**
	SD	1.56	1.16
Education level	*n*	212	8
	M	**4.45**	**3.25**
	SD	1.07	0.71
Income	*n*	201	8
	M	2.89	2.75
	SD	2.28	0.89

Note. Means of the same row are embolden when the group difference (English vs Malay) differed significantly at $p < 0.05$..

3.2. Main Analyses

3.2.1. The Impact of Distance

Our first study goal focused on how residential proximity to a solar power plant affects one's attitudes and energy behaviors. To fulfil this research aim, we performed a set of partial correlation analyses that examined the associations between distance and energy-related variables by controlling for the effect of language version. Correlation analyses associated with education level and income were performed using Spearman's rho correlation. See Table 2 for the correlation coefficients between distance and energy-related variables.

The findings (see Table 2) showed that how far one lives from the solar plant did not affect her/his energy behavior and energy knowledge. However, distance did somehow affect people's attitudes. Those who lived farther away from the Banting solar plant showed a greater tendency to view the solar plant as having great potentials in bringing more job opportunities and economic growth. Other energy-related variables were not significantly associated with distance.

3.2.2. Opinions about the Impacts of the Banting Project

To understand the second research goal regarding how the public views the impacts of the Banting Project, we performed a series of partial correlation analyses to examine the associations between participants' perceived level of impact of and their attitudes toward LSS power projects. Language version was controlled as a covariate. Correlation analyses associated with education level and income were performed using Spearman's rho correlation.

The findings of these analyses showed that participants were in general optimistic about the impacts of the project (see Table 5 for the correlation coefficients). Those who believed that the project would bring greater impacts tended to be those who had received higher education and possessed knowledge about the project. The more impactful they viewed the project to be, the more likely they agreed that the project would bring advantages, such as improving electricity supply to their home, electricity supply to public facilities, electricity bills, and quality of life, and creating new job opportunities. In terms of the disadvantages, the more impactful they viewed the project to be, the more likely they agreed that the project would cause noise pollution. Other energy-related variables were not significantly associated with perceived impact.

Table 5. Correlation coefficients between perceived impact and energy-related variables.

Topics	Variables	Correlation Coefficient
Energy behaviors		0.11
Energy knowledge		−0.01
Demographic variables	age	−0.11
	education level	0.22 **
	income	−0.07
Attitudes	knowledge about the Banting project	0.16 *
	Benefits of the Banting project	
	improve the electricity supply at home	0.23 **
	improve the electricity supply in public facilities	0.21 **
	improve the electricity bill	0.17 *
	improve the quality of life	0.26 ***
	Disadvantages of the Banting project:	
	Take up too much space	−0.02
	Some toxic materials and hazardous products	−0.03
	Light reflection from the PV panels	0.12
	Energy storage for solar power is inefficient	−0.01
	Create noise pollution	0.18 *
	Create unseemly view	0.09
	Very expensive investment	0.04
	Advantages of the Banting project:	
	Reduce greenhouse gas	−0.01
	Require less water to generate electricity	0.03
	Require less maintenance	0.11
	Create new job	0.17 *
	Main concerns for the Banting project:	
	The potential environmental impact	0.05
	Disruption to the current lifestyle	0.05
	Potential job opportunities	0.04
	Economic growth due to this project	0.08
	People migration due to this project	0.08
	Increase of foreign workers due to this project	0.09

Note. * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$.

We conducted a set of ANCOVAs to test the differences between individuals who were aware of the Banting project and those who were unaware in terms of their energy behaviors, knowledge, and attitudes. Language version was again controlled in these analyses as the covariate. Non-parametric tests were used for analyses involving education and income. Table 6 shows the means and standard deviations of the group that was aware of the project and the group that was unaware.

Table 6. The Descriptive Statistics of Individuals who were Aware and Those who were unaware of the Banting Project.

Topics	Variables	Yes		No	
		M	SD	M	SD
Energy behaviors		2.59	0.44	2.52	0.41
Energy knowledge		5.38	2.13	5.79	1.48
Distance		53.56	29.08	51.08	60.49
Demographic variables	age	**38.79**	14.95	**28.66**	12.59
	education level	4.76	1.39	4.34	1.00
	income	**4.37**	2.47	**2.63**	2.11
Attitudes	knowledge about the Banting project	**2.26**	0.86	**1.14**	0.47
	impact the project has to household	**3.36**	1.78	**1.96**	1.87
	Benefits of the Banting project				
	improve the electricity supply at home	4.16	1.63	3.88	1.44
	improve the electricity supply in public facilities	4.56	1.39	4.24	1.29
	improve the electricity bill	**4.59**	1.34	**3.85**	1.54
	improve the quality of life	4.69	1.47	4.23	1.48
	Disadvantages of the Banting project:				
	Take up too much space	**3.38**	1.66	**3.99**	1.41
	Some toxic materials and hazardous products	3.35	1.38	3.84	1.41
	Light reflection from the PV panels	3.80	1.42	3.66	1.44
	Energy storage for solar power is inefficient	4.06	1.44	3.84	1.51
	Create noise pollution	**3.65**	1.66	**2.86**	1.54
	Create unseemly view	**3.90**	1.60	**3.11**	1.58
	Very expensive investment	4.56	1.41	4.52	1.28
	Advantages of the Banting project:				
	Reduce greenhouse gas	4.48	1.28	4.87	1.16
	Require less water to generate electricity	4.61	1.17	4.42	1.22
	Require less maintenance	4.15	1.46	3.83	1.40
	Create new job	**5.00**	1.48	**4.38**	1.43
	Main concerns for the Banting project:				
	The potential environmental impact	4.32	1.43	4.29	1.34
	Disruption to the current lifestyle	4.47	1.35	4.28	1.28
	Potential job opportunities	**4.65**	1.39	**4.04**	1.34
	Economic growth due to this project	4.65	1.37	4.32	1.20
	People migration due to this project	4.06	1.37	4.23	1.22
	Increase of foreign workers due to this project	4.44	1.56	4.36	1.37

Note. Means of the same row are embolden when the group difference (aware vs not aware) differed significantly at $p < 0.05$.

Compared to those who did not know about the Banting project, those who were aware were older and had more income. These people also had more knowledge about the project and believed that the project could bring impacts to their households. In particular, they had positive views on the project, such as improving electricity bills and bringing in more job opportunities. In addition, they were less likely to agree that the project could take up too much space. However, they believed that the project could create noise and unseemly view.

3.2.3. Opinion about the Usage of Lands for Solar Plants

We created two questions that asked participants to indicate whether they agree or disagree that vacant land of the size of several football fields can be replaced with PV panels and to indicate why.

Agreement. *For those who indicated their opinions, a large number of them (n = 127, 56%) indicated an agreement with the plan. When indicating the reasons for their agreement, most of them (n = 42) believed that such a plan may help generate (green) energy. These participants generally agreed that solar plants may help generate more electricity as an additional source of energy. Some statements provided by the participants included "Because it can provide additional electric energy to the nearer building or facilities", "I do believe that Msia (Malaysia) will consume most of it fossil fuel in the future. Therefore, an additional source should be used largely", and "Renewable energy source".*

The participants who agreed to the plan also indicated that such plan may contribute to keeping our environment sustainable (n = 24). They believed that solar plants or using solar power may save our earth by reducing carbon emission and fossil fuel usage. For instance, "It might reduce the greenhouse effect and other environmental problem", "Instead of more buildings, why not something else like PV panels that could improve the environment", and "It would help reduce global warming, despite the cost".

Many of the participants (n = 18) who agreed believed that the plan may put vacant land to good use. These participants believed that vacant land, when used in an appropriate way, may bring benefits to the society, such as by generating electricity. For instance, some participants stated that "It would be a better usage of the vacant land in long term", "Land in non urban areas are not used at all. It is better to make use of it", "It is much more beneficial to put PV panels on such vacant lands rather than leaving it as it is since this can lead to soil erosion, and other problems", and "Since the vacant land is not used, it could be replaced with PV panels that could generate electricity". Additionally, one participant cautioned that it is necessary to use only unused land for this purpose and to preserve forests, for example "Unused land should be given purpose; however we need to ensure to have enough forests are across the country."

Seven participants agreed because such plans are possible. "It has sufficient space", and "Maybe possible". Some participants (n = 6) agreed because of the potential benefits of such plans. "Brings benefits" and "Because it is for good cause". Only a small number of participants (n = 4) agreed based on the cost-saving effect of the plan. For instance, one participant stated, "It's worth to invest". And another participant stated, "Because lesser fossil fuel will be used and renewable energy is cheaper on the long run".

Two participants indicated agreement but listed unreasonable reasons for agreement. "It requires space" and "Solar farms need lots of space". Other participants did not indicate any reason.

Disagreement. *There was a smaller proportion of participants who disagreed to using large fields for solar plants (n = 59, 26%). Among those who disagreed with the plan, some participants (n = 8) specified that the lands could be used for other purposes, such as to develop buildings and create job opportunities, to plant trees, to be used for industrial and agricultural purposes, to build shelters for animals, and to improve economic welfare. For instance, one participant stated, "It can be used for developing buildings which can create more job opportunities to improve the standard of living. If standard of living increase, people will be more likely to invest in PV panels". Another participant stated, "Plant trees/reforestation to reduce carbon foot print".*

Many participants (n = 7) thought that the plan would be a waste of the lands. "Because it seems like a waste of space/land" and "Wasting land for household". Some participants (n = 7) disagreed with the plan because they believed the land should be used for sports. For instance, "It will make people play sports less" and "There is no place to play football and for other activities".

A few participants felt that the plan could be very costly (n = 5). One participant expressed, "It is very costly and Malaysia is not investing such big amount". Another participant stated, "No, it may cost up to billions? Or millions of ringgit to construct".

Some participants (n = 3) preferred individual installation instead of LSS power. "PV panel can be installed at roof top. no need to clear land just for solar farm", and "Solar installation can be built on the rooftops of buildings to capture the maximum amount of sunshine. Better keep the vacant land for other usage/planning purpose".

Three participants believed that LLS power was not necessary. "It does need as much space, not necessary" and "We do not need PV panels, it is useless".

One participant suggested to use the land to grow more greens, "I believe vacant lands should be used to grow more greens. Humans can do with less electricity". One participant disagreed because s/he thought that the plan is not strategic, "unstrategic, sunlight might not reach". One believed that such plan would trouble the residents/citizens, "menyusahkan kita (*English translation: trouble us*)". Some participants thought it might "affect (the) lighting of the field" (n = 1), there is not "enough space" (n = 1), the plan "is not efficient enough" (n = 1), it might cause radiation (n = 1) and unseemly view (n = 1). One was skeptical about the advantages because "chances it would expand to other parts of Malaysia is low".

One participant, although they indicated disagreement, was rather open-minded. "Depends on location, geography and sunlight in the area". One participant indicated an unreasonable reason. "If the field is not in use why not?"

There were many participants (n = 6) who disagreed with the plan but indicated that they had no knowledge about the plan or renewable energy. For instance, "Because I do not know anything about it", "I do not know how PV panels work", and "I have no idea at all what is it all about".

Agree and disagree. *Nine participants indicated that they agreed and disagreed with the plan. One of them indicated disagreement because s/he believed that the land could be used for other purposes, such as playgrounds, "Because where would the kids play then? obesity rates would further increase and bunch of other health outcomes would rise". On the other hand, s/he also agreed with the plan because of the long-term benefit, "As in the long term, the football fields probably will be converted either into a mall, shop lots, houses, so either way, better PV installed as it brings more long term benefits".*

Another participant disagreed with the plan due to the locations of the plant and households, "Most lands that are PV panels friendly are out of town, and most electrical needs are in the city". However, this participant also agreed with the plan, "If the public sector has the fund to run the project, why not?" One participant disagreed because s/he believed that the land could be used for recreational purposes, "Other recreational purpose", but agreed because it could take an " … advantage of usable land". One participant disagreed out of concern about the cost, "Too much work and money to build those PV panels", but agreed due to the long-term benefit it could bring, "In the long run more environment-friendly". A participant disagreed because "We will need the land some day to build or to grow, better to put them on buildings", but agreed "because if we are not using it for anything else, we might as well use it for this". Four participants checked the agreement and disagreement boxes but did not provide comments.

No comments. *There were 30 participants who did not indicate agreement or disagreement and did not indicate the reasons.*

3.2.4. Opinions about Relocation

Since LSS power projects often involve occupying a sizable area of land and sometimes relocating nearby residents, we collected participants' opinions about these issues. We designed a question asking participants to indicate their preferred housing relocation plan if the solar power plan causes them to be relocated. We provided four options for participants to choose: unaware, cash to buy new houses, land to construct new house, do not mind, and other (to which participants could specify their preference). Almost half of them (n = 96, 43%) preferred receiving cash to buy new houses. The second most popular choice was receiving land to construct a new house (n = 48, 21%). Those who chose to receive cash and receive land lived neither very close to nor very far from the solar farm in Banting (average distance about 50 km). About 19% (n = 42) of the participants were unaware of the availability of housing relocation plans if they are asked to relocate. This group of participants lived relatively closer to the solar farm in Banting (M = 42.69 km). There was a small proportion of participants who did not mind the housing relocation scheme provided for them (n = 19, 8%) or did not respond to the question (n = 5, 2%). These participants tended to live farther from the solar farm (M = 72.17 km).

In addition, some participants (n = 15, 7%) chose the 'other' option. Nine of these participants indicated that they would refuse to be relocated without specifying the reasons; one of them would reject relocation plans if the offer was not satisfying; one preferred a "1000% better house"; one preferred a better environment; one preferred "$5 million compensation fee"; two chose this option but did not specify their preference.

4. Discussion

4.1. Key Findings

The major findings of the present study may inform us of the appropriate policies and approaches to encourage and support the public's involvement in renewable energy. The present study served to answer three main research questions: How will residential distance to the Banting project location affect the public's energy behavior and awareness of energy-related issues? How will the public think of the benefits and hazards associated with the LSS power project in Banting, Selangor? What are the public's attitudes toward use of land and relocation due to LSS power projects?

4.1.1. Research Question 1

Pertaining to the first research question, the LSS power project in Banting did not seem to affect the public's awareness of solar power and energy behavior. In addition, the residential proximity to the solar farm did not affect participants' energy behaviors, energy knowledge, and their opinions about the Banting Project. However, those who lived farther from the solar farm who tended to believe that the project would bring job opportunities and economic growth.

4.1.2. Research Question 2

Regarding the second research question, the public had various views about the Banting Project. The results showed that participants who were aware and those who were not aware of the Banting did not differ in terms of energy behaviors and energy knowledge. The participants who tended to view the project as being impactful seemed to focus more on the advantages of the project and less on the disadvantages. The participants who were aware of the project, relative to those who were unaware, believed that it would bring job opportunities and improve electricity bills. On the other hand, they also believed that the project would bring negative impacts, such as noise and unseemly view.

4.1.3. Research Question 3

Regarding the use of land, participants' answers generally demonstrated their support for renewable energy development in Malaysia and environmental issues. Many participants showed support for the use of land for solar farms as they believed that this may generate renewable energy and keep the environment sustainable. Although many participants indicated disagreement with the use of land for solar farms, some specified that individual installations of PV panels on roofs of buildings would be a better option than using vacant lands for solar farms. When asked about the preferred methods of compensation if they were asked to relocate to make space for solar farms, participants preferred receiving cash or land. Some participants did not have any preference, and they generally lived farther from the solar farm.

4.2. Theoretical and Practical Implications

The government's aspiration to rely more on renewable energy [24] may sustain the economic and societal growth and cleaner environment in the long run. To achieve this goal, it requires not only the government's but also the society's effort and support.

In addition to individual installations of solar PV panels, LSS power implementations is another approach to solar power. This approach requires LSS plants that generate solar power and feed the energy to the national grid, which then combines solar energy with energy from other sources (e.g., biogas, biomass, and hydropower). This method does not require individual installation and may overcome the issues pertaining to high cost with individual installation. However, how the public respond to LSS power implementations is crucial for the development of solar energy.

In the present study, we examined how residential spatial proximity to the solar farm in Banting may affect the public's opinion about renewable energy and energy behavior. We measured the residential distance to the solar farm in Banting and participants' attitudes toward renewable energy. We found that residential distance did not affect attitudes in general. These findings were consistent with previous studies (e.g., [13]), where the public living closer to LSS power project locations were no less supportive of the development renewable energy. The findings also suggested that the NIMBY approach might not be applicable or sufficient to explain the public's opinion about LSS power projects.

We took a novel approach to go beyond the public's opposition to large-scale power projects and focused on the construal levels of attitudes, whether concrete or abstract attitudes were formed. The construal level theory [11] suggests that people generally see spatially near objects or events in a more concrete and specific way and spatially distant objects or events in a more abstract and holistic way [15]. Our participants who lived farther from the solar farm in Banting formed high-level construals of the project. They viewed the project from a global/holistic perspective, such as taking the global, long-term economic perspective. Such findings might add to the NIMBY approach such that the NIMBY mindset might not explain opposition to large-scale energy projects well, but it might be useful to explain concrete and abstract attitudes toward such projects. It should be noted that the Banting project did not cause any resident to relocate. We might expect a different pattern of associations between distance and attitudes among respondents who are directly affected by the project, such as those requested to relocate.

The participants of our study demonstrated a high level of support for LSS power projects. When asked about the potential impacts of the project, our participants predominantly focused on the advantages of the project and agreed that the project would bring benefits. In the open-ended questions that required participants to indicate why they agreed or disagreed with using vacant land for solar farms, their answers also implicated supportiveness for LSS power implementations. The majority of the participants agreed with using vacant land for solar farms and believed that this kind of initiatives may generate green energy for a more sustainable environment. A smaller portion of participants disagreed to this initiative, but some of them disagreed because they preferred installing solar panels on rooftops. Only four participants responded to this open-ended question with ecological concern (land restoration, such as trees planting and animal shelters), showing most people place attention to socioeconomic development rather than nature preservation. Participants' responses to the open-ended question and to the question related to relocation did not indicate place attachment. This might have to do with the fact that none of our participants had to relocate due to the Banting project. In between relocation and urban development, our respondents tended to place more focus on the latter and were able to foresee the long-term benefits of LSS power.

It is expected that having awareness about LSS power projects would promote energy-conserving behaviors. However, our findings showed that the awareness did not affect participants' energy-related behaviors. Our participants demonstrated a low level of energy-conserving behaviors, with an average of 2.53 on a 9-point Likert scale. This worryingly low level of energy-conserving behaviors highlighted the urge to change Malaysians' energy behaviors.

The energy knowledge of our participants was rather encouraging. Of the highest possible score of 8 in the energy quiz, the average score of the sample was 5.73 and the median was 6.00, which were higher than the mid-point of 4.5. However, it is intriguing how having energy knowledge could not be translated into energy-conserving behaviors in the present study. In sum, our study showed that having energy knowledge is not sufficient in changing Malaysians' energy behaviors.

The data we obtained in the present study, although it may not provide the actual data to quantify the long-term impacts of LSS power, could provide some preliminary data to make predictions about the long-term impacts. Since large-scale implementations of solar power are only starting to emerge in Malaysia, it is not possible to measure the actual long-term impacts. Nevertheless, our findings portrayed the energy attitudes and behaviors of Malaysians when LSS plants started sprouting in the country. Continuous research efforts are needed to record the trajectory changes of the development of solar power in Malaysia over the years.

Studies regarding the psychosocial impacts of LSS power projects in Malaysia have been rare. Our study filled the gap in the literature by providing insights into the public's responses to LSS power projects in Malaysia. In general, our findings shed some light on the public's positive responses to LSS power projects in Malaysia. Malaysians tend to focus on the long-term socioeconomic benefits of such projects, rather than on place attachment and nature preservation. These may provide important implications to Malaysian government as more LSS power projects are in the pipeline [25]. Additionally, our findings highlighted an important energy-related issue to tackle, which is low energy-conserving behaviors among Malaysians. While having energy knowledge and close proximity to LSS plants does not seem to be effective, as shown in our study, more research is needed to look for effective interventions.

4.3. Limitations and Suggestions for Future Studies

As one of the pioneer pieces of research that examined the public's responses to LSS power projects in Malaysia, this study provides several important theoretical and practical implications. However, the findings of the present study should be interpreted with caution due to the following limitations.

Most of the participants in the present study lived in Klang Valley, an area that includes the capital city of Malaysia and Selangor, the most developed state in Malaysia. Klang Valley is between 40 and 60 km from the Banting project location, which explains the average residential distance of 51 km in the study. The demographic characteristics of residents in this area could explain the findings we obtained. For instance, most of the residents in Klang Valley are migrants from other states [26], and therefore they might not develop place attachment to their locations. To these city dwellers, being asked to relocate to make space for LSS power projects might possibly not happen to them.

The participants recruited for this study were mainly well versed in English, as most of them completed the English version of the questionnaire. They were also highly educated and had high income. These characteristics are typical of those found among residents in Klang Valley [27]. Although there was a small proportion of less educated and low-income participants in the present study, they might not be well represented. Therefore, some of the findings of the present study might not be representative. For instance, the high level of supportiveness for renewable energy and LSS power projects might be overrepresented by the high income, high education group in the study.

The present study showed that residential proximity and awareness of LSS power projects affected energy attitudes. Future studies may consider other predictors of attitudes toward LSS power. Researchers may consider psychosocial factors such as place attachment [10]. Additionally, the attitudes of residents who are directly or indirectly affected by LSS power projects is worth studying. We encourage more research efforts to be devoted in examining this research question.

Our study showed a low level of energy-conserving behaviors among Malaysians, and that having energy knowledge did not seem to mitigate this issue. Therefore, more research effort is needed to design approaches to improve energy behaviors among Malaysians.

5. Conclusions

The LSS power project in Banting marked an important step in the development of solar power in Malaysia. As one of the limited number of studies that investigated Malaysians' responses to LSS power projects, our study provided important findings and implications for social issue campaigns and policy makers. In particular, our study showed that Malaysians were supportive of the development of green energy in Malaysia. Their attitudes toward LSS power projects were not affected by place attachment but by the long-term socioeconomic benefits to the nation. These may provide important implications to Malaysian government as it is planning for prospective LSS power projects. Additionally, our findings highlighted low energy-conserving behaviors among Malaysians. Having energy knowledge and proximity to LSS plants does not seem to be effective. More initiatives or social policies are needed to change the behavior. Although this study gives us a preliminary glimpse into the public's view on LSS power, it highlights several questions that need further research to resolve.

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