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A Study To Explore The Research And Development Process Of Malaysia's Renewable Energy Industry

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ABSTARCT

Given the country's diminishing fossil fuel sources and growing domestic energy use in Peninsular Malaysia, Malaysia is being utilised as a case study to examine energy security concerns. Malaysia ranked third among Southeast Asian nations for carbon dioxide emissions in 2014. In keeping with these two tenets, this thesis were investigate the potential for reducing our dependency on fossil fuels by 73.8% via the generation of electricity from renewable sources such as wind, biomass, sun, and hydro. In order to address the growing demand in peninsular Malaysia, this research examined the advantages and disadvantages of using solar power in combination with renewable energy systems or fossil fuels. Improving environmental conditions and reducing the possibility of energy shortages are among the countries' priorities. Two halves of the case study, one covering 2030 and the other 2040, were used to analyse different combinations of renewable systems and hybrid power producing systems. The acronym HOMER (Hybrid Optimisation of Simulated Using Multiple Energy Resources) was used by both sections to represent the different cases. Based on demand figures gathered from the Malaysia Energy Information Handbook (MEIH) and publicly accessible growth factors from the Malaysian Energy Commission, the model projected demand for the next twenty years. Reputable organisations such as IRENA and the EIA provided recommendations for renewable energy sources and estimated costs.

Keywords: *Renewable Energy, Solar Energy, Wind Energy, Development Process.*

INTRODUCTION:

Worldwide energy consumption is expected to increase by 53% by 2030, with 70% of the increase coming from developing countries, according to the International Energy Agency. When adjusted for purchasing power parity, Malaysia's GDP per capita is second only to Singapore's among ASEAN member nations. The gross domestic product grew by 4.6% in 2009. With a GDP growth of 5% in 2005, experts predict that Malaysia's energy consumption would rise by 6% annually. Final energy consumption in Malaysia increased 5.6% to 38.9 Mtoe in 2005, a result of the country's rapid economic growth between 2000 and 2005. **S. Gsänger, (2020)** projects that global energy consumption would reach 98.7 Mtoe in 2030, almost triple the amount from 2002. With an anticipated growth rate of 4.3%, the industrial sector is poised to see the quickest expansion. With 48% of the overall consumption in 2007, industry was the energy hog. **Vaka M, (2020)** claims that the present pace of oil usage was exhaust the resource in sixteen years, but the predicted stockpile for natural gas is over seventy years. Ensuring a consistent and reliable supply of electricity while also diversifying energy sources is the primary goal of Malaysia's power industry when it comes to sustainability. To ensure the smooth progress of development projects and the improvement of our economy, they must solve the issue of supply security and dependability and diversify our energy sources so that Malaysia is not dependent on any one source. When it comes to solving energy and environmental problems, Malaysia shares the opinion of other nations that green technology is the way to go. Malaysia is getting back to its origins by recommitting to creating its own "green economy."

More and more people are putting pressure on the government to increase the country's revenue and improve its standing in the global value chain because of the country's vulnerability to pollution and climate change. Both the growth of renewable energy in Malaysia and the country's various energy policies have been the focus of this study so far.

In the fight against climate change and the exhaustion of fossil fuels, more and more people are turning to RE. Also, RE are abundant, largely unexplored, and eco-friendly. The strategy known as the Five-Fuel Diversification took the role of the Four-Fuel Strategy in 1999. The target is to add 5% to the total energy mix by 2010. The eighth Malaysia Plan, which ran from 2001 to 2005, includes renewable energy as one of its energy sources. With its glacial growth rate, Malaysia's real estate market is still in its early stages. Here we shall go over where RE is now **(Davis, 2018)**.

BACKGROUND OF THE STUDY:

The Small Renewable Energy Programme (SREP) was formed in May 2001 by the Special Committee on Renewable Energy (SCORE) to support the government's goal of promoting the development and utilisation of renewable energy (RE) as a fuel resource for generating electricity. **Lorenzo-Sáez (2020)** points out that renewable energy hardly makes up 1% of Malaysia's overall energy mix, even though the country launched its fifth fuel strategy a decade ago. Energy efficiency initiatives are the backbone of the 9th Malaysian Plan (2006–2010), which is focused on sustainable development and aims to address the country's energy crisis. A new ministry was formed to oversee water, sustainable technologies, energy, and communications after the Ministry of Energy, Communications and Multimedia said earlier in 2009 that Malaysia sought a "clean and green" economy that prioritised sustainable solutions. The current prime minister of Malaysia, Datuk Seri Najib Tun Razak, unveiled a fresh plan for environmentally friendly technologies in April 2009. His comment is followed by this. **Zaslavskyi (2019)** explains that the plan's specific goal was to help various sectors flourish, which would then boost the economy as a whole. The following goals are outlined in the National Green Technology Policy, as per GT (2010):

- Promote economic expansion while simultaneously minimizing energy use. In order for the expansion of eco-friendly technologies to have a beneficial effect on the country's economic development. Making Malaysian green technology more competitive in the global arena is one of the goals, along with improving the country's innovation potential. Preserving the environment for the sake of future generations and making sure our efforts last are our top priorities **(Hossain, 2020)**. Environmentally friendly technology adoption can only be achieved via public education and outreach initiatives. Even though wind, solar, biomass, biofuel, and geothermal heat—all forms of renewable energy—are expected to have tripled in size by 2030, they were likely only account for around 5.9% of the world's energy consumption. The dominance of fossil fuels, however, is expected to persist for the time being. All of the energy policies that have been suggested are detailed here: Formerly known as Petroleum Company Berhad, Petronas was founded in 1974. Some examples of these policies in use are as follows: various national policies, such as those concerning petroleum, energy, depletion, the four fuels, and diversification, that were passed between 1975 and 1981. From 1995 to 2005, the mix of fuels used to generate power was the main emphasis. The Fifth Fuel Policy has prioritised renewable energy sources since its establishment in 2000. If what **Leonard, (2019)** claims is true, the energy sector was one of the main focuses of the Ninth Malaysia Plan (2006–2010), an endeavor that built on the Energy Efficiency (EE) program of the Eighth Malaysian Plan (2001–2005).

PURPOSE OF THE STUDY

Researchers examined the main obstacles to renewable energy adoption in Malaysia from three angles: technological, economic, and societal. From a technical standpoint, it is crucial to choose a technology that is suitable with Malaysia's resources. For example, since Malaysia's wind resources are very small compared to other nations, the chosen wind technology should be resilient enough to endure low-wind conditions. Research or small-scale pilot projects are required to establish the true applicability of biogas and BESS to Malaysian circumstances, since they are still in the early phases

of implementation. When faced with most obstacles, the business sector emerged victorious. Since renewable energy (RE) is a new kind of energy for Malaysia, it's a promising investment opportunity. To initiate a deployment, government incentives are crucial. Even while the FiT system seems to be functioning in terms of implementation, the rates may still not be enough for some technologies when all other factors are considered. For instance, micro hydro projects could wind up costing more than expected because of compensation payments made to Aboriginal and other impacted organizations. Because this technology has the potential to address the current issue of treating MSW and extend the life of landfills in our nation, it is necessary to update FiT to designate FiT for biogas production from MSW or food waste **(J. Harper, 2019).**

LITERATURE REVIEW:

The extraordinary level of energy use in 2018 was plain to see. An increase in fuel consumption about double the average pace of the previous decade caused a meteoric rise in the global demand for energy. In spite of the fact that renewable energy has outpaced all other energy-related metrics since 2010, fossil fuels continue to constitute over 80% of the world's principal energy use. According to the US Environmental Protection Agency, energy use is the main cause of pollution and greenhouse gases. One 25% of the world's greenhouse gas emissions come from power plants and other energy-intensive activities, which burn fossil fuels. Buildings, which include both the production of external energy and internal combustion for heating and cooking, make up 6% of all energy-related enterprises, followed by transportation at 14%, other energy-consuming industries at 10%, and power plants at 21% **(Balaraman, 2020).**

In 2018, global energy consumption climbed 2.3%, as reported by the World Energy Outlook. The United States, China, and India accounted for 70% of the rise in worldwide energy consumption. The Institute of Energy Economics Japan predicts that China will continue to be the world's largest consumer in the 2040s, with a predicted 4.0 Gtoe. Costs are likely to rise because to the fast-growing middle classes and populations in the Indian subcontinent, Southeast Asia, and the Middle East and North Africa. Conversely, it is anticipated that energy consumption in the US and EU would decrease. The growing human population over the last several decades has led to an increase in both the demand for housing and energy consumption. In terms of global energy consumption, the construction sector is among the top. Buildings used for either residential or commercial purposes account for 40% of total energy usage in the US and EU. In order to provide precise energy recommendations, it is necessary to investigate building interfaces, design (including location), and tenant behaviour. The energy sector is responsible for the majority of greenhouse gas emissions in the European Union—80%. The majority of the carbon dioxide emissions (36% of EU total) and almost 40% of EU total energy production come from just one industry. Still, it has already shown levels that are lower than the target for 2020. Compared to the target for 2020, consumption in 2006 was 9.1% higher at 1.046 Mtoe. In order to compile a database describing total energy consumption and to identify the cooling energy requirements of specific buildings, scientists in Madagascar studied the energy usage of both commercial and residential buildings. The researchers discovered that residential buildings' cooling energy consumption was increasing at the quickest pace, while commercial buildings' overall energy consumption was the greatest. Until at least 2050, fossil fuels will remain the principal source of energy demand, according to **Deign (2020).**

RESEARCH QUESTION

- How to encourage the research, design, and implementation of renewable energy sources?
- How to increase non-renewable energy independence and decrease reliance on fossil fuels?

METHODOLOGY

Mathematical measurements of variables are the building blocks of quantitative research, which then use statistical models to draw conclusions about the relationships between variables and their correlation coefficients. Quantitative

study aims to provide a more comprehensive understanding of society. Researchers often use quantitative methods while studying factors that affect humans. Quantitative research yields factual information presented clearly in graphical form. The systematic collection and interpretation of numerical data is the essence of quantitative research. It has many potential applications, including averaging data, making predictions, exploring relationships, and generalising results to bigger groups.

Sampling: 20 energy industry workers in Malaysia participated in pilot research using the questionnaire, and 520 workers from the energy sector made up the final sample for the study. Using a systematic random sample method, a total of questionnaires was delivered to individuals working in the energy sector. For this study, the researcher only used fully filled out questionnaires; those that were missing information were immediately dismissed.

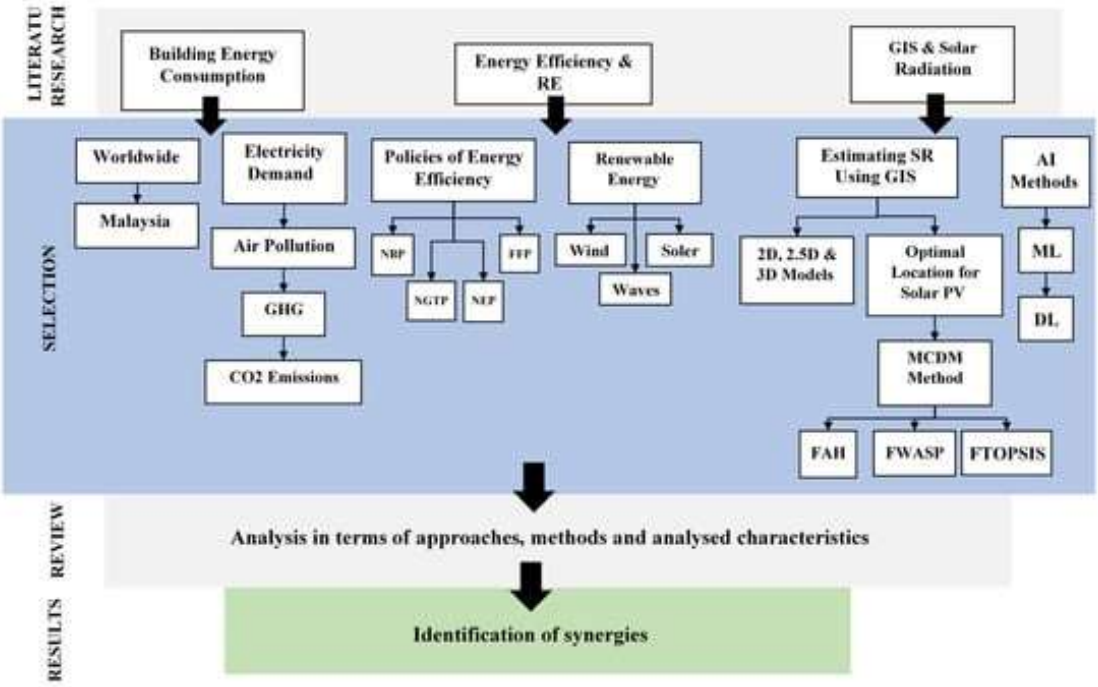
Data and Measurement: Questionnaire surveys (either one-to-correspondence or Google Form) were used to gather primary data for the study. There were two sections to the questionnaire - (A) breakdown of the sample demographic; (B) a 5-point Likert scale including answers from online and offline media. Information gathered from secondary sources, mostly online.

Statistical Software: The statistical analysis was conducted using SPSS 24 and MS-Excel.

Statistical tools: In order to grasp the fundamental character of the data, descriptive analysis was used. Researchers used factor analysis to check for validity.

Greenhouse gas emissions, energy efficiency, use of geographic information systems, energy consumption, and restrictions are some of the most common keywords in this research. First, we were look at how buildings' main energy usage impacts the environment, particularly in Malaysia. What follows is an explanation of how to use a geographic information system (GIS) to forecast solar radiation and evaluate energy efficiency. They were concluded by talking about renewable electricity and energy efficiency as possible alternatives to traditional energy sources. See Figure 1 for the overarching strategy of this research.

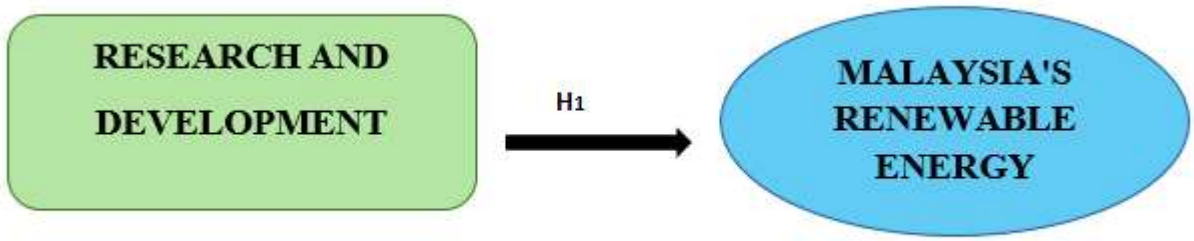
Figure 1: Identification of synergies



With an area of 329,750 square kilometers, the Southeast Asian nation of Malaysia is generally located near the equator, between the latitudes 2°30′ N and 112°30′ E. The climate is consistently muggy and humid with an annual rainfall

average of 250 cm and temperatures of 27 °C. With an area of 329,847 square kilometers, Malaysia is a massive nation. Liquefied natural gas exports put Malaysia in fifth position globally in 2019, while its natural gas and oil production placed it second in Southeast Asia.

CONCEPTUAL FRAMEWORK:



RESULT

- **Factor Analysis:**

Validating the latent component structure of observable data is a common use case for Factor Analysis (FA). Regression coefficients are often used to generate scores in the absence of readily measurable visual or diagnostic indicators. Success in FA requires models. The goals of modelling are to identify errors, intrusions, and visible linkages. The Kaiser-Meyer-Olkin (KMO) Test is a tool for evaluating data sets obtained from multiple regression analyses. We check whether the variables in the sample and the model are representative. Data overlap is shown by the statistics. The data is simpler to comprehend when the proportions are lower. The output from KMO is 0-1. Assuming KMO values between 0.8 and 1, the sample size is sufficient. According to Kaiser, the following are the acceptable limits:
The following are the acceptance criteria set by Kaiser:
A pitiful 0.050 to 0.059, below-average 0.60 to 0.69
Middle grades often fall within the range of 0.70-0.79.
With a quality point score ranging from 0.80 to 0.89.
They marvel at the range of 0.90 to 1.00.
Table1: KMO and Bartlett's Test
Testing for KMO and Bartlett's
Sampling Adequacy Measured by Kaiser-Meyer-Olkin.520
The results of Bartlett's test of sphericity are as follows: approx. chi-square
df=190
sig.=.000
This proves that claims made for the sake of sampling are legitimate. We used Bartlett's Test of Sphericity to make sure the correlation matrices were relevant. The sampling adequacy value according to Kaiser-Meyer-Olkin is 0.520. According to Bartlett's sphericity test, the p-value is 0.00. The correlation matrix is not an identity matrix, as shown by a significant test result from Bartlett's sphericity test.

Table 1: KMO and Bartlett's Test

KMO and Bartlett's Test	
Kaiser-Meyer-Olkin Measure of Sampling Adequacy.	520

Bartlett's Test of Sphericity	**Approx. Chi-Square**	6524.542
	df	190
	Sig.	.000

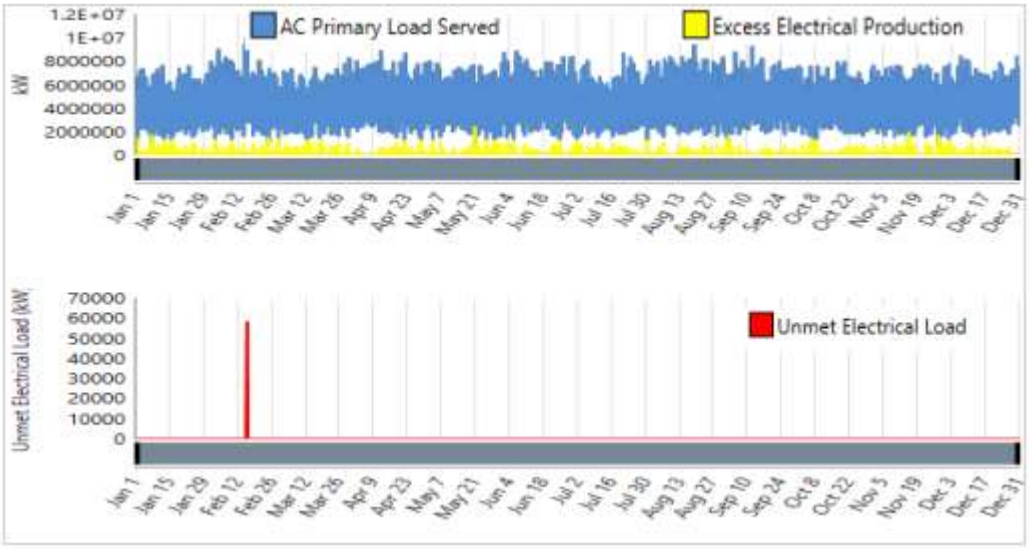
This proves that claims made for the sake of sampling are legitimate. We used Bartlett's Test of Sphericity to make sure the correlation matrices were relevant. The sampling adequacy value according to Kaiser-Meyer-Olkin is 0.520. According to Bartlett's sphericity test, the p-value is 0.00. The correlation matrix is not an identity matrix, as shown by a significant test result from Bartlett's sphericity test.

Research and Development:

Whether in the private or public sector, innovation is often associated with the idea of research and development. A business may keep ahead of its rivals by supporting research and development. A firm's ability to innovate depends on its research and development (R&D) programme. Without it, the company may not make it and may have to resort to alternative strategies like partnerships or mergers and acquisitions (M&A). Research and development allow businesses to create new goods and enhance their current ones. Unlike the majority of a company's operational operations, research and development fall under a separate category. In most cases, the goal of doing research and development is not to make a quick buck. The expectation instead is that it were help a company's bottom line in the long run. As a result of their research and development efforts, many firms are able to obtain patents, copyrights, and trademarks for their goods and ideas. Businesses that establish and staff R&D departments devote a significant number of resources to the endeavour. They are compelled to assess the return on investment (ROI) after adjusting for risk, which inherently entails capital risk. This is due to the fact that both the payout and the ROI are not immediately apparent. Increases in R&D spending are accompanied with rises in capital risk. For various reasons, such as size and expense, other businesses may choose to outsource their research and development.

Since natural gas currently accounts for over half of peninsular Malaysia's power generating system, NGG was chosen as the baseline scenario. With a yearly capacity deficit of less than 0.1%, the 10 GWh NGG facility was deemed enough to supply the needed demand. Considering that this system was linked to the current electrical grid, which can stabilize a sudden surge, and since the peak unmet power demand for 2030 is only 60 kW more than the capacity, this shouldn't be too concerning.

Figure 2: Unmet Electrical Load



Because it is a dispatchable system, NGG can adapt its power production to match fluctuating demand. This allows for an annual reduction in surplus power of 0.74% and an annual reduction in unmet electricity of 0.07%. Because peninsular Malaysia already has a well-established gas network, the initial expenditure of USD 11.7 billion for this system is acceptable, and there was little investment needed for infrastructure. But because natural gas is the primary fuel for this power plant, it releases a lot of carbon dioxide into the atmosphere. The NGG plant is shown to emit 29.18 billion kg of CO_2 per year in this scenario. Due to the need to conduct many environmental impact assessments and establishing a mitigation strategy before beginning the project, this massive emission would discourage its implementation. Not only that, but this system was impact climate change in the long run.

Malaysia's renewable energy:

The fast economic expansion in emerging Malaysia has increased the country's energy consumption compared to industrialised nations. Creating a huge quantity of carbon emissions and endangering long-term sustainability due to an energy crisis. When it comes to producing power, fossil fuels remain the mainstay of Malaysia's power industry. Because of the negative effects on the environment and the diminishing supply of fossil fuels, their use was soon become unsustainable. To keep up with its growing population and business energy needs, Malaysia must investigate potential alternative energy sources. Ten percent of Malaysia's total energy consumption comes from renewable and alternative sources. Hydropower and solar energy are the two main forms of renewable natural resources that Malaysia presently uses.

Relationship between research and Development and Malaysia's renewable energy:

One of the factors that may significantly impact a country's economic growth is the use of renewable energy. Deploying renewable energy sources may provide a steady supply of power while also lowering emissions from fossil fuels, which helps slow global warming and has long-term environmental benefits. Renewable energy development has been a top priority for Malaysia as the country seeks to diversify its energy supplies for power production in accordance with the market force concept. But past attempts failed, and the administration saw that doing things the same way isn't going to lead to sustainable growth. To guarantee a comprehensive strategy for renewable energy businesses in Malaysia, the government drafted an effective policy in 2008 known as the National Renewable Energy Policy and Action Plan, taking into account the important lessons from the previous approach. The policy's stated goal is to promote long-term economic and social growth by increasing the share of renewable energy sources in the country's power grid. Accelerating the expansion of the renewable energy sector and driving economic advantages via the production of innovative goods and services is emphasised in the strategy through the necessity of systematic research and development (R&D) programmes and human capital development. To hasten the expansion of Malaysia's renewable energy sector, it is crucial to establish a comprehensive research and development strategy that would encourage the creation of novel goods and services on a local level. As a result of local innovation, renewable energy technologies will be simpler to use and less expensive to disseminate. Local firms will gain a competitive advantage because of this. Rising adoption of renewable energy sources, falling reliance on fossil fuels to power the country's electrical grid, and lower carbon dioxide emissions are all quantifiable results of Malaysia's robust research and development programme.

The following hypothesis, based on the preceding discussion, will be used to analyse the relationship between Research and Development and Malaysia's renewable energy.

H_1: "There is a significant Relationship between Research and Development and Malaysia's renewable energy."

H_{01}: "There is no significant Relationship between Research and Development and Malaysia's renewable energy."

Table.2: ANOVA test (H_1)

ANOVA					
Sum					
	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	75207.347	207	4700.459	536.410	.000
Within Groups	681.563	312	8.212		
Total	75888.910	519			

The finding is noteworthy in this research. With a p-value of.000 (less than the.05 alpha level), the value of F, which is 536.410, approaches significance. Thus, it follows that ***H_1: "There is a significant Relationship between Research and Development and Malaysia's renewable energy."*** is accepted and the null hypothesis is rejected.

DISCUSSION

The government of Malaysia has implemented many policies pertaining to energy in response to the ongoing need for energy. During the Malaysian Plan, the Malaysian government once again stated a goal of using 5% renewable energy across the board. Unfortunately, the current limitations make it exceedingly difficult to achieve this goal, and they are also completely impractical. Even though the government's policies and programs have highlighted the importance of renewable energy in a sustainable system, the public and NGOs still need to step up their efforts to promote, use, and coordinate energy from renewable resources if Malaysia is serious about increasing its usage of this type of energy supply.

CONCLUTION

To meet the expected demand in peninsular Malaysia over the next two decades, the practicality of renewable energy systems. Thorough literature evaluations indicate that peninsular Malaysia has a wealth of renewable energy resources that might be used to supplement the power produced by fossil fuels. Out of the many simulation examples that were run, four were chosen for further analysis. The results show that NPC values were highest in the scenario with a large renewable portion (100% RF), and lowest in the hybrid scenario with an NGG plant. Given the current state of development in each technology, however, the technological viability of the system design is of paramount importance. The results-based conclusions are summarized below.

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