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An Investigation of the Renewable Energy Sector in Malaysia: A Case Study of Research and Development

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Malaysia is being used as an example to investigate energy security issues because of its declining fossil fuel reserves and increasing consumption of energy in the peninsular region. In 2014, Malaysia's carbon dioxide emissions were the third highest among Southeast Asian countries. Continuing with these two principles, this thesis will explore the possibility of generating power from renewable sources including wind, biomass, solar, and hydro in order to decrease our reliance on fossil fuels by 73.8%. This study will compare solar power to other options in order to assess its pros and cons in order to meet the increasing demand in peninsular Malaysia. Among the nations' top concerns is minimizing the likelihood of energy shortages and enhancing environmental circumstances. In order to examine the various combinations of environmentally friendly systems and hybrid energy generating systems, the research project will be split into two halves, one focusing on 2030 while the other addresses 2040. Both parts will make use of HOMER (Hybrid Optimization of Simulated using Multiple Energy Resources) to model the various scenarios. Utilizing publicly available growth indicators from the Malaysian Electricity Council and a twenty-year demand projection sourced from the Malaysia Electricity Management Handbook (MEIH), the model was constructed. Credible groups like IRENA and the EIA provided suggestions for renewable energy sources and estimated costs.

Keywords: Renewable Energy, Solar Energy, Wind Energy.

1. Introduction

The International Energy Agency predicts that emerging nations will account for 70% of the projected 53% rise in global energy demand by 2030. Malaysia has the second-highest GDP per capita among ASEAN member states when purchasing power parity is accounted for, behind only Singapore. Imported goods and services contributed 4.6% to GDP growth in 2009. Energy consumption in Malaysia is expected to increase by 6% each year if the country's GDP grows by 5% in 2005, according to analysts. Because of the country's fast economic expansion from 2000 to 2005, Malaysia's final energy consumption rose 5.6% to 38.9 Mtoe in 2005. Global energy consumption is projected to reach 98.7 Mtoe in 2030, almost tripling the amount from 2002, according to S. Gsänger, 2020. We expect the industrial sector will increase at a pace of 4.3%, which is the fastest. In 2007, industrial use accounted for 48% of total consumption. The current rate of oil use will deplete the resource in sixteen years, according to Vaka M. 2020, whereas the anticipated supply of natural gas is more than seventy years. When thinking about sustainability, Malaysia's power business mainly aims at ensuring a

steady supply of electricity and diversifying energy sources. To make sure that development projects go smoothly and that our economy becomes better, we need to diversify our energy sources so that Malaysia isn't reliant on any one thing and figure out how to make our supplies more reliable. Green technology is the method to solve energy and environmental challenges, according to Malaysia and other countries. To return to its roots, Malaysia has recommitted to building its own "green economy." Because of the country's susceptibility to pollution and climate change, there is growing demand on the government to enhance the country's income and position in the global value chain. This research has so far concentrated on two main areas: the expansion of renewable energy sources in Malaysia and the many energy policies put in place by the government. In response to rising global temperatures and the depletion of fossil fuels, an increasing number of individuals are embracing renewable energy. On top of that, RE are plentiful, mostly uncharted, and environmentally benign. Substituting the Four-Fuel Strategy with the Five-Fuel Diversification Approach was a 1999 move. The goal is to increase the overall energy mix by 5% by 2010. Renewable energy was one of the energy sources included in the eighth Malaysia Plan, which was in place from 2001 to 2005. The Malaysian real estate market is very young, with a slow but steady expansion. Our current location in RE will be discussed here (M. Davis, 2018).

2. BACKGROYND OF THE STUDY

To help achieve the government's objective of encouraging the development and use of renewable energy (RE) as a fuel resource for producing power, the Special Committee on Renewable Energy (SCORE) established the Small Renewable Energy Program (SREP) in May 2001. Even though Malaysia implemented its fifth fuel plan ten years ago, Lorenzo-Sáez (2020) reports that renewable energy accounts for only 1% of the country's total energy mix. The 9th Malaysian Plan (2006–2010) seeks to foster sustainable growth and solve the country's energy issue via energy efficiency projects. Following previous 2009 statements by the Ministry of Energy, Communications and Multimedia on Malaysia's pursuit of a "clean and green" economy that prioritizes sustainable solutions, a new ministry was established to supervise water, sustainable technologies, energy, and communications. In April 2009, Datuk Seri Najib Tun Razak, the current prime minister of Malaysia, laid forth a new strategy for eco-friendly technology. His statement is followed by this. According to V. Zaslavskyi (2019), the plan's declared objective was to stimulate growth in several industries, which would ultimately benefit the economy overall. According to GT (2010), the National Green Technology Policy lays forth the following objectives:
Make recommendations to reduce energy use and increase economic development. For the development of eco-friendly technologies to have a beneficial impact on the prosperity of the country. Improving Malaysia's innovative capabilities and increasing the worldwide competitiveness of Malaysian green technology are among the goals. Public education and outreach initiatives are essential for promoting environmentally friendly technology adoption; nonetheless, our main priorities are safeguarding the environment for the sake of subsequent generations and making sure our efforts last (J. Hossain, 2020). By 2030, its size is expected to triple, thanks to renewable energy sources including wind, solar, biomass, biofuel, and geothermal heat. Still, experts predict that these sources will only account for around 5.9% of global energy consumption. However, fossil fuels are expected to maintain their dominance

for the foreseeable future. All of the energy policy proposals are laid forth in this document: After changing its name from Petroleum Company Berhad in 1974, Petronas was founded. Some examples of national policies that were put into effect between 1975 and 1981 include those concerning petroleum, energy, depletion, the four fuels, and diversification. The several fuels used to generate power were the main points of discussion from 1995 to 2005. The Fifth Fuel Policy has prioritised renewable energy sources since its inception in 2000. T. Leonard (2019) states that the energy sector was the main focus of the Ninth Malaysian Plan (2006-2010), which followed the Eighth Malaysian Plan's (2001-2005) expansion of the Energy Efficiency (EE) program.

3. PURPOSE OF THE STUDY

From a technical, economic, and social perspective, they will analyze the primary hurdles to renewable energy adoption in Malaysia. It is critical to choose a technology that is compatible with Malaysia's resources from a technological perspective. Take wind power as an example. With relatively little wind resources compared to other countries, Malaysia needs a reliable system that can withstand low-wind situations. Since biogas and BESS are still in their early stages of application, research or small-scale pilot projects are needed to determine their genuine relevance to Malaysian conditions. The commercial sector will triumph over the majority of challenges. Renewable energy (RE) is an exciting investment opportunity for Malaysia since it is a new sort of energy. Government incentives are vital to launch a deployment. Despite the fact that the FiT method seems to be working in terms of implementation, some technologies may still not have sufficient rates when all other aspects are taken into account. Compensation payments to Aboriginal and other affected groups, for example, can lead micro hydro projects to exceed budget. The present problem of managing municipal solid waste (MSW) and the need to prolong the life of our nation's landfills may be met by redesignating FiT for biogas generation from MSW or food waste (J. Harper, 2019).

4. LITERATURE REVIEW

There was no mistaking the unprecedented amount of energy used in 2018. Fuel consumption increased at a rate almost twice that of the preceding decade, leading to a dramatic spike in the world's need for energy. Over 80% of the world's primary energy consumption is still derived from fossil fuels, even though renewable energy has surpassed all other energy-related measures since 2010. The US Environmental Protection Agency states that energy use is the leading source of pollution and greenhouse gas emissions. Power plants and other energy-intensive activities consume fossil fuels, resulting in one quarter of the world's greenhouse gas emissions. Among all energy-related firms, 6% are buildings (including both external energy generation and internal combustion for heating and cooking), 14% are transportation, 10% are other energy-consuming sectors, and 21% are power plants (K. Balaraman, 2020). The World Energy Outlook reports that global energy consumption climbed 2.3% in 2018. The United States, China, and India accounted for 70% of the rise in worldwide energy consumption. According to the Institute of Energy Economics Japan, China is projected to continue being the world's leading consumer with an anticipated 4.0 Gtoe in the 2040s. Spending is predicted

to be driven up by the fast-growing middle classes and populations in the MENA, Southeast Asian, and Indian regions. Conversely, it is anticipated that energy consumption in the US and EU would decrease. Two byproducts of the global population boom in the last few decades are rising energy consumption and housing costs. When it comes to global energy use, the building sector is right up there. The energy needs of commercial and residential buildings account for forty percent of total energy consumption in the EU and US. Providing appropriate energy recommendations requires research on building interfaces, architecture (including location), and tenant behavior. Eighty percent of the greenhouse gas emissions in the EU originate from the energy industry. Most of the carbon dioxide emissions (36% of EU total) and almost 40% of EU total energy production come from just one industry. But values below the 2020 target have already been observed. Compared to the target for 2020, consumption in 2006 was 9.1% higher at 1.046 Mtoe. 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 study indicated that residential buildings had the quickest increase in cooling energy consumption, whereas commercial buildings exhibited the greatest overall energy consumption. Until at least 2050, fossil fuels will remain the principal source of energy demand, according to J. Deign, 2020.

From a variety of perspectives, including technological, economic, sustainability, and social, the idea of national development is discussed and evaluated. It is possible to broaden the scope of the word "development" to include not just economic but also other types of national advancement. To be more inclusive than only economic growth, literature has associated development with prosperity, which includes social aspects, ecological sustainability, and quality of life. Because of variables like globalization and the movement of products and services, researchers say that consumption, not total primary energy, is the best metric to use when analyzing development (2016). The correlation between energy consumption and increased development is strong for LMI countries (HDI ≤ 0.8) when energy usage is low, but it plateaus for developed countries (HDI ≥ 0.8) when energy intensity is minimized, and efficiency is maximized. For 2012, Steinberger discovered a very positive correlation for small levels of energy consumption f between HDI and energy usage per capita for 137 countries in his sample. However, according to the concept of diminishing returns, the connection stops improving as energy consumption per capita grows, reaching a plateau of about 0.8 for the HDI (ibid). It should be mentioned that this research only looked at overall energy usage per capita and didn't differentiate between renewable energy and fossil fuel energy.

5. RESEARCH QUESTION

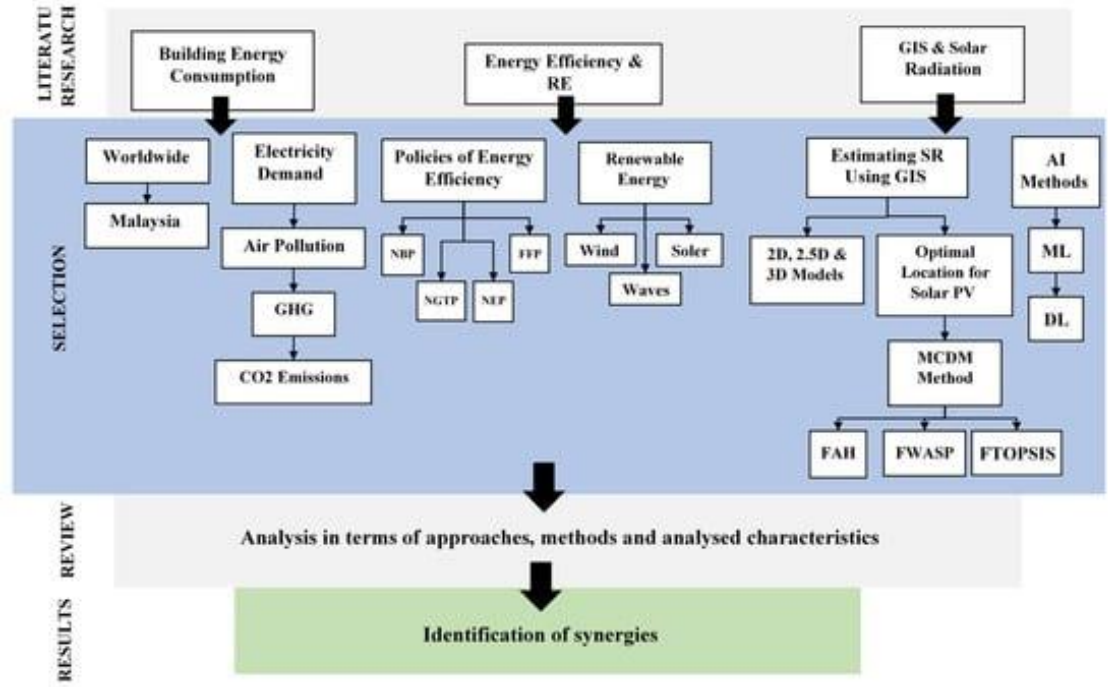
- How to develop economic development and employment creation?
- What are the ways to reduce production of greenhouse gases to slow global warming?

6. METHODOLOGY

Publications such as books, journals, websites, and previously published articles provide the

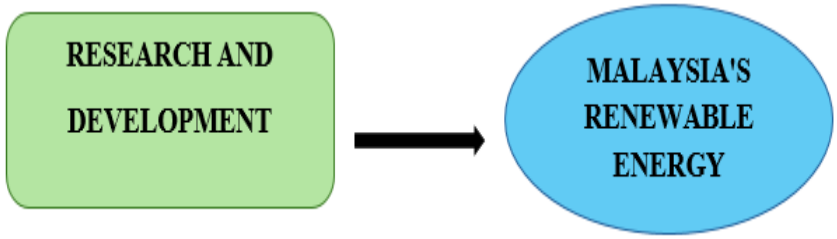
data used in this study. Scopus has indexed about 130 of the 177 papers that were published between 2008 and 2021. Some of the most often used terms in this study were energy efficiency, greenhouse gas emissions, energy consumption, usage of geographic information systems, and limits. The environmental effects of buildings' primary energy use will be examined first, with a focus on Malaysia. Here we will go over the steps to take to utilize a GIS for solar radiation forecasting and energy efficiency evaluation. Finally, as a substitute for conventional power, we shall discuss renewable energy and energy efficiency. Figure 1 shows the overall plan for this study.

Figure 1



Malaysia, a country in Southeast Asia, has an area of 329,750 square kilometers and is roughly positioned around the equator, between 2°30′ N and 112°30′ E. The weather is always hot and muggy, with an average of 250 cm of rain per year and 27 °C temperature. The country of Malaysia is enormous, spanning 329,847 square kilometers. In 2019, Malaysia ranked fifth internationally for liquefied natural gas exports and second in Southeast Asia for natural gas and oil output.

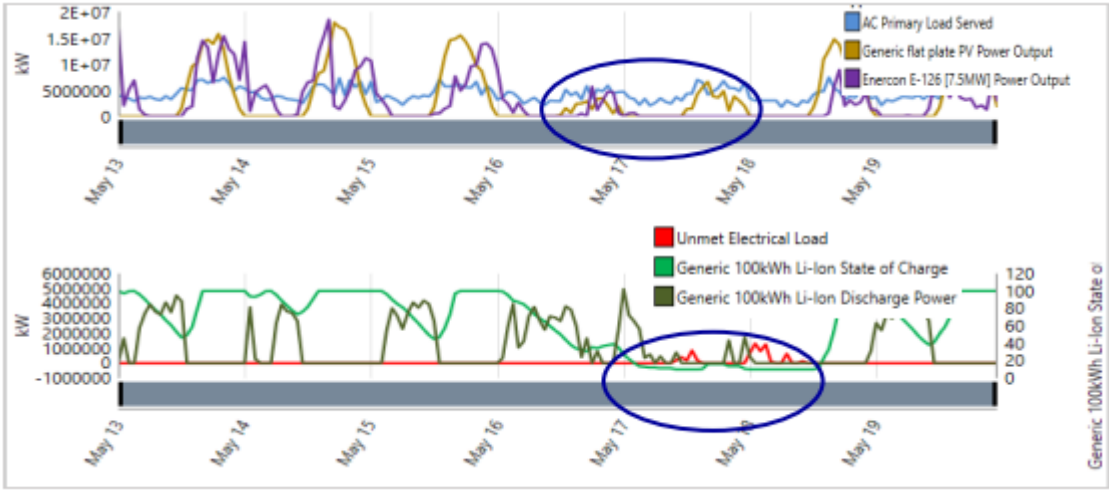
7. CONCEPTUAL FRAMEWORK



8. RESULT

Case 1, with its almost 99.99% decrease in CO2 emissions and lowest NPC value of USD 63.4 billion, is the most economically advantageous of the three scenarios considered for Scenario 1. However, instance 1's extra power, which is mostly generated by the wind turbine, is the greatest. During the rainy season, electricity generation reaches 1.5 GW, which is much more than consumption, which stands at 7 GW (Figure 2). With 39,712 units of wind turbines, the power production grows in direct proportion to the strength of the wind, allowing the turbines to generate more energy. At the same time, solar PV generates more electricity than the wind turbine does during the dry season.

Figure 2



Furthermore, as seen in Figure 2, the electricity produced falls short of meeting demand by 1.3 MW from May 17th to May 18th, which is the stress point for Case 1. Battery life was severely reduced throughout the two-day period, and wind and solar resources were both depleted to the highest possible value. The power is inadequate during the dry season since neither the solar PV system nor the wind turbine can provide enough energy, even if the total extra electricity is 78% every year. Because renewable energy sources are notoriously unpredictable, this is to be anticipated. On the other hand, adding more solar PV and batteries may solve this power deficit. However, as indicated before, this system will be linked to the

current electrical grid on the peninsula. That way, the system may achieve equilibrium between supply and demand. Since the biogas generator consistently produces power monthly, its output is not included for the sake of comparison. For both Case 1 and Case 2, an enormous quantity—anywhere from 10,000 to 40,000 units—of wind turbines would need to be put into operation. According to Power Technology | Energy News and Market Analysis (2019), the Gansu Wind Farm in China is the biggest onshore wind farm. It is now operating at 8 GW and plans to reach 20 GW by 2020 using 7,000 wind turbines. Meanwhile, England's Walney Extension is home to the world's biggest offshore wind farm. With a total capacity of 659 MW, this wind farm is comprised of 87 units of 8 MW turbines and occupies an area of 145 km2. This is why the Case 3 model limits the amount of wind turbines to 435 units, which is five times more than the Walney Extension turbines. There was also a restriction on the biogas generator, which could only produce 1.5 GW from a single unit. Ironbridge near Severn Gorge, United Kingdom, was the biggest biomass facility (330 acres) with a capacity of 740 MW until it was shut down in 2015. Case 3's model limits the biogas generator capacity to 1.5 GW, which is double the capacity of the Ironbridge biomass plant, and to one unit due to the vast land area necessary to build this facility. This assumes that biomass generator technology and offshore wind farm technology will have advanced to a point where a biomass plant of this magnitude is theoretically feasible by 2030.

9. DISCUSSION

Considering the persistent need for energy, the Malaysian government has enacted a plethora of energy-related legislation. Renewable energy in Malaysia only accounted for only 1% of the country's overall energy consumption by 2005, even though the government had set a target of 5% in the Eight Malaysia Plan for 2001-2005. The government of Malaysia reaffirmed its aim of using 5% renewable energy nationwide in 2006 during the 9th Malaysian Plan. The present constraints are not only totally unrealistic, but also make it very difficult to accomplish this objective. If Malaysia is serious about increasing its usage of renewable energy, the public and NGOs must increase their efforts to promote, use, and coordinate energy from these sources. This is even though the government's policies and programs have emphasized the importance of renewable energy in a sustainable system.

10. CONCLUSION

Renewable energy systems are feasible options to fulfill peninsular Malaysia's anticipated demand in the next twenty years. According to reviews of the relevant literature, peninsular Malaysia is home to many renewable energy resources that might be used to augment the electricity generated by fossil fuels. Only four of the many simulated cases were considered for in-depth evaluation. According to the findings, the NPC values were greatest in the 100% RF scenario, which had a heavily renewable component, and they were lowest in the hybrid scenario, which included an NGG plant. However, the technical feasibility of the system design is crucial, considering the present status of each technology. The following is a synopsis of the findings.

References

1. Vaka M, Walvekar R, Rasheed A and Khalid M 2020 A review on Malaysia's solar energy pathway towards carbon-neutral Malaysia beyond Covid'19 pandemic J. Clean. Prod. 273 122834
2. S. Gsänger, "A dangerous trend is challenging the success of wind power around the globe: Concentration and monopolization", WindTech International, 4 February 2020
3. J. Hossain, WWEA, "Experience with auctions in India", from WWEA, "Webinar: Wind power and renewable energy policies: What is best to reach 100% RE", 14 May 2020.
4. T. Leonard, "Wind market storming ahead in Vietnam, but possible obstacles remain", DNV GL, 24 June 2019.
5. J. Harper, "German wind power blown off course", DW, 21 November 2019, https://www.dw.com/en/german-wind-powerblown-off-course/a-51341340.
6. J. Deign, "Germany's maxed-out grid is causing trouble across Europe", GTM, 31 March 2020.
7. K. Balaraman, "Wind plants can provide grid services similar to gas, hydro, easing renewables integration: CAISO", Utility Dive, 13 March 2020.
8. V. Zaslavskyi and M. Pasichna, "Optimization techniques for modelling energy generation portfolios in Ukraine and the EU: comparative analysis," in Advances in Intelligent Systems and Computing vol. 761, ed, 2019, pp. 545-555.
9. M. Davis, M. Ahiduzzaman, and A. Kumar, "How will Canada's greenhouse gas emissions change by 2050? A disaggregated analysis of past and future greenhouse gas emissions using bottom-up energy modelling and Sankey diagrams," Applied Energy, vol. 220, pp. 754-786, 2018.