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Examining Large-Scale Solar (LSS) Photovoltaic (PV) Operating Utilities by using Environmental Impact Screening (EIS)

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ABSTRACT

For Malaysia's future energy needs, solar photovoltaic (PV) technology and farming is becoming a more cost-effective option and technology in achieving Malaysia's goal of having 31% renewable energy in its power mix by year 2025. Malaysia's global climate commitment is to reduce its economy-wide carbon intensity (as a percentage of GDP) by 45% by 2030 compared to 2005 levels. Realizing the government's vision is critical to assisting the country in meeting its Nationally Determined Contributions (NDC) targets (SEDA, 2022). Hence, this paper highlights the evaluation of an existing solar farm located at Seberang Perai Pulau Pinang, Malaysia as a case study to examine the potential environmental impact arising from of large-scale solar (LSS) PV development utilising the Analytic Hierarchy Process (AHP) under the Multi-Criteria Decision Making (MCDM) technique. The approach for this study was conducting in depth interviews with 16 people, including academics, authorities, and experts in the field. Large projects need to be evaluated to make sure that any potential problems are found and resolved early in the planning and design phases. This study considers the effects on the environment and chemicals (EC), as well as occupational safety (OSH) and economic impact (EI). AHP is then used to assess the data and utilized to produce the final component rankings. By showing the outcomes, the bar chart will aid in improved decision-making. The bar chart's ability to display the results will help in the decision-making. From the results, LSS PV farm were conducive to achieving strong sustainability however in term of environmental degradation, mitigation action must be implemented on site to tackle the arising issues.

Keywords: large-scale solar; renewable energy; environmental impact screening

INTRODUCTION

Solar energy is a power that uses sunlight to generate power without giving bad impacts to the environment. It is one of the major types of renewable energy. Solar energy is the most abundant, unlimited, and clean renewable energy supply which is publicly known. The amount of energy received by the earth from the sun is around 1.8×1011 MW, which is several times greater than the current rate of all energy consumption. Photovoltaic (PV) technology is one of the most effective methods for harnessing solar energy (Parida B. et al. 2011). Since 2009, the capacity of PV solar energy generators has increased by 41% annually. By 2040, energy system predictions show a nearly ten-fold growth in PV solar energy generating capacity, reducing climate change, and assisting universal energy access. However, according to Kruitwagen L. et al. (2021), no research has been conducted on the environmental implications of large-scale solar photovoltaics utilizing an Environmental Impact Screening (EIS), which is the first step in conducting Environmental Impact Assessment (EIA). As a result, this gap of knowledge must be investigated as a modern approach for decreasing environmental impact degradation.

Solar PV technology is becoming a more cost-effective option for Malaysia's future energy demands. This increasingly efficient and economical technology is an important step for Malaysia's target of having 31% renewable energy in its power mix by 2025. The dramatic reduction in solar power costs is a welcome opportunity for ASEAN countries, providing a more cost-effective low-carbon power alternative. The development of Malaysia's solar power business could potentially pave the

door for mutually beneficial opportunities. It builds on crucial industry experience to expand into other markets, such as TNB's recent investment in the solar business in Vietnam. According to Watch E. (2021) and McDonagh S. (2021), Nanping City Solar Far is one of the examples of a large-scale solar project that preserves the natural environment. The people behind this masterpiece, Xinyi Solar, have been involved for most of China's massive growth into solar energy in this decade. The placement among these panels generates a geometric looking which represent of the Fujin mountains under the appropriate light. It is covering an area around 2.33 million square meters with a ground-mounted solar farm in the end of August 2014. Solar farm's average annual electricity power is estimated to exceed 173,350,000 kWh once it starts producing on-grid electricity. Carbon dioxide emissions are estimated to be lowered by about 172,827 tonnes each year on averages, since it meets the yearly electricity needs of about 109,713 families (Limited, X. S. (2014).

LARGE SCALE SOLAR SCHEME (LSS)

LSS stands for large scale solar scheme which is a programmed that allows us to generate our own electricity and sell it to the grid using a solar PV farm with an installed capacity ranging from 1MW to 30MW (for distribution linked solar PV plants). The Energy Commission is in charge of this project, and potential developers will be chosen through competitive bidding. A bidder may bid for a maximum capacity of 50MWac and may submit no more than three bids, which are LSS1, LSS2, and LSS3 (Choi C. S. (2020). Fourth Competitive Bidding Round (LSS@ MEnTARI) or LSS4 is a fourth competitive bidding program in Malaysia. It is used for bids to develop a large-scale solar power plants with a capacity up to 1000MWac in Malaysia. Figure 1 below shows the example of shortlisted bidders for project capacity 30 MW to 50 MW.

Energy Commission of Malaysia : Shortlisted Bidders
Package P2: Project Capacity from 30 MW to 50 MW

Shortlisted Bidders	Capacity (MW)
Asiabina Properties Sdn. Bhd.	50
Classic Solar Farm Sdn. Bhd.	50
Gopeng Berhad	50
JAKS Solar Power Sdn. Bhd.	50
Perbadanan Kemajuan Negeri Pahang and Kumpulan Powernet Berhad	50
Ragawang Corporation Sdn. Bhd.	50
Ranhill Utilities Berhad	50
Sharp Ventures Sdn. Bhd.	50
TNB Renewables Sdn. Bhd.	50
Uzma Environergy Sdn. Bhd.	50
Total	**500**

Source: Energy Commission, Malaysia — Mercom India Research

FIGURE 1. Example of shortlisted bidders for project capacity 30 MW to 50 MW
Source: (Nair, 2021)

ENVIRONMENTAL IMPACT ASSESSMENT (EIA)

EIA is a study on how a planned activity will affect the environment, including biodiversity, flora and ecology, water, and air quality. An EIA is necessary to determine and assess the environmental consequences at an early stage of a project's planning and design besides predicting the negative or positive impact from the affected projects. Moreover, to protect the biodiversity environment by recommend strategies for a safer project designs and methods. By referring Overview of the EIA process stated at DOE, claimed that it is essential to emphasize that the EIA process does not ensure that a project will be changed or denied if serious environmental concerns are identified. Table 1 below shows the stages of each process of EIA with its involvement.

ENVIRONMENTAL IMPACT SCREENING (EIS)

While EIS stands for Environmental Impact Screening (EIS). Screening is the first stage of EIA process. A screening conducted by evaluate whether a project requires an EIA, project proponents evaluate their project against a set of criteria defined by an authorized agency and be done early as possible in the proposal's development. The need to conduct a screening to determine the level of impact of the proposed project, development, or initiative. Next, impacts are considered throughout the EIA process, from the building phase to operations and after closing. Based on the guideline from DOE (2022) said that the benchmark criteria for an EIA varied by nation; some laws define the types of activities or projects that require an EIA, whereas others demand an EIA for any development that may have a major environmental impact or that exceeds a specific financial value. This study presents the best identifying and mitigation to reduce the degradation of environment towards LSS PV development. The objective of this study is to evaluate and identify the potential for environmental deterioration of photovoltaic farming through data collection at the study site, and able to recommend an appropriate solar farm mitigation measure by using Multi-Criteria Decision Making (MCDM) approach. Figure 2 below indicates the typical steps in preparing EIA which include the screening process.

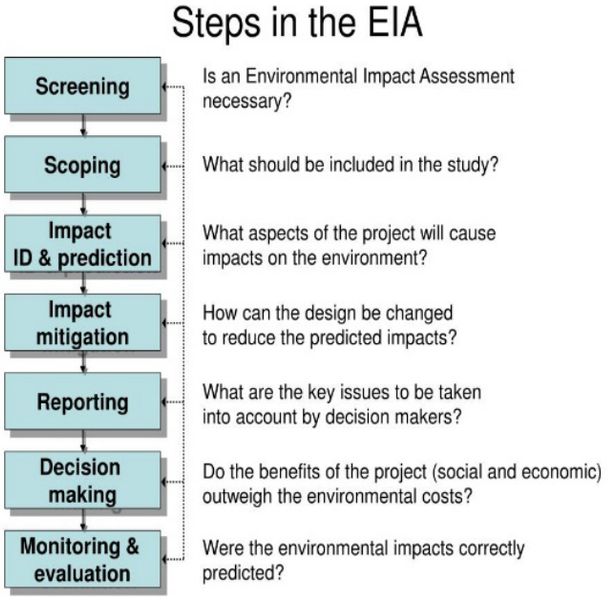

FIGURE 2. Steps in the EIA
Source: (DOE Malaysia, 2022)

TABLE 1. Stages of the EIA process with the details of each stage's involvement (Bhole G. P & Deshmukh D.T. (2018))

Stage	What is involved
Screening	Determining whether an EIA is necessary or not
Scoping	Determining what should be included in the assessment and published in the "EIA Report"
Preparing EIA report	The expected significant effects on the environment of the development must be included in the EIA report
Do the application and consultation	The EIA Report and development application should be made publicly (including through and electronic methods), relevant stakeholders and the public must be given the chance to comment on it
Decision making	Before deciding whether to approve consent for the development, the competent authority must consider the EIA Report as well as any comments made on it. It is necessary to make the decision statement publicly
Post decision	Any monitoring mandated by the relevant authority is performed by the developer

METHODOLOGY

The methodology and approach that were used in the execution of this research will be discussed in this chapter. The main aim of this study was to investigate the issues and the possible environmental impact arising from a LSS PV project, and to develop mitigation strategies for the purpose of minimizing the obstacles that may be encountered. By gathering all of the data through the use of MCDM, and then analyzing it through Analytic Hierarchy Process (AHP). This analysis of the technique is mandatory to guarantee that the entire information, techniques, and data collection are reliable and organized. To get the desired result, every step of this project has been properly performed. The AHP includes a scoping process to establish environmental assessment components that consists of three (3) categories, which are as follows: economic impact, ecological and chemical impact, and occupational health and safety impact.

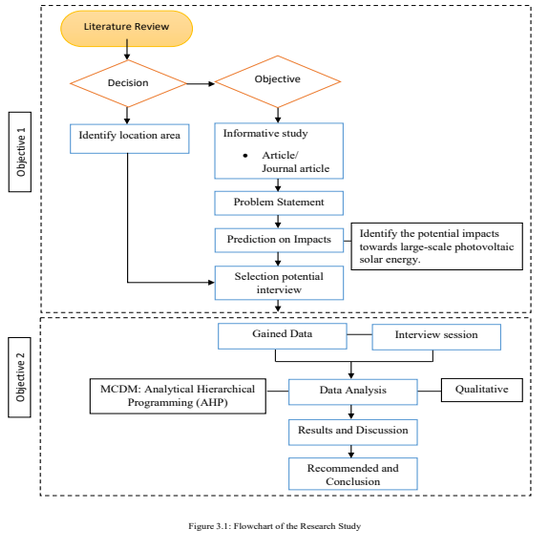

FIGURE 3. Flowchart of the Research Study

LOCATION OF RESEARCH AREA

The selected study area is Seberang Perai Selatan Pulau Pinang, Malaysia. The LSS PV area is 214,681.38 m² or 53.05 acres. Figure 4 depicts the position of the site and its existing surrounding buildings, including a dwelling within community area, solid waste facilities, educational institution, and other significant structures that may be influenced by the presence of LSS energy. Table 2 shows the sign with its colors representing its building while figure 6 shows the cardinal direction from LSS PV on site within 5 km radius zone area. From here, it shows the possible location that might have direct and indirect impact from this project especially in terms of environmental challenges.

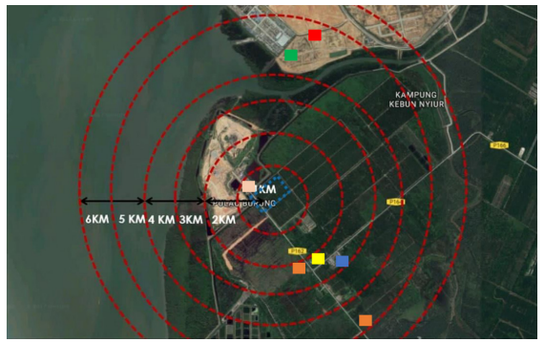

FIGURE 4. Location of research area within 5km radius
Source: Google Earth, 2022

TABLE 2. Signs with its color represents of the building

Below shows the sign with its colors represents its building:

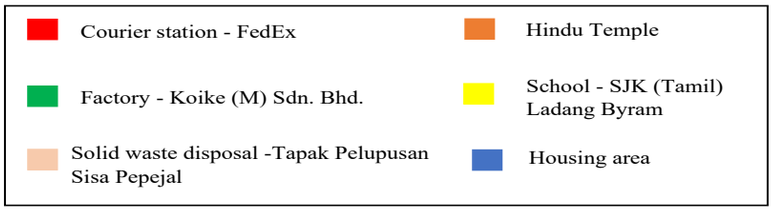

TABLE 3. Cardinal direction from this project up to 5km

Location/Direction	1km	2km	3km	4km	5km
North	Agriculture	Pulau Burung	Pulau Burung	- Pulau Burung -Sea	- Factory - Courier - Pulau Burung
Northeast	Agriculture	Agriculture	Agriculture	Agriculture	- Agriculture - Sea
East	Agriculture	Agriculture	Agriculture	Agriculture	Agriculture
Southeast	Agriculture	Agriculture	- School - Temple - Housing area	Agriculture	Agriculture
South	Agriculture	Agriculture	Agriculture	Agriculture	Agriculture
Southeast	Agriculture	Agriculture	Agriculture	Agriculture	- Agriculture - Sea
West	- Agriculture - Pulau Burung	Agriculture	Agriculture	- Agriculture - Sea	- Agriculture - Sea
Northwest	Solid waste disposal	Agriculture	Agriculture	- Agriculture - Sea	- Agriculture - Sea

DATA COLLECTION

Among the most fundamental aspects of every research project is the selection of appropriate techniques for data collection. In-depth interview with various stakeholders was the method used throughout this process. The interview was conducted to evaluate the significance of the LSS PV installation's environmental impact on the affected community and stakeholders included approving local authorities, Jabatan Alam Sekitar, Jabatan Kerja Raya (JKR), Jabatan Pengairan dan Saliran (JPS), etc. During this session, the input from relevant solar consultants and other experts in this field are also considered. Potential respondents were identified based on their active roles in the solar industry, such as solar farm operator, submitting consultant, relevant approving authority, and subject matter expert.

This interview was conducted by collecting the weightage and percentage effect value for each component. This information was then used to analyze the results of the interview. After that, the data will be extracted and analyzed by using the MCDM approach and AHP tools analysis. The methods will examine the impact in terms of economic, ecological and chemical, and occupational health and safety parameters. It is possible to determine the environmental impact of the proposed project based on the results of the study. The goal of determining these values is to discover a mitigation strategy that can be employed to lessen the large scale solar photovoltaic negative impact on the environment.

MULTI-CRITERIA DECISION MAKING (MCDM)

The terms MCDM stands for "multi-criteria decision making," which refers to a method that is both well-structured and multidimensional. This method was developed to address decision-making issues that arise in

a variety of contexts and to find the most desirable alternative while considering all relevant criteria. According to Eltarabishi et. Al (2020) and Velasquez et al. (2013), methods for Multi-Criteria Decision Making (MCDM) have a wide range of applications. Numerous ways were produced, even minor changes to existing methods in creating new research fields to used MCDM. This method is important in a variety of applications and has increased rapidly which is as a new and existing one improved method. There are many methods can be used in MCDM, such as Multi-Attribute Utility Theory, AHP, Fuzzy Set Theory, Case-based Reasoning, Data Envelopment Analysis, Simple Multi-Attribute Rating Technique, Goal Programming, ELECTRE, PROMETHEE, Simple Additive Weighting, and Technique for Order Preference by Similarity to Ideal Solution. While according to [11] they said MCDM is a decision-making tool for both quantitative and qualitative criteria. MCDM techniques were created to identify a better option, categorize an option into a limited number of categories, or rank an option into a subjective in a preferences order. MCDM refers to a variety of method for assisting people in order to decide based on their preferences when multiple criteria are in conflict. The process of deciding involves evaluating several options in order to settle on a selection or a plan of action that will allow one to achieve their intended aims and goals. An effective decision-making process can also be important to an organization's success (Haddad M. & Sanders D. (2018).

ANALYTICAL HIERARCHY PROCESS (AHP)

AHP was introduced as a MCDM. Many researchers select the AHP approach because of its mathematical features and ease of data input. AHP method is a decision making that can be applied in many different of situations. It is also a multi-level hierarchical structure that includes criteria, sub-criteria, objectives, and alternatives. By using this process of pair-wise comparisons, the relevant data is produced. From this comparison, they can get the decision criteria's importance weights. Figure 5 below shows the general four level structure of the AHP process. Table 4 below shows the Saaty scale for pairwise comparison (Leal. J. E (2019)).

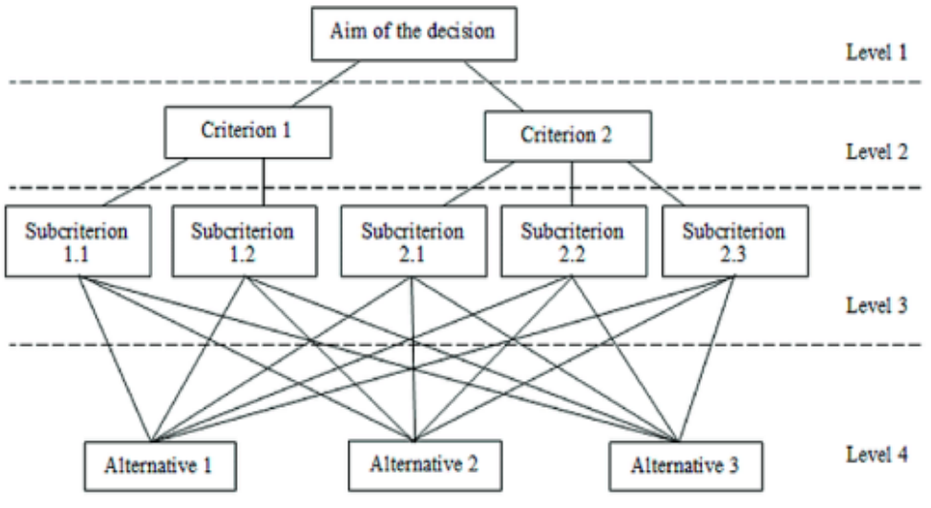

FIGURE 5. The general four-level structure of the AHP (Bhole G. P & Deshmukh D. T (2018).

TABLE 4. Saaty scale for pairwise comparison (Leal. J. E (2019)).

Intensity of importance	Definition
1	Equal importance
3	Moderate importance
5	Strong importance
7	Very strong importance
9	Extreme importance

EXCEL TEMPLATE: ANALYTICAL HIERARCHY PROCESS (AHP)

MS Excel is required to use as a baseline for the AHP template in order to conduct the analysis. For pairwise comparisons, the workbook has 20 input sheets, one for consolidating judgments, one for summarizing the results, and one with reference tables (randomness index, judgement ranges, geometric consistency index GCI limit ranges) as well as a sheet for finding solutions the eigenvalue problem through the eigenvector method (EVM). The maximum number of criterions should be 10, while the largest possible number of decision-makers and participants must be 20. Figure 6 below shows the results which EVM will be used to determine the weights and errors for each criterion. Figure 6 below shows the results which EVM will be used to determine the weights and errors for each criterion. The required number of "iterations" is displayed in the column labeled "Iterations." It is recommended that the "EVM check" value be very near to zero as mentioned in Goepel K. D. (2013).

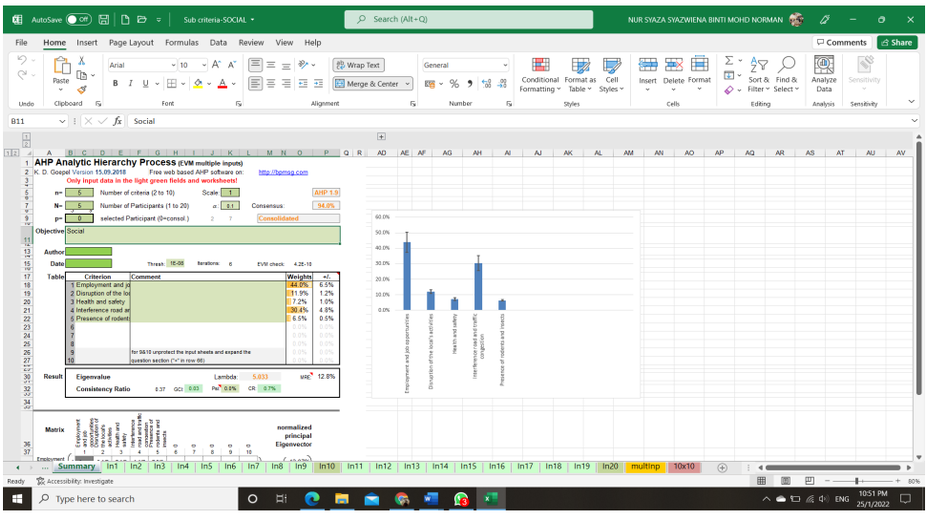

FIGURE 6. Analytic Hierarchy Process (AHP) template (Goepel K. D. (2013)).

QUESTIONNAIRE ANALYSIS

The information was gathered by conducting in-depth interviews with 16 stakeholders who were specialists in the field of study. The respondents are academician or expert review, consultant, MBSP, JKR, JAS, and JPS. These professionals were selected due to their participation in the development of the project, which will contribute to the collection of data for this study. As can be seen in Table 5 below, expertise is given one of the following codes: E1, E2, E3, and so on. Questions concerning the effects that using solar photovoltaics on a big scale could have on the natural environment were asked throughout the interview. After that, the input from the professionals is collected, and the Analytic Hierarchy Process excel is used to conduct the analysis.

TABLE 5. List of respondents

No.	Code	Department
1	E1	Consultant
2	E2	Consultant
3	E3	Consultant
4	E4	Consultant
5	E5	Consultant
6	E6	Consultant
7	E7	Academician / Expert Review

continue ...

... cont.

8	E8	
9	E9	Engineering Department of Majlis Bandaraya Seberang Perai (MBSP)
10	E10	
11	E11	
12	E12	Building Department of Majlis Bandaraya Seberang Perai (MBSP)
13	E13	Engineering Department of Jabatan Kerja Raya (JKR)
14	E14	Jabatan Alam Sekitar
15	E15	Jabatan Pengairan dan Saliran (JPS)
16	E16	

INTERVIEW SESSION

Interview session with local authorities, consultant, and expert review is conducted to obtain various feedback and opinions on the environmental degradation contributed from this scale of project e.g. technical input on why this is happening and how to minimize the impact towards environment. They are given a set of questionnaires during the interview session to gather feedback on the environmental implications of large-scale photovoltaic solar energy industry and their knowledge. Below shows a sample of questionnaire form that potential interview answered for giving an opinion regarding this study.

Part A of the questionnaire described on the Identification of Impact towards Environmental Degradation on LSS 4. The respondent opinion on the Ecological or Chemical Impact and Hazardous Material and Waste Management and Part B is the suggestion for better Environmental from Solar Farm. The pilot test was conducted before the questionnaires are distributed by selecting 2 - 3 people from the target group to pretest. Pretesting this survey is critical for identifying problem areas, reducing measurement error, reducing respondent burden, determining whether respondents are correctly interpreting questions, and ensuring that the order of questions does not influence how a respondent answer. The corrected version of questionnaires is then distributed to the respondents during the actual interviews.

RESULTS AND DISCUSSION

The acquired results are addressed in table 4 and figure 7 below. The criteria of impacts are displayed in the table 5 to be analyses by using AHP method. The three components are shown in the table below with the weight and its ranking in each criterion. These three criteria are:

•Ecological and chemical impact
•Occupational health and safety impact

Table 6, explain the positive (+) and negative (-) impact from your analysis for criteria's weight identification.

TABLE 6. Summarize for each criteria's weight

Criteria		Sub-criterion	Weight	Impact	Ranking
E1		Ecological and Chemical Impact			
EC	EC1	Chemical component in solar production	0.133	-	5
	EC2	Habitat loss and fragmentation	0.222	-	5
	EC3	Changes in soil moisture and temperature	0.243	-	1
	EC4	Land disturbance	0.153	-	3
	EC5	Air pollution	0.106	-	6
	EC6	Reduce greenhouse gas emissions	0.143	+	4
		Occupational Health and Safety Impacts			
OSH	OSH1	Danger works environment for workers	0.169	-	5
	OSH2	Health risk towards workers and local area	0.189	-	4

The data presented in figure 7 below shows from my survey of 31% of stakeholders stated that they are agree with a statement that persons who live in close proximity to LSS PV pose as a threat to both their environment and their health. While the majority of them, 69% believe that persons who live in close proximity to an LSS do not pose any threat to the environment or their own health. According to Flower G. & Cleveland T. (2017) solar inverters and photovoltaic technologies are not known to present any serious health risks to its surroundings.

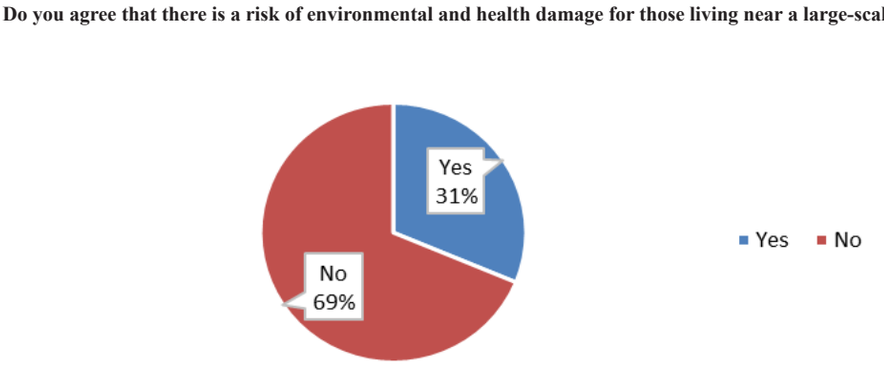

FIGURE 7. Chart on the agree that there is a risk of environmental and health

Next, the data shows below in figure 8 stated that the risk of environmental and health damage for those living near a LSS are 35% increase in habitat loss, 26% increase in cancer risk, 22% toxic chemicals in photovoltaic manufacturing process such as hydrochloric acid, and the smallest percentage is 17% for exposure to hazardous materials. According to Courage K. H (2021) due to the size required to supply electricity systems, solar installations are enormous and impose a new type of built environments on those areas. This may have unforeseen and unanticipated effects on regional wildlife, flora, and even the microbiome.

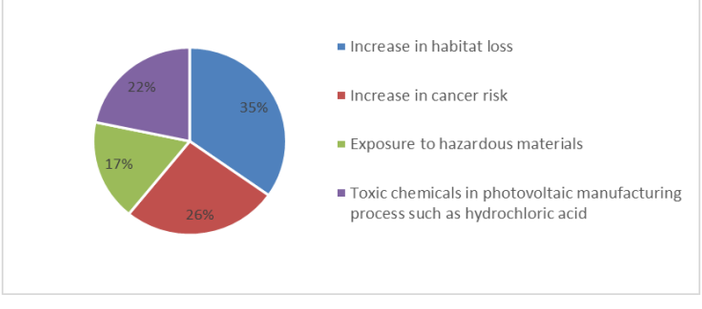

FIGURE 8. Chart on the risk environmental and health damage

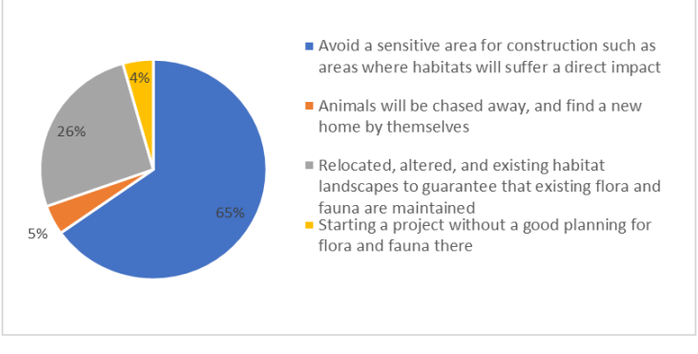

FIGURE 9. Chart on planning for animals before solar farm is constructed.

Figure 10 below shows most of stakeholders stated that the reason why constructing a LSS can be affected to the environment is due to clearing the land or earthworks can harm natural vegetation and wildlife in a variety of ways such as habitat loss and interference with rainfall (44%). Courage K. H (2021) also said that a large solar farm in general have the possibility of altering the landscape, impede gene flow for both animal and plant species, and disrupt crucial habitat for wildlife or migration routes with fences. The second highest is 40% which is from LSS project, it will require a lot of space to be clearing the land for solar generating installations which can impact on soil such as erosion and loss of nutrients. Lastly, hazardous waste due to heavy metal content in the solar panel and solar panel's fragility is 16%.

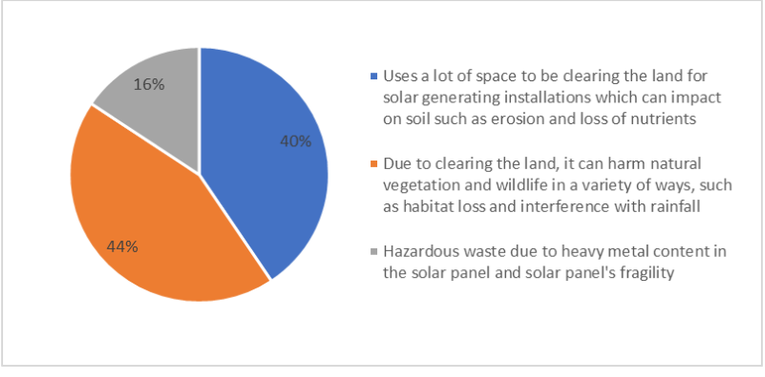

FIGURE 10. Chart on why LSS can affected to the environment with bad impacts

From my survey, the suggestion made by a stakeholder during the interview session is depicted in Figure 11, and it refers to the potential improvement of the LSS photovoltaic system towards environmental degradation. Most of them claimed that hazardous material impacts can be minimized by proper planning and excellent maintenance method (38%). Aesthetic impacts on the landscape can be avoided by making the appropriate site decisions and carrying out an Environmental Impact Assessment (EIA) for the project, given the fact that there is a common percentage that applies to both options. Mygov.scot (2019) also stated that EIA will help to ensure that project decision-makers consider the potential impacts on the environment as early as possible and try to avoid, lessen, or mitigate those consequences. This guarantees that proposals are correctly understood before judgments are taken.

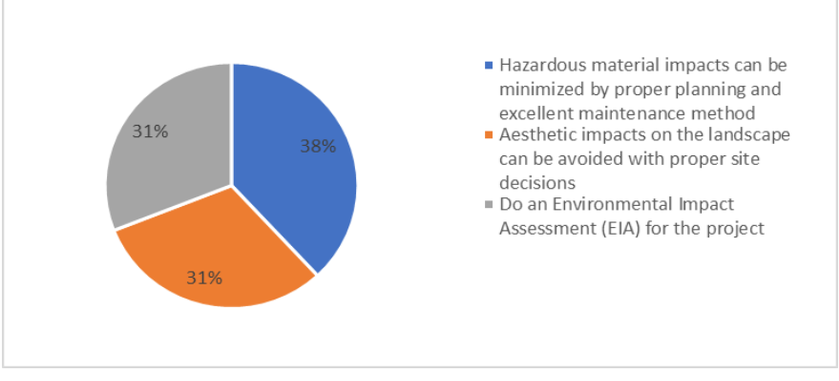

FIGURE 11. Chart on suggestion to the potential improvement of LSS towards environment degradation

MITIGATION MEASURES

According to this study, mitigating actions need to be taken to ensure that the impact of large-scale solar photovoltaic systems on the environment is reduced.

Table 7 shows mitigation measures proposed for this study.

TABLE 7. Mitigation Measure (Environmental Impact Assessment Guideline In Malaysia EGIM, 2016)

ECONOMIC IMPACT	
Sub-criterion	Mitigation Measures
Changes in land values	It is a positive impact.
Cost saving payment on electric bill	It is a positive impact.
Employment opportunities	It is a positive impact.
ECOLOGICAL AND CHEMICAL IMPACT	
Chemical component in solar production	Provision for a system that will lessen, avoid, or compensate for any potential unfavorable environmental impacts that may result from development operations.
Habitat loss and fragmentation	Construction phase Avoid the forest's critical habitat region. Schedule daily activities so as to prevent disturbing resources during crucial hours such as mating. Dispose a construction waste in a way that does not endanger aquatic life. In order to avoid birds from hitting with transmission lines, put a visual warning measure, such as permanent markers on transmission lines, at a regular interval. Cut down the trees in stream buffers that will become a conductor clearance zone within three to four years. Operation Reduce as much of the human and vehicular activities. Restore and preserve as many places as possible in their natural state. For safety and security reasons, use only the required amount of lights to reduce the number of migratory birds and endangered species. When raptor nests are found on transmission line support structures, inform the wildlife organization. Eliminate an abandoned raptor nests which do not have eggs anymore. Wildlife agencies should be notified to relocated or destroyed the nests. Decommissioning Optimize the area that is reclaimed to reduce habitat loss and fragmentation Replace damaged areas with topsoil taken at the start of a project or during decommissioning.
Changes in soil moisture and temperature	When constructing roads, it is important to consider the local climate, the amount of moisture in the soil, and the probability of erosion. This will help to prevent both erosion and changes in surface water runoff. Providing a protective soil cover and surroundings that is suitable to robust growing plants, nutrients replenishment solutions can help to recover soil organic matter.
Land disturbance	Avoid constructing a slope that are too steep. It is possible that excavations and earthwork in ecologically sensitive locations will need to be monitored by a qualified paleontologist.
Air pollution	Control the amount of damage and vegetation that is removed from the landscape. Reduce on-site vehicle usage and requiring a regular preventative maintenance to make sure the optimal combustion and lowest emissions. Prepare a dust control plan specific to the project and site. Built a wind fence around every disturbed location that might have an effect on the surrounding area that reaches beyond the site borders. Before entering paved public routes, check and cleanse the tires of equipment vehicles to ensure they are clear of dirt and remove any apparent track out dirt. Adhere to state emission regulations for all combustion sources.
Reduce greenhouse gas emissions	It is a positive impact.
OCCUPATIONAL SAFETY AND HEALTH IMPACT	
Danger works environment for workers	Set up rules for facility with materials that work well together in a safe way. If somehow the facility will have to use a pesticides or herbicides, make a plan for managing the plants. Discover the area that has been used for in the past and find out if there might be any dangerous materials there.

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Health risk towards workers and local area	In the process of a health risk assessments, take into account the possibility that workers may be exposed to noncancerous as well as cancer dangers during the development and operation of the facility.
Hazardous material that will endanger to public health	Create and run the systems with dangerous materials in a way that restricts the chance that they will be released.
Producing solid waste from construction phase	Make a list for all the dangerous materials that will used, stored, moved, or discarded during activity. Create a waste management plan that lists the expected a solid and liquid waste stream, as well as procedures for determining, inspecting, and reducing waste, as well as places to store waste and the management and disposal needs for each type of waste. Verifying that extra structural steel pieces (such as metal poles and rods) are not transported, stored, or lifted in locations in which impact with overhead electric lines could happen.
Increased risk of fires and contamination of environmental media from improper storage	Establish a fire protection and prevention plan to reduce the risk of fires caused by compounds used and stored on the site, especially the heat exchange fluid used at the facility, which is highly flammable. Make sure to follow all of the necessary approach when putting away and transporting explosive items and blasting equipment. During each stage of the project, prepare and take precautions against the risk of wildfire by developing and putting into action an appropriate wildfires control measure. These should include worker training as well as inspection and monitoring procedures.

CONCLUSION

In conclusion, environmental factors are extremely important to consider during the process of developing LSS PV farm at Seberang Perai Pulau Pinang. This study has employs the EIS method, which is the first phase of the EIA, to assess the project's impact. This research project was successful in achieving its general objectives, which included analysing and identifying the possibility for environmental deterioration caused by solar farming and also collecting of data in the Pulau Burung, Pulau Pinang as a case study, which has been identified through the analysis and evaluation of the site, in addition to the opinion of an expert.

The Analytical Hierarchy Process (AHP) considers any and all possible implications. From the AHP process, it classifies the impacts into three categories which is economic impact, ecological and chemical impact, and occupational safety and health impact. The data were analysed by using AHP method. Mitigation measures has been analysed based on the results, in order to achieve objective 2 which is to recommend an appropriate solar farm mitigation measure by using MCDM approach. In order to reach target 2, which is to recommend an acceptable solar farm mitigation measure by using the MCDM approach, mitigation measures have been assessed based on the results. This was developed in order to ensure the goal of achieving objective 2.

This research demonstrates how solar installations can better protect and potentially improve local ecosystems, as well as the bottom lines of operators and nearby landowners. These solutions can be as simple as prioritizing native plants or choosing a site that has previously been disturbed by humans.

Habitat loss and fragmentation, changes in soil moisture and temperature, and land disturbance are all major concerns for the LSS PV project. PV installations on this scale are, by necessity, massive, transforming the lands on which they are located into a new type of built environment. They can alter everything from sun exposure to moisture levels to surface temperatures. This has the potential to have unintended and unexpected consequences for local flora and fauna, and even human settlement. The completion of the aforementioned project necessitates a multidisciplinary effort involving both the utility infrastructures and territory, as well as the overall utility construction. The operator is looking for more ways in mitigating appropriate measures that will either reduce the environmental impact of large PV plants or produce a more positive outcome. To maximize the social benefit for local communities, solutions should ideally also consider local inclusion.

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DECLARATION OF COMPETING INTEREST

None

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