RESEARCH ARTICLE

Solar Cell (PV System) Preference Factor Analysis among Jakarta Home-owners

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ABSTRACT

Indonesia is emerging as an attractive market for solar energy businesses due to the growing demand and untapped potentials in renewable energy. Before 2017, there were no Indonesian solar energy company that specifically focused for residential installation. In this sense, SolarKita was established to capitalize on this opportunity in Indonesia. This study was aimed to investigate the attributes that the potential customers prefer in purchasing solar PV system. Other than that, relationship and relevancy on how the preferable attributes to the potential customer's value was also identified in this study. Laddering interview and means-end chain theory were used as methodologies for this study to generate insights into reasoning behind potential customer's choices. There were 20 interviews conducted for this study and successfully generated 33 A-C-V ladders, which were further processed and visualized into a hierarchical value map (HVM). From the HVM, the results were showing four apparent attributes from the solar PV system, which are: *(1) converting sunlight into electricity, (2) highly durable, (3) supported by the government policy, and (4) easy monitoring*. Moreover, the attributes were then linked to consequences the potential customer expects that were initially driven from personal value.

Keywords: solar cell; PV system; preference factors

INTRODUCTION

Utilization of Solar Power

Humans have harnessed solar energy since the beginning of history. Starting from as far back as the prehistoric time, humans used solar energy to warm their dwelling, dry their clothes, and cure their food (Environmental Science Activities for the 21st Century, n.d.). In the modern era, the development of solar technology started to shift towards solar energy to produce electricity as an alternative renewable energy source. However, at that time when fossil fuels were widely available and affordable, it was not a priority to develop the commercial use of solar energy (Ã. H. Z. Wei et al., 2011).

With the growing energy demands, declining fossil fuels and environmental problems have led to the exploration of renewable energy resources. The twenty-first century is also already seeing the start of the next great transition in energy sources away from fossil fuels to renewable energy—energy derived from a limitless source.

Overview of Solar Power Demand and Market

Solar energy is one of the most prominent sources of renewable energy currently available (Ekins-Daukes, 2009). Solar energy can be used to produce electricity, one of the ways to produce electricity from solar energy is by using photovoltaic (PV) cells or widely known as solar cells. Compared to other ways of making electricity (e.g., thermal electricity), photovoltaic systems were considered as expensive during the early 2000s. However, the price for PV systems has dropped by around fifty percent in recent years in alignment with the impressive growth and demand for the systems in the U.S (Rogers & Wisland, 2014). The solar cell (PV system) has shown an impressive 33% growth per year (Hoffmann, 2006). Therefore, to the developing nations like Indonesia, this transition offers unique business opportunities.

Solar Power Opportunity and Demand in Indonesia

Geographically, Indonesia has 10 times better solar power potential compared to Germany, Japan, and the United States. Utilization of solar energy is very potential and is suitable for Indonesia with average production up to 4 hours a day. Moreover, Perusahaan Listrik Negara (PLN) targets national energy mix as high as 23% coming from renewable sources. Indonesia Ministry of Energy and Mineral Resources (ESDM) also has an ambitious target implementation of 6.4 GWp PLTS by 2025. The government also has a plan to leverage this infinite energy source and solve the ever-growing energy needs of Indonesia which is expected to reach an equivalent of 400 million ton of fossil fuel in 2015, and through Peraturan Presiden No. 5/2006, stated that 0.2 - 0.3 percent of national energy mix is expected to come from solar energy or equivalent to 1,000 MWp by 2025—it indicates that the demand for solar energy in Indonesia is continue to grow as the country has potential solar energy resources reaching 5.1 kWh/m2 per day. With the availability of export-import net metering by PLN has allowed people to install their own solar cells to help reducing electricity bills (IndoSolar, 2017). Therefore, the commercial potential for the solar PV system is significant for Indonesia.

Current Situation of SolarKita

Along with the growing demand and the untapped potential for solar energy makes Indonesia an attractive market. Before 2017, no Indonesia solar energy company focuses on residential installation, until SolarKita was established to be one of the Indonesia companies to leverage the opportunity. SolarKita is a Jakarta-based renewable energy company that currently on its initial stage in providing solar PV system for residential use and focuses on the consumer market. The product includes real-time online software monitoring for electricity produced from the device. As of January 2018, SolarKita is in the stage of formulating the marketing strategy and plan for the future sales. Therefore, SolarKita is currently seeking for market data and customer study.

Opportunity for SolarKita

With the untapped potential and opportunity for solar cell (PV system) in an unsaturated market in Indonesia, SolarKita has the opportunity to step up as a first mover. To capitalize on this opportunity, SolarKita needs a better understanding of what product attributes that correlate with the potential customers' value. Understanding of consumers' value is important because consumers group are likely to have different preference and criteria according to their value systems. The concept of understanding customer's value has become an important

factor in attracting and retaining customers, and an essential aspect in most business strategy models (Simova, 2009). Developing an effective marketing strategy requires strategic insight and comprehensive understanding of the product-market domains one operates within. This understanding must not only come from the firm's perspective, but rather from that of its consumers (Huber, Herrmann, & Morgan, 2001). In this relatively new market of solar PV system installation in Indonesia, SolarKita needs to identify the factors that personally relevant to customers. Then marketing strategy can be developed to appeal to those customers in accordance with their values. From that, SolarKita could potentially hold the market leadership.

Problem Statement

In spite of the growing demand and potential of solar energy in Indonesia, there is currently no company that really focuses on providing solar PV system for residential use. Thus, there is a lack of understanding of which of the product attributes are preferred by consumers. In this sense, this research is conducted to explore on how product attributes of SolarKita's solar PV system connected with specific motives and value of customers. This study is conducted to analyze customers' preference on product attributes of SolarKita's solar PV system in connection with particular motives and value of customers. Therefore, SolarKita could develop an effective marketing strategy for its solar PV system installation. Furthermore, the focus of this research lies in answering the following questions: what are the product attributes associated with the solar PV system?; what are the consequences of the product attributes?; what are the potential customers' values concerning solar PV system?.

Study Objectives

The study objectives is to identify which product attributes that the customers prefer for SolarKita's solar PV system installation. To understand how the product attributes relate to the customers' value towards SolarKita's solar PV system installation.

LITERATURE REVIEW AND METHODOLOGY

This study is an application of the laddering technique. Basically, an in-depth interviewing was conducted with open-ended questions to let respondents express the reasoning behind their choice of certain product attributes in relation to their personal goals and values. The result from this methodology is a set of potential customer's values related to SolarKita's solar cell (PV system) installation product in the form of hierarchical value map (HVM).

Laddering Technique Process

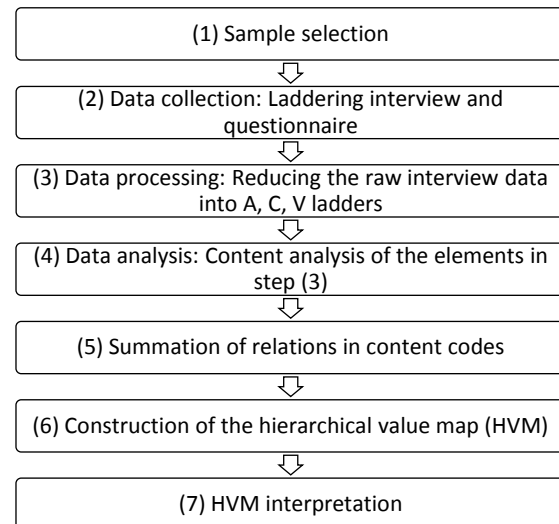| (1) Sample selection |
| --- |
| ⇩ |
| (2) Data collection: Laddering interview and questionnaire |
| ⇩ |
| (3) Data processing: Reducing the raw interview data into A, C, V ladders |
| ⇩ |
| (4) Data analysis: Content analysis of the elements in step (3) |
| ⇩ |
| (5) Summation of relations in content codes |
| ⇩ |
| (6) Construction of the hierarchical value map (HVM) |
| ⇩ |
| (7) HVM interpretation |

Figure 1. Laddering Technique Flow Process

Pre-Test

The practice of pretesting is highly regarded as an effective technique for improving validity in qualitative data collection procedures and the interpretation of findings (Bowden et al., 2002). For this study, a pretest was done to 5 people.

Pretesting can also provide advance warning about how or why a main research project would not achieve its objective. Therefore, this pretest involves administering the interview to the group of individual that has characteristics with the target study population.

Sample Selection and Data Collection

Candidates for this study were selected through personal contacts. During the recruitment, candidates were presented with the objectives of the study, duration of the interview, and the general procedure of the study. Moreover, candidates need to serve criteria of owning a house in Jakarta area—in order to increase the validity of the data obtained. As a general rule, a minimum of 20 respondents were included in a study with laddering technique (Abrafi Saaka, Blake, & Hughes, 2004).

Research Instrument

Open-ended question guidelines were constructed in order to guide the interviews to be able to obtain information from the respondents in a form of three levels A-C-V chains in accordance to Means-End Chain Theory.

Data Analysis and Expected Results

Content analysis from interview was performed by grouping the rough data from the interviews in a representation of attribute concepts (concrete and abstract), consequences (functional and psychological), and values. This was done through scanning, identifying the levels of the means-end chain theory. Moreover, from each element, a key sentence that best presented the elements was identified as the representative element as a way to provide a clearer data by limiting the numbers of element in next step of data processing (Leão & Mello, 2007).

The succession of data processing and analysis led to the construction of hierarchical value map (HVM). The purpose of mapping the hierarchical relations is to interconnect all significant chains in a manner that is easy to read and interpret (Reynolds & Gutman, 1988). The software LadderUX was selected to design the HVM from the ladders. The cut-off level for the HVM is in the range between 2-4 (Abrafi Saaka et al., 2004).

Data Validation Methodology

Triangulation methodology was used in assessing the validity of the data obtained in this research—specifically, theory triangulation was used in this study. Theory triangulation uses theories to analyze and confirm data. With this type of triangulation, different theories would assist researcher in supporting data and findings (Carter, Bryant-Lukosius, DiCenso, Blythe, & Neville, 2014).

The essence of qualitative research is to make sense of recognize patterns among words in order to construct a meaningful picture without compromising its richness and dimensionality (Leung, 2015). Given the very broad and diverse scope of qualitative research, there is no consensus for assessing any piece of qualitative research work. However, Leung (2015) also stated that there is a leading school of thoughts in assessing the qualitative research, which emphasizes on methodology. Therefore, Dixon-Woods et al. produced a checklist for assessing the validity and reliability for qualitative data. Validity in qualitative research means "appropriateness of the tools, process, and data. Below are the checklists for a valid qualitative research in accordance to publications by Leung (2015); Sousa, D (2014); and Creswell et al. (2010):

- Validity 1: Appropriateness of the research question for the desired outcome

As stated in chapter 1, the research question and study objectives of this study are aligned with the goal of identifying and understanding how the product attributes relate to the customer's value towards the solar PV system product.

- Validity 2: Trustworthiness of the methodology
  Means-end chain theory and laddering techniques are essentially tied up together as complimentary methodology, which the end results confirms that it answered the objective because it provides an apparent results on customer's logical reasoning behind a purchasing decision with a theoretical basis.

- Validity 3: The design is valid for the methodology
  The execution of this study design is confirmed to be in accordance with the rules of the interview should be one and one interview with open-ended questions and dive to an in-depth interview.

- Validity 4: Data analysis is appropriate for the methodology
  Firstly, by using the LadderUX software that was specially designed to analyze laddering techniques data, it proves that the data analysis tool is confirmed to be appropriate. Moreover, a cut-off level of 2 was also determined to strengthen the data as well as literature reviews were also taken into account in elaborating the data results.

- Validity 5: Results coherence
  The validation data from qualitative research is directly related to the interpretation of the results, and these are considered to be reliable when they are supported by previous studies, literature reviews, or theoretical basis.

- Validity 6: Application of the results
  The applicability of results is also important criteria in assessment of validity of qualitative research. This study provides a clear and coherent application to construct a marketing strategy basis for SolarKita.

Comparative Analysis of Values and Product Attributes

Customer's Value - There are several views about the definition of customer's value. According to Zeithaml (1988), value is the customer's assessment of a product utility based on perceptions of what is given and what is received. Whereas, Butz and Goodstein (1996) stated that customer's value is the emotional bond established between customer and producer from a product or services and found the product to provide an added value. Moreover, in 1997, Woodruff upgraded the definition of customer's value and became the most cited interpretations of customer's value. Woodruff defines customer's value as a customer perceived preference for an evaluation of a product's attributes, performances, and consequences from that use that facilitate achieving customer's goals and purposes.

Importance in Marketing - According to Vinson et al. (2014), knowledge of customer's value has a potentially significant impact on all aspects of a product's marketing program. Some of the most favorable avenues for laddering technique application include market analysis and segmentation, product planning, promotional strategy, and public policy and society. Customer's value orientation knowledge provides an efficient, measurable set of variables that closely related to the needs that expand the knowledge beyond demographic and psychographic differences.

Moreover, value provides a basis for product positioning by designing products with the attributes that are connected to the values (Simova, 2009). It is also stated that values appear to be connected to the importance of product attributes—this suggests that value-based promotional strategy that creates and reinforces a preference by appealing to centrally held values could be highly effective. Furthermore, the appeal to closely hold personal value might have the effect of making customers even more aware of product attributes which previously may not have been considered salient or of awareness may not have existed.

A publication by (Anderson, 1998) in Harvard Business Review also mentioned that by having the understanding of the customers' personal value, one could use those data to inform and guide their own decision making as well as to create persuasive sales tools. Moreover, value assessment can also become a service that one offers as a part of a consultative selling approach

Literature Review: Laddering Technique - Laddering technique is a way to gather information that defines cognitive categories. The term "laddering" refers to a set of questions that aims to know the causes of each statement a respondent gives. Laddering technique is used in consumer research to elicit customer's preferences towards certain products or services based on the *means-end chain theory.* In this sense, laddering technique would help SolarKita in preparing its strategy for the market launch. Moreover, this method is selected because the interview served with open-ended questions that let the respondent's imagination and value express itself. In this costumer-oriented market, it creates a significant benefit by paying attention to the customer. Understanding customer could significantly decrease the risk

of a mistargeted marketing strategy (Saaka, Sidon, & Blake, 2004). Below are the advantages of using laddering techniques:

1. Hierarchical value map (HVM) as the end-results give apparent results on customer's segmentation. The resulting segments are different from the ones that resulted from using demographic or socioeconomic variables (Saaka et al., 2004).

2. Laddering technique can identify the positive and negative association of the product in terms of customer's preferences. Compared to questionnaire surveys, laddering provides an exploration and deeper analysis on respondent's view of products (Saaka et al., 2004).

3. Laddering technique gives awareness of what attributes are more important to customers and what value the company can reinforce to the customers. From that, laddering can help marketers determine how their advertising and marketing campaign would be significantly more effective (Saaka et al., 2004).

On the other hand, the laddering technique also possesses some challenges. The most apparent challenges hindering the proper use of the laddering technique are:

1. Laddering technique is time-consuming. The interview requires repetitive questions and the interviewee might lose patience in answering them (Woodruff and Gardial, 1996). Thus, in conducting this study, the researcher needs to clearly state the study objective and clarify its expected length of interview time.

2. Laddering technique might serve some artificial set of answers, some respondents want to appear intelligent and respectable. Moreover, some respondents might not feel comfortable in talking at the level of personal values (Botschen et al., 1999). Thus, in conducting this study, the researcher needs to assure confidentiality and anonymity of the respondents.

Literature Review: Means-End Chain (MEC) Theory - Means-end chain (MEC) theory was conceived to supply a theoretical structure capable of linking customer's values to their behaviors based on the adaptation of Hinkle's laddering method (1965). As laddering technique is a suitable method to bring out people's goals and values, the MEC theory is a good frame to reach the purpose of laddering technique since it has a systematic and hierarchical order to be followed (Vinson et al., 2014).

Gutman (1982) defines MEC as,

"Means are objects (products) or activities in which people engage (running, reading). Ends are valued states of being such as happiness, security, and accomplishment. A means-end chain is a model that seeks to explain how a product or service selection facilitates the achievement of desired end states" (p. 60)

According to Gutman (1982), there are four assumptions that support MEC theory. First, personal values defined as final desired states of existence play a dominant role in directing individual's choice. Second, potential means of satisfying needs and values. Third, all people actions have consequences. Fourth, people learn to associate a particular consequence with particular actions. Therefore, from the people's point of view, it is not the product attributes that in fact matter, but the problem solution is coming from the consequences of personal values. Therefore, the MEC model revolves around why and how products are important in an individual's life, going beyond the understanding of their functional properties

MEC sequentially links product attributes (A) to consequences of product use (C) and to individuals' personal value (V)—an A-C-V sequence form is called the means-end chain

or a ladder (Gutman, 1982). Attributes are features or aspects of products or services (Vallette-Florence & Rapacchi, 1991). The chainset formed from various ladders is then represented on a Hierarchical Value Map (HVM), which indicates the relationship of all the attributes, consequences, and personal values relative to a product.

Moreover, Olson and Reynolds (1983) then proposed a broadening of the ladder chain by subdividing the attributes, consequences, and values on Gutman's (1982) model. Below is the explanation of the modified chain:

1. **Attributes (A),** subdivided into concrete and abstract attributes.
   a. Concrete attributes are defined as the apparent perceptible physical characteristics of a product—such as a price, color, and weight (Vriens & Hofstede, 2000).
   b. Abstract attributes are defined as a relatively intangible property of a product—such as style, brand, or perceived value (Botschen et al., 1999).
2. **Consequences (C),** subdivided into functional and psychological consequences.
   a. Functional consequences act directly on the customer's from the time of the product is used or consumed—such as ease-of-use, comfort, convenience.
   b. Psychological consequences are the results of functional consequences, such as when the product use produces a sophisticated image or status convenience.
3. **Values (V),** subdivided into terminal and instrumental values.
   a. Terminal values represent the final states of existence—such as peace, self-achievement, and prosperity.
   b. Instrumental values are ways of living that lead to terminal values—such as ambition and resourcefulness that

might be necessary for achieving prosperity.

About SolarKita

SolarKita was established in 2017 with a mission to enforce the utilization of residential solar cell (PV system) in Indonesia. SolarKita is based in Indonesia—specifically in Cilandak, Jakarta. The company's core values are to (1) always put customers first, (2) provides high-quality product and service, and (3) be involved in community development.

SolarKita provides solar cell (PV system) installation for residential level as the main product. Other than that, SolarKita also provides consultation for the solar panel design (pre-installation) and performance maintenance (post-installation). However, this study is focusing on the product attributes of the solar cell (PV system) installation.

Solar Cell (PV System)

Overview of How Solar Cell (PV System) Works - Converting solar energy into electrical energy by photovoltaic installations is the most recognized way of using solar energy. Photovoltaic system was first discovered in 1839 by Alexandre-Edmond Becquerel. In general, a photovoltaic system is able to supply electric energy to given load by directly converting solar energy through the photovoltaic effect where light is absorbed causing excitation of an electron or another charge carrier to a higher-energy state. The array of a photovoltaic system produces direct current (DC) power which fluctuates with the sunlight's intensity. In general usage, DC requires to be converted to alternating current (AC) through the use of inverters. Therefore, the system starts from the solar cells that are connected to the modules, which are wired together to form arrays. The modules then tied to an inverter, which produces power at the desired voltage and currents.
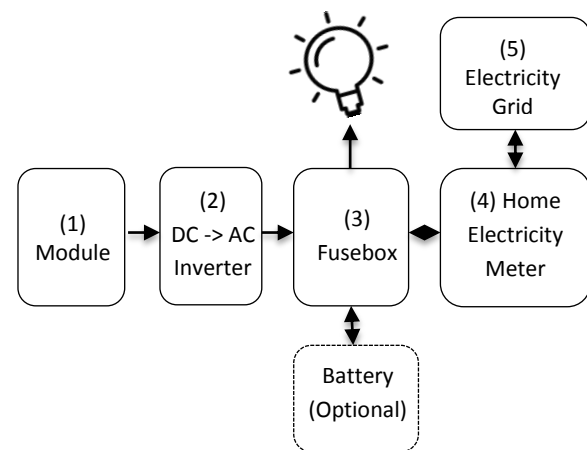

Figure 2. Diagram of Solar Cell (PV System)

Advantages and Disadvantages

Utilization of solar power for electricity has been widely known to have a lot of advantages in the environment and personal level. Below is the discussion of some advantages of solar power system installation:

1. Reduce environmental pollution—research by (Kalogirou, 2004) stated that utilization of solar energy helps in saving considerable amounts of greenhouse polluting gases. Moreover, renewable energy also improves public health. Coal and natural gas plants produce water and air pollution that is harmful to human health.
2. Increase property value—a study by Lawrence Berkley Laboratory (2011) found that homes with solar panel installation have the benefit to a premium price when it is sold because of the buyer's willingness to pay more for a home with solar panels.
3. Reduce monthly electricity bills and saves money—the average 20-year savings for Americans who went solar in 2011 were projected to be over $20,000. In Hawaii alone, with its sunny weather, the projected savings were nearly $65,000 (Shahan, 2013).

On the other hand, solar power system installation also possesses some disadvantages. Fortunately, solar power disadvantages are actually not so plentiful. One apparent disadvantage of solar power utilization is that the sun does not shine 24 hours a day. Moreover, the solar power system may be fluctuating due to the cloud shades. In other words, currently, it is unlikely to have 100% power source from the sun (Shahan, 2013).

Grid-Tied Solar Cell (PV System)

Renewable energy around the world was boosted in 2016 and delivered at a markedly lower cost due to the enhanced industrialization, growing population, and improvement of living standard of people in a global level (Pandey, Tyagi, Selvaraj, Rahim, & Tyagi, 2016). According to Global Status Report 2017 from Renewable Energy Policy Network for 21st Century stated that solar PV is now considered a cost-competitive source of new generation in many emerging markets across the world. The lower price in solar PV system and the shorter payback period making more people will go for solar energy, which allows for residential solar PV installation possible. In 2016, solar PV system installation increased 48% in a year which resulting in a competitive market.

There have been an impressive efforts from the scientific field to seek to improve the performance of solar PV systems. The advances in the grid-tied system for solar PV allows the solar PV installation way more affordable rather than using battery storages that are expensive and has a short shelf-life (Pandey et al., 2016). Grid-tied system installation is a much simpler set-up than off grid. In a grid-tied system, the power generated goes straight to the home's utility meter. Whereas, there are a few more steps in off-grid installation and requires much more investment in batteries and maintenance. With a grid-tied system, it does not require expensive battery storage, any excess power generated from the solar cells goes back into the grid—helping in reducing carbon footprint (Greenhalgh, 2010).

In Indonesia, the government is also supporting the installation of grid-tied solar PV as stated in *Peraturan Direksi PT. PLN (Persero) No. 0733.K/DIR/2013 tentang Pemanfaatan Energi Listrik dari Fotovoltaik oleh Pelanggan PT. PLN (Persero)* and *Surat Edaran Direksi PT. PLN (Persero) No. 0009.E/DIR/2014 tentang Ketentuan Operasional Integrasi Fotovoltaik Milik Pelanggan ke Dalam Area Sistem Tenaga Listrik PT. PLN (Persero)*. The government supports export-import net-metering where PLN obligated to basically "credit" energy produced by the solar PV system to a customer's account. Therefore, it is a service where the electric consumer can generate their own electricity from eligible on-site facilities and can supply back the excess energy to distribution line to be used by other electric consumers and getting their monthly bill reduced in exchange.

RESULTS
Pre-Test Results and Validity

A total of 4 interviews were conducted with home-owners in the Jakarta area. The results showed that the instrument and methodology were able to achieve the objective of this study indicated by achieving the A-C-V ladder. Moreover, referring to *section 3.1*, this study has fulfilled all the criteria of a valid and reliable study. Furthermore, second and third opinions were also asked to assess the validity and reliability of the instrument and methodology. As a result, the instrument and methodology were considered as a valid and reliable. Therefore, the study was continued for the bigger target population.

Interview Results

A total of 20 interviews were conducted with home-owners in the Jakarta area, of which 33 A-V-C ladders were constructed. This leaves a total of 116 data points. The following table contains the profile of the sample of potential customers.

Domicile	Qty	Percentage
Central Jakarta	4	20%
South Jakarta	5	25%
East Jakarta	4	20%
North Jakarta	4	20%
West Jakarta	3	15%

Table 1. Summary Table of Sample Potential Customers Domicile

Content Codes

The laddering interviews revolve around the mental network of associations that the potential customers do in his/her mind when thinking about buying solar PV system. Once again, the theory underpinning this approach is the Means-Ends Chain Theory (MEC Theory) and the end result of a Hierarchical Value Map (HVM) was constructed from total 34 ladders.

Table 2 provides the summary of content codes from the study.

Attributes	Consequences	Values
Concrete Attributes	**Functional Consequences:**	(15) Self-esteem
(1) Converting sunlight into electricity	(8) Environmentally friendly	(16) Social-recognition
(2) Spacious	(9) Increase property value	(17) Self-satisfaction
(3) Highly durable	(10) Worthy long-term investment	
(4) Silent operation	(11) Save more money	
Abstract Attributes:	**Psycho-social Consequences:**	
(5) Easy monitoring	(12) Convenience	
(6) Supported by government policy	(13) Beneficial for the country	
(7) Pricy	Prestige	

Table 2. Summary Table of Interview Content Codes

Implication Matrix and Hierarchical Value Map (HVM)

The cut-off level for the HVM construction for this study is 2, that is to say only the links between categories that are at least listed two times are taken into account based on the implication matrix (Table 2). The implication matrix displays the number of times each element leads to another element both direct and indirect relations.

Implication Matrix

	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16	17	sum
01 Converting sunlight into electricity			1|0					13|0	0|2	0|4				0|4	0|4	0|1	0|10	14|25
02 Spacious								1|0	0|1					0|1	0|1			1|3
03 Highly durable								1|1		4|1	0|1				0|2		0|2	5|7
04 Silent operation												1|0					0|1	1|1
05 Easy monitoring									0|1			3|0			1|0		1|1	5|2
06 Supported by government policy								1|0	2|1	0|2	1|0			0|1	0|1		0|3	4|8
07 Pricy									1|0					1|1		0|2		2|3
08 Environmental friendly									4|0	2|1				4|1	0|4	0|1	5|6	15|13
09 Increase property value										2|2	1|0			2|0	1|4		3|1	9|7
10 Worthy long-term investment											2|0	1|0		2|0	3|0	0|1	5|1	13|2
11 Save more money															0|1		0|1	0|2
12 Convenience																	1|1	1|1
13 Beneficial for the country																	2|0	2|0
14 Prestige															1|0	3|0	3|1	7|1
15 Self-esteem																	2|0	2|0
16 Social-recognition																		
17 Self-satisfaction																		
sum			1|0					15|0	7|5	9|11	4|1	5|0		9|8	6|17	3|5	22|28	sum

Table 3. Implication Matrix
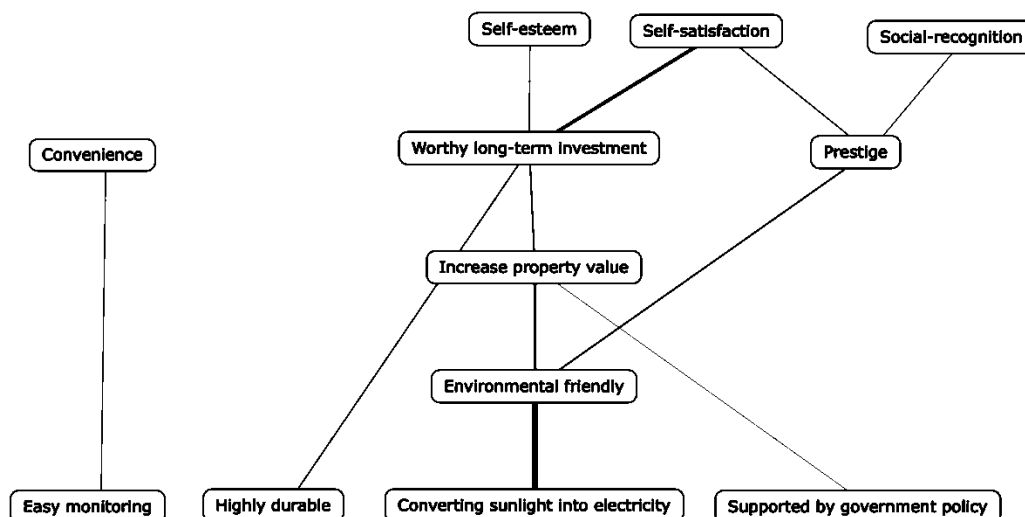
Hierarchical Value Map (HVM)

Figure 3. Hierarchical Value Map (HVM) for Solar PV System Product

RESULTS AND DISCUSSIONS

According to the results summarized in *Table 3,* by installing solar PV system in their houses, the main ends are (1) gaining **"self-esteem"**, (2)**"self-satisfaction"**, and (3)**"social-recognition"**.

Out of 20 interviews, 14 potential customers are interested in installing solar PV system in their house based on the product feature or attribute of **"converting sunlight into electricity"**. This means that the majority of the potential customers think that this functional attribute plays an important role in their buying decisions. Thus, **"converting sunlight into electricity"** is the main attribute for the solar PV system and the base of the hierarchical value map (HVM).

According to the implication matrix, the link between attribute **"converting sunlight into electricity"** and the consequence **"environmentally friendly"** is very strong as seen in *Table 3* with the darkest blue color, which means that this logical reasoning has been evoked many times during the interviews (13 data points). The fact that the solar PV system works by converting sunlight into electricity is important to the potential customers because it means that they are **"environmentally friendly"** by reducing

pollution and also minimizing their carbon footprints. This consequence leads to the main ladder of the HVM as shown in *Figure 5* The main ladder of the HVM is the A-V-C chain with the strongest relations
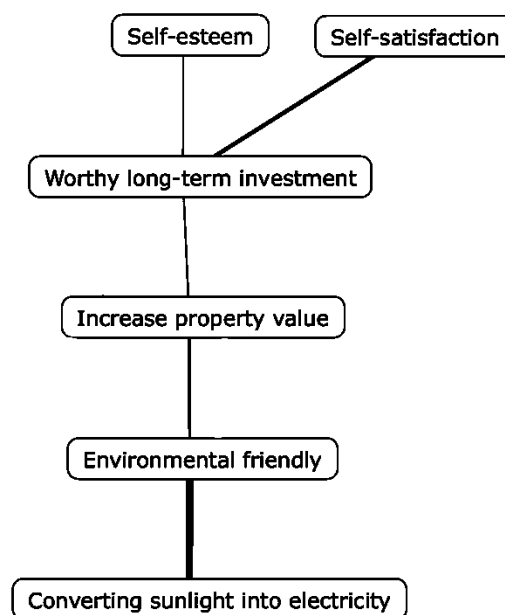

Figure 5. Main Ladder of HVM for Solar PV System Product

Linked from **"environmentally friendly"** consequence leads to two other consequences. The first relation is to the **"increase property value"** with 4 direct

relations, which continues the main ladder of the HVM. This result is consistent with a study by Lawrence Berkeley National Laboratory (LBL) (2011), which stated that the solar PV system adds more value to a home. The study concluded that homes with solar PV system would benefit from a *"solar premium"* when they are resold, which means that homes with solar PV system would likely to be resold in significantly higher price. An essential logical structure in here is to consider that **"increase property value"** is important to determine a **"worthy long-term investment"** with two direct and indirect relations, which aligned with the fact that a homeowner can benefits both economically and environmentally from the solar PV system installation in the long-term. In this case, potential customers also emphasize that it is more than just a financial investment—but also a worthy contribution for the environment by reducing the pollution, carbon footprint, and more environmentally friendly act (investment) that would be beneficial for the earth in the long run.

> *"…..Investing in solar PV system is also investing in our future. Reducing the pollution and going green will be paid back in the future by having a sustainable environment…"* (NJ-4)

Further, **"worthy long-term investment"** strongly ties with the value of **"self-satisfaction"** with 5 direct and 1 indirect relations indicated with slightly darker blue in *Table 3* Other than that, **"worthy long-term investment"** consequence is chosen because of the value of **"self-esteem"** on the potential customers with three direct relations. A study by LBL (2011) also confirmed that getting a solar PV system for a home would give a homeowner a boost of mental quality, which coherent with the end value of **"self-satisfaction"** and **"self-esteem."**

Therefore, from the main ladder, it can be concluded that potential customers think that they would get a solar PV system because of its attribute of **"converting sunlight into electricity"** for their home. By having their home co-powered by sunlight, it leads to the consequence of being **"environmentally friendly".** Moreover, with the world moving towards the renewable energy sources makes solar PV system an attractive product in the market, which the potential customers perceived the product would **"increase the property value"** and would be a **"worthy long-term investment".** Moreover, the end values of **"self-satisfaction"** and **"self-esteem"** are emerged from making a "smart" investment decision for their homes.

> *"…..I do think that if I have this system in my home is an excellent movement from myself to contribute to the earth condition for now and later. I think it would be great if more people are interested in buying this as it is an investment in our future, both financially and environmentally"* (CJ-1)

> *"……nowadays, I believe that environmentally friendly is now an added value in our property since the trends of 'go green' as well as in the increased awareness of our people towards the environment…"* (WJ-2)
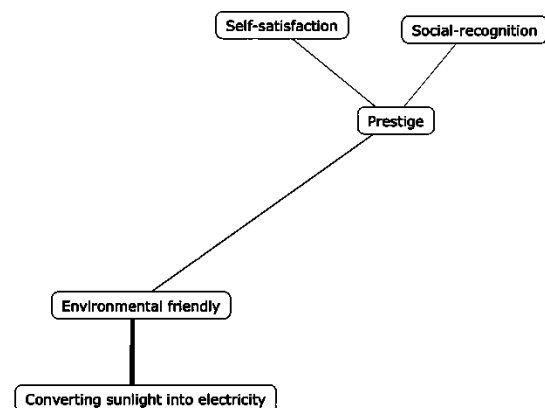

Figure 6. Environmentally Friendly Consequence Branch 2

A secondary link from the **"environmentally friendly"** in the main ladder leads to **"prestige"** consequence (4 direct relations). This link is consistent with writing by VerdeNieto (2011) that there have been positive efforts within sustainability movement to redefine luxury as something that embodies the environmental credentials of a product. This consequence emerged from the other two final values that the potential customers have, which are **"self-satisfaction"** (3 direct relations, one indirect relation) and **"social-recognition"** (3 direct relations). As concerns over environmental issues arise, evidence points to a shift towards a behavior where people favor environmentally friendly goods. This ladder is consistent with a study by Sexton and Sexton (2014) that mentioned that the behavior of being **"environmentally friendly"** conspicuously enough to be a *"prestigious goods"* in exchange for a boost **in "social-recognition".** This result was also supported by Venhoeven et al. (2016) on his study, it is suggested that engagement in environmentally-friendly behavior is related to how people see themselves. Furthermore, Venhoeven's study also mentioned that environmentally friendly behavior was significantly associated with a more positive self-image, more strongly so when people were reminded of behavior—which is consistent with this ladder *(Fig 6)* with the end value of **"social-recognition".** Moreover, people who practice environmentally friendly behavior also experience more happiness and higher satisfaction (Brown and Kasser, 2005; Xiao and Li, 2011), which also consistent with this ladder (*Fig 6*) with the end value of "self-satisfaction"**.**

> *"…….I feel like I'm way cooler than the other people* (on owning a solar PV system), my friends would see me as a better person….." (NJ-1)*
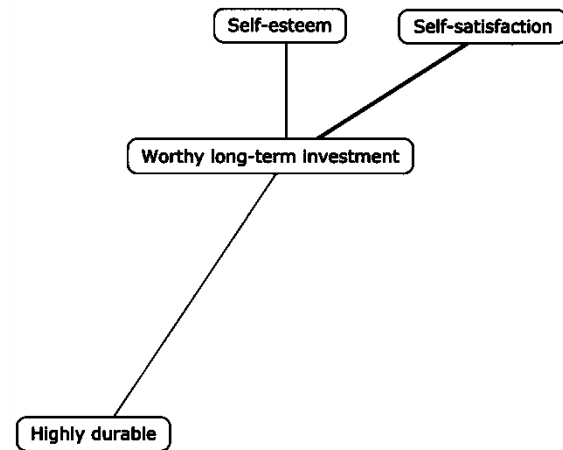

Figure 7. Highly Durable Attribute Ladder

Moving on to the other attribute of **"highly durable",** which found to be the second most important factor in installing a solar PV system with 5 data points recorded. This attribute is linked to the **"worthy long-term investment"** consequence, which joins the main ladder in the HVM with **"self-esteem"** and **"self-satisfaction"** end values. Logically, by purchasing a highly durable product, one could use the product for a long time. Also, a highly durable product means lower maintenance and repair costs in the long run. Moreover, a highly durable product would minimize the depreciation cost in the future. Therefore, **"highly durable"** attribute is linked to the **"worthy long-term investment"** consequence:

> *"…..knowing that solar PV system would function for about 20-25 years interests me to have one, it would be beneficial for me in the long-run. One initial investment in the beginning would be a worthy for long-term…." (CJ-1)*
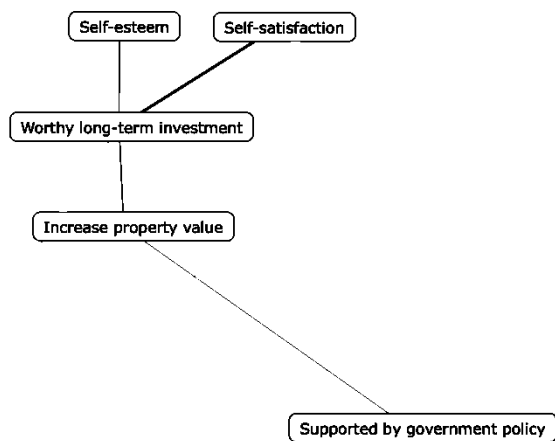
Figure 8. Supported by Government Policy Attribute Ladder

The intangible attribute, or *"abstract attribute"*, of solar PV system of **"supported by government policy"** is linked to the consequence of **"increase property value"**, which links to the main ladder of HVM *(Fig 5)*. The link indicates that the support from government policy would increase their property value. This is supported by a study by Lund (2009), which stated that energy policy could significantly enhance home markets and growing industrial activities.

> *"…….it is a very good thing that the installation for residential solar PV system is supported by the government policy. By being supported means that there will be enforcement of renewable energy and thus it could potentially increase my home values when I wanted to resell it…."* (SJ-2)

Through solar PV system installation in their home, they perceived that it would increase their property value. And thus, it would be a **"worthy long-term investment"** for them and which emerged from the value of **"self-satisfaction"** (5 direct, 1 indirect relations) and **"self-esteem"** (3 direct relations).

> *"……buying a home requires a lot of consideration. […] Knowing that my buying-decisions for our home affecting the property value, especially higher, itself would give me a very considerable*

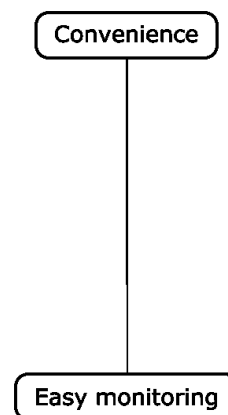*sense of satisfaction for myself"* (NJ-4]

Figure 9. Easy Monitoring Attribute Ladder

Lastly, another intangible attribute is **"easy monitoring"** is also found to be significant with five data points recorded. This attribute has no significant links to any other consequences other than **"convenience"** with three direct links. At the beginning of the interview, all the interviewees are given the same knowledge of SolarKita's solar PV system includes online monitoring via mobile application or website. From the implication matrix *(Table .3)* results showed **that "easy monitoring"** attribute is important for them with 5 data points.

> *"….I think that the online monitoring feature is very important. With that, I can easily monitor how much effectivity and production of the solar PV system. […] it is convenient"* (CJ-3)

CONCLUSION

There were 20 interviews conducted for this study, the results showed that there are seven attributes related to solar PV system *(Table 3).* To answer the first objective of this study—to identify which product attributes that the customers prefer for a solar PV system, therefore a cut-off level of 2 was determined. This cut-off level is chosen to reduce the complexity of the results and increase the clarity of the answers. After the results were run through the software and

presented in an implication matrix with 2 as the cut-off level, there were four attributes that the potential customers prefer for a solar PV system, which includes *(1) converting the sunlight into electricity, (2) supported by the government, (3) highly durable, and (4) easy monitoring.*

Further analyses were conducted to answer the second objective of this study, which to understand how the product attributes relate to the customers' value towards the solar PV system. From the constructed HVM, it is apparent that there is a main ladder *(Fig 5)*, which visualize how the most of the sample of potential customers logical reasoning on why they think they would buy the solar PV system. The main ladder explains that the solar PV system functional attribute that converts sunlight to electricity is important for them in purchasing the product. That attribute is strongly linked with the environmentally friendly consequence, which logically aligned with the fact that the solar PV system would reduce pollution and carbon footprints. Moreover, most of the potential customers also perceived that environmentally friendly benefits from the solar PV system would increase their property value, this is also consistent with the environmentally friendly trends in the market. There is also a very important logical structure to consider that the consequence of increasing property value leads to the other consequence of having a worthy long-term investment, which aligned with the fact that one can benefits both economically and environmentally from the solar PV system in the long run. Furthermore, a worthy long-term investment would give one a boost of mental quality, which coherent with the end value of self-satisfaction and self-esteem in the main ladder.

Some of the potential customers also believe that they will get a sense of prestige from the solar PV system due to its environmentally friendly benefit. The results highlight the important role of the **"environmentally friendly"** consequence of the product, which perceived as prestigious. This affects the potential customers to feel the sense of satisfaction from their purchase of solar PV system. Other than that, the potential customers also believed that it would give them a boost in social-recognition.

Further, the potential customers also consider that the solar PV system is a highly durable product with 20-30 years lifespan—and they do think that is important for them. This attribute is strongly associated with a worthy long-term investment since it means that they would get the benefits from the solar PV system for a quite long time. Moreover, other than in financial terms, the potential customers also think that their investment in a solar PV system would give environmental benefits for them in the long-term. In other words, making worthy long-term investment results in direct consequence-value relations—which are self-satisfaction and an increase in self-esteem. The final values indicate a strictly personal and subjective end from the potential customers.

Last but not least, there is another attribute of easy monitoring, which also found to be significant. This attribute has no significant links to any other consequences other than convenience. It created a logical correlation where online real-time monitoring would significantly create a convenient feel for the user itself because they can see how the electricity production through one-click away on their PC or phone.

Managerial Implications

The results of this study have an interesting implication for the marketing managers in Solar Kita that handles communication or advertising for the solar PV system. Looking at the fact that there are

currently no apparent players in the residential solar PV market in Indonesia, understanding of this study may help the marketing manager of SolarKita to understand the potential market behaviors. According to Reynolds & Olson's book (2001), focusing on the potential customers' behaviors rather than the conventional market research may seem a minor subtle point, but it has important ramifications for the marketing managers. This study could help value-based promotional strategy that creates and reinforces a preference by appealing to centrally held values, which proven could be highly effective. The consequence level would give information on solar PV system's positioning. In this sense, the most apparent consequence that leads to the end value in this study is being environmentally friendly. Therefore, it is suggested for SolarKita to employ "Green Marketing" to address the apparent environmentally friendly consequence that emerged from the study.

As explained by Polosky (1994),

"*Green Marketing consisted of all activities designed to generate any exchanges intended to satisfy human needs or wants, such that the satisfaction of these needs occurs, from no or less detrimental impact on the environment.*"

This Green Marketing possesses a great opportunity for SolarKita, as also stated by Murphy (2003) that some researchers also have called green markets as the "next big thing" in upcoming years. Moreover, also supported by Sharma et al. (2008) that environmentally friendly business strategies could leverage a superior financial performance as well as gaining competitive advantage in the market.

Moreover, another salient attribute is that the solar PV system has the support from the government policy in Indonesia. Therefore, SolarKita could also leverage this by enforcing the fact that this product has the government support in the marketing activity. This is supported by Chang & Kristiansen (2006) that the Australian government once tried to use the term "clean and green" and shows significant support for agricultural products. The study confirmed that these claims are valid and effective in the marketing of the products. Therefore, SolarKita could also create its brand reputation and positioning by enforcing this attribute.

Further, the value level may be useful to devise a better communication strategy (Peter et al., 1999). From the study, it is apparent that the end values of this HVM are: (1) self-esteem, (2) self-satisfaction, and (3) social-recognition. In this sense, the communication strategy for SolarKita to market the solar PV system is suggested to be something that involves a "YOU view", which touches the personal level of the potential customer. For example, by enforcing an important role of the potential customers in supporting the environment by purchasing the solar PV system.

Furthermore, a study also stated that purchasing something that environmentally friendly make one see oneself as someone who acts "green" and thus boosting one's self-image, and therefore feeling good and satisfied (Venhoeven, Bolderdijk, & Steg, 2016). Moreover, this strategy is also aligned with SolarKita's core values to thrive for better Indonesia by providing solar PV system (Appendix C1). Therefore, by having this strategy implemented, it is expected that more people would realize much more proactive action is necessary for the earth. In the end, this strategy would be a simultaneous process that could provide insight into how to motivate people to engage in pro-environmental actions more often, while keeping them personally happy and satisfied at the same time.

Future Research Direction

Future direction of this research is to consider another variables of cultural differences in each location to also confirm further optimization of this methodology. The business environment changes in response to the continued dynamic market as there appears to be entering a more diverse set of market (Wolf, 2000), especially for Indonesia with a significantly wide archipelago and cultural differences. Therefore, in order for SolarKita to be able to achieve the long-term target of expanding target market for Indonesia-wide, there is a need to understand market characteristics on each location with different cultures. According to Markus and Kitayama (1991), cultural differences remain an important aspect in marketing because cultural norms and beliefs are powerful forces shaping people's perceptions, dispositions, and behaviors. Therefore, it is suggested for further study in different places in Indonesia with different cultures to see how the marketing strategy on each location would be effectively implemented.

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