UNIVERSITI PUTRA MALAYSIA

PUBLIC ACCEPTANCE OF NATIONAL RENEWABLE ENERGY POLICY AMONG LANDED RESIDENTS IN PENINSULAR MALAYSIA

FATIMAH AZZAHRAA' BINTI MOHD SOBRI

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By

FATIMAH AZZAHRAA' BINTI MOHD SOBRI

Thesis Submitted to the School of Graduate Studies, Universiti Putra Malaysia, in Fulfilment of the Requirements for the Degree of Doctor of Philosophy

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Chair : Mariani binti Ho Nyuk Onn @ Ariffin, PhD
Faculty : Forestry and Environment

Policy goals for sustainable energy will be hampered without sufficient public acceptance. While there is a growing body of literature on public acceptance of solar energy, most studies tend to investigate public acceptance of new technology, not on the policies constructed to help the successful deployment of the technology. This research was conducted to identify public acceptance of solar-related items of the National Renewable Energy Policy among landed residents in Peninsular Malaysia and key factors contributing to the acceptance. The theoretical framework underlying this research follows Stern's Attitude-Behaviour-Context (ABC) framework that integrates attitudinal, contextual, and personal capability factors in one framework that is both comprehensive and feasible to undertake. These are personal norm, environmental concern, economic, social, roof position, certain socio-demographic factors, and home ownership. The study extends the ABC framework by proposing solar policy acceptance role as an antecedent to intention to adopt and information provision to increases policy acceptance. A survey design and an experimental design was conducted to achieve the research objectives. For the survey design, questionnaires with a 5-point Likert scale were distributed via multistage cluster systematic sampling to landed residents in Peninsular Malaysia (N=508) and analysed both descriptively and inferentially using Statistical Package for Social Science (SPSS) and Partial Least Square Structural Equation Modelling (PLS-SEM). The experimental design follows the Solomon Four Group Design where the data from four groups were analysed using a string of t-test analysis. The structural model analysis provides evidence of moderate model fit with $R^2 = 0.44$ for policy acceptance and significant path relations for attitudinal variable ($\beta = 0.342$) and contextual variable ($\beta = 0.442$) to policy acceptance. Several main findings that emerged were contextual factors, especially economic factors, prove more important than other factors and can be the focus for future solar policy decision-making. Another finding is the proof that policy acceptance (passive behaviour) can act as an antecedent to intention to adopt solar PV (active behaviour) at homes which shows the importance of the public to accept

the National Renewable Energy Policy. Another conclusion was that policy information that is simple and appealing to the public can boost policy acceptance. Policy makers need to be aware that although both attitudinal and contextual factors are important for acceptance, certain contextual factors may carry more weight as a determinant for solar policy acceptance. The research is significant in extending the policy acceptance model by identifying unique variables to solar policy acceptance and the extension of intention to adopt solar PV after policy acceptance. It also provides more literature on the controversial Knowledge Deficit Model on the way information of the policy can be conveyed to affect solar policy acceptance. Lastly, the findings provide recent and essential data of the current acceptance and factors that interest the public so that policy makers can make informed decisions for future policy improvements.

Abstrak tesis yang dikemukakan kepada Senat Universiti Putra Malaysia sebagai memenuhi keperluan untuk ijazah Doktor Falsafah

PENERIMAAN AWAM TERHADAP DASAR TENAGA BOLEH DIPERBAHARUI NEGARA DALAM KALANGAN PENDUDUK DI SEMENANJUNG MALAYSIA

Oleh

FATIMAH AZZAHRAA' BINTI MOHD SOBRI

April 2022

Pengerusi : Mariani binti Ho Nyuk Onn @ Ariffin, PhD
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Matlamat dasar untuk tenaga lestari akan terhalang tanpa penerimaan awam yang mencukupi. Walaupun terdapat semakin banyak literatur mengenai penerimaan tenaga suria oleh orang ramai, kebanyakan kajian cenderung untuk menyiasat penerimaan awam terhadap teknologi baharu, bukan pada dasar yang dibina untuk membantu penggunaan teknologi yang berjaya. Penyelidikan ini dijalankan untuk mengenal pasti penerimaan awam terhadap perkara berkaitan solar Dasar Tenaga Diperbaharui Negara dalam kalangan penduduk di Semenanjung Malaysia dan faktor utama yang menyumbang kepada penerimaan tersebut. Rangka kerja teori yang mendasari penyelidikan ini mengikuti rangka kerja Sikap- Tingkah Laku-Konteks (ABC) Stern yang menyepadukan faktor keupayaan sikap, kontekstual dan peribadi dalam satu rangka kerja yang komprehensif dan boleh dilaksanakan. Ini adalah norma peribadi, kebimbangan alam sekitar, ekonomi, sosial, kedudukan bumbung, faktor sosio-demografi tertentu, dan pemilikan rumah. Kajian ini memanjangkan rangka kerja ABC dengan mencadangkan peranan penerimaan dasar solar sebagai anteseden kepada niat untuk menerima pakai dan penyediaan maklumat untuk meningkatkan penerimaan dasar. Reka bentuk tinjauan dan reka bentuk eksperimen telah dijalankan untuk mencapai objektif kajian. Bagi reka bentuk tinjauan, soal selidik dengan skala Likert 5 mata telah diedarkan melalui persampelan sistematik kluster berbilang peringkat kepada penduduk darat di Semenanjung Malaysia (N=508) dan dianalisis secara deskriptif dan inferensi menggunakan perisian Statistical Package for Social Science (SPSS) dan Partial Least Square Structural Equation Modelling (PLS-SEM). Reka bentuk eksperimen mengikut Reka Bentuk Kumpulan Empat Solomon di mana data daripada empat kumpulan dianalisis menggunakan rentetan analisis ujian-t. Analisis model struktur menyediakan bukti kesesuaian model sederhana dengan R2 = 0.44 untuk penerimaan dasar dan hubungan laluan yang signifikan

untuk pembolehubah sikap (β= 0.342) dan pembolehubah kontekstual (β=0.442) kepada penerimaan dasar. Beberapa penemuan utama yang muncul ialah faktor kontekstual, terutamanya faktor ekonomi, terbukti lebih penting daripada faktor lain dan boleh menjadi tumpuan untuk membuat keputusan dasar solar masa hadapan. Penemuan lain ialah bukti bahawa penerimaan dasar (tingkah laku pasif) boleh bertindak sebagai anteseden kepada niat untuk mengamalkan PV solar (tingkah laku aktif) di rumah yang menunjukkan kepentingan orang ramai menerima Dasar Tenaga Diperbaharui Negara. Kesimpulan lain ialah maklumat dasar yang mudah dan menarik kepada orang ramai boleh meningkatkan penerimaan dasar. Pembuat dasar perlu sedar bahawa walaupun kedua-dua faktor sikap dan konteks adalah penting untuk penerimaan, faktor kontekstual tertentu mungkin membawa lebih berat sebagai penentu untuk penerimaan dasar solar. Penyelidikan ini penting dalam memanjangkan model penerimaan dasar dengan mengenal pasti pembolehubah unik kepada penerimaan dasar solar dan lanjutan niat untuk menerima pakai PV solar selepas penerimaan dasar. Ia juga menyediakan lebih banyak literatur tentang Model Defisit Pengetahuan yang kontroversi tentang cara maklumat dasar boleh disampaikan untuk mempengaruhi penerimaan dasar solar. Akhir sekali, penemuan ini menyediakan data terkini dan penting tentang penerimaan semasa dan faktor yang menarik minat orang ramai supaya pembuat dasar boleh membuat keputusan termaklum untuk penambahbaikan dasar pada masa hadapan.

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Sincerely, Thank you all!

This thesis was submitted to the Senate of Universiti Putra Malaysia and has been accepted as fulfilment of the requirement for the degree of Doctor of Philosophy.The members of the Supervisory Committee were as follows:

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Date: 13 October 2022

Declaration by Graduate Student

I hereby confirm that:

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LIST OF ABBREVIATIONS

α	Alpha
β	Beta
%	Percentage
°C	Degree Celsius
AVE	Average Variance Extracted
CFA	Confirmatory factor analysis
CO2	Carbon dioxide
EC	Environmental concern
EE	Energy Efficiency
FiT	Feed-in-Tariff
GHG	Greenhouse gases
GoF	Goodness of Fit
GoM	Government of Malaysia
GW	Gigawatt
kWh	Kilowatt hour
LCOE	Levelized cost of energy
MW	Megawatt
NREP	National Renewable Energy Policy
NIC	Newly industrialised countries
NEM	Net energy metering
PLS	Partial Least Square
PN	Personal norm
PV	Photovoltaic
ROI	Return of investment

r	Correlation
R2	Determination of coefficient
RE	Renewable energy
ROI	Return of Investment
s.d	Standard deviation
SD	Socio-demographic
SDG	Sustainable Development Goals
SEDA	Sustainable Energy Development Authority
SEM	Structural Equation Modelling
SRMR	Standardized Root Mean Square Residual
TNB	Tenaga Nasional Berhad

CHAPTER 1

INTRODUCTION

1.1 Introduction

Renewable energy (RE) policies have proven to be an effective method for successful RE deployment (Liu et al., 2020; Zverinova Iva et al., 2013). Despite numerous policies, Malaysian RE deployment has been limited, particularly individual RE uptake. Among the RE available, Malaysia has a high potential for harnessing solar energy due to the country's strategic geographical location (Ab Kadir et al., 2010; Bellini, 2019; Islam & Meade, 2013; Muzathik, 2013). The nation's Renewable Energy Transition Roadmap (RETR) 2035 provides a strategic roadmap to achieve the present Government's goal of reaching a 20% renewable energy mix in installed capacity by 2025 (excluding large hydro of more than 100MW installed). Additionally, the Malaysian Government has revised the RE target of 20 % to 31 % RE share in the electricity generation mix by 2025, and 35 % by 2035 (Hin & Chiah, 2021) which is quite an ambitious target. This research intends to provide insights on the current acceptance level as well as factors that contribute to the acceptance of National Renewable Energy Policy (NREP) in Malaysia and how information provision might contribute to better acceptance of policies.

Section 1.2 explores the research's background, while section 1.3 provides the scope and limitation of the research. Section 1.4 identifies the research problem. In addition, section 1.5 addresses the research questions, while section 1.6 details the research objectives. Finally, section 1.7 explains the significance of the study and section 1.8 defines the operational definition used in the research. The chapter ends with the chapter summary in section 1.9.

1.2 Background of Study

Based on the newly released International Energy Outlook 2019 reference scenario, the US Energy Information Administration (EIA) predicts an approximately 50% rise in worldwide energy use between 2018 and 2050 due to industrialisation and urbanisation. The majority of this growth is centred in areas with strong economic growth, primarily in Asia (IEO, 2019). Energy consumption in the building sector, which includes residential and commercial structures, would increase by 65 % between 2018 and 2050, from 26.67 trillion to 47.03 trillion kWh (IEA, 2021). Residential energy usage rises in tandem with rising living standards, resulting in increased demand for appliances and personal items. Carbon dioxide emissions are predicted to increase proportionally due to this increase and have been linked to environmental degradation. Energy-related CO^2 emissions currently account for two-thirds of all

greenhouse gas (GHG) emissions (IEO, 2019). Thus, a transition away from fossil fuels towards more low-carbon alternatives is essential.

The United Nations' Sustainable Development Goals (SDGs) established a robust foundation for international collaboration to ensure the planet's long-term survival. The 17 Sustainable Development Goals (SDGs) and associated 169 targets are at the core of "Agenda 2030," setting a course to end extreme poverty, fight inequality and injustice, and protect the environment. The achievement of Agenda 2030 depends on the use of sustainable energy. SDG 7 focuses on three major goals: guaranteeing affordable, dependable, and universal access to modern energy services, increasing the percentage of renewable energy in the global energy mix and doubling the rate of energy efficiency improvement around the world (UN, 2015). Previous research on future energy routes indicated that it is technically possible to improve energy availability, air quality, and energy security while avoiding severe climate change (see works by IRENA, 2018; Patel, 2014; Sagar, 2021; Tyagi et al., 2013). In fact, a range of resource, technological, and policy combinations capable of achieving these aims have been discovered (Riahi et al., 2012). In this context, many national decarbonisation policies include developing renewable energy (RE) resources to fulfil the growing demands of the power sector (Ellabban et al., 2014).

According to the International Energy Outlook (2019), RE resources such as solar, wind, and hydroelectric power will expand at the most significant rate between 2018 and 2050, surpassing petroleum and other liquids to become the most widely used energy source (IEO, 2019). RE resources are abundant, largely untapped, naturally replenished on a human timescale, and less destructive to the environment (Solangi et al., 2011), which helps the government achieve its sustainability goals. Renewable energies or clean energies has already made an impact in many countries throughout the world, particularly in Brazil, certain parts of Afrika, and European Union (Ritchie & Roser, 2020). Due to its enormous economic and environmental potential, it is rapidly gaining traction as a new growth area in other world regions.

The share of renewable energy in the energy mix of respective countries are depicted in Figure 1.1. Norway has the highest percentage of RE generation used for electricity consumption in the World. Brazil also has high percentage of RE in the energy generation mix. This is largely attributed to 77% of its electricity generation derives from hydropower (Karpavicius, 2021). Canada and most countries in the European regions (particularly Norway and Sweden) also show high percentage. These countries also obtain most of the share from hydropower, but are steadily increasing wind energy as their main and focal source (Mundaca & Samahita, 2020; Ritchie & Roser, 2020). Southeast Asia and the Middle East (excluding Sudan) are lagging in RE share where the regions have less than 20% share of RE in electricity generation mix. Among the

countries leading in RE share in Southeast Asia include Laos, Cambodia, and Vietnam. However, the shares in these countries are also largely attributed to hydroelectricity (Erdiwansyah, Mamat, et al., 2019). However, Vietnam has been increasing solar technology adoption through various policy incentives in just the past three years (2019-2021) (Shani & Suryadi, 2021).

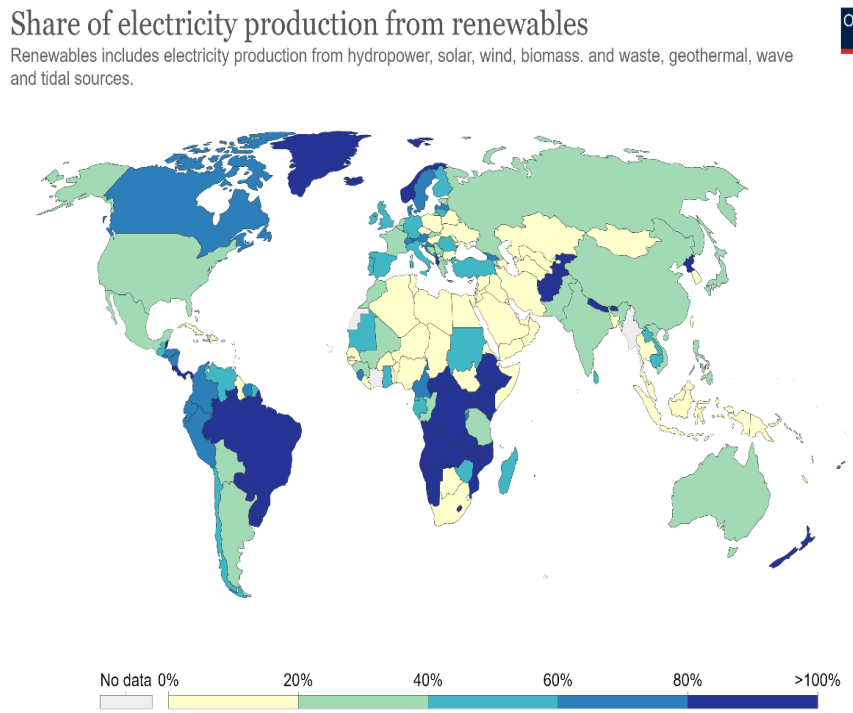

Figure 1.1: Share of electricity production from renewables in 2020
(Source: Ritchie & Roser, 2020)

Conventional energy based on oil, coal, and natural gas still plays a significant part in worldwide energy production. Petroleum-based fuel reserves are limited and concentrated in specific parts of the world. 70 % of the world's diminishing oil and gas reserves are held by Middle Eastern countries and the Russian Federation (Aburas & Demirbas, 2015). When oil prices are high, oil importers or countries that rely on the energy have restricted purchasing power, low industrial activity, and high inflation. (Demirbas et al., 2017). On the other hand, RE exists over a wide geographical area where most countries can exploit individually depending on the type of RE resources available. This fact alone gives hope for a more sustainable energy system to countries depending on the roller coaster trend of global fuel prices.

Success stories highlight that energy transitions from conventional energy (fossil fuels) to cleaner energy (RE, nuclear) based on government-supported energy policy frameworks can accelerate and direct energy transitions. In the past decade, renewable energy technology advancement, rapid cost reductions, as well as the global increase in capacity, has largely been attributed to policy acceptance which has been able to attract investments that has led to adoption and the reduction of costs through economies of scale (Frondel et al., 2015; Liu et al., 2020; REN21, 2021; Stokes & Warshaw, 2017).

Malaysia is an emerging economy listed under the Newly Industrialised Countries (NIC) with high energy demand per unit of GDP, developmental needs, and fossil resources sufficient to allow net energy exports (Shahzad et al., 2021). The 11th Malaysian Plan identified a growth rate of 6.6% annually from 1.5 toe/person (17445 kWh) energy usage to 1.9 toe/person (22097 kWh) energy usage in just five years (2010-2015) due to industrialisation. Until now, Malaysia's energy demand has been primarily met by fossil fuels such as oil, coal, and natural gas, as illustrated in Figure 1.2, with natural gas being the most abundant. In 2010, fossil fuels produced 94 % of all electricity, while hydropower accounted for only 5.6 % of all electricity generated. Malaysia's oil reserves are gradually depleting and are expected to last no more than 14 years (Worldometer, 2020). This estimate was also cited in a news release by the economic affairs minister in 2018, who stated that if no new reserves were discovered, both oil and gas reserves will run dry in ten years (Eusoff, 2018).

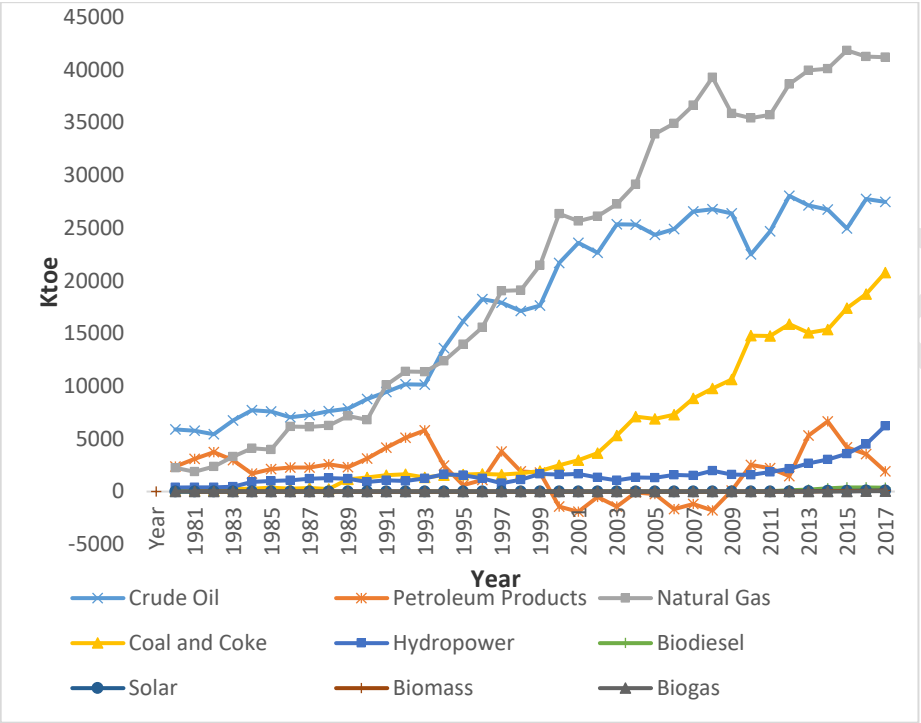

Figure 1.2: Malaysia's primary energy supply from 1980-2017
(Source: Suruhanjaya Tenaga, 2019)

While conventional energy sources such as crude oil, natural gas, and coal continue to dominate and are expected to continue to do so in the next years, new policies for introducing new resources have been emphasised to offset difficulties that develop when conventional energy sources are mainly used. Furthermore, Malaysia agreed in the 2016 Paris Agreement to the United Nations Framework Convention on Climate Change to lower 45 % of GHG emission intensity of gross domestic product (GDP) by 2030 compared to the GHG level in 2005 (UNFCCC, 2015). This pledge is consistent with the commitment to the 2030 Agenda for Sustainable Development of the United Nations (REN21, 2021). As a result, one of the country's main goals in meeting these promises is to incorporate renewable energy sources (RESs) into the energy generation mix. Malaysia has historically used hydropower to generate electricity, and it is now using solar biogas, biodiesel, and biomass energy, as well as planning to incorporate wind and geothermal energy into the mix (Energy Commission, 2020; SEDA, 2019a).

There are various key reasons behind the RE sector's deployment, but the government plays the most important role by developing strategic goals and putting them into effect through support programmes (Abdmouleh et al., 2015; International Renewable Energy Agency, 2012). This is because policies can influence the price of conventional energy through subsidy reform or can be pro-

RE by providing fiscal incentives such as rebates, grants, and tax exemptions, as well as securing public finance through loans and guarantees (Gastli & Armendariz, 2013).

The electricity supply sector in Malaysia retains a single-buyer model with a competitive generation market. The transmission, distribution, and supply market is monopolized by three different companies marking respective geographic regions. Tenaga Nasional Berhad (TNB) serves Peninsular Malaysia, whereas Sabah Electricity SDN Berhad (SESB) serves Sabah and Sarawak, respectively. Although the government owns the bulk of these utilities, they are investor-owned (Luis & Sidek, 2013). However, in the 1990s, the GoM opened the generation sector to private sector investment, allowing independent power producers to enter (IPPs).

Peninsular Malaysia is responsible for approximately 96 % of the country's electricity demand (Shafie et al., 2011). Thus, the focus of the distributing company in the current research is TNB. The Energy Commission (EC) regulates the energy supply industry and enforces energy-related rules and regulations, while the Ministry of Energy, Green Technology, and Water oversees energy planning and policy creation.

Policies on the utilisation of RE sources have been introduced since 2009 by the National Renewable Energy Policy and Action Plan and were further improved by the introduction of Feed-in-Tariff (FiT) in 2011 and Net Energy Metering (NEM) in 2017, managed by the Sustainable Energy Development Authority (SEDA). The FiT policy was expected to be the turnkey for a more aggressive renewable energy deployment in the country (Solangi et al., 2015), while NEM was expected to replace FiT and sustain the RE sector in the long run (Razali et al., 2019). The installed capacity of RE is expected to increase by more than 30% by 2030, from 36 gigawatts in 2020 to 47 gigawatts in 2030, with solar energy installations accounting for the majority of the increase (Sivaprasad & Kumbhare, 2021).

Over the previous decade, the solar energy levelised cost of energy (LCOE) has decreased by 19 % annually. Solar energy will be a primary driver of regional renewable energy development in Southeast Asia. Solar capacity has increased by 66 % in the last decade, owing to large-scale solar projects that have been completed in recent years (Sivaprasad & Kumbhare, 2021).

1.3 Scope and Limitation of The Study

Looking at the policy acceptance of Renewable Energy Policy scenario from a bigger perspective , one of the most important variables influencing the adoption of RE is social acceptance (Batel et al., 2013; Wolsink, 2013; Wustenhagen et al., 2007).The importance of social acceptance in RE development has been studied in a variety of scenarios, including wind (Firestone et al., 2020; Maruyama et al., 2007; Songsore & Buzzelli, 2014), hydropower (Tabi & Wüstenhagen, 2017), and, most notably, solar (Solangi et al., 2015; Sovacool & Ratan, 2012; Yuan et al., 2011).

The dimension of social acceptance proposed by Wustenhagen and colleagues (2007) are (1) acceptance on a socio-political level; (2) acceptance in the community; and (3) acceptance in the marketplace. As pointed by Wustenhagen (2007), all levels of acceptance are equally important for measuring societal acceptance. Furthermore, Sovacool and Ratan (2012) suggested that the three dimensions (socio-political, community and market) are to be viewed as layered (Figure 1. 3).

Such positive decisions necessitate market actors' willingness to accept the consequences of implementing renewables, and this willingness is strongly reliant on socio-political approval of institutional changes required to establish the essential circumstances for market and community acceptance. Having said that, for policy acceptance of RE, the main dimension focused is socio-political acceptance (Zverinova Iva et al., 2013) as community acceptance refers more to the acceptance of technology (Wolsink, 2013).

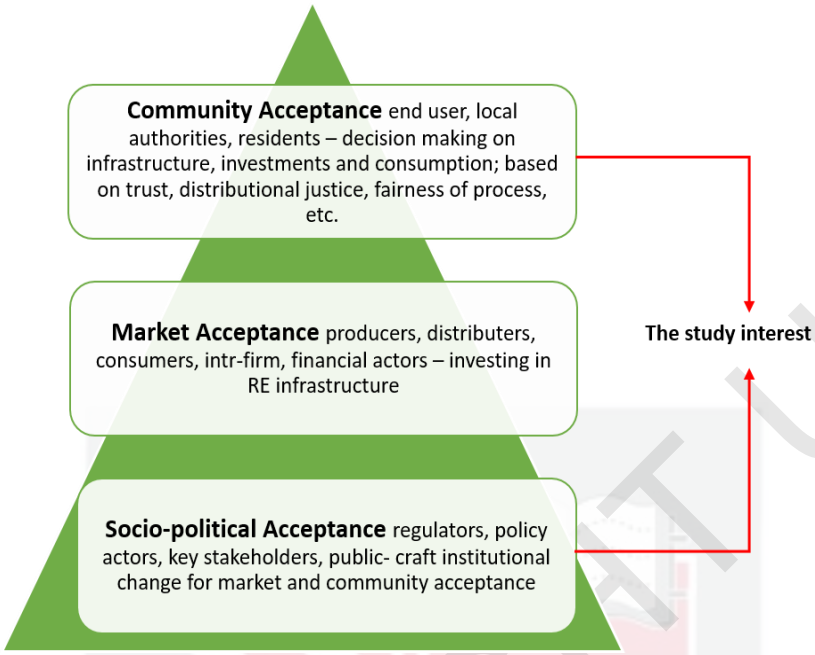

Figure 1.3: Three dimensions of societal acceptance of RE innovation with their main attributes
(Source: Sovacool & Ratan, 2012; Wustenhagen et al., 2007)

Thus, in this regard, this thesis focusses mainly on the socio-political acceptance dimension and the relation it has with market acceptance, and only one stakeholder – the public. The public is defined as citizens of a country who have the right to vote. Because the scope of this thesis is only on one dimension of societal acceptance, the term policy acceptance will be used instead of social acceptance.

Since this research will mainly identify and assess the different factors that affect the solar-related National Renewable Energy Policy acceptance, the scope of the research will be on current or potential renewable energy producers. The renewable energy of interest is solar energy since solar energy is the most accessible for individual power producers due to various programs and incentives provided by the government of Malaysia. Additionally, although the National Renewable Energy Policy encompasses other renewables in their strategic plans, other RE types will not be discussed in this research.

1.4 Problem Statement

Malaysia has been on board with the world to slowly reduce reliance on non-renewable and transition to cleaner energy sources. So much so that the

Malaysian Government has recently revised (announcement made on 21st June 2021) the RE target under the National Renewable Energy Policy and Action Plan targets of 20% RE share in the electricity generation mix by 2025, to 31 %, and 40 % by 2035 (Hin & Chiah, 2021). This new target is overly optimistic since all the previous RE targets set by the government have not been reached (SEDA, 2016, 2019a). Although the Feed-in-Tariff (FiT) programme under the National Renewable Energy Policy was introduced in 2011, the target regarding renewable energy (RE), as mentioned in the 10th Malaysian Plan to generate 5.5 % of the total electricity generation mix which is 985 MW by the end of 2015, failed miserably. It only achieved 319.55 MW as of 30th September 2015 (SEDA, 2016). The introduction of Net Energy Metering (NEM) program was also unpopular among individual electricity consumers (Razali et al., 2019).

According to Rhodes et al. (2017), public resistance hinders the attainment of important project or environmental goals. The fact that the success of new technologies is almost always associated with good policy support (Zverinova Iva et al., 2013) reflects the people and policy acceptance are interrelated. Thus, it is essential to understand how the public forms opinions on renewable solar energy programmes and assess the level of acceptance. Building from this, this study focuses on the public's acceptance of the National Renewable Energy Policy, specifically solar-related policy items for individual solar producers like Feed-in-Tariff and Net Energy Metering.

While Kardooni et al. (2016) reports that Malaysians do not have any issue in accepting renewable energy in their everyday lives, the statistics offered by SEDA official website (2020) shows that the number of participants in solar renewable energy is minimal. The total installed capacity for the FiT program was 378MW by the end of 2015, as opposed to the 985MW targeted in the 10MP. This value is approximately 38% of the target to achieve 5.5% RE in the generation mix. During the FiT program duration from 2012 to 2017, the total cumulative installation was just above 500MW. The introduction to NEM shows a slower uptake of RE where to date (August 2019), less than 10MW of NEM solar PV has been implemented, compared to the 200 MW target per year. Considering the importance of people's acceptance of policies and programs implemented by the authorities and the fact that RE has not fully penetrated the energy market, the factors contributing to National Renewable Energy Policy acceptance in Malaysia should be evaluated.

Usually, technology acceptance leads to the utilisation and use of the technology (Alomary & Woollard, 2015; Olumide, 2016), whereas policy acceptance also leads toward technology usage but at a lower level (Wustenhagen et al., 2007). There can be situations where people accept the policy but do not adopt the technology due to their respective constraints. As the aim of the National Renewable Energy Policy is to increase renewable shares in the electricity generation mix and help achieve RE targets set by the government, it is imperative to assess whether the policy acceptance of the National Renewable Energy Policy can lead to intention to adopt solar PV in homes.

Although there are several studies regarding the acceptance of solar energy in Malaysia (see works by Ahmad, Rashid, Omar, & Alam, 2014; Cheam et al., 2021; Jayaraman, Paramasivan, & Kiumarsi, 2017; Kardooni .; Lim & Lam, 2014; Muhammad-Sukki, Ramirez-Iniguez, Abu-Bakar, McMeekin, & Stewart, 2011; Solangi et al., 2015), these studies focus on the technology acceptance of solar PV. In contrast, there is little understanding of the public acceptance of Malaysia's policies surrounding renewable solar energy (Derasid et al., 2021).

Moreover, previous solar energy acceptance related studies examine a wide range of factors. Some research concentrate on intrinsic or psychological components of policy support, like personal values and views about climate change (Chen et al., 2016; M. Klein & Deissenroth, 2017), others are more concerned with contextual factors, such as economic, social, and geographic considerations (Briguglio & Formosa, 2017; Hafeznia et al., 2017; Mignon & Bergek, 2016; Simpson & Clifton, 2017b). When investigating individual factors of policy support, some factors might weigh more heavily than others, and when not measured collectively, the reality of the policy acceptance might be misinterpreted (Rhodes et al., 2014). This research employs a more comprehensive model that integrates the intrinsic and extrinsic factors – The Attitude-Behaviour-Context (ABC) framework proposed by Stern (2000). This framework identifies policy acceptance from an attitudinal, contextual, and socio-demographic perspective that is comprehensive but still feasible to undertake.

Furthermore, even when certain environmental policies are developed explicitly for public participation, it can be argued that the knowledge of policies is beyond the public's comprehension except for field experts and the most actively interested citizens (Rhodes et al., 2014). Disputes over public policy and science are sometimes linked to a lack of understanding among citizens, referred to by scientists as a knowledge gap between citizens and specialists commonly termed the knowledge deficit theory (Stoutenborough & Vedlitz, 2014). Environmental issues and new technology are among the challenges faced by this dilemma. Because RE resources are an essential part of many national decarbonisation strategies, public awareness of the benefits of renewable energy in terms of CO2 reduction and opportunities to become energy independent can influence public support and the efficacy of RE policies by reducing opposition and increasing uptake in homes (Gastaldo et al., 2019; Gurtner & Soyez, 2016; Heidari et al., 2020). This scenario raises crucial questions concerning citizen support for programmes and how policy knowledge may influence public support. Additionally, providing policy information to which the public can relate at an individual level is proven to be more effective than general scientific information (Setyawati, 2020; Stoutenborough & Vedlitz, 2014). For example, Setyawati (2020) found the Indonesian recommended the government to be more active in their campaign for knowledge dissemination by highlighting factors like saving money on electricity bills to attract potential PV system adopters towards the Rooftop Photovoltaic Solar Systems (RPVSS) policy. Rhodes et al. (2014) conducted an intervention study of understanding effect of information provision on policy acceptance as it was found providing

direct and clear information of the policy and environmental issues was able to increase the susceptibility to acceptance of policies and regulations.
The above argument and the existing literature's limitations, thoroughly investigating the underlying factors that contribute to the acceptance of solar policies and intention to adopt is warranted. While there might be several factors contributing to solar policy acceptance, a theoretical guide following Stern's ABC model (2000) of attitudinal, contextual, and socio-demographic variables are used to foothold the theoretical model of this research. Given the heightened emphasis on policy knowledge towards policy acceptance, this research proposes that policy information can increase policy acceptance. Thus, this research integrates the ABC theory of policy acceptance and the knowledge deficit theory to assess the factors contributing to policy acceptance, current policy acceptance and the effect of information provision on policy acceptance among landed-home residents in Peninsular Malaysia.

1.5 Research Questions

Based on the research background and problem statement, this research aims to understand and measure the policy acceptance towards individual solar PV policies in Malaysia. Specifically, this research will be guided by four primary questions.

RQ1: What is the current acceptance of National Renewable Energy Policy solar-related items among landed residents in Peninsular Malaysia.

RQ2: How do intrinsic and extrinsic factors influence solar-related policy acceptance among landed residents in Peninsular Malaysia?

I. What is the relationship between attitudinal variables (personal norm and environmental concern) and policy acceptance?
II. What is the relationship between contextual variables (economic, social, and roof position) and policy acceptance?
III. What is the relationship between personal capability (age, education level, household income) and homeownership and policy acceptance?

RQ3: What is the relationship between policy acceptance and intention to adopt solar systems in homes?

RQ4: What is the policy acceptance level before and after exposure to solar-related policy information.

1.6 Research Objectives

The ultimate objective of this research is to determine the current acceptance of the National Renewable Energy Policy, specifically the Feed-in Tariff (FiT) policy

and Net Energy Metering (NEM) policy among landed home residents in Peninsular Malaysia, how policy acceptance can lead to intention to adopt, as well as the effect of information provision towards the acceptance of policy. Specifically, the objectives of the research are as follows.

RO1: To assess current acceptance of solar-related items of National Renewable Energy Policy among landed residents in Peninsular Malaysia.

RO2: To measure the relationship between attitudinal variables and National Renewable Energy Policy acceptance.

RO3: To measure the relationship between contextual variables and National Renewable Energy Policy acceptance

RO4: To measure the relationship between personal capability variables and National Renewable Energy Policy acceptance

RO5: To determine the relationship between policy acceptance and intention to adopt solar policy

RO6: To compare policy acceptance level among landed home residences before and after exposure to solar-related policy information.

1.7 Significance of Study

This research is made with the aim to provide crucial information and knowledge regarding the acceptance of the National Renewable Energy Policy among landed residents in Peninsular Malaysia and how the information collected can be of use to the stakeholders and parties involved.

From a national point of view, this research is important to tackle the growing need for alternative energy sources that will only increase in the future from advancement of technology. Insights on the current position and the readiness of Malaysian citizens will help the government to forecast and prepare for the challenges in adopting RE in our electricity generation mix. As information is a crucial part to acceptance, testing the effect of information provision might help the governing body to be equipped in spreading information that are reliable and of interest to the public. Identifying certain policy items that are rejected can help identify what areas should policy makers focus in gaining the interest of the public to eventually install solar PVs in homes. Insights on policy acceptance can help increase the number of participations from the public to apply for specific schemes under the National Renewable Energy Policy. Apart from that, this study will help increase awareness of the current solar scheme available that might be of interest to the respondents.

Furthermore, this study is also important to the residents of Malaysia. Most of the residents living in Malaysia is currently already affected by the renewable energy programmes in Malaysia, whether consciously or subconsciously. Tenaga Nasional Berhad (TNB), the utility company in Malaysia has already impose a 1.6% surcharge to current electricity users for the Renewable Energy Fund, which is a by product of the FiT program. Residents that participated in this thesis will be more aware and gain information of the policy that will in some ways change their perspective on the policy whether positively or negatively. This aligns with the knowledge deficit theory of how information can help increase acceptance. The ABC Model by Stern (2000) helps to provide insights on what is the main variables that could affect policy acceptance that can show if the residents in Malaysia prioritize attitudinal variables or contextual variables.

The significance of this research from a literature point of view is that this study will help shed some light on the acceptance of solar energy policies research. Although there are a few studies measuring solar policy acceptance, these kinds of studies are far behind compared to studies measuring the acceptance to solar technologies. Additionally, for studies that do measure solar policy acceptance, only specific characteristics were measured. This study intends to measure all found factors and test them simultaneously for a more wholesome understanding. Furthermore, this research will help contribute to literature on the knowledge deficit theory and whether information provision is crucial in policy acceptance since most studies on policy acceptance have suggested to increase awareness and information provision but the intervention study for solar policies have been lacking. Lastly, this research set in Malaysia will provide insights and important literature on the current situation from a developing country as well as a newly industrialized country's side as most research found in the area of renewable energy and renewable energy policies are from developed countries.

1.8 Operational Definition

The following terms are defined in the context of this research.

Economic aspects:	It entails a variety of general environmental viewpoints or is equivalent to the perceived impacts of environmental issues.
Environmental concern:	It is a wide - ranging concept that includes all types of general environmental attitudes or is synonymous with the perceived impacts of environmental concerns.
Intention to adopt (ITA):	Refers ITA to the acceptance and intent to use or install individual solar PVs at home.

Knowledge of Policy (KoP):	Refers to any knowledge or information regarding a specific policy that is already learnt or being presented to an individual.
Landed residents:	Refers to homeowners or tenants that live in landed homes in which each house has its own personal roof.
National Renewable Energy Policy:	Refers to the national policy that recognizes the need to increase RE contribution in the national power generation mix and reduce carbon emissions via related renewable energy acts and programs. Specifically, programs like Feed-in-Tariff and Net Energy Metering that is of interest in this thesis.
Personal norm:	Personal norm is the conviction that one must act in a certain way (Schwartz, 1977). It occurs when a person feels compelled to protect the environment, sustain it, and take concrete steps to do so.
Policy acceptance:	The dictionary definition of the term *acceptance* is "to receive with approval or favour: to agree or consent to" (Merrian Webster, 2021) while *policy* is defined as "a law, regulation, procedure, administrative action, incentive, or voluntary practice of governments and other institutions" (Cambridge English Dictionary, 2021). In this thesis, the term policy acceptance refers to the judgments and evaluations about the policy being in place (Dreyer & Walker, 2013; Schuitema et al., 2010).
Renewable energy:	Renewable energy is energy obtained from the earth's natural resources that are not finite or exhaustible, such as wind and sunlight.
Renewable Energy Fund:	The RE Fund is a fund collected by the government from energy consumption by consumers. As per the RE Act 2011, the RE fund is collected by a 1.6% surcharge on consumers' electricity use, which is applied to all customers who consume more than 300kWh per month (TNB, 2021).
Social aspects:	The observations for the social aspect chosen in this thesis can be measured using trust. The research explores three social aspect affiliations: trust in the efficacy of government policies and schemes, trust in government, and trust in solar retailers.
Solar photovoltaic:	Solar PVs is referred to the RE technology that is used to capture solar energy and converts them to electricity.

1.9 Chapter Summary

This chapter starts with explaining the the current environmental problems that arise due to unsustainable energy consumption and generation and the need for renewable energy sources. However, despite the government's efforts to promote solar energy in Malaysia, the country's efforts to meet its targets for the renewable energy industry have not been met. This has prompted the government of Malaysia to formulate various policies that will help boost the uptake of solar energy in the country. The chapter proceeds with the gap in existing literature regarding a comprehensive study of factors influencing solar policy acceptance and the effect of policy information on policy acceptance. Following this, the chapter proceeds with questions that arise from the identified problems and the research objectives. Lastly, the significance of the study and the summary was presented.

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